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INDEX TO VOLUME XLIV

January 1 to June 30, 1916

EXPLANATORY NOTE

Illustrated articles are marked with an asterisk (*), book notices with a dagger (†). Cross references to a particular initial word may apply also to its derivatives. The cross references condense the matter and assist the reader but are not to be regarded as complete or conclusive. So, if there were a reference from "Milling" to "Jigs and fixtures," and if the searcher failed to find the required article under the latter topic, he should look through the "Milling" entries, or others that the subject might suggest, as he would have done had there been no cross reference.

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American Machinist

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Contents, First Page
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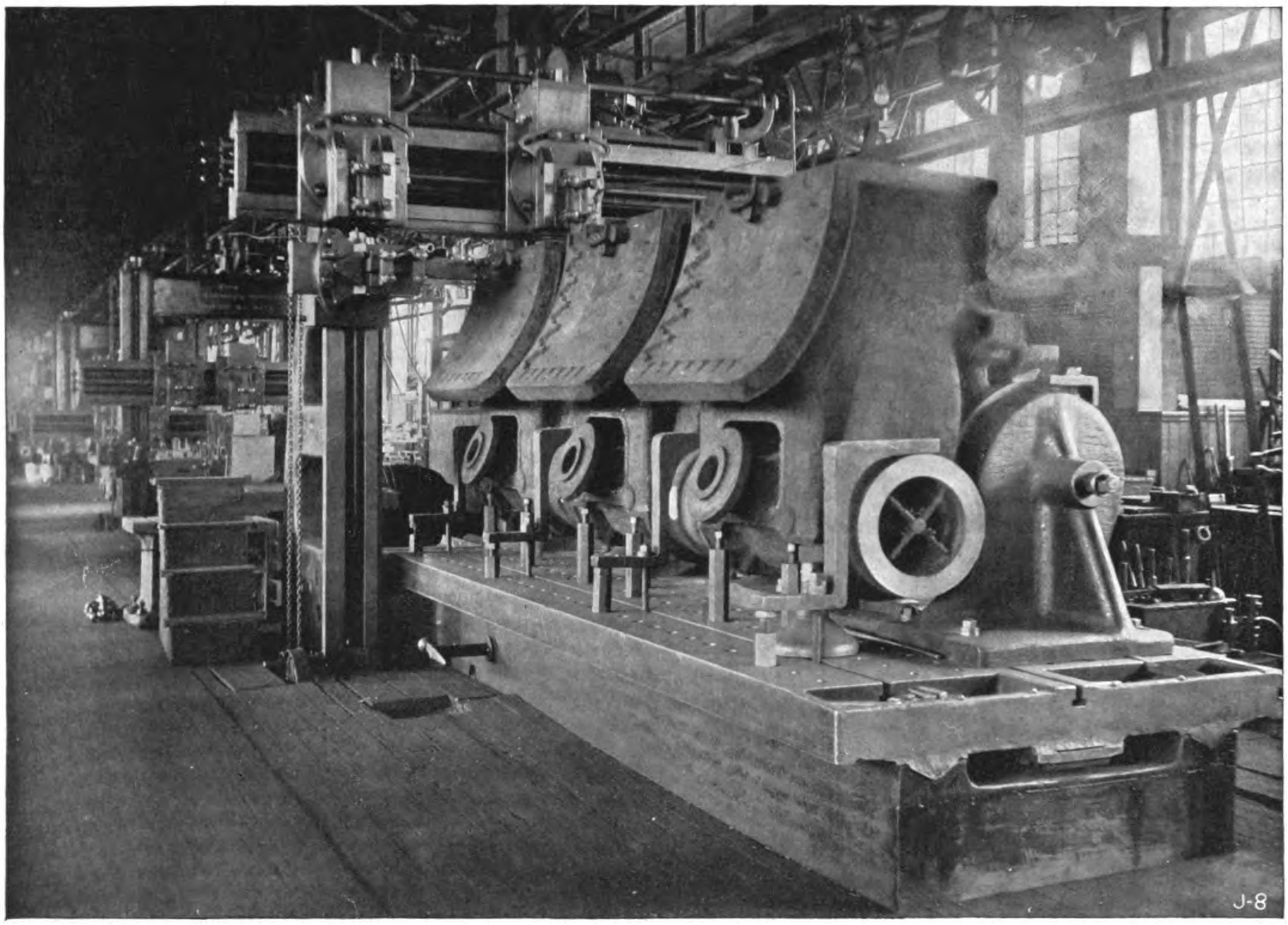
Standing Up on Heavy Work



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(*See page 3*)

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DESIGN, MACHINE

American Machinist

L. P. ALFORD, *Editor*

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WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormay processes, protected by United States patent issued June 22, 1915, and another pending

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Talks With Our Readers

By the Publisher

FOR a number of years past we have used this page in the year's first issue to give a glimpse or very brief outline of what is in store for you. It is a special pleasure to do this for the year 1916 because of the many good things that are forthcoming.

As in the past, it will be our endeavor to make every issue of the American Machinist touch all the broad divisions of the machinery-building industry. Each issue is to contain articles of interest and value to every responsible man in the machine shop, whether he be manager, superintendent, foreman, engineer, designer or draftsman.

One of the features for 1915 was several series of articles completely detailing the manufacture of war material. Similar series will be published in 1916. Their exceptional value and widespread interest are evident to all.

The small-shop article has now become a looked-for feature each week and will be continued, showing details of shop practice, easily applied shop engineering and a few character sketches of men in typical small-shop situations.

Jigs, fixtures and special tools are all important in solving problems in machinery manufacture. Two pages will be devoted each week to these, continuing the use of the background perspective illustrations that were developed a year ago to show such details in the plainest, most compact and most easily read form. Production records and machining times will be included. These pages will be called "Jig and Fixture Data Pages."

The hot-working of metal, forging, welding and heat-treating will be adequately treated from the viewpoint of the man responsible for results and the application of these processes.

The usual number of designing articles will be presented covering points not treated of elsewhere and putting into usable shape, the results of the latest investigations into the strength and application of materials and factors of design for special cases.

The graphical charts that have made our designing articles of such exceptional value to the designer will also be freely used.

The important subject of management will continue to be treated from a thoroughly practical viewpoint —that is, by showing methods in successful use and results that have been actually obtained.

In addition each issue will contain at least two articles on machinery manufacture, showing more particularly the application of the machines and tools. These will cover a wide range of machinery as regards kind—for the field of the American Machinist is as wide as all kinds of machinery building.

In order to carry out the plans we have in mind for 1916, the editors will require more space. We will therefore move the Classified Advertisement Department from the position it has so long occupied to Page 229. It will in future occupy this same relative position in the paper.

We will continue to accept only advertising directly in our line. This advertising must be truthful and from reliable concerns only.

In line with our policy of making the American Machinist easier and easier for you to use we call your attention to an improvement we have recently made—the Buyers Cyclopedia. We will make this a real cyclopedia, corrected up to date each week by co-operation between the manufacturer and the publisher to furnish you with necessary specifications and facts when wanted *quickly*—It will carry no claims, guarantees, reason-why copy or argument. *Only such facts as any cyclopedia would have if published for general use.*

It is not intended to take the place of the newsy, informative advertising which you are in the habit of reading. It is only supplementary, and is for the busy man when he is in a hurry. It makes directories in our field useless.

Our constant aim is to give you each week a tool that you can use with pleasure, with safety and with profit.

Manufacturing British 18-Pounder High-Explosive Shells—I*

By E. A. Suverkrop

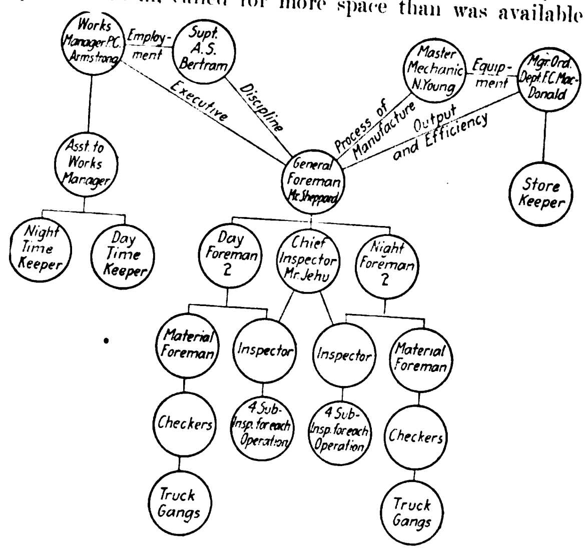
SYNOPSIS—The manufacture of this shell presents an entirely different group of problems from those encountered in the production of either the 4.5-in. high explosive or the 18-pounder shrapnel shell. The blank instead of being a hollow forging is a solid block of steel 3½ in. in diameter by 9¾ in. long. It weighs nearly 27 lb. By various machine and hand operations the weight is reduced to a little less than 15 lb.: that is to say, about 12 lb. of metal must be removed from the blank, and of this about one-half must come from the inside.

Before undertaking the manufacture of this shell the Dominion Bridge Co., Ltd., Montreal, Canada, had turned out large quantities of 18-pounder British shrapnel, which in external appearance is somewhat similar to the high-explosive shell. As a large part of the work on shrapnel had been successfully done on turret lathes the attempt was at first made to use these tools on the high-explosive shell. So a part of the shrapnel shop was commandeered and the first high-explosive shells made on the tools used for the production of shrapnel.

Perhaps the greatest handicap to manufacturing on machines which require a fair amount of intelligence is the dearth of skilled operators here in Canada; and it was soon apparent that if the required output of 4,000 shells per day was to be attained, the job would have to be reduced to simple operations on simple machines wherever possible, so that unskilled help could soon be broken in to do the work. Even the few necessary turret-lathe operations have been made so elementary that skilled operators are not required, and green hands can in a few minutes be instructed so that they will produce good work.

The working out of the system is a long story, similar to many others of a like nature with which all shopmen are familiar. It is, as it should be, the result of the combined brains and hard work of executives of the ordnance department and not any one man's guess or fiat. In Fig. 1 is shown the organization chart of the ordnance department.

The simplifying of operations, and consequent multiplying of them and of the number of tools necessary to perform them, called for more space than was available



Note—The Manager of the Ordnance Department, the Works Manager, Superintendent, and Master Mechanic are to confer and agree on all general Shop Policy.

FIG. 1. ORDNANCE ORGANIZATION CHART

in the shrapnel shop. It was therefore decided to build a new shop, to be known as the No. 2 shell shop, which should house all the machining operations on the 18-pounder high-explosive shell.

As previously stated, the required output is 4,000 shells per day of 22 working hours. Under the new system of simplified manufacturing operations, a floor area of about 42,000 sq.ft. is necessary. The building for the No. 2 shell shop is a single-story structure, chiefly of wood.

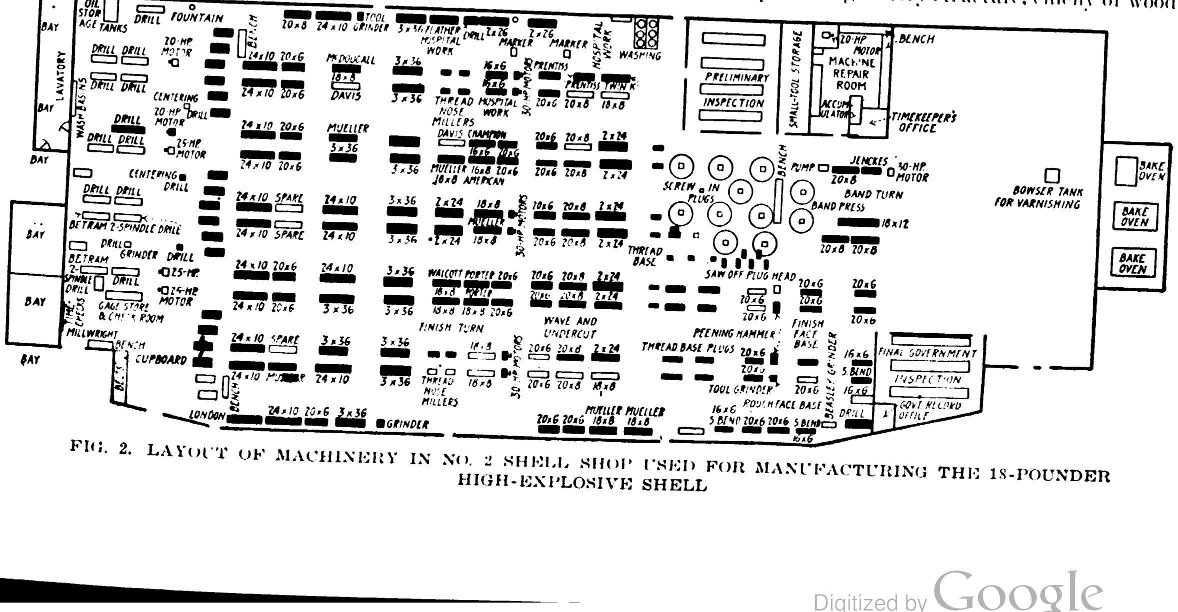


FIG. 2. LAYOUT OF MACHINERY IN NO. 2 SHELL SHOP USED FOR MANUFACTURING THE 18-POUNDER HIGH-EXPLOSIVE SHELL

It is about 120 ft. wide by 350 ft. long. There is plenty of light from the windows on the sides and ends and from numerous skylights in the roof. Structural work is of course the regular work of this concern, but even at that the building of a shop 120 by 350 ft. in 17 days is some stunt.

Elsewhere in this issue are shown progress views showing the building 2 hr. and 45 min. after work was begun on it; one taken 7 days later; one 14 days later and one 21 days later.

Before taking up the shop and manufacture a few words on the system, which has resulted in the practical elimination of scrap, may not be out of place.

By referring to Fig. 1 it will be noted that the general foreman is in direct charge of the shop. Under him are two day and two night foremen. These have a head inspector and material foreman for the day and night shifts. Over the head inspectors is a chief inspector. Below each head inspector and under his general supervision are four inspectors for each operation. All questions concerning inspection are referred to the head inspector, or to the chief inspector as a final court of appeal. The inspectors examine the work on the completion of each operation, and that which passes inspection is stamped with a symbol.

Besides inspecting the work in its various stages, the inspectors must examine the shape and depth of the centers in the work; and also, to insure good work, they must inspect the centers on the lathes and see that they are kept in good condition.

The duty of the material foreman is to keep the machines supplied with work, to keep track of the work as each operation is completed and to see that it is kept moving as soon as it has passed inspection.

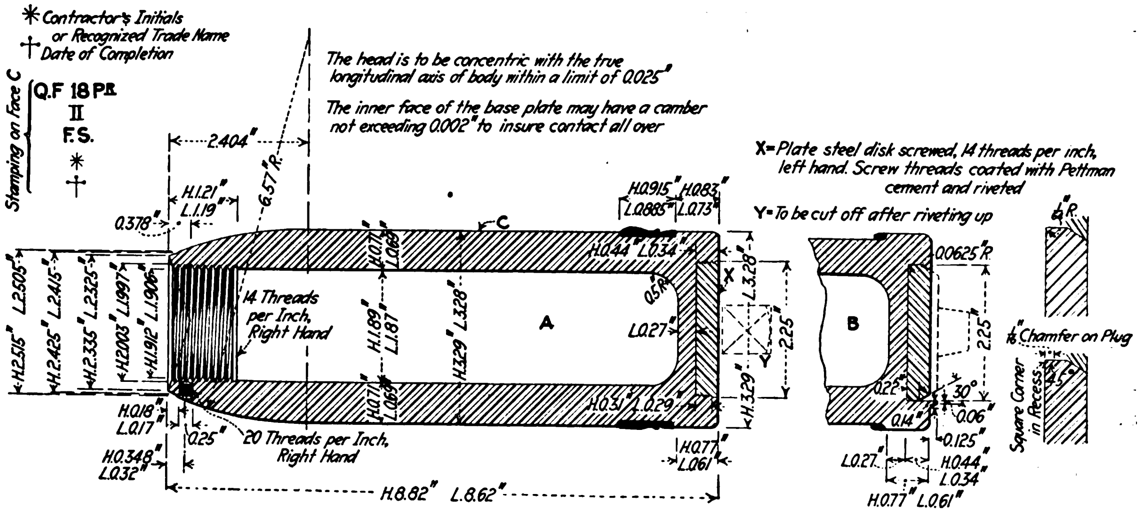
In order to fulfill these duties the material foreman has a staff of checkers for each operation. They follow the inspectors on each operation and mark up to each operator's credit the number of pieces passed and stamped by the inspector for that operation. The checkers turn in their reports to the general foreman so that he can inform himself of any shortage or surplus of work from any of the operations. He can then find the reason and correct it, or if necessary, change over a machine which is ahead with production and set it up for the operation which is in arrears.

Also under the material foreman but more directly under the checkers are the truck gangs, whose duty it is to truck the work from operation to operation after it has been tallied on the checkers' forms.

In Fig. 2 is shown the floor plan of the No. 2 shell shop with the layout of the machines, and in Table 1 is given the layout of work and the make and capacity of machines in the shop. It would perhaps be as well to read these two together, for apart from the descriptions of individual operations, they really tell the whole story of the manufacture of the 18-pounder high-explosive shell.

The rough blanks enter the No. 2 shop at the left and travel thereafter in a straight line to completion at the other end of the shop. With a very few exceptions only, and these due to misadventure, there is no back-tracking of the work after it once enters the door.

As previously stated, the blanks are cut from bar stock and are therefore solid. The steel from which they are made must have a yield point of at least 42,500 lb., tensile strength between 78,400 lb. and 87,360 lb., elongation of 20 per cent., carbon content between 0.45 and 0.55 per cent.; nickel under 0.50, manganese between 0.4 and 1, sulphur and phosphorus under 0.05 per cent. Having



WEIGHTS:	LB.	OZ.	DRS.
EMPTY BODY	14	8	6½
DRIVING BAND		4	12
TOTAL EMPTY UNPAINTED	14	13	2½
PAINT			5½
BURSTING CHARGE		13	0
FUSE: No.100 with Gaine or No.4 with Gaine and Adapter, No.80 Adapter and Gaine, No.[illegible] and Adapter	2	13	8
TOTAL FILLED	18	8	0±5 DRS.

ALLOWABLE MODIFICATIONS IN WEIGHT LIMITS: +1 OZ. −2 OZ. At Inspector's Discretion +3 DRS. −5 DRS.

18 PR HIGH-EXPLOSIVE SHELLS		
OPERATIONS	DIMENSIONS	
	Old	New
Rough Shell Blanks	9⅝"	9¾"
After Operation 8 Length	9.48"	9.605"
" " 8 Thickness Base	H.0.77"	H.0.895"
" " 15 " "	L.0.27"	L.0.27"
" " 2 " "	⅞"	1⅛"

FIG. 3. THE 18-LB. SHELL WITH OLD AND NEW TYPES OF BASE PLATES

fulfilled these requirements a heat number is marked on each lot in the steel mill.

In the Dominion Bridge Co.'s plant, but not in the No. 2 shop, there are three heavy cold-sawing machines used for sawing blanks from bar stock. However, as these are unable to keep up with the demand, blanks already cut to length are bought from other shops.

The various ways of cutting blanks have already been shown in the *American Machinist*, but a short résumé may be of value here, especially as the files of the paper may not be at hand for ready reference.

The methods include cold-sawing singly or in multiple in cold-sawing machines; cold-sawing by a quasi-continuous method in a heavy wide-slab miller equipped with a jig for holding a number of bars at a time and having a gang of cold-saws mounted on the arbor; multiple parting on a heavy wide planer equipped with a jig for

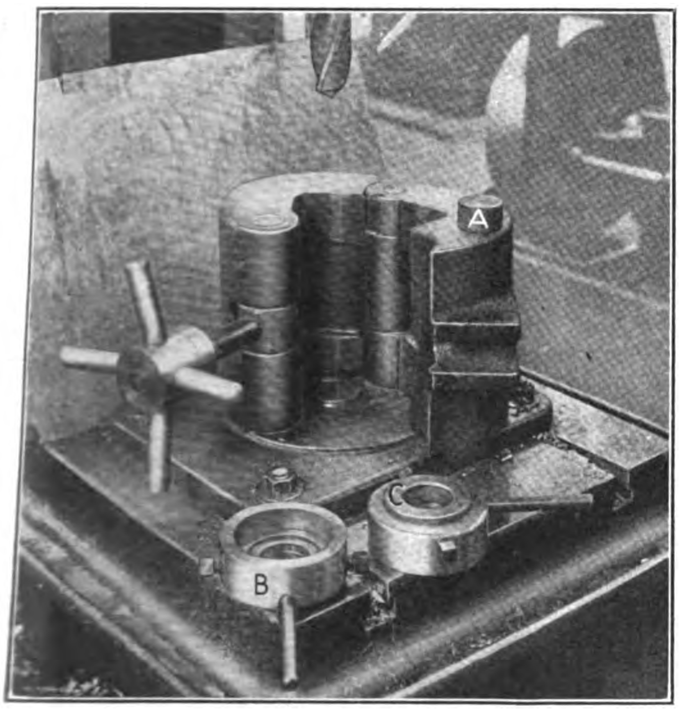


FIG. 4. HINGED DRILL CHUCK

holding a number of bars and with two or four tools in the heads; single cutting in a turret lathe and single cutting in a cutting-off machine.

The output by the various methods varies considerably. A standard Gorton hollow cold-saw working on a single bar $3\frac{1}{2}$ in. in diameter can cut about 19 blanks per hour. A heavy cold-sawing machine with four bars in the vise at a time can cut about 25 blanks per hour. A turret lathe or cutting-off machine in which the work is rotated can cut off about 25 blanks per hour. A heavy slab miller wide enough to pass between its housings bars four blanks in length and having on its table a jig about 12 ft. long and, with four saws on the arbor, by the quasi-continuous method, cut about 38 blanks per hour. It must, however, be remembered that when this method is used, the commercial bars must first be cut to length to pass between the housings of the machine. After cutting, the heat number is stamped on the base of each blank.

The cut blanks for the 18-pounder high-explosive shell are brought to the No. 2 shop on cars either from their own yards or from the outside source of supply. The cars are unloaded and the blanks, piled on shop trucks, are run to the first operation, which consists of grinding off the burr left by the cold-saw. This is removed, as it might prevent the blank from centering properly in the chucks in the first machining operation. For this work an ordinary dry-grinder is used with a wide rest for the work, as shown in operation sheet 1. A man can remove the burrs from about 300 blanks per hour.

To digress for a moment: In Canada, and I suppose elsewhere, more shells have been scrapped because they were under weight than for any other single reason. Knowing this the executives decided to obviate it by the very simple expedient of working to the high limits from the start. It would then be an easy matter to bring the shell to weight by turning off or boring out the excess of metal. Figured from the drawing of the shell shown in Fig. 3 the sum of the allowances amounts to nearly a pound, and the tolerances of weight on the finished empty body allow a total variation of $3\frac{1}{2}$ oz. At *A* in Fig. 3 is shown the 18-pounder as originally made. It will be noted that it has a threaded base plate similar to that in the 4.5-in. shell recently described in the *American Machinist*. The manufacture of a shell with this type of base plate if all the Government requirements are adhered to is not nearly as easy a job as it may seem. The thread is of the Whitworth standard and is very difficult to make and keep correct. The thread alone is not depended on to seal the base, Pettman cement being smeared on the threads before screwing it in and a final riveting operation being performed on the plate to close the base recess hermetically. Everyone knows that hammering on male and female threaded members loosens rather than tightens them. For this reason it is probable that many base

TABLE 1. LAYOUT OF WORK; MAKE AND CAPACITY OF MACHINES

Operation	Number of Machines in Operation	Size and Name of Machine	Capacity per Machine Per Hr.	Capacity per Machine Per 22-Hr. Day	Total Capacity in Shells
Drill	9*	24-in. Foote-Burt	5	110	990
	11*	25-in. Foote-Burt	5	110	1,210
	3	2-Spindle Bertram	12	264	792
	10	Dom. bridge drills	15	345	3,450
Center	3	Herbert drills	65	1,430	4,290
Rough turn	10	24x10 C.M.C. lathes	20	440	4,400
Rough nose	2	18x8 Mueller	23	506	
	6	24x10 C.M.C	23	506	4,554
	1	18x8 McDougall	23	506	
Face base	4	20x6 Gardner	48	1,056	4,224
Face to length	3	20x6 Gardner	30	660	1,980
Bore and ream	12	3x36 J. & L.			
	4	3x36 Acme			
	6	2x24 J. & L.	9	198	4,752
	2	2x26 P. & W.			
Thread nose	8	Thread millers	25	550	4,400
Finish turn	4	18x8 C.M.C			
	1	18x8 Walcott			
	1	16x6 American	20	440	4,400
	1	16x6 Champion			
	3	18x8 Mueller			
Face to weight	6	20x6 Gardner	35	770	4,620
Round corner, groove	6	20x6 Gardner	35	770	4,620
Wave and undercut	9	20x8 Gardner	21	462	4,150
Recess base	2	2x24 J. & L.			
	2	18x8 Mueller	25	550	4,400
	4	20x10 C.M.C			
File base to gage	2	16x6 Gardner			
	2	16x6 Prentiss			
	1	16x6 Flather	35	770	4,620
	1	16x8 Twink			
Mill base thread	6	Thread millers	36	790	4,740
Drill ¼ hole in Nose	1	4-spindle drill	200	4,400	4,400
Tap ¼-hole	3	Herbert drills	80	1,760	5,280
Marking	2	London air markers	125	2,750	5,500
Saw-off square on base plate	6	Racine hacksaws	25	550	3,300
Rough face base plate	6	20x6 Gardner	35	770	4,620
Rivet base plate	2	High speed hammers	100	2,200	4,400
Finish face base plate	7	20x6 Gardner	30	660	4,620
Band press	1	6-cylinder Lymburner	120	2,640	5,280
	1	West Tyre Co.			
Band turn	2	20x8 C.M.C			
	1	18x12 L. & S.	50	1,100	4,400
	1	Jenckes			
Threading base plates	8	Automatic (Bridgeport)	10	220	1,760
Turn base plates	4	16x6 S. Bend	75	1,720	4,300

In addition to the lathes listed there are on shell work, exclusive of the toolroom 1 London 18x12; 1 C.M.C. 20x8; 1 C.M.C. 18x8; 1 J. & L. 2x24; 1 C. M. C. 20x8; 1 Gardner 20x6.

* These machines will be dispensed with.

plates which were a fairly close fit when screwed into the base recess were so slackened after riveting that they would not pass inspection. To obviate these difficulties, the base plate shown at *B*, Fig. 3, was devised. With it threading of the base recess and base plate are eliminated. The recess is a plain cylindrical blind hole with a fillet in the corner. Nothing could be easier to make right and keep so. The only extra work with this type of base plate is the turning of the base for the riveting flange *C*, or "angle," as it is termed in the shop operation. This also makes necessary an additional ⅛ in. of length on the blank to provide for the riveting angle. The amount of riveting necessary with this type of base plate is a little greater than that necessary with the threaded type, but riveting is a simple operation and does not require either a great amount of time or a high degree of skill.

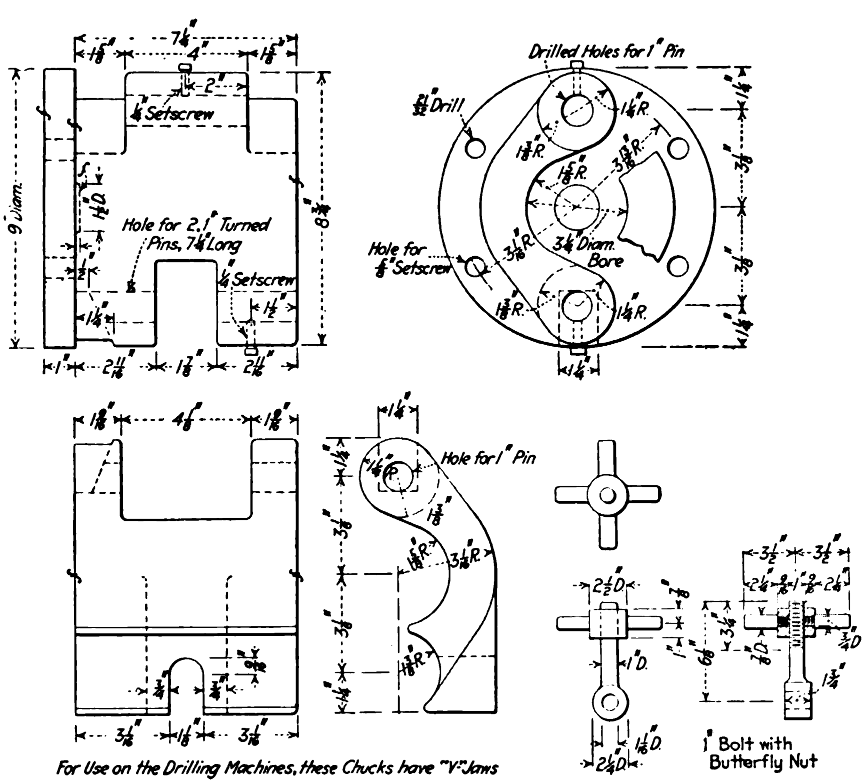


FIG. 5. DETAILS OF HINGED CHUCK

The base plate is a plain cylinder with a rounded edge and a conical portion at the back, over which the riveting angle is turned in the riveting operation. It is a simple piece to make accurately and is turned out on plain engine lathes.

The use of this type of base plate, besides calling for a shell blank ⅛ in. longer than with the original base plate, requires slight changes in four of the operations, as shown in the table attached to Fig. 3. In this table the threaded type of base plate is referred to as the "old" and the unthreaded as the "new" type of base plate. Having had the burrs ground off, the blanks are taken by the truck gang to the drilling machines.

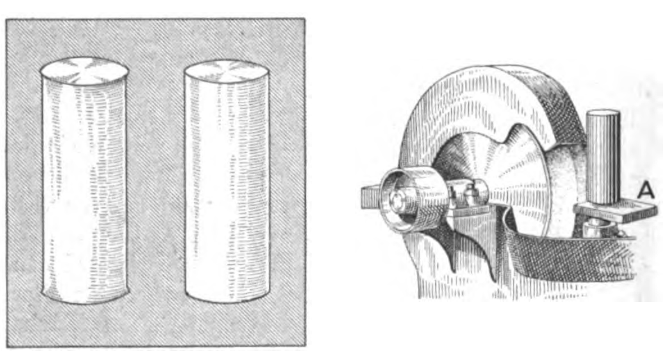
The drilling operation is, from the viewpoint of time consumed, the most important of the machining operations. Three different makes of machines are used for this operation. There are nine 21-in. and eleven 25-in. Foote-Burt heavy-duty drilling machines, three 2-spindle Bertram horizontal drilling machines and sixteen Dominion Bridge Co.'s air-feed horizontal drilling machines.

The hole to be drilled in the blank is 1⅛ in. in diameter, 8¾ in. deep. In drilling deep holes the problem is not so much the cutting of the metal as the removal of the metal after it has been cut; that is to say, the removal of the chips from the hole to prevent them from choking the drill. The difficulty of chip removal is much greater with vertical machines than with horizontal ones. In vertical machines a drill must be used that will clear itself, as it is very difficult to install oil or water-tube drills in such a manner that they will not sling the lubricant. For that reason twist drills have been and always will be popular for use with vertical machines. They keep the chips moving upward, and a small amount of the flood of coolant no doubt gets down the hole to within a few inches of the cutting edges.

The great objection to twist drills at this time is their cost. At the time of writing, a 1⅛-in. twist drill made of high-speed steel, of the length required for drilling 18-pounder blanks, costs from $55 to $60, depending on the make. In normal times the same drill can be bought for from $10 to $12. The average life of such a drill is about 450 holes; thus the drill cost alone is about 13c. per hole apart from the labor and other charges.

With horizontal machines the conditions are entirely different. There is no great difficulty in installing oil- or water-tube drills. With these installed it is only a question of pressure on the lubricant to determine how fast the chips shall come out of the hole. With these drills the lubricating of the cutting edge is also settled, for the lubricant must go to the end of the hole before it can return, bringing the chips with it.

A further advantage with this type of drill is its low cost. The body of the drill can be made of any good bar stock. Steel about 60 to 70 points carbon, well hammered, makes a good stiff shank for such a drill, and two high-speed bits costing at the present time 50c. each will do as much work as a $60 twist drill. Further, if the drill be properly made it will drill a hole that no twist drill can approach as regards accuracy.



OPERATION 1: REMOVE BURRS FROM BLANKS
Machine Used—Dry grinder.
Special Tools and Fixtures—Wide rest A set in line with the wheel center.
Gages—None.
Production—One man and one machine, 300 per hr.
References—None.

On the Foote-Burt drilling machines two types of chucks are used to grip the work. The one shown in Figs. 4 and 5 was the first one designed for use on the drilling machines and was not very satisfactory, but is all right for use on the benches, where it is now used. Rapid manipulation was not possible, and the chips gave more or less trouble as there was no way for them to fall clear through. The little block shown at A is for setting the drill to depth when a newly ground drill is inserted in the spindle and the feed stop is to be set. The bushing B is for centering the drill at the start of a hole. The large part of the bore of B is a somewhat slack fit on the rough shell blank. This cannot be otherwise, as the hot-rolled stock from which the blanks are cut varies somewhat in diameter. The operator on starting a new hole places the bushing B over the end of the blank with the drill guiding bushing up, as shown at C. He then runs the drill in till the lips are below the surface. The drill is then elevated, the bushing removed, the drill lowered to cutting position and the automatic feed thrown in.

The holding jig in Fig. 6 is much better and quicker. The two jaws are operated by a right- and left-hand screw controlled by the handwheel A. There is plenty of space between the jaws so that the chips can be swept out when chucking a new blank. Centering at present is accomplished in the same way as with the old chuck, but a centering device is now being made for these drilling machines to center the drills positively, irrespective of the diameter of the blank. This drill guide is shown in Fig. 7. The bracket A is made of steel plate $1\frac{1}{8}$ in. thick, forged to shape. It is gibbed and doweled to the ways that carry the table of the machine. The two arms B are pivoted at C to the bracket A. The swing bolt D clamps them securely together at the forward end, and the stop E assures that they always register properly. At G is the guide for the drill. The hole G is bored after the device is set up in place. The knurled nut on the bolt D is easily operated without a wrench; the arms can

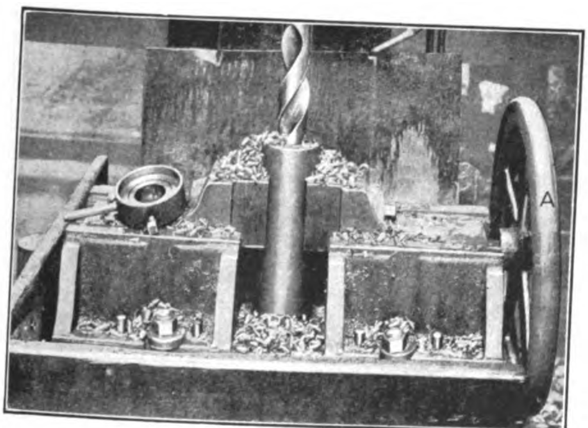
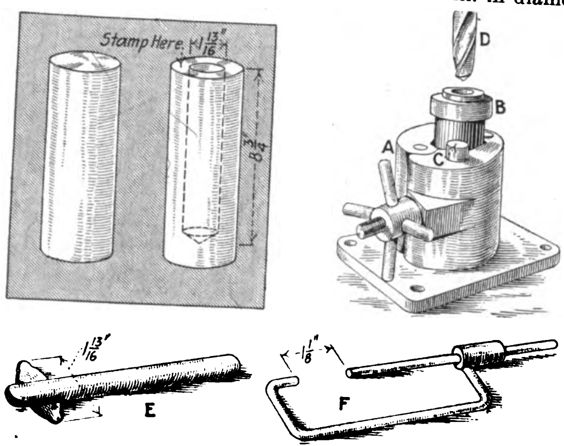


FIG. 6. DRILLING VISE WITH RIGHT AND LEFT SCREW

then be swung out of the way and the work placed or removed.

Two Foote-Burt drilling machines are attended by one operator. Their nominal output is 5 pieces per machine per hour. A man can, however, do a little better than this, but in many of the shops where these machines have been forced there has been more or less trouble with breakage, so it has been found more economical to run slower.

The Dominion Bridge Co.'s air-feed drill is a recent development. Mr. MacDonald, manager of the ordnance department, is responsible for it, and in it he has nothing of which to be ashamed. It is simple and rugged in construction, drills a more accurate hole than the vertical machine in about a third of the time and costs very much less. The machine is shown in Figs. 8 and 9, together with the drill used. The air cylinder A is 7 in. in diame-



OPERATION 2: ROUGH DRILL
Machines Used—Foote-Burt vertical drilling machines. Dominion Bridge Co.'s air-feed horizontal drilling machines. Bertram two-spindle horizontal drilling machines.
Special Tools and Fixtures—Chuck like A or vise with R- and L-screw operated jaws for the vertical machines. Centering jig B. Drill setting block C. $1\frac{13}{16}$ in. twist drill D. For horizontal machines $1\frac{13}{16}$ in. hogging drill is used.
Gages—Diameter gage E. Base thickness gage F.
Production—One man and 2 vertical machines, 10 per hr. One man and one horizontal machine, 15 per hr.
Note—Drilling compound used as lubricant.
References—See Figs. 4, 5, 6, 7, 8, 9 and 10.

ter and is supplied with air at 90 lb. per sq.in., giving a total pressure of about 3,500 lb. on the piston and drill. The piston rod B is 4 in. in diameter and at its forward end is secured to the sliding saddle C. A taper reamed socket in the extreme end accommodates the drill shank. The drill is hollow, and lubricant under pressure is admitted to it through the connection at D. The belt-driven pump E supplies the lubricant at present. The main spindle of the machine is 6 in. in diameter. At the forward end is a heavy combination chuck for holding the work. The rim of the faceplate that carries the chuck is used as a brake drum, the band of the brake being controlled by the lever F. In front of the rear spindle bearing is a ball thrust bearing G to take the drilling pressure. With one of these machines a man can drill 15 blanks per hour.

After the blanks are drilled the work is inspected for diameter of hole and thickness of base by one of the four inspectors assigned to the drilling department, who uses the gages shown in the second operation sheet. Work that passes inspection is stamped by the inspector as indicated in the operation sheet. The checker now credits the driller with the number of pieces drilled, the truck gang is notified and the work loaded on trucks and transferred to the next operation.

Before passing to the next operation it may be well to call the reader's attention to the fact that even the location of the inspection marks has been standardized. While this may seem a small matter it is in reality the means of saving a great amount of time, for there is little expense of effort in looking for a thing when one knows just where to find it. The location of the various marks

is shown in their entirety in Fig. 10. Besides these marks the steelmakers' heat or melt number must always be kept on the work. Before those operations which remove it from the work, it must be stamped on the side or end of the piece, whichever will leave the mark uneffaced after the operation is completed. The next operation is centering. The center must conform as nearly as possible with the axis of the hole, not the outside of the piece. The work in place in the jig is shown in Fig. 11 and the details of the jig in Fig. 12. The work *A* is slipped over the vertical post, the leaf *B* swung on the pivot *C* to the position shown in Fig. 11 and the pin *D* entered in the hole in the top of the side post *E*. By referring to Fig. 12 it will be seen that the weight of the piece and the drill pressure throw three radial locking pieces which prevent the piece from turning. At the top of the center post is the wedge-like plunger *A*. A helical spring normally keeps it up in the position shown. Three radial jaws *B* are disposed 120 deg. from each other around the conical part of the plunger *A*. When

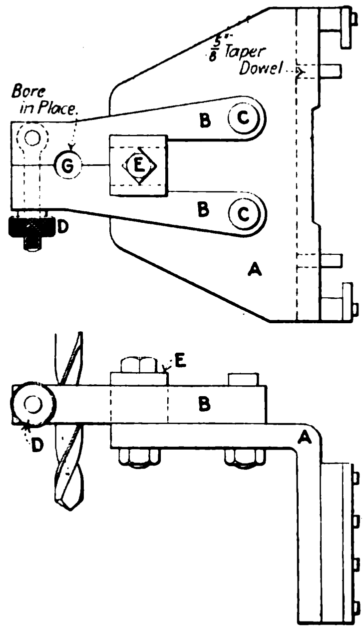
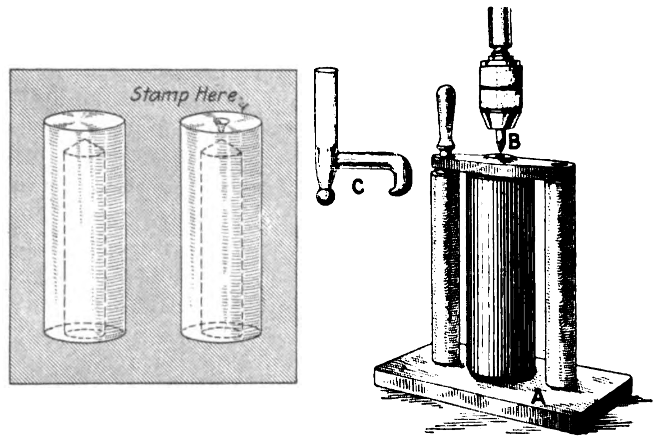


FIG. 7. DRILL GUIDE FOR FOOTE-BURT DRILLING MACHINES

but this operation has been done at the rate of over 81 blanks per hour for a period of 10.5 hr.

After centering, the work is again inspected to see that there is enough metal all around for the shell to clean up properly in the subsequent operations. The inspection gage is a set wing gage with a ball point, and the work



OPERATION 3: CENTER THE BASE END OF THE BLANK
Machines Used—Herbert sensitive drilling machines.
Special Tools and Fixtures—Centering jig A. Combination center drill B.
Gages—Wing caliper gage to test if stock will clean up.
Production—One machine and one boy, 65 per hr.
References—See Figs. 10, 11 and 12.

is marked, all as shown in the third operation sheet and Fig. 10. The checker tallies the work, after which the truck gang collects and distributes it to the machines on the next operation.

The next operation is done on 24-in. by 10-ft. engine lathes. In the spindle nose there is a plug center to fit the hole in the shell blank, and on the nose a driver plate. An ordinary lathe dog is tightened on the open end of the

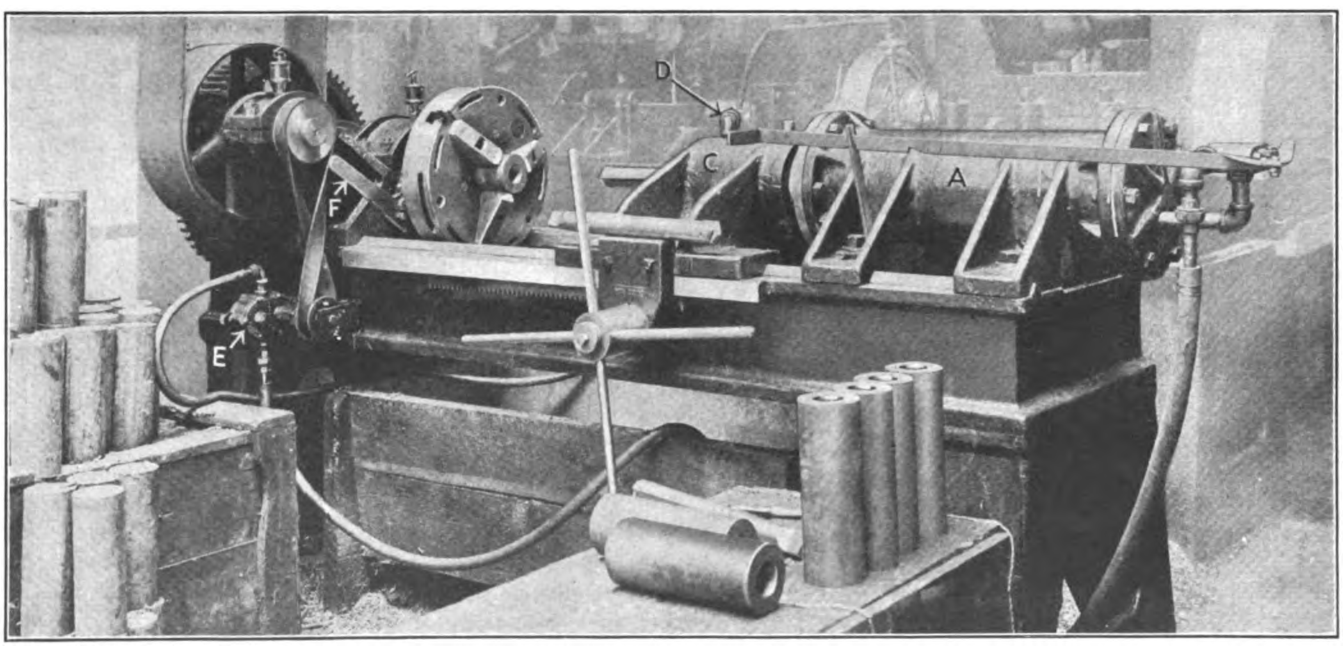


FIG. 8. DOMINION BRIDGE AIR-FEED DRILLING MACHINE

the drilled blank is placed over the post it forces the plunger downward, and it in turn forces the three radial jaws outward. These simultaneously center the work with relation to the hole, grip it and prevent it from turning during the centering operation. The [illegible]eduled time on this operation for a boy is 65 bl[illegible] per hour,

shell blank, the hole in the blank entered on the plug center and the center in the base entered on the tail center, all as shown in Fig. 13 and the fourth operation sheet. The tool is an ordinary roughing tool; the cut is run toward the headstock as far as the dog will permit. The operator has two snap gages for this operation. They are

30 for the high and 3.320 for the low, a fairly large owance for a piece of this diameter even on a rough-ning operation. The scheduled output for this opera-n is 20 pieces per hour. However, if the steel in the nks is not too hard and the tools are of good steel and ll-tempered, a man can average 28 pieces per hour.

The inspection for this operation requires the same gages as those used by the operator. After the blanks are passed and marked by the inspector, a boy assigned to the rough-turning operation makes the first transfer of the heat number from the base of the blank, where it was put by the steelmaker, to the side of the shell.

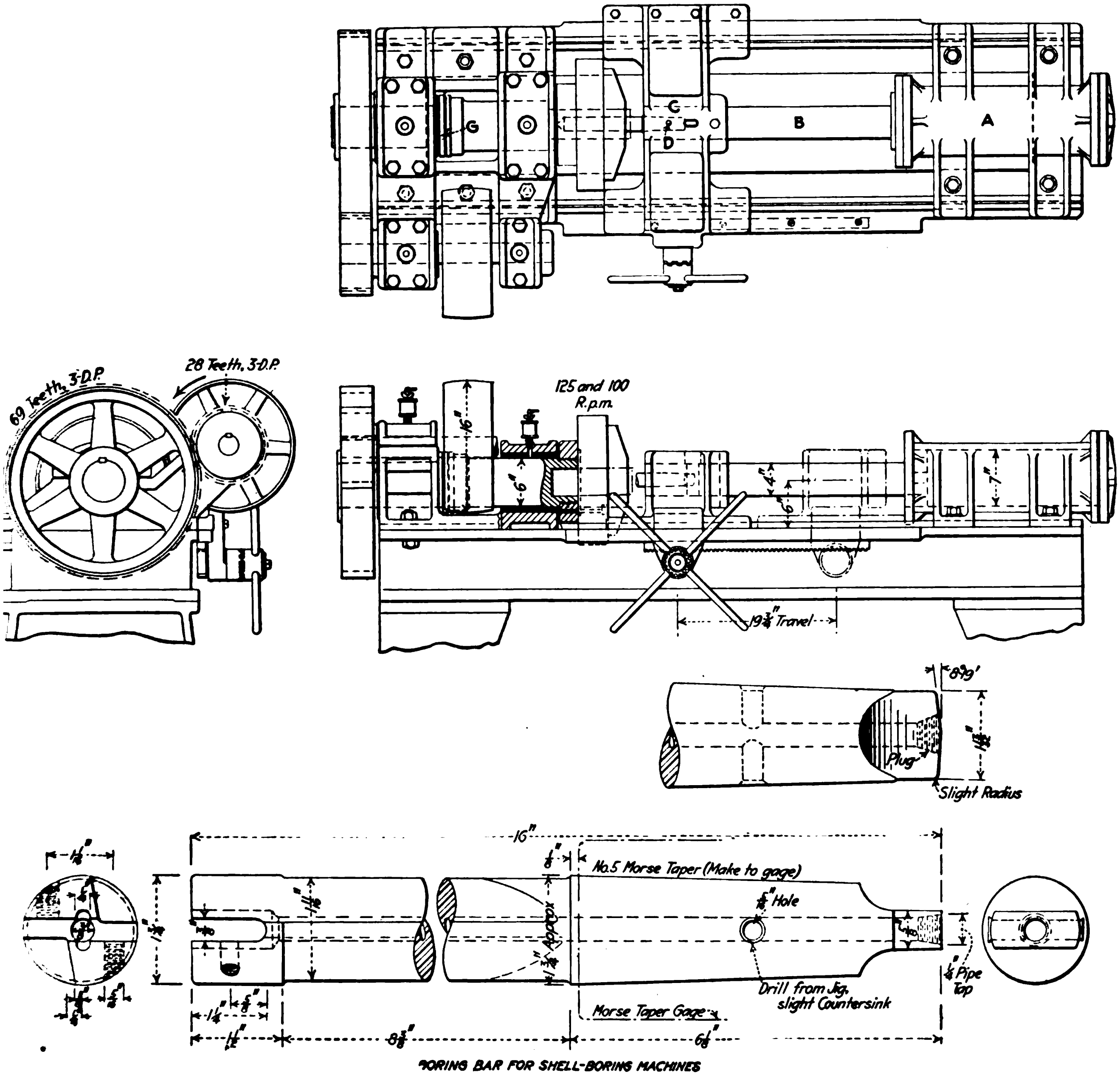
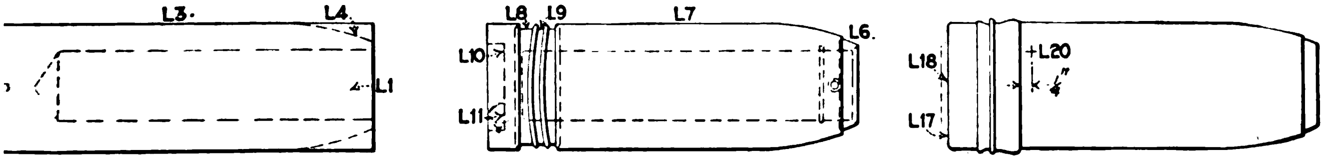


FIG. 9. THE HIGH-EXPLOSIVE SHELL-BORING MACHINE



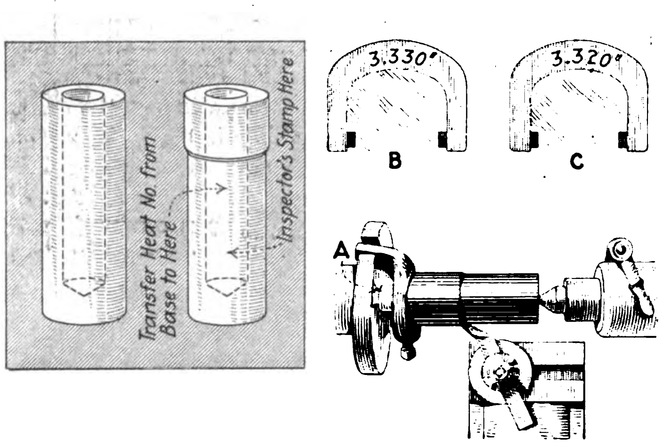
Operation	Description	Stamp, In.	Operation	Description	Stamp, In
L1	Drill $1\frac{11}{16}$ in. ϕ hole	$\frac{1}{4}$	L11	Mill base thread	$\frac{3}{16}$
L2	Center	$\frac{1}{4}$	L12	Drill $\frac{1}{4}$ in. ϕ hole	none
L3	Rough turn body	$\frac{1}{4}$	L13	Tap $\frac{1}{4}$ in. ϕ hole	none
L4	Rough turn nose	$\frac{1}{4}$	L14	Screw in base plugs	none
L5	Face base	$\frac{1}{4}$	L15	Saw off square end	none
L6	Bore, ream and tap inside	$\frac{3}{16}$	L16	Rough face plug	none
L7	Finish turn	$\frac{1}{4}$	L17	Rivett or roll plug	$\frac{1}{4}$
L8	Face base round corners and rough groove	$\frac{1}{4}$	L18	Finish face plug	$\frac{1}{4}$
L9	Wave and undercut	$\frac{1}{4}$	L19	Band press	none
L10	Recess base	$\frac{1}{4}$	L20	Band turn	$\frac{3}{16}$

All men, whether on piece work or daywork, must stamp all shells as shown above.

FIG. 10. STANDARD STAMPS FOR OPERATIONS ON THE 18-POUNDER HIGH-EXPLOSIVE SHELL

The checker then credits the operator with the work, and the truck gang transfers the shell blanks to the next operation.

The next operation is roughing the nose. This work is done on 18- and 20-in. engine lathes. An ordinary lathe dog is tightened on the base end of the blank. The live spindle carries a 60-deg. center and driver plate. The tail spindle carries a plug center with a thrust



OPERATION 4: ROUGH TURN

Machines Used—18- and 24-in. engine lathes.
Special Tools and Fixtures—Plug center A.
Gages—High and low limit snap gages B and C.
Production—One man and one machine, 20 per hr.
Note—Cutting compound used.
References—See Fig. 13 and Fig. 10 for position of inspector's mark.

collar so that it will turn easily. In the tool post there is an ordinary roughing tool. The crossfeed of the tool is made with the compound slide. The lengthwise feed is under the control of a former at the back of the lathe. A roller bears on the former and is kept in contact with it by a fairly stiff spring. The first of these forming attachments in use at this shop had a plain former with

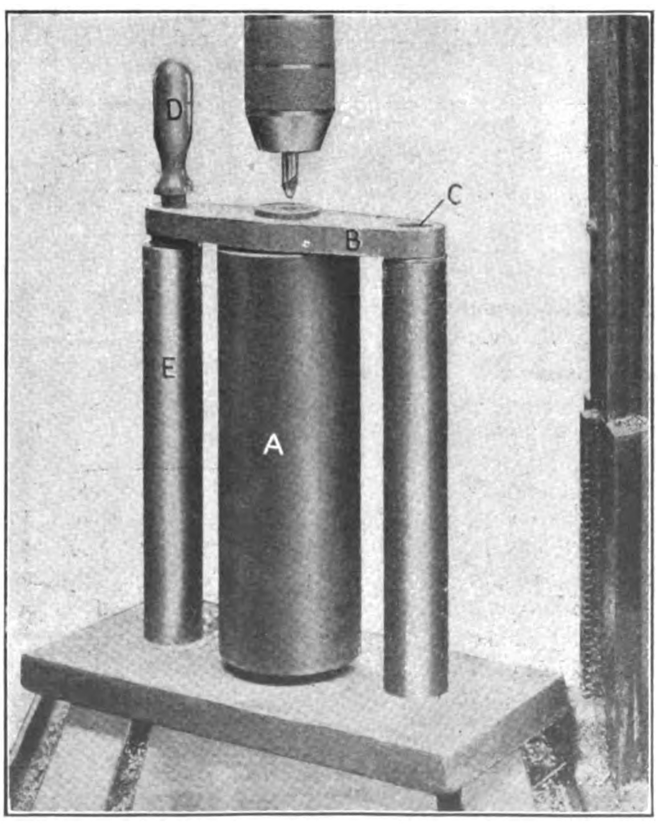


FIG. 11. CENTERING THE BLANKS

a follower of the "knife-edge" type. This was not satisfactory. The next one tried was equipped with a cam groove and roller fitting it. This also proved unsatisfactory, so the present type shown in operation sheet five was installed and has given no trouble. It is well to remember that devices like this should be kept well lubricated and should be well protected from dirt and possible damage. The attachments in use here have a

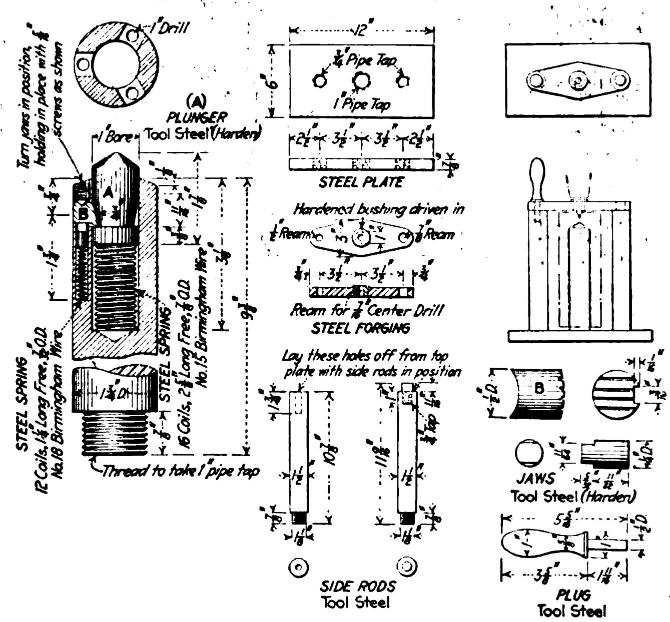
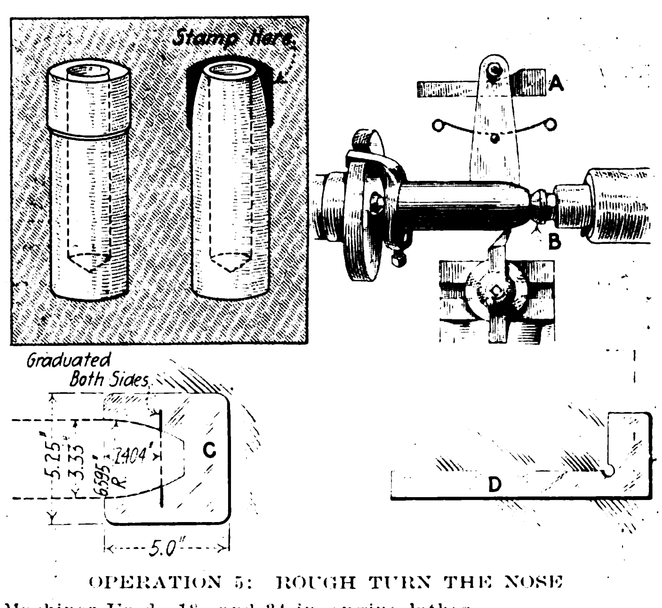


FIG. 12. DETAILS OF CENTERING

fairly heavy sheet-iron cover, so made that it can be readily removed.

The feed of the lathe for this operation is away from the headstock. Two cuts are taken with an ordinary roughing tool. The first one starts at the point where the roughing cut in the former operation left off, but not quite to the same depth. The second cut is started a little way back on the parallel part of the body and to the same diameter as the rough body size. The scheduled out-



OPERATION 5: ROUGH TURN THE NOSE

Machines Used—18- and 24-in. engine lathes.
Special Tools and Fixtures—Former and roller A. Plug center B.
Gages—Profile gage C. Over-all length gage D.
Production—One machine and one man, 23 per hr.
Note—Cutting compound used.
Reference—See Fig. 14 and Fig. 10 for position of inspector's mark

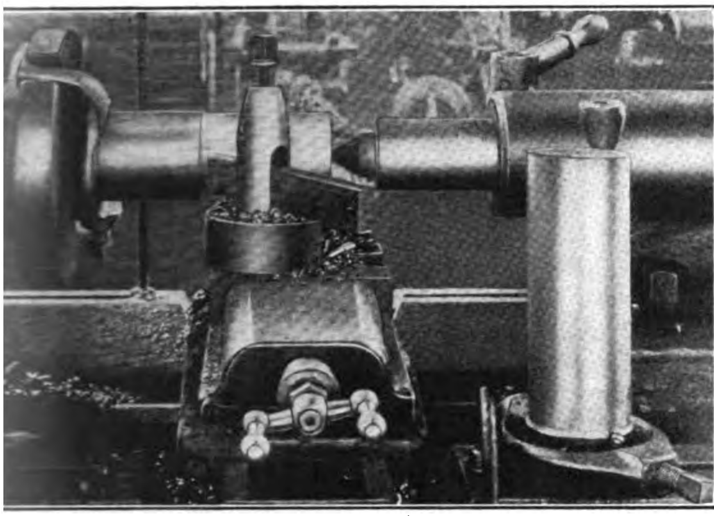


FIG. 13. ROUGH TURNING THE BODY

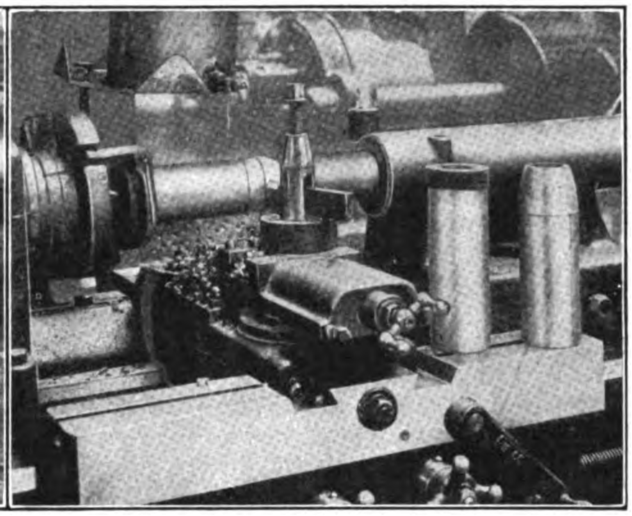


FIG. 14. ROUGH TURNING THE NOSE

ut on this operation is 23 per hour, but with everying going right a man can get out 28 pieces per hour.

The work is now inspected to see if the contour of le nose is correct and if the length overall is right, and the inspector's stamp is affixed to the work, all as shown in the fifth operation sheet. The checker now credits the workman with the number of pieces passed and the truck gang transfers the shells to the next operation.

A Shell Shop Built in 17 Days

FIG. 1. JUNE 14, 1915. 9:45 A.M.

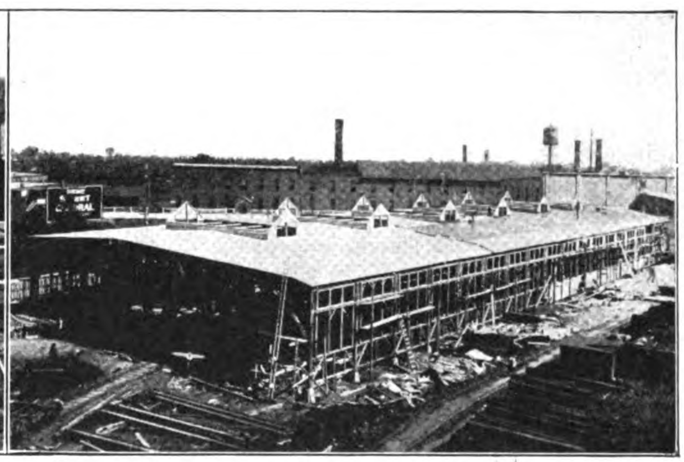


FIG. 2. JUNE 21, 1915. 3:15 P.M.

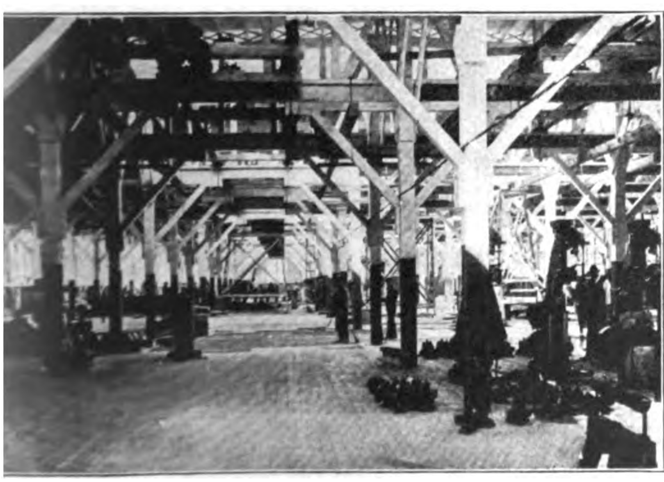


FIG. 3. JUNE 28, 1915. 3:30 P.M.

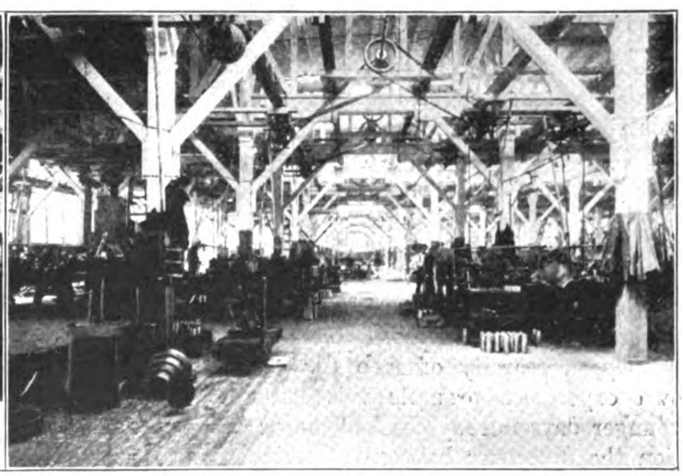


FIG. 4. JULY 5, 1915. 3 P.M.

This is a little story, practically without words, of how the Dominion Bridge Co., Montreal, Canada, built the No. 2 Shell Shop for the manufacture of the 18-pounder high-explosive shell. The shells at the right on the floor in Fig. 4 were made in this shop. It will be noted that the date on this photograph is July 5 and on Fig. 1 it is June 14

Miller Designer and Shop Superintendents

By E. P. Armstrong

I have never seen a miller either in stock or in print that struck me as having a long enough saddle for the traveling table to work on. In the construction of planers the bed, or in other words the ways that the table slide on, are always of sufficient length so that when the table is at its extreme of travel at either end it will lie down in the ways naturally; that is, the center of gravity of the table or bed is always within the scope of the slides that support the movable table.

In almost all millers the saddle is too short for this. When the table travels toward either end a little way beyond the center, the center of gravity gets beyond the end of the support; it is useless to say that the slides should fit close enough to cause the table to travel in a straight line from end to end, because it will not do it, especially when mounted with heavy index centers and the work, or with other heavy fixtures for manufacturing. I realize that in the case of universal millers a long slide might interfere when the table is set at an abrupt angle. However, the miller could be designed so that the long slide would not interfere. It would not need to be wider than the oil catcher on the table so that if the table were clear, the headstock when swung around at an angle, the slide would also clear it. The slide should always be long enough so that the center of gravity of the table would always be within the slide.

There have been such rapid advancement and such radical changes in millers within the last few years, I have been hoping to see somebody heed this plain requirement. As I expect to be in the market for one or more milling machines in the near future, I am much interested.

Another question I should like to see discussed more forcibly in the near future in your paper is on the requirements of a shop superintendent. The scarcest men in the country today are men who are capable of satisfactorily filling the superintendent's position not only in machine shops, but in various other institutions. There is a reasonable supply of skilled workmen, but they lack training for superintendents. There seems to be in papers like yours a lack of the use of printers' ink bearing on the needs in this line. Young men and machinists who are ambitious and wish to become superintendents should have constantly available pointers and information showing them the things they need to learn to fill this important position, because it is not altogether a question of skill in cutting iron and machinery, but of broad-sightedness, diplomacy and tact coupled with well-developed executive ability.

Men need ability not only to carry out an established system themselves in every detail, but to see that those under them do it. A perusal of the want ads in your paper every week shows conclusively my contention, namely, a scarcity of men for responsible jobs. My own experience prompts this letter to you. In my younger days nobody coached me or called to my attention the difference between a workman, no matter how skillful, and a man filling a position of responsibility. And it took me many years to get on the right track. A little plain, straight-forward, consistent, wholesome exposition of this subject would be of great value to the machine-shop and other industries in this country. And do not print it one week and then drop it; but select a suitable place in your paper and print a short piece in condensed form, yet comprehensive, and leave it there constantly.

I hope these suggestions may help along the principles that your valuable paper stands for.

Ornamental Foundry in Brazil

The highly utilitarian American usually discards all ornament when building his shop and would consider unnecessarily ornamental such a foundry front as shown herewith. There is, however, another side to the story, and it is an open question whether a little more attention to ornamentation might not pay in its effect on a city and its people. The group of manufacturers who have built on University Ave., Rochester, N. Y., seem to feel that this is the case.

AN IRON FOUNDRY IN BRAZIL

The illustration shown is the front of the foundry of Carvalho Paes & Co., in Rio de Janeiro, Brazil, which is certainly more of an ornament to a city than many to be found in this country.

Important Constituents of Steel—The most important constituent of steel, upon which the nature of the metal largely depends, is carbon. Depending upon the carbon content, ordinary steel castings vary from very soft to dead-hard steel. The carbon content in each class of steel castings is approximately as follows:

Class	C., per Cent.	Special Trade Names
Very soft	Up to 0.15	"Malleable-Iron Castings"
Soft	0.15 to 0.30	....
Medium	0.30 to 0.40	....
Hard	0.40 up	"40-Point Steel"

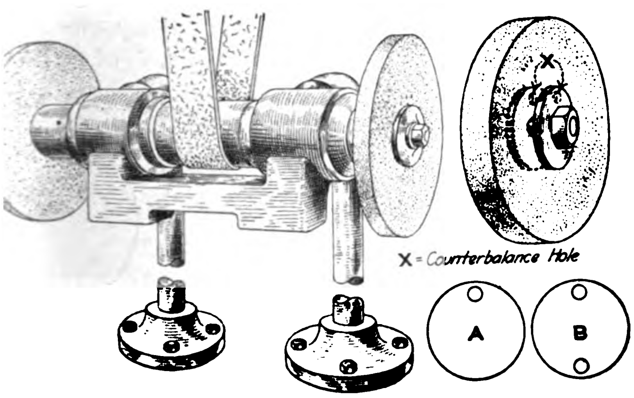
The effect of silicon in steel castings is chiefly to promote soundness and to discourage the formation of blow-holes. The average silicon content of steel castings is from 0.25 to 0.40 per cent., though in "very soft" steel it is sometimes as low as 0.15 or even 0.10 per cent. The silicon content should not be specified by the purchaser but left to the judgment of the maker. Manganese in "very soft" steel castings is sometimes as low as 0.20 per cent., but in the average casting it runs from about 0.40 to 0.80 per cent., or even higher. As manganese additions are absolutely essential in the manufacture of steel, and in most cases the steel could not be made sound at all without it, the manufacturer is in a position to know how much he should use and should not be hampered by limits imposed in specifications. The effect of phosphorus in steel is to produce brittleness in the metal when cold. Hence the limits are sharply specified. No steel casting should contain over 0.10 per cent. of phosphorus, and 0.08 per cent. is better.

The Small-Shop Grinding Wheel

By John H. Van Deventer

SYNOPSIS—Although often wrongly selected, incorrectly mounted, improperly speeded and unfavorably used, the small-shop grinding wheel plays no inconsiderable part in getting out the work. This article is intended as a help to the better understanding and use of this crude but effective shop appliance.

Some day perhaps the creator of "Happy Hooligan" l lead him into a small machine shop and then show in pictures what happens to him. The old fellow must getting tired of the regular routine of mishaps and ild appreciate something different, such as getting nped with a planer table or being scalped by a driving t. But for all-around entertainment let him be in-



FIGS. 1 AND 2. TWO WAYS OF SIDETRACKING THE VIBRATION QUESTION

one exciting. And mind you, I am speaking of the simple apparatus found in all shops, which consists mainly of wheels and belts—not the "grinding machine" that is nine-tenths machine and only one-tenth wheel. On these simple appliances tools are ground, keys are fitted, castings are snagged, hurry-up jobs are surfaced, that which is too long is shortened, that which is too wide is made narrow, and that which is rough is made smooth. Yet in spite of its broad application, you find in many shops that grinding wheels are more abused than used.

The error that I will attack first, because it is the most common one, is the lack of running balance.

"What's that, an earthquake?" you ask as you feel the floor beginning to shake and tremble.

"Oh, no," is the reply, "it's just Tom starting up the grinding wheel."

One can hardly stand within ten feet of a grinding wheel in the average shop without feeling the vibrations running up and down his backbone. That this is an entirely unnecessary condition is seen when you consider that plain grinding machines with wheels running at the limit surface speed are practically free from vibration. They have to be, in fact, to produce accurate work. The result is not obtained by sleight of hand, but is due to three simple factors—a substantial base, true spindle and bearings, and well-balanced running parts.

The first essential of a smooth, quiet running wheel is a heavy frame. It is easier for a dog to shake a little tail than a big one. Some shop owners sidetrack the vibration question, in a manner shown in Fig. 1, by attempting to mount the grinding wheel on a springy frame, with the

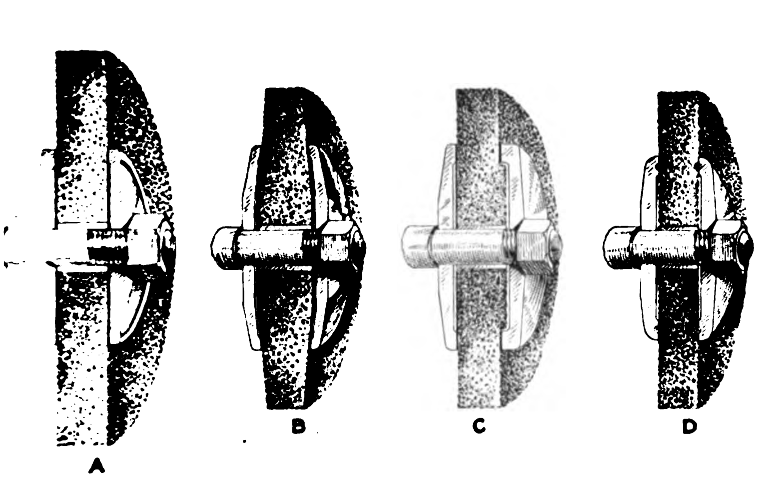


FIG. 3. FOUR METHODS OF MOUNTING GRINDING WHEELS

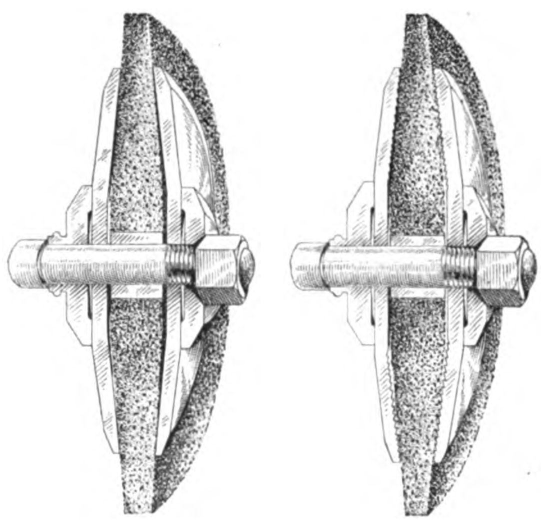


FIG. 4. SAFETY COLLAR MOUNTING

duced to a grinding wheel. Picture to yourself the ression of his face after feeling of the wheel with his ers or upon taking hold of the "heavy" end of the e of work! Imagine him trying to light his "snipe" a stream of sparks. Picture him reclining gracefully inst a swiftly moving snagging wheel and then mak- a hasty exit with a newspaper held to conceal the nages!

The small-shop owner finds as many ways to make a nding wheel helpful as a Hooligan would find to make

idea that it will absorb vibration. Considering the amount of work that is expected from a grinding wheel, it should not be begrudged a sufficiently heavy base.

It is not uncommon to find shop owners with the idea that a grinding head may be shaken together out of the crudest kind of material. Bearings and spindles that are shaken together in this manner will continue to shake together as long as they last. The speed at which a grinding wheel must run requires not only a smooth, round, true and well-balanced spindle, but also bearings of the

most improved design, well lubricated and dustproof, and the spindle pulley must be carefully balanced.

"Shall I use a plain bearing or a ball-bearing grinder head?" This depends absolutely upon whether you will keep the wheel running true and in balance, or allow it to vibrate. Ball bearings on apparatus of this kind will save power, especially on wheels that are run idle a large part of the time. But there is no make of ball bearing that can possibly live under the hammering punishment of an unbalanced emery wheel.

Grinding wheels when received from their manufacturers are likely to be in good running balance; but as the density of the material in these wheels is not uniform, it is quite likely that after one of them is worn down an inch or two it will get out of balance. A means of quickly overcoming this is shown in Fig. 2. It consists of balancing flanges having light spots, which may be placed either opposite or together, or in any other relation to secure the desired counterbalancing effect. The use of such flanges is a mighty good scheme and saves time in making a wheel vibrationless.

While vibration is the most common defect of the grinding wheel, it is not the most important one, if the importance of these things is to be measured by their effects on safety. Bad wheel mountings and lack of guards have been responsible for more accidents than any other causes. I for one would much prefer to stand in front of a correctly mounted wheel running 10 per cent. overspeed than in front of a badly mounted wheel running 10 per cent. underspeed.

Clang! Clang!

"There goes the ambulance. Wonder what's the matter! Oh, it's old Bill from the Triumph Works—he's all smashed up. Emery wheel let go and hit him. They say it broke three ribs and tore off half of his face—mussed him up so you wouldn't know him. Oh, well, such things will happen. Say, ain't this war dreadful!"

Old Bill will spend the next two months in the hospital—if he is lucky or (unlucky) enough to live at all. When he comes out he will be as complete a wreck as any shrapnel-torn victim of bloody carnage. Bill's boss says the war should be stopped—that it's a shame for people to allow such things to happen nowadays. But why did *he* allow Bill to run his wheel without a guard and with flanges that were too small? That crime of negligence will stand against Bill's boss as black as many of the war-inflamed atrocities against those who in blind anger perpetrate them. You can't stop the war, Mr. Small-Shop Man, but you can make your grinding wheels safe! The old excuse that "My work won't allow of a guard" is getting threadbare and won't be presentable much longer.

Grinding-wheel guards have been illustrated so frequently in the columns of the *American Machinist* that I will not attempt to illustrate them here. All reputable makers of grinding stands equip them with guards, and if the stand is a home-made affair the guard can be also. Make the scroll out of 3/8 or 1/2-in. boiler plate, and bolt on side plate as an additional precaution. Keep the inside diameter of the scroll as near that of the wheel as possible, so that if a wheel lets go, it can't get far enough to work up much momentum.

There are certain principles in connection with mounting a grinding wheel which have been found by experience to lessen the risk of breakage. First, the bore of the wheel should be about 0.005 in. larger than the diameter of the spindle, or in other words, an easy fit. The inner flange should be fixed to the spindle, either being shrunk on and turned in place or mounted as a light drive on a sliding key. Both flanges should be recessed so that the wheel is grasped by the outer edges of the flanges. Blotting-paper gaskets should be placed between the flanges and the wheel, and the wheel itself should not be clamped too tightly. These principles apply to any one of the four methods of mounting, shown in Fig. 3, of which the most common are shown at *A* and *B*, being what are called the "straight" mounting and the "safety" mounting respectively. Unguarded wheels should be of the safety type, with flanges so large that the wheel itself does not extend over two inches beyond them. The use of these flanges, however, should not be taken as an excuse to do without a guard. The ideal scheme may be said to be to use both precautions, making doubly sure against accident. A well-known form of safety flange is shown in Fig. 4. It is the product of the Safety Emery Wheel Co., of Springfield, Ohio.

Be sure that the wheel rotates in a direction that tends to tighten, and not loosen, the outer flange nut. Vibra-

TABLE 1. MINIMUM SIZES IN INCHES OF MACHINE SPINDLES

Diam. in In.	Thickness of Wheel in Inches: 1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	1	1	1	1
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	1	1	1	1	1 1/4
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	1	1	1 1/4	1 1/4	1 1/4
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	1	1	1	1	1	1 1/4	1 1/4	1 1/4
14	[illegible]	[illegible]	[illegible]	[illegible]	1	1	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/2
16	..	..	..	..	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2	1 1/2
18	..	..	..	..	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2

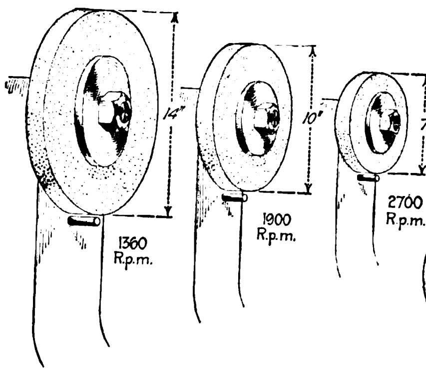


FIG. 5. KEEPING GRINDING WHEELS AT PROPER SPEED

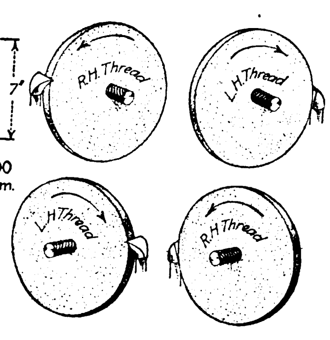


FIG. 6. BE SURE THAT THE SPINDLE NUT TENDS TO TIGHTEN

TABLE 2. DIMENSIONS IN INCHES OF TAPERED FLANGES AND TAPERED WHEELS WHERE HOODS ARE NOT USED IN CONJUNCTION THEREWITH

a Maximum flat spot at center of flange. b Flat spot at center of wheel. c Minimum diameter of flange. d Minimum thickness of flange at bore. e Minimum diameter of recess in taper flanges. f Minimum thickness of each flange for single taper at bore.

Diam. of Wheel in In.	a	b	c	d	e	f
6	0	1	3	[illegible]	2	[illegible]
8	0	1	5	[illegible]	3 1/2	[illegible]
10	0	2	6	[illegible]	4	[illegible]
12	4	4 1/2	6	[illegible]	4	[illegible]
14	4	4 1/2	8	[illegible]	5 1/2	[illegible]
16	4	6	10	[illegible]	7	[illegible]
18	4	6	12	[illegible]	8	1

on will cause a nut to dance off of the end of the spindle this precaution is not taken, and it is sometimes anoying to have to dodge the wheel that follows, or to reıir the hole in the shop roof left by its exist. The illusation, Fig. 6, shows the proper thread to use for various otations and hands of wheels.

Grinding wheels cut most efficiently at certain definite eeds, depending upon the grain, grade and use. Usuly this speed is stamped upon the wheel by the makers, . terms of revolutions per minute. This does very well r a new wheel; but as work is done and the wheel is essed, it becomes smaller in diameter, and while the

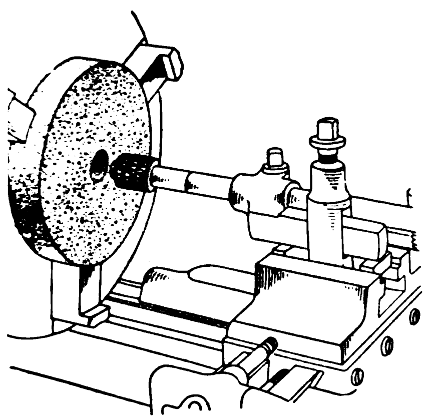


FIG. 7. ENLARGING THE HOLE IN A GRINDING WHEEL

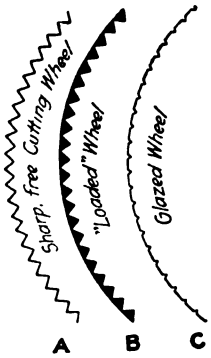


FIG. 8. THINK OF THE GRINDING WHEEL AS A CIRCULAR SAW

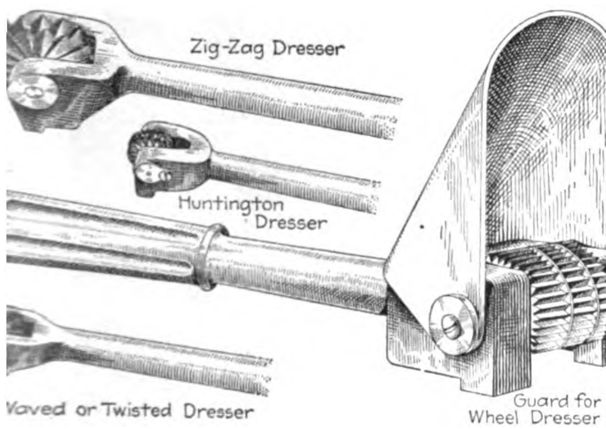


FIG. 9. PLENTY OF VARIETIES TO CHOOSE FROM

olutions per minute stay the same the surface speed reases and the wheel becomes less efficient. The me shown in Fig. 5 is a good one to overcome this wback in a shop where two or more grinding stands in operation. As the wheels become smaller, they are ı-ferred to spindles of higher speed. Limit pins are l, as shown, to prevent getting on a wheel larger than roper for the spindle speed.

. grinding wheel should be thought of as a circular . When the teeth are sharp and the cutting speed is ıt, it removes metal freely. Such a wheel is illustrated rammatically in Fig. 8 at *A*. A "loaded" wheel is vn at *B*, in which the teeth still remain but have their es filled with the material being ground, so that cut- g is slow. A glazed wheel corresponds to a saw with teeth ground away, and is shown at *C*. Very fre- ntly the tendency of a wheel either to load or glaze be overcome by running at a decreased speed. On other hand, wheels which appear to be too soft are made to operate correctly by increasing their speed, taking care, however, not to exceed the safe limit.

There is no excuse for the small-shop owner pleading ignorance of good grinding-wheel practice. The Committee Report of the National Machine Tool Builders on grinding-wheel and machine safeguards was published in

TABLE 3. DIMENSIONS IN INCHES OF STRAIGHT FLANGES AND STRAIGHT WHEELS AND FOR SAFETY FLANGES USED WITH PROTECTION HOODS

A Diam. of Wheel in In.	B Minimum Outside Diam. of Flange	C Minimum Diam. of Recess*	D Minimum Thickness of Flange at Bore
6	2	1	[illegible]
8	3	2	[illegible]
10	3½	2¼	[illegible]
12	4	2¾	[illegible]
14	4½	3	[illegible]
16	5½	3½	[illegible]
18	6	4	[illegible]

* Recess to be at least $\frac{1}{16}$-in. deep.

the *American Machinist* in Vol. 40 on p. 921. An elaborate table showing the causes of emery-wheel accidents was published in Vol. 39, p. 1060. On p. 129 of Vol. 42 a comprehensive "safety code" drawn up by a committee appointed by the abrasive-wheel manufacturers was presented to the readers. All three of these reports, modified and combined, were presented in one paper[1] at the recent annual meeting of the American Society of Mechanical Engineers.

The following extracts are taken from this paper:

Before mounting, all wheels shall be closely inspected to make sure that they have not been injured in transit, storage, or otherwise. For added precaution, wheels other than of the elastic and vulcanite types should be tapped slightly with a hammer; if they do not ring with a clear tone they should not be used. Stamped wheels when tapped with a hammer may not give a clear tone. Wheels must be dry and free from sawdust when applying this test.

Wheel spindles shall be of sufficient length to permit of the nuts being drawn up at least flush with the end of the spindle, thus providing a bearing for the entire length of nut.

Protruding ends of the wheel arbors and their nuts shall be guarded.

Flanges, whether straight or tapered, must be frequently inspected to guard against the use of flanges which have become bent or sprung out of true or out of balance. If a tapered wheel has broken, the tapered flanges must be carefully inspected for truth before using with a new wheel. Clamping nuts shall also be inspected.

TABLE 4. REVOLUTIONS PER MINUTE TO GIVE PERIPHERAL SPEED IN FEET PER MINUTE

Diam. of Wheel in In.	4,000	4,500	5,000	5,500	6,000	6,500
6	2,546	2,865	3,183	3,500	3,820	4,140
7	2,183	2,455	2,728	3,000	3,274	3,550
8	1,910	2,150	2,387	2,635	2,865	3,100
10	1,528	1,720	1,910	2,100	2,292	2,485
12	1,273	1,453	1,592	1,750	1,910	2,070
14	1,091	1,228	1,364	1,500	1,637	1,773
16	955	1,075	1,194	1,314	1,432	1,552
18	849	957	1,061	1,167	1,273	1,380
20	764	860	955	1,050	1,146	1,241

The work rest must be kept adjusted close to the wheel to prevent the work from being caught. Work rest must be rigid and always securely clamped after each adjustment.

A speed of 5,000 peripheral feet per minute is recommended as the standard operating speed for vitrified and silicate straight wheels, tapered wheels, and shapes other than those known as cup and cylinder wheels, which are used on bench floor, swing-frame and other machines for rough grinding. Speeds exceeding 5,000 ft. may be used upon recommendation of the wheel manufacturers, but in no case shall a speed of 6,500 peripheral feet be exceeded.

A wheel used in wet grinding shall not be allowed to stand partly immersed in the water. The water-soaked portion may throw the wheel dangerously out of balance.

Work shall not be forced against a cold wheel, but applied gradually, giving the wheel an opportunity to warm and thereby eliminate possible breakage. This applies to starting work in the morning in grinding rooms which are not heated in winter, and to new wheels which have been stored in a cold place.

[1]Copies of this report may be obtained from the A. S. M. E. by mentioning its title, "Safety Code for the Use and Care of Abrasive Wheels," and inclosing 10c. with the request.

Machining an Eight V-Motor

By Robert Mawson

SYNOPSIS—In this article are shown the first operations used in machining the casting of an eight-cylinder V-type automobile motor. The operations in sequence are milling, drilling and boring.

On page 19 is shown and described the only single-casting, eight-cylinder V-type automobile motor made. It is a distinct departure in motor design and is the product of the Ferro Machine and Foundry Co., Cleveland, Ohio. This article is the first of three that will show all of the tools and operations in machining the cylinder casting. The first operation is milling the parting-line surfaces. Afterward two holes are drilled and reamed in the parting-line flange. These holes, by means of pins are used for locating the other tools.

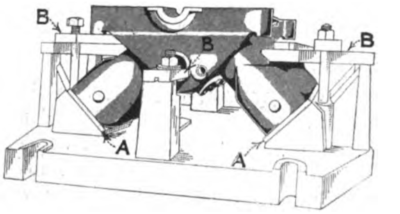


Fig. 1

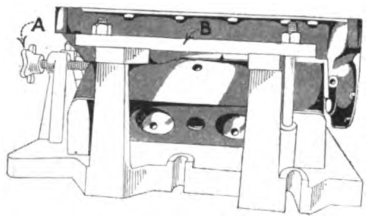


Fig. 2

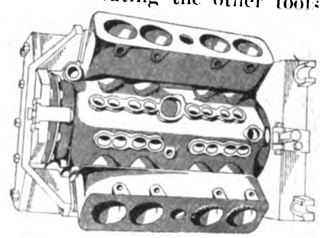


Fig. 3

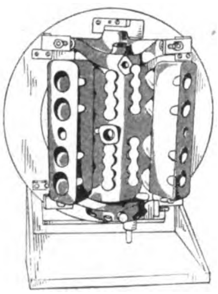


Fig. 4

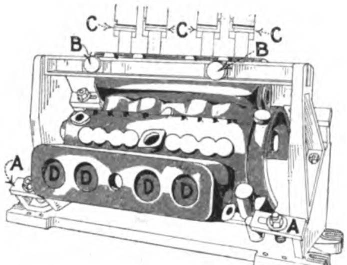


Fig. 5

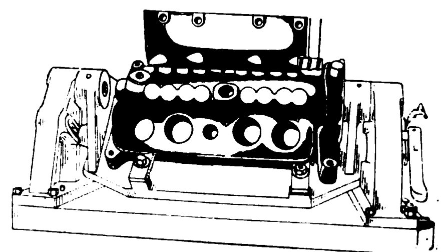


Fig. 6

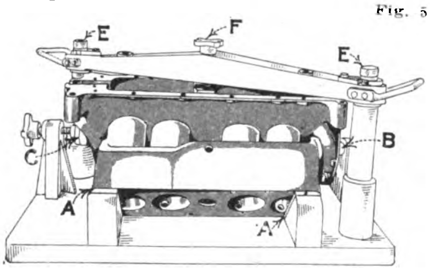


Fig. 7

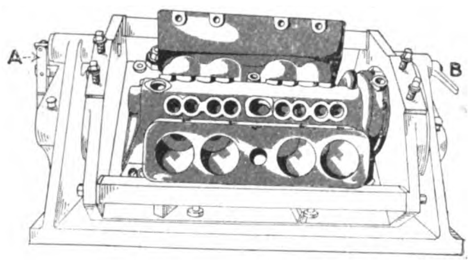


Fig. 8

JIGS AND FIXTURES FOR EIGHT-CYLINDER V-MOTOR WITH PIECES IN POSITION

Figs. 1 and 1-A

Operation—Milling parting line of cylinder. Located on steel pads A on angular surfaces previously machined. Straps B are then slid on the casting and nuts tightened to hold the part securely, three fixtures being used at once. Use 16-in. inserted cutter; speed, 16 r.p.m.; feed, 0.19 in. per revolution.

Figs. 2 and 2-A

Operation—Milling cam gear-housing surface on cylinder. Placed on steel pads and located by the knob screws A. Held down with straps on each side, as B. Use 10-in. inserted-tooth cutter at 65 r.p.m., 0.13 in. per revolution.

Figs. 3 and 3-A

Operation—Machining locating holes in cylinder placed on steel pads A, forced back against locating plugs B with screw C. Cover D dropped on posts held with open washers and knurled nuts E. Knob screw F tightened on casting to hold it in position.

Holes Machined—Two 33/64-in., drilled, then reamed to 17/32 in.

Figs. 4 and 4-A

Operation—Drilling holes in cylinder at cover end. Casting located by two pins that fit into reamed holes; two straps then tightened to hold the part in position.

Holes Machined—Six ¼-in. drilled which are later tapped with 5/16-in. U. S. F. threads.

Figs. 5 and 5-A

Operation—Drilling for oil tube. Cylinder located by two pins set in reamed holes and held in position with four straps.

Holes Machined—One ½-in. to suit tube and one ¼-in.

Figs. 6 and 6-A

Operation—Milling small bosses. Casting located by two pins fitting in reamed holes and held in place with four straps. Positions determined for various machined surfaces by index pin A fitting in bushed hole and operated by a lever.

Surfaces Machined—Valve and water-intake pads, using 2-in. mill; speed, 145 r.p.m.; feed, 0.04 in. per revolution.

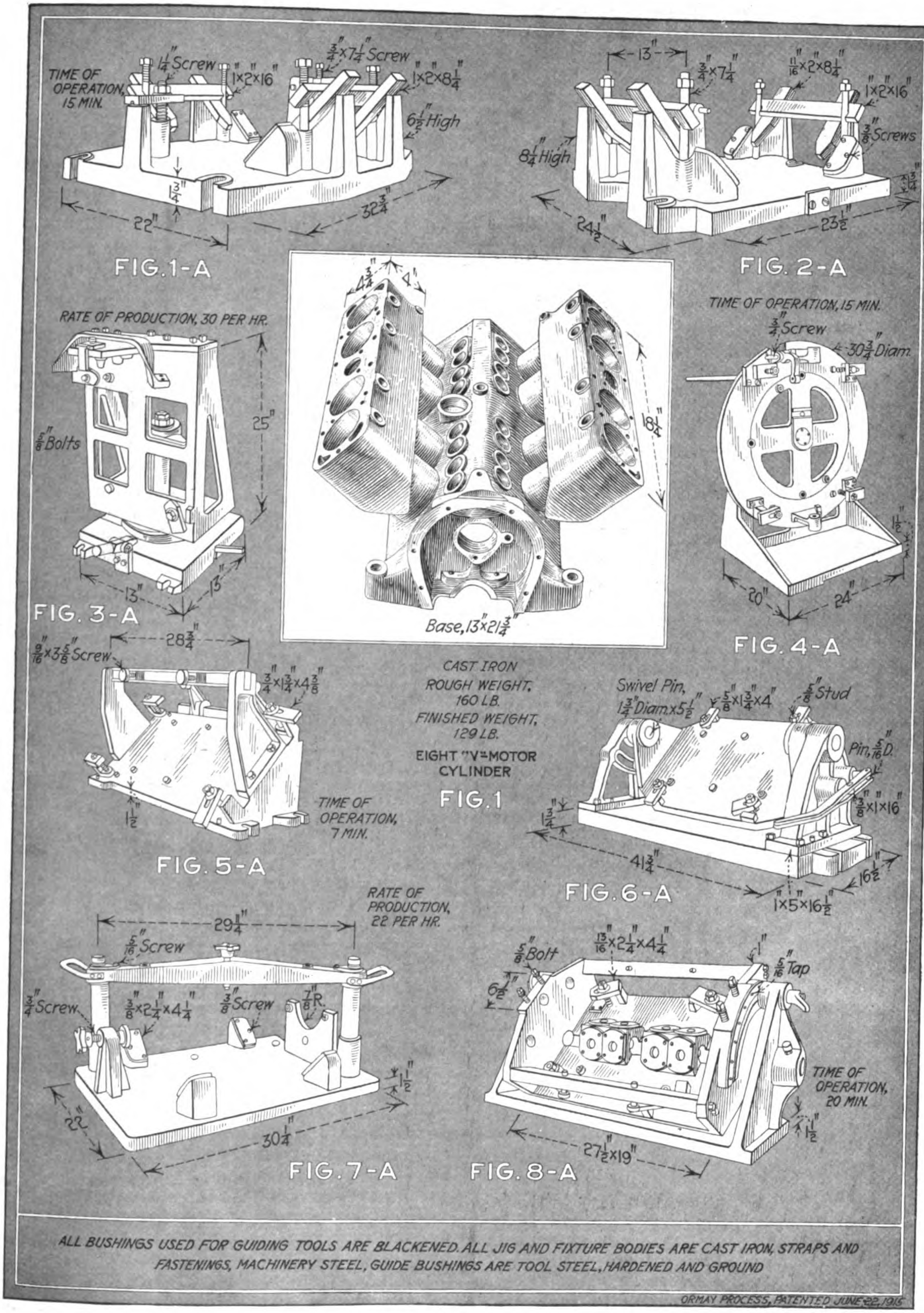
Figs. 7 and 7-A

Operation—Rough-boring cylinder. Casting located by two pins fitting in machined holes, held in place with four straps, as A. Screws B tightened to assist in holding them. Holes rough-bored with tools C. Casting taken out, turned 180 deg., relocated, and four holes D bored.

Holes Machined—Eight bores.

Figs. 8 and 8-A

Operation—Finish-boring cylinder casting, located by two pins fitting in reamed holes, then held down with four straps. Position obtained with index pin operated with the lever A and locked with the handle B. Four holes are bored to size, the tools being piloted in hardened bushings at the lower end.



DETAILS OF JIGS AND FIXTURES USED IN MACHINING 8 CYLINDER V-MOTOR

Getting Paid for Knowing How

By W. D. Forbes

Ira Clark was a Down-Easter. He came from somewhere in the State of Maine and had been working for O. B. Jennings for a number of years. He was a real machinist, not one of the old-time talkative type who is always telling how much more he knows than the foreman or boss, but an old workman right up to date. His tool box had the very latest styles of micrometers, depth gages and all the other obtainable new tools. One of his peculiarities was that he never seemed to do a job like anyone else, and seemingly took pride in this.

Jennings used to offer work to his men at a fixed price, so much for the job, and they always made big money at it. One day three or four barrels of brass circular disks came into the shop, and Ira got the job of doing the machine work on them. The disks were a little over $\frac{1}{16}$ thick, the largest being $2\frac{1}{2}$ in. in diameter and the smallest one $1\frac{1}{2}$ in. They all had a $\frac{5}{8}$ hole that had to be reamed. All the diameters varied, and they had to be exact. I think they were used for a train of gears, but I am not sure. Anyway they were ordered in sets, and Ira took them at so much a set. The first thing he did was to plane up a shallow V-block large enough in the angle to take the largest disk. This he used to center the various sizes of disks for drilling and reaming.

He hired a young lad to do this work, but very much to our surprise he did not drill all of one size of disk at a setting, but shifted about every two hours. While the lad was doing this shifting and reaming work, Ira made three arbors out of tool steel, like Fig. 1, also some steel disks a trifle smaller than the diameter of the various brass disks that had to be turned. Of course he hardened the ends of these arbors and fitted a nut to them; then he fitted up a plate of cold-rolled steel, which was an inch thick, for a tool holder. The tools were pieces of $\frac{5}{16}$-in. drill rod and were held in place in the tool holder by setscrews, as in Fig. 2. By the time he got the tools and arbor ready the boy had drilled and reamed a lot of blanks. These Ira slipped on the arbor, putting five disks of each size, together with the steel spacing disks between them, and drew them up solid with the nut. Then he bolted his tool holder to the carriage of his lathe, packing it up to the proper height and setting each tool so as to finish the disks to their proper diameter. By this method five sets of disks were finished on each arbor, and the boy was kept busy filling the two spare arbors while Ira turned the off disks.

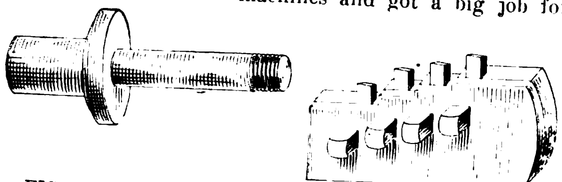
Another peculiar thing about Ira Clark was that he made money whenever he got the chance, and he never let a chance slip. We boys questioned him as to the value of doing this job I have described and suggested that he would have saved making his multiple tool post by machining one size of disk complete and then taking up another size. Ira admitted this, but rather chuckled to himself when he said that he would make more money that way. This astonished us, but we got on to the idea a few days later.

It seems that the man who had ordered the work came into the office in great trouble, as he had to have some of the set of disks at once and could not wait until each size was machined up. So Ira was sent for by O. B. to find out how much more it would cost to break up and get out some sets in a hurry.

Ira shook his head and looked very thoughtful, and it was finally agreed that he was to get 20 per cent. more on his contract if he could get out 50 sets in the next three days. If he could work overtime and get out the 50 sets by the next evening there was an extra five-dollar bill in it for him. Ira did not work overtime of course, but the man got his disks and we questioned Ira as to the fairness of the transaction.

"Well," said he, "I look at it this way. My hair is gray and I am getting old. I would have a mighty hard time getting a job if I lost this one. The years that have gone have taught me something, and I think I have the moral right to use the knowledge which those years have given me. O. B. Jennings got his money, and I did him no injustice. The customer got his work when he wanted it and was satisfied. I got more money because my experience had taught me that when a job like this one comes along, part of it is always wanted in a hurry. I simply used my brains to meet conditions, and I asked pay for it. A banker does not lend money without getting interest on his capital, and my capital is my brains and hands; but most machinists seem to use only their hands when it comes to making money."

Several months after this, O. B. Jennings put in three automatic screw machines and got a big job for



FIGS. 1 AND 2. TOOLS FOR TURNING BRASS DISKS

them. A demonstrator came down and started them up. All went well for a while until trouble arose from the stock running bad. Some of it worked up as nice and smooth as could be desired, then a bar would be found that worked so rough that if you tried to wipe it off with a piece of waste it would look like a woolly lamb. The man who sold the stock could not account for it, and the trouble continued for about a week; but after that all the work came out nice and smooth.

This is what had happened. Ira had watched the trouble, and after the salesman had come over to investigate once or twice, Ira told him that for fifty dollars he would show him how to overcome the difficulty. In a very few days the troubles ceased. Ira got his fifty.

The cure was so simple that when we found out what had occurred we thought that Ira's price was pretty high, but there again Ira contended that "know how" should be paid for. All Ira did was to tell the salesman to have the operator of the screw machines, if a bar started to cut rough, take it out and reverse it; and that did the trick every time. We did not get the philosophy of the thing at all, so we asked Ira about it.

He took a lead pencil from his pocket and opening his knife, started to sharpen the pencil in the usual way, that is, cutting from the outside toward the lead. This made a nice smooth surface; but when he reversed the operation and tried to cut from the lead toward the outside, he cut against the grain and got a rough result.

"Of course," Ira said, "there are materials which do not act in this way, but I have found that very often stock cuts better when it is fed to the tool in the direction in which it is drawn.

Metal-Working Machine Market in Switzerland

BY LUDWIG W. SCHMIDT

SYNOPSIS—The war has brought great industrial handicaps and economic hardships to Switzerland. Cut off from natural European markets both for the purchase and the sale of commodities, she has to turn to the United States for materials and machines. The Swiss demand for machine tools has been greater than ever before and seems destined to continue throughout the period of the war.

The export of American metal-working machines to Switzerland was not large during the second half of 1914 and the first half of 1915. For several months, however, an increase has been noticed, and some manufacturers say that they have recently received larger orders for metal-working machines for the account of Swiss buyers than ever before. This confirms information from Switzerland to the effect that the country has undergone a considerable change in her economic conditions and now seems ready for a forward movement.

Switzerland has suffered greatly from the war. The little republic has been completely hemmed in by the fighting nations and consequently has not been able to develop on a scale in keeping with former years. For some time it looked as if the war would create a serious economic crisis. This danger is now gone, happily, and manufacturers are beginning to make ready for the coming business revival. In addition to these hopeful signs comes the influence of the economic isolation which the country has suffered since the outbreak of the war. Switzerland has not only been cut off from some of her best markets, but she has also been unable to buy many things which she has been accustomed to obtain from abroad. For instance, the large imports from Germany, France and England failed nearly entirely.

It has taken some time for the country to accommodate itself to the new conditions and to begin to make some goods which were withheld from it by the war. The most difficult problem of course has been the feeding of its population. With the coming of the harvest of the past autumn and through agreements with the warring nations, this situation seems to have been greatly relieved.

SWITZERLAND'S DIFFICULTY IN GETTING MANUFACTURING SUPPLIES

Another difficulty that has retarded a revival of industrial enterprise has been the unwillingness of the nations around the republic to let her have any sort of industrial supplies, owing to the danger that they might reach an enemy by way of Switzerland. This restriction has affected the trade of the republic in many directions. The formation of a Swiss Foreign Trade Trust of the same character as like institutions in Holland, Norway and other countries has removed this distrust, and Swiss manufacturers can now buy their supplies direct. The only marked difficulties remaining are those of labor and transportation. As there is the continual danger that parts of the contending armies on both fronts may enter Swiss territory, Switzerland must keep part of her army mobilized, to secure her neutrality against any transgression. Further, she has to rely on the good will of all the countries around her for the transportation of her outgoing goods as well as of those destined for her. France has done her best to secure an outlet for the trade of the small republic, but this outlet has been frequently interrupted, and even now complaints are heard about lack of car facilities. One cannot expect the French railways to take overmuch trouble with that sort of traffic when transportation facilities are urgently needed for other purposes.

American manufacturers wishing to ship to Switzerland ought to consider carefully the traffic conditions, so that they will not see their goods held up unnecessarily by consigning them to crowded ports. As a rule the shipper is able to advise on this point.

SWITZERLAND AS A BUYER OF METAL-WORKING MACHINES

Switzerland, according to her own statistics, is not a large buyer of foreign metal-working machines. Only $1,250,000 worth enters the country yearly. The reason for this is that she is well able to take care of a large part of her own consumption. Swiss metal-working machines are of good quality and of course especially designed and constructed for the needs of the market. Also Switzerland has even been able to keep quite a respectable export business in comparison to the country's industry, sending every year to foreign markets metal-working machines of a value of about $500,000.

The demand for machinery, however, is not limited to metal-working machines. In fact Switzerland is a considerable buyer of many classes of machines. The extent of that trade is best shown by the accompanying list, giving the imports for 1914 and 1913. Of course the figures for the last year are rather misleading and may tend to discourage American manufacturers.

SWISS MACHINERY IMPORTS

	1913	1914
Boilers of iron and steel	$464,260	$364,160
Boilers of other metals	29,040	21,460
Spinning machines	450,200	231,540
Looms	80,300	594,460
Weaving machines	113,820	87,000
Knitting machines	70,840	49,600
Embroidery machines	273,380	55,740
Sewing machines	495,480	272,040
Printing machines	492,820	310,540
Agricultural implements	143,320	122,280
Agricultural machines	406,100	316,620
Electrical machines	308,560	274,960
Paper machines	283,080	266,640
Flour-milling machines	36,980	26,480
Waterwheels	149,100	92,980
Steam prime movers	130,280	98,800
Metal-working machines	1,240,850	825,040
Other machines	2,373,400	1,657,660
Automobiles	1,820,000	1,520,000
Locomotives	62,800	98,880
Internal-combustion motors	101,940	108,000
Brick-making machines	213,620	290,980

Only the last three classes show an increase. The small gain in the import of internal-combustion engines has most likely continued, because Switzerland has a well-developed automobile-building industry that has prospered during the war. Not only have large orders been received from the Swiss Government for cars for mobilization purposes, but the exports of motor cars were fairly

large to Germany, France and Austria during the beginning of hostilities. The influence of the war on automobile exports can be easily seen from the fact that the sale of chasses has increased from $921,400 in the first half of the year 1914, that is, before the war, to $1,738,000 in the second half.

Exports and Home Consumption of Swiss Machines

Not all of the machines imported by Switzerland can be supplied conveniently by the United States. Many of them are machines for special purposes, the sale of which depends upon the industrial methods employed; for example, some of the knitting, weaving and lace-making machines. In fact in many of these machines Switzerland has been able to develop types of her own which are in demand in other countries.

Switzerland has a fairly large machine-building industry, considering the size of the country, and her manufacturers had developed the industrial possibilities of the market rapidly during the years immediately before the war. The import of boilers, for instance, is small in comparison with the number made at home. There is a highly developed industry for lace-making and knitting-machine manufacture. Agricultural machines and printing presses are also built. In printing machines the country has been able to produce a product of international fame; the agricultural machines find their sales mostly in Switzerland itself. Her internal combustion engines are widely exported and sell readily, for they are of good construction. Further, there must be mentioned the electrical industry of the country. One of the largest electrical enterprises of the world is located in Switzerland, and the import as well as the export of electrical machines is large. This latter industry finds good support in consequence of the geographical position of the country, which is very favorable to hydro-electric developments.

All of these industries have exported, and the importance of their foreign trade may be seen from the table herewith.

EXPORTS OF SWISS MACHINERY

	1913	1914
Automobiles	....	$2,659,400
Boilers of iron and steel	$391,500	212,380
Boilers of other metals	63,520	62,700
Spinning machines	467,604	387,200
Looms	936,280	875,640
Weaving machines	566,060	372,300
Knitting machines	325,940	285,180
Lace machines	550,460	373,920
Electrical machines	4,070,600	3,115,660
Flour-milling machines	1,650,800	1,238,900
Steam engines	2,098,840	1,180,000
Internal-combustion motors	2,181,180	1,750,060
Metal-working machines	487,740	476,060

The export of all those machines has been reduced during the last year, and in every case the reduction can be traced to the influence of the war.

Sudden Demand for Machines Has Come as a Result of the War

The sudden demand for all kinds of machines from Switzerland, especially for metal-working machines, seems to have come as a surprise to many American manufacturers. Those who knew the economic conditions there can, however, hardly be surprised at this development, as the country has been practically starved of her machine imports during the past twelve months. How serious the effect of the war must have been on the regular supply of machines can be seen best from statistics supplied by the Verein Schweizer Maschinen Industrieller (Union of Swiss Machinery Builders) which compare the records of the first and the second half of the year 1914 and were made especially to show the effect of the war. The tabulation shows that the whole import of machines was cut to about half the normal amount in the second half of last year, and leaves no doubt that the Swiss manufacturers must have felt the shortage very seriously.

This association includes the leading machinery builders of Switzerland and has 154 members, employing 36,123 workmen. Most of its members are in or near Zurich, although the Canton of Berne is another important industrial center. The Swiss market is not very difficult to work, and in many cases manufacturers have relied on agencies in southern Germany or Paris for this business. An agent of course has better facilities for studying the demands of the market while in its center, and Zurich is possibly the best location for establishing a local agency.

Prospects for Sale of Machinery in Switzerland in the Immediate Future

Undoubtedly there is much business just now to be had in Switzerland. Whether this will hold on is difficult to say. There are several industries, as the famous Swiss silk and the lace making, which export to the whole world. But much of the prosperity depends upon the so-called travelers' industries—hotels, summer resorts and the like.

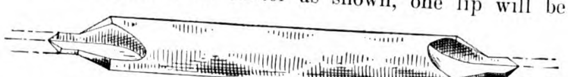
Should the available wealth of Europe be seriously curtailed, this would mean that Europeans would not visit Switzerland as much as before, and such an event would spell ruin for a large percentage of the Swiss population. Consequently nobody can wish more fervently for an early end of the present struggle than the Swiss.

As regards metal-working machines at present, it seems that very little choice is left to Switzerland other than to buy in this country as long as the war lasts. Neither of her former suppliers is able to care for her wants. Before the war Germany had the lion's share in Swiss imports of metal-working machines, supplying about $750,000 worth annually. The imports of American machines had not been so large but were increasing. In 1914 there was $22,627 worth of metal-working machines exported by the United States to Switzerland. This figure has been greatly exceeded during 1915, with prospects of still larger sales in 1916.

One Way To Avoid Breakage of Center Drills

By Gilbert J. Marion

When a combination drill and countersink breaks off in the work it is usually difficult to take it out. The breakage is generally caused by the drill part binding. If this is ground off center as shown, one lip will be



AVOIDING BREAKAGE OF CENTER DRILLS

longer than the other and will cut a hole larger than itself and seldom break. Sometimes through careless feeding the point will break off, but even then it will be found to be free in the work and will come out easily.

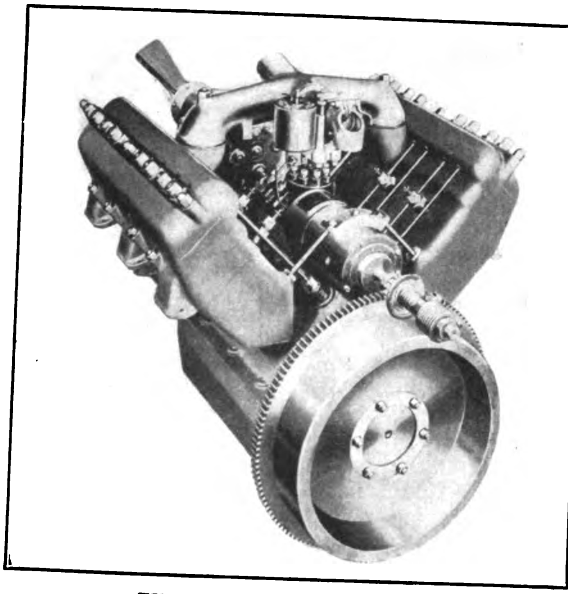
The Ferro Eight V-Motor

On page 14 is printed the first of a series of articles describing the tools and methods used in manufacturing the eight V-motor shown in the illustration.

This cylinder is made with what is on four- and six-cylinder motors the cylinder and upper crank case cast in one part. This arrangement lends itself admirably to a simplification of the manufacturing operations, as the bases and other surfaces may be machined easily.

The lower crank case, or oil pan, is a light pressed-steel stamping. The motor is what is known as valves-in-the-head-type motor and is carried in a separate casting attached to the cylinder. Over this is fastened the cylinder-head cover, which carries the separate plugs.

The valves are operated by a camshaft fitted with 16 integral cams through roller-valve lifters. The bore of



THE FERRO EIGHT V-MOTOR

the cylinders is 3 in. and has a 3½-in. stroke. The crankshaft and the camshaft are each fitted with three bearings of sufficient diameter and length to insure the desired rigidity. Recently one of the motors was given a 300-hr. endurance test, which was equivalent to a car traveling 35 mi. per hr. at a motor speed of 1,500 r.p.m. for a distance of 11,000 mi.

After the test the parts were examined and measurements taken. In every case the wear was inappreciable, the greatest wear being on the connecting-rod bearing, which was only 0.0008 in. The main bearings showed a wear of 0.0004 in. The construction was babbitt against the crankshaft for the connecting-rod bearing and a hardened-steel connecting-rod against phosphor bronze for the middle bearing of the rod.

Charts for Strength of Gear Teeth--Marx Formulas

BY JOHN B. PEDDLE*

The most recent investigations into the strength of cast-iron gear teeth have been made by Guido H. Marx and Lawrence E. Cutter. The main purpose of the study was to determine the effect of an increase of pitch-line velocity upon gear-tooth strength. The first series of experiments, reported to the American Society of Mechanical Engineers by Professor Marx in 1912, covered speeds up to 500 ft. per min. The second series, reported by the investigators jointly in September, 1915, extended the range to 2,000 ft. per min. This latter paper was reviewed editorially in Vol. 43, p. 610.

The summary of these studies gives two formulas—the first for the strength of cast-iron, Brown & Sharpe, 14½-deg. involute gear teeth; the second for cast-iron Fellows, 20-deg. involute, stub gear teeth. Tables are also included for two of the factors—v, the velocity coefficient, and a, the arc-of-action coefficient.

These formulas are somewhat complex, as each contains seven variables. To increase the ease of their use in the hands of designers, each has been plotted in the form of a full-page alignment chart (see Charts 1 and 2). Following the customary arrangement, the original formula and a brief explanation of how to use the chart accompany each.

The notation for the formulas follows:

W = Safe equivalent load at pitch line, pounds;
s = Modulus of rupture = 36,000 lb. per sq.in. for cast iron;
p = Circular pitch, inches = pitch arc;
f = Width of face of gear, inches;
n = Number of teeth in gear;
k = Factor of safety;

Suggested values: $k = 4$, for steady load, no reversal of stress;
$k = 6$, suddenly applied load, no reversal of stress;
$k = 8$, suddenly applied load, with reversal of stress.

v = Velocity coefficient (see tables);
a = Arc-of-action coefficient (see tables).

The tables for v and a are also given, although these values are plotted on their proper scales on the charts.

VALUES OF v

Pitch-Line Velocity, Ft.-Min.	v: Brown & Sharpe 14½-Deg. Involute	v: Fellows 20-Deg. Involute Stub Tooth	Pitch-Line Velocity, Ft.-Min.	v: Brown & Sharpe 14½-Deg. Involute	v: Fellows 20-Deg. Involute Stub Tooth
0000	1.000	1.000	1100	0.470	0.540
100	0.795	0.825	1200	0.455	0.525
200	0.730	0.755	1300	0.445	0.515
300	0.675	0.705	1400	0.435	0.505
400	0.635	0.665	1500	0.430	0.495
500	0.595	0.635	1600	0.420	0.485
600	0.565	0.615	1700	0.415	0.475
700	0.540	0.595	1800	0.410	0.470
800	0.520	0.580	1900	0.405	0.460
900	0.500	0.565	2000	0.400	0.450
1000	0.485	0.550	....	....	....

VALUES OF a

Number of Teeth in Engaging Gears		Corresponding a: Brown & Sharpe 14½-Deg. Involute	Corresponding a: Fellows 20-Deg. Involute Stub Tooth
Single tooth engages		1.00	1.00
12	12	1.10	1.12
20	30	1.15	1.20
30	30	1.47	1.22
30	40	1.60	1.24
30	60	1.60	1.25
30	80	1.60	1.26
30	100	1.60	1.27
30	Rack	1.60	1.29
100	100	1.60	1.31
100	Rack	1.60	1.33

In using these charts in design, it should be borne in mind that the experiments on which they are based were made with cast-iron gears only and with small pitches—10 diametral pitch in the case of the Brown & Sharpe gears and 10/12 diametral pitch in the Fellows gears.

*Professor of machine design, Rose Polytechnic Institute.

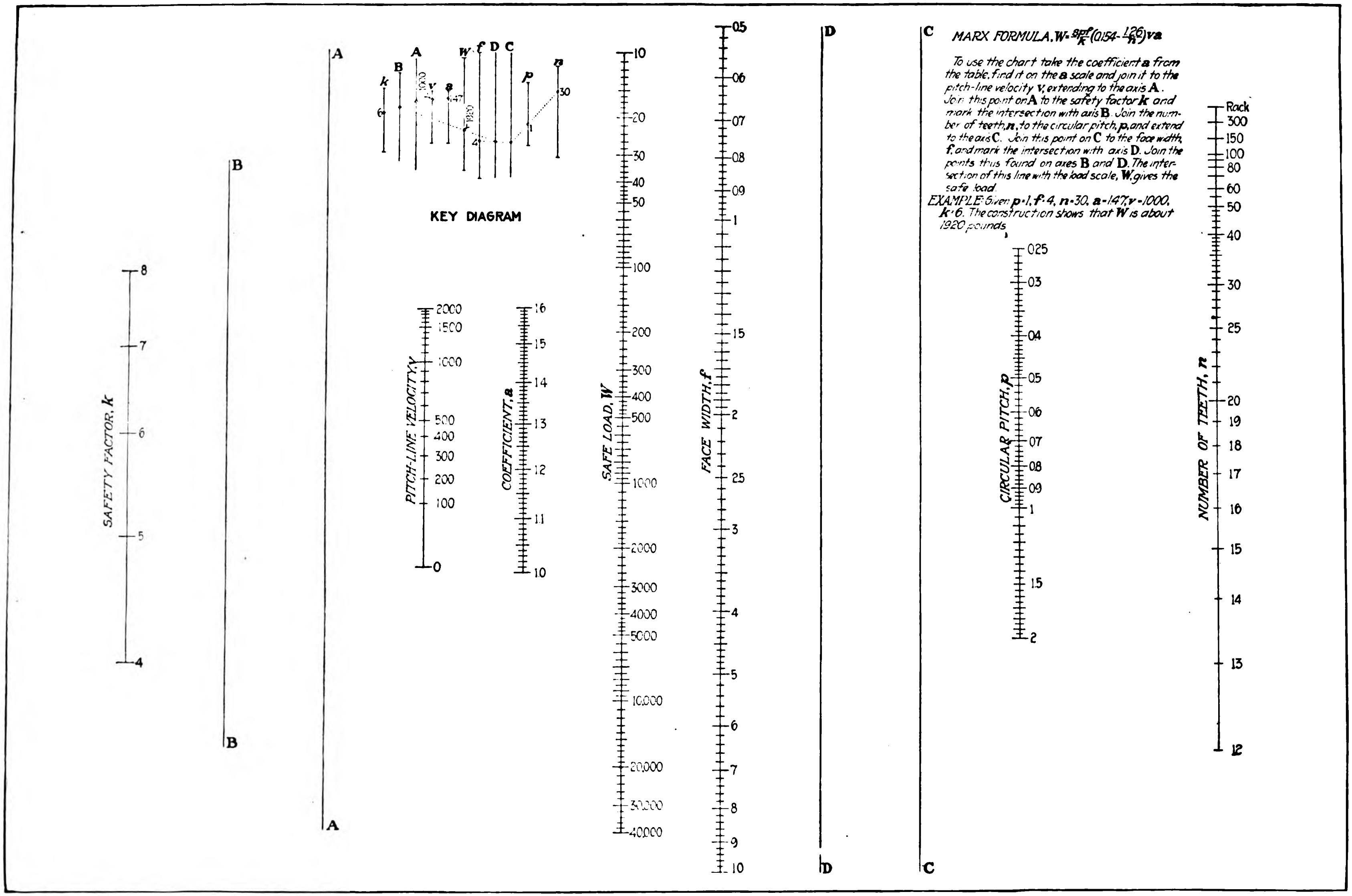


CHART 1. SAFE LOADS ON CAST IRON, BROWN & SHARPE, 14½-DEG. INVOLUTE GEAR TEETH

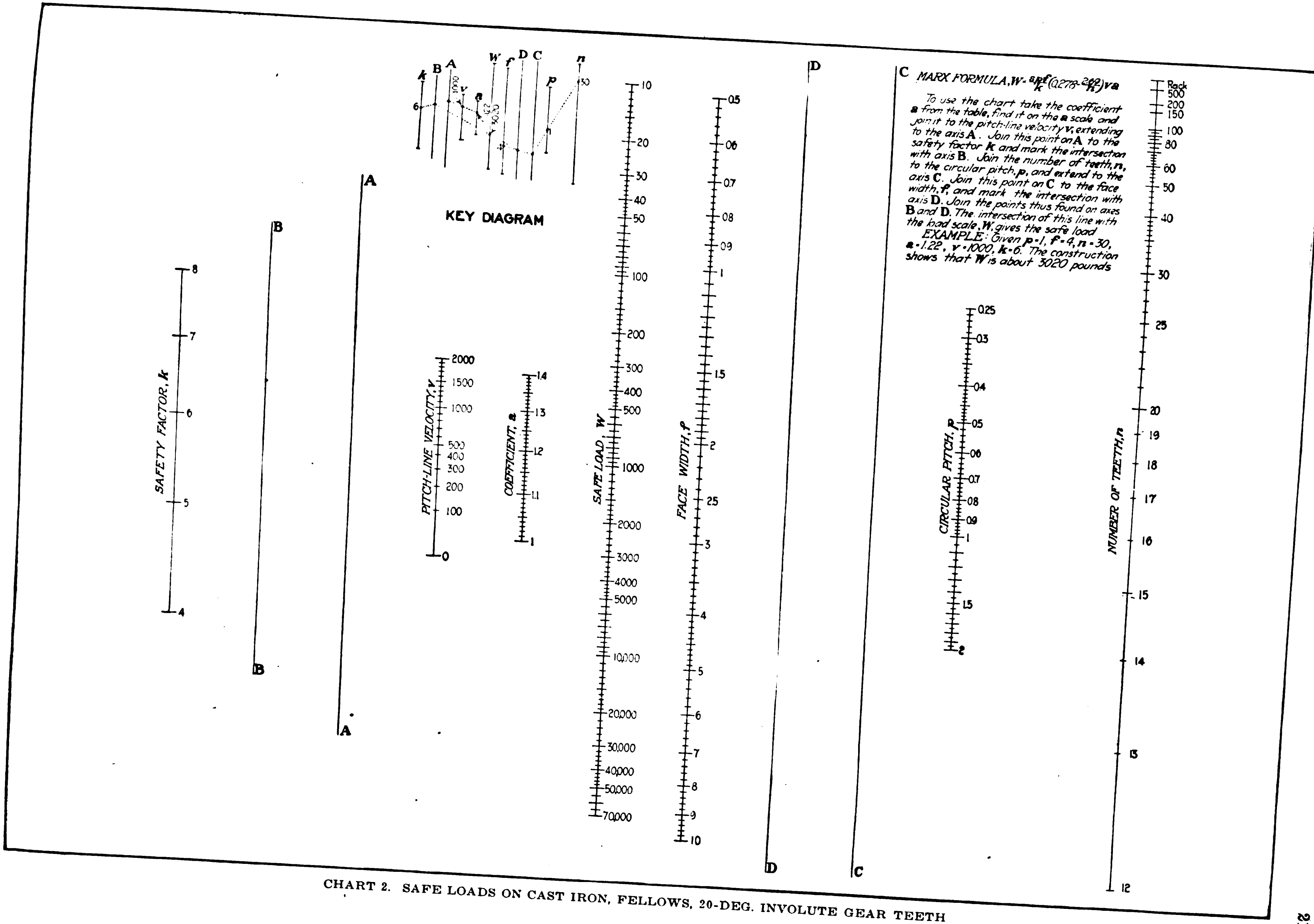


CHART 2. SAFE LOADS ON CAST IRON, FELLOWS, 20-DEG. INVOLUTE GEAR TEETH

Effective Hand Wire Benders of Various Types

By F. C. Mason

In manufacturing plants where springs are used that are made of wire, and not in sufficient quantities to warrant an automatic machine, the hand bender is employed. These benders make from 1,000 to 20,000 springs per day. The amount varies with the size of wire and the number of operations. This article will describe and illustrate some of the elementary bends and simplified methods of making them.

There are three movements that may be used to produce almost any shape. These turn, brake and form with a die. The die may be actuated by hand power or in a punch press.

There are a great many ingenious machines made embodying a combination of these movements. Fig. 1 is a view of a simple machine with which to make a spring with two extended ends, each spring having one or more tension coils. The spring is shown at *E*.

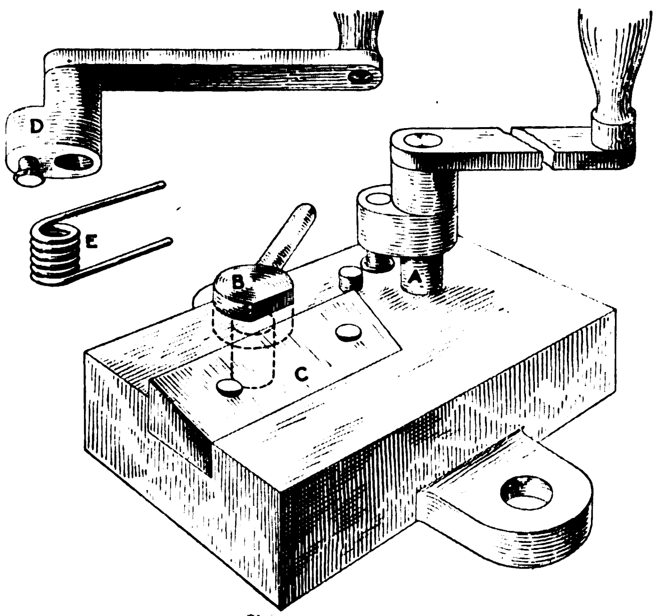


FIG. 1. SIMPLE SPRING BENDER

A is the forming pin, *C* the clamp stop and *B* the clamp. With this bender the handle shown at *D* can be used satisfactorily.

The stop which gages the length of wire for the start is not shown. The wire is slipped into the clamping device against the stop, is clamped and the desired number of turns made with the handle, which wraps the wire around pin *A*. This pin should be made of tool steel hardened and drawn down to a blue color, leaving it hard enough not to dent and still as strong as possible. The clamping device should also be hardened.

Figs. 2 and 3 show two forms of brake for bending wire at an angle. They are both made on the same principle, but their adaptation for this purpose makes a great difference in the output. The brake is at *A*; *B* is the brake block and *C* the slot to hold the wire. It is obvious that by changing the side of the form any angle from 30 to 45 deg. can be produced. This brake principle is very useful in wire-bending machines and can be used in many combinations. The bends shown at *D* are made by this bender.

Fig. 4 shows another modification of this principle, which I believe is original. This bender bends simultaneously two right angles, as shown at *B*.

There are two brakes *AA* working right and left, actuated by one lever or handle *C*. These two brakes mesh

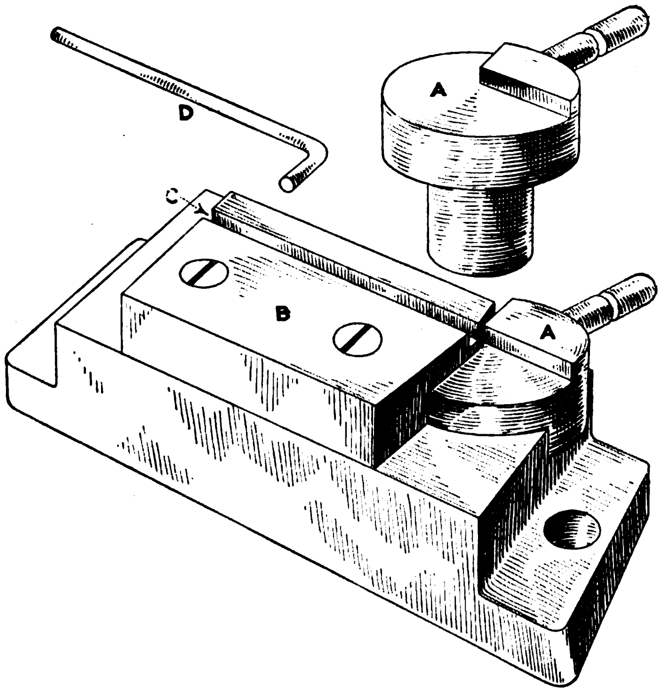


FIG. 2. BRAKE FOR BENDING WIRE AT AN ANGLE

together, using gear teeth to actuate the one opposite the handle. I have used one of these for several years for bending No. 12 door-spring wire that was only $\frac{1}{32}$ in. on the inside. The gear segment was $\frac{5}{8}$ in. in outside diameter, using a 20-pitch cutter to cut the teeth.

Fig. 5 shows a form of bender made to produce the hook shown at *H*. With this type of bender one can

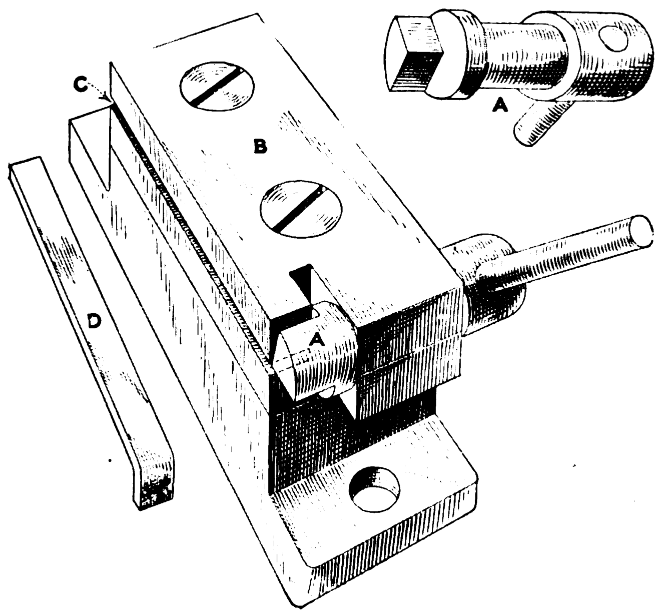


FIG. 3. ANOTHER VIEW OF BRAKE FOR BENDING VARIOUS WIRE ANGLES

make rapidly almost any shape of flat work, all the bends being made on one block. It is only a question of having the pins of the proper size, located in the right place, and of handles to fit for the desired turns. The design shown will exemplify the principle. Handles similar to

that illustrated and at D in Fig. 1 should be used with this bend.

The wire is placed between the pins against the stop A, and with the handle shown in Fig. 1 the wire is bent out as indicated by the dotted lines C. The eyelet is

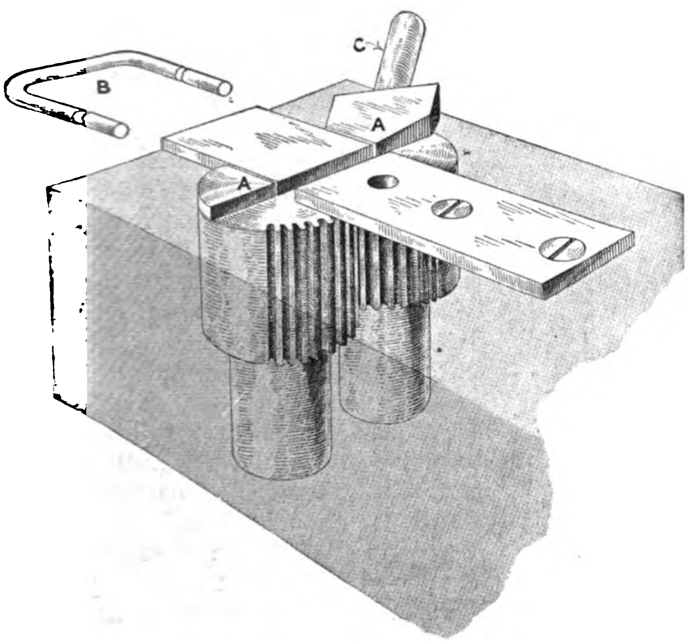


FIG. 4. MACHINE FOR BENDING TWO RIGHT ANGLES

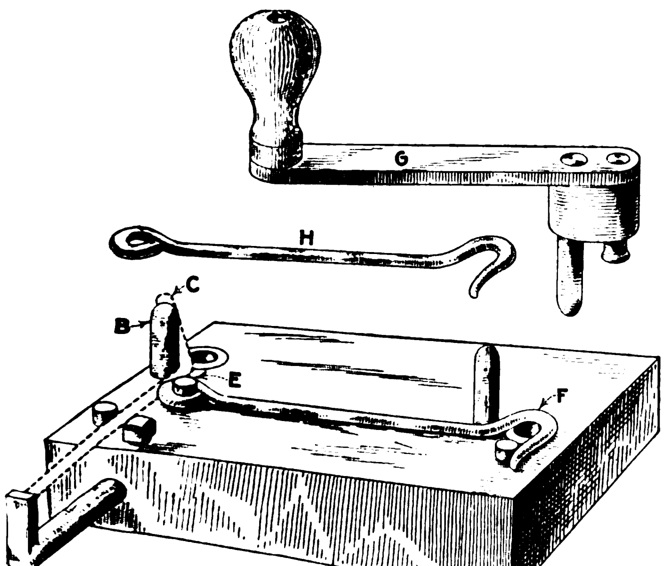


FIG. 5. RAPID-ACTION HOOK BENDER

completed with the handle G. Next is taken the wire with the eyelet and the eyelet put over the pin for a gage. The first operations are then repeated, which produces the hook as shown in position at F. Benders made in this manner are cheap and efficient.

20-In. Faceplate on 10-In. Lathe

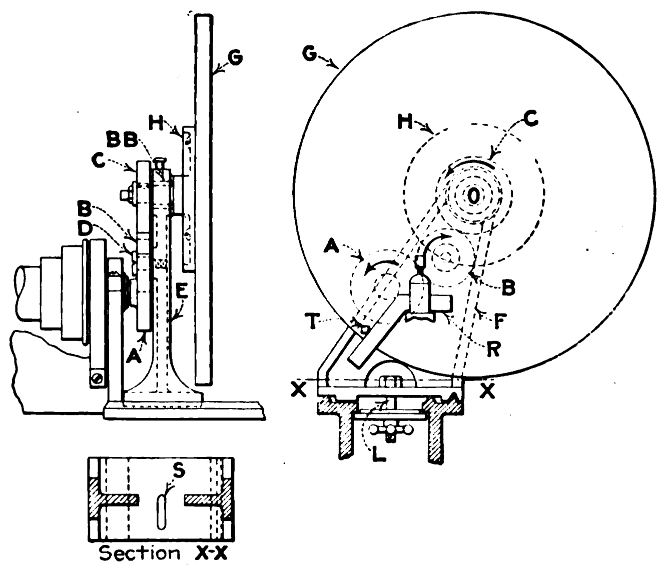
By Martin Fogel

The great variety of work which falls to the lot of the average job or experimental shop compels it to make use of all sorts of makeshifts to turn out the work without a prohibitively large equipment.

One job which fell to our lot gave promise of repeat orders and was therefore valuable enough to take pains with. We had to produce a large quantity of 18-in. fiber and brass rings from $\frac{1}{16}$-in. stock.

The only available lathe was one with a 10-in. swing. It was out of the question to have the rings done outside, as we wanted that work ourselves, so I designed the fixture shown in the illustration. It has served the purpose first rate and has been of use on other similar work. It increases the swing from 10 to 20 in. It is not suitable for heavy work, though that is but a matter of proper construction.

The frame is a casting F, machined on the bottom as shown and has a V groove to fit one way on the lathe bed. The long slot S allows the bolt L to be dropped through from the top. The gears B and C are a pair of standard change gears of the lathe. Gear C is keyed to the spindle of the faceplate H. Gear B acts as an idler and direction changer for the gear train. The stud D



LARGE FACEPLATE FOR A SMALL LATHE

is screwed into the boss cast on the frame. Gear A is made from an old faceplate and screws on the headstock spindle in the usual way.

To use the fixture, the frame F is placed on the way as shown, with the gears B and A in proper mesh, and fastened with the bolt. To the faceplate H is attached the 20-in. wood disk G, on which the work is mounted.

The tool rest R is a bar of machine steel bent so as to bring its upper edge parallel with a line passing through the center O. This is necessary to prevent the hand tool shown by the section T from digging into the work. The working end of R is really very short, being limited by the tool carriage, but for the sake of illustration it is shown longer.

The new center O is set back of, as well as above, the lathe center. The bosses on F were so laid out as to bring the edge of a 20-in. disk in the same relative position as that occupied by the front edge of a 10-in. disk on the old center. Since we had only hand turning to do, we found the tool rest R sufficient. The lathe tool post, being so far below the new center, does not lend itself very well to cross-feeding. The lathe was run on the low pulley, the large diameter of the work giving it a sufficiently high peripheral speed. The brass bushing B is for the purpose of renewal. A short bearing at this point lessens the tendency of the frame F to spring out of line in either direction.

Tools in Western Automobile Repair Shop

By O. D. Carter

Since the automobile has reached general use its repair has become an important item. The garage is being transformed into a machine shop and exclusive automobile-repair shops are showing rapid growth. The full economic value must be realized, and this can only be done by judicious repairs.

Herewith is a description of the methods and equipment of a garage shop the facilities of which are somewhat above the average in this section, the central districts of California. The shop is owned by the Waterman Brothers Co., at Fresno.

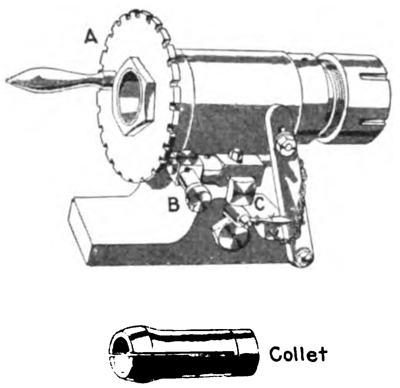


FIG. 1. DIVIDING HEAD FOR GEAR ENDS AND KEYWAYS

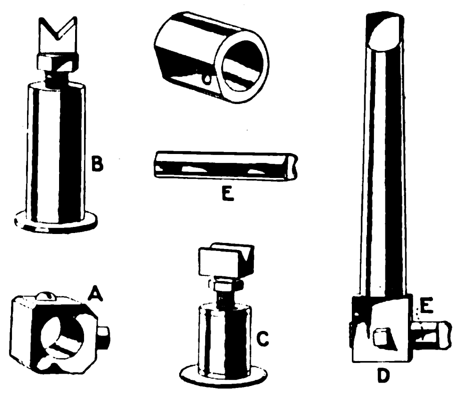


FIG. 2. AXLE DRILLING AND SPLINING TOOL

The machine-tool equipment consists of two Lodge & Shipley lathes of the quick-change type—one 14 in. by 8 ft., the other 20 in. by 10 ft.; a No. 2 Brown & Sharpe miller with dividing head, a Green River universal cutter grinder, two grinder heads, two drill presses and a power hacksaw. A Barnes screw press, a forge and a small oxy-acetylene outfit are also useful. A 4-hp. motor furnishes power.

Slack periods are utilized for making up a stock of axles for the various models of a popular car. These are made of cold-rolled chrome-nickel steel. For squaring the gear end and cutting keyways a dividing head was built as shown in Fig. 1. This has a collet chuck, which holds collets of several sizes. At the other end of the spindle is a disk *A*, having 24 divisions and positioned by the stop pin *B*. A pin *C* locates the angles of the axles while cutting keyways. Two cutters on an arbor, with an adjustable spacer between them, complete the square on the gear end in two passes. Fig. 2 shows a jig at *A* for drilling the gear-retaining pin on another type of axle. Pins riding in the keyway hold it in alignment. Two handy jackscrews, made of tubing, with ends pressed in and hardened swivel blocks on top, are shown at *B* and *C*.

For finishing splined shafts after they are roughed with a small cutter, the cutter and holder *D* are used. The cutter is shaped to the contour of the shaft and held stationary in the holder. A few passes of the table by hand make a neat job. The cutter is shown at *E*.

A holding fixture for slitting bushings of various diameters and lengths is shown in Fig. 3. The shank *B* fits the collet of the dividing head, in which it is held while in use; *C* is pressed on the arbor and is bored to hold the washer, which has a tapered face. A spring behind this washer holds it out against the bushing to be slitted, thus centralizing it. The washer *D* is feathered to slide in a groove on the shaft so that the slits in both *D* and *C* will be in line. Any number of washers may be used as at *E* to make adjustments for length, the nut *F* holding the bushing firmly between the disks. A bushing is shown after splitting at *A*. It must be borne in mind that, in order to keep their cost within reason, all fixtures in a small shop must be made to cover as great a range of sizes as possible.

In making wristpins we found it best to use the special chrome-carbon steel, with holes already drawn. This steel is cut off, the ends faced and taper bored and turned to rough size on an arbor with a tapered shoulder and nut. It is then drilled, hardened and drawn for temper. The latter operation gives good results, saves time and is more satisfactory in every way than case-hardening in small lots. It is only necessary to allow from 0.006 in. to 0.008 in. for grinding, as there is little distortion in hardening. The wristpins are ground on the universal grinder, on the same arbor and in the same position on the arbor as in roughing. The arbors are shown at *G* and the pins at *H*, Fig. 3.

Valves are ground in the small chucks shown at *I* and *J*. The universal cutter grinder is set at the proper angle, the valve stem is placed in the chuck and the whole is swung on centers and driven by dogs on the shank of the chuck. With the new tungsten valves, turning is next to impossible.

In making new pistons, the old piston is sawed in half and one-half used as a core box by the foundry, which saves the expense of making an assortment of patterns.

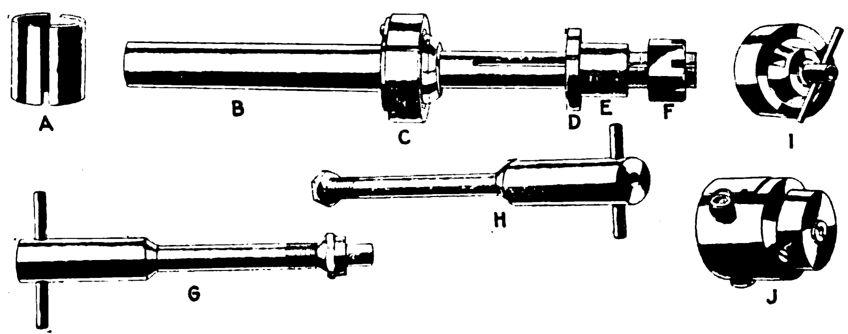


FIG. 3. HOLDING FIXTURE FOR SLITTING BUSHINGS

At *A* and *B* in Fig. 4 are shown a centering device and driving dog for turning pistons of various sizes. The pistons are first held in the four-jaw chuck by the upper end and roughed inside and out, including a cut inside the bosses to insure their being faced central. The pistons are next held in a three-jaw universal chuck and the end roughed, finished and centered. The driver *A* is then screwed on the nose and the piston mounted between the fixture and lathe center. The taper portion will

accommodate pistons from 3 to 7 in. in diameter, and the dog *B* may be any size, as it fits in a slot in the end of *A* and engages the bosses. A cross-boring fixture for pistons is shown at *C*. This is also universal in action, fitting the nose of the lathe spindle. Two beveled strips *D* are bolted to its face, parallel and equidistant from its center. An adjustable stopscrew at the end controls the position of the piston pinhole.

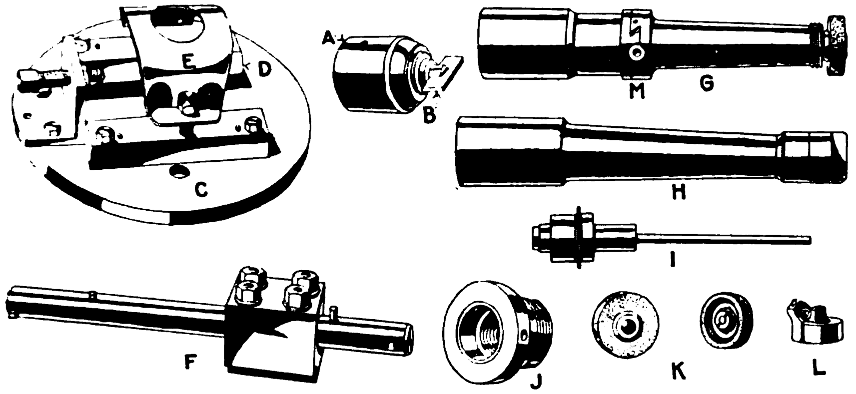


FIG. 4. CENTERING DEVICE AND DRIVING DOG FOR PISTONS

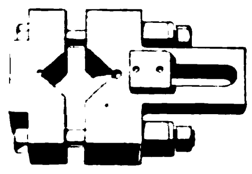


FIG. 7. CRANKSHAFT FIXTURE

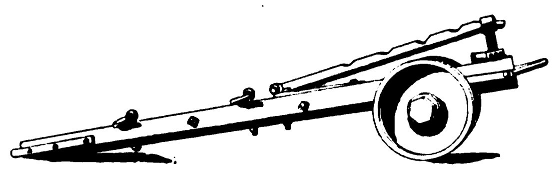


FIG. 8. ADJUSTABLE WOODEN GARAGE TRUCK

The flexible band *E*, with bolts at each end, fits over the piston and holds it against the strips by means of nuts at the back of the plate.

At *F* are shown a boring bar and a holder. The tools are held by a pin and wedge as shown and are rapid in action. *J* is an adapter for the small lathe. This screws on the nose of the lathe and has the nose of the larger lathe duplicated on its outside, which permits all the chucks and fixtures of the large machine to be used on the small one. This makes the equipment flexible, as the large machine is tied up with cylinder grinding a great part of the time, and at other times the small machine is busy with light work.

If too deep to bore and grind out, the scored cylinders are first filled by the oxyacetylene process. Even if filled they will finish at least one-thirty-second larger than their original diameter, due to the falling away of the cylinder while the torch is on it.

A grinder head is shown at *G* and the boring head *H*, as well as the driving pulley and rod for the grinder head *I*. Front and back views of the wheels are shown at *K*. *L* is a boring head for the grinder. The head *L* screws on the grinder supports and carries an inserted tool.

The grinder head screws on the lathe nose as in Fig. 5. It has an eccentric motion, due to an offset, with screw adjustment at *M*. This controls the diameter of the bore when the lathe is in motion. Timken bearings with a spring tension make a free-running bar without chatter. The wheel is driven by the independent belt shown.

The boring head has an offset adjustment at its outer end and is used for removing the filling metal and bringing the cylinders nearly to size, also for chamfering the bore.

A view of the faceplate for holding cylinders is shown at *A*. The faceplate is mounted on the carriage and has screw adjustments both vertically and horizontally. The cylinders are clamped to the back of the plate and supported on the other end with an adjustable bracket, which holds them steady.

For grinding crankshafts, a grinder head, driven from a wooden drum overhead, was made to fit the tool post. This, together with a small internal grinder which may be used in either lathe and driven from the same drum, is shown in Fig. 6. The large head has cast-iron boxes, bored taper, and the spindle is hardened and ground. A hole runs through the spindle, one end forming a split chuck, so that each wheel may be mounted on its own arbor and overhung at will.

Fig. 7 shows a fixture for offsetting the crankshaft while grinding the crank pins. It is adjustable for any size shaft. The center block is adjustable for any throw.

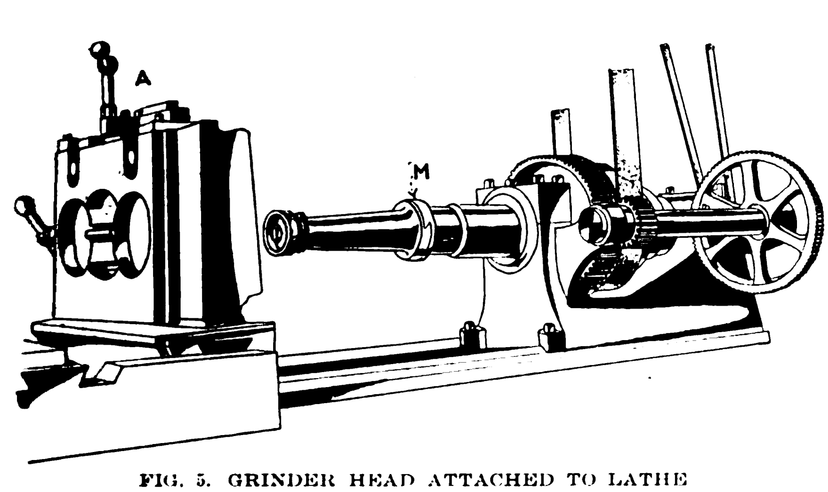


FIG. 5. GRINDER HEAD ATTACHED TO LATHE SPINDLE NOSE

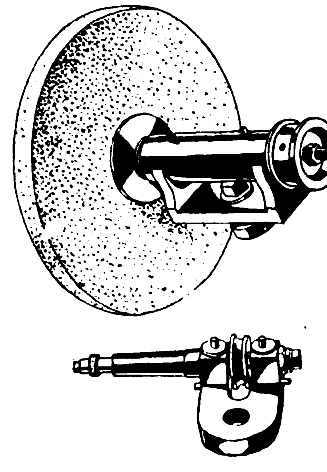


FIG. 6. TOOLPOST GRINDER HEAD

A useful garage tool is the truck or "dolly," shown in Fig. 8. It has an oak beam fitted with rings and a loop at each end. The wheels are bored and run on Hyatt rollers. They are oiled through the hub caps and have oil retainers. An adjustable bar supported by a jack-screw levels the car under which it is placed.

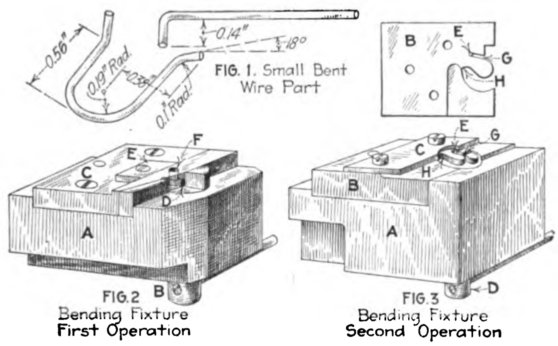
Hand Wire-Bending Fixtures

By G. P. Breitschmid

Short bends in wire can be easily made if proper tools are designed for the operation. A piece that illustrates this is shown in Fig. 1. The specifications call for No. 22 (0.048 in. diameter) music wire. The length before bending is $1\frac{13}{32}$ in.

Two operations were arranged for, to be performed in hand-operated bending fixtures. The first operation makes the short upward bend at one end, and the second the longer circular bend and the reversed end.

The fixture for the first operation is shown in Fig. 2. The base *A* is of cast iron, in which is set the tool-steel wiper *B*, and to which are attached the locating piece *C* and stop *E*. The piece *C* has a hole drilled at *D* to receive the end of the piece of wire to be bent, while *E* determines how far it shall enter. The hole *F* allows the



FIGS. 1, 2 AND 3. HAND-OPERATED WIRE-BENDING TOOLS OF SIMPLE DESIGN

operator to see the end of the wire and make sure it is against the stop. It also lets dirt fall away from the stop.

The method of operating is the same as in other similar fixtures. The end of a piece of wire is inserted into the hole and pushed against the stop. A swing of the handle of the wiper through an arc of a little more than 90 deg. makes the bend.

The fixture for the second bending operation is shown in Fig. 3. It is also made from a cast-iron body *A*, tool-steel locating piece *B* and tool-steel wiper *D*. The shape of *B* is most irregular and must be determined by trial, for the temper of the wire must be taken into consideration and allowance made for the amount of spring back, as in any other bending tool.

The hole *E* and slot *G* in the piece *B* locate the wire by receiving the short bent end in the hole and allowing the long part to lie in the slot. The longer end is guided by the tool-steel piece *C* as it is wiped around the form *B* and allowed to slip between *B* and *C* and receive its final shaping against the surface *H*.

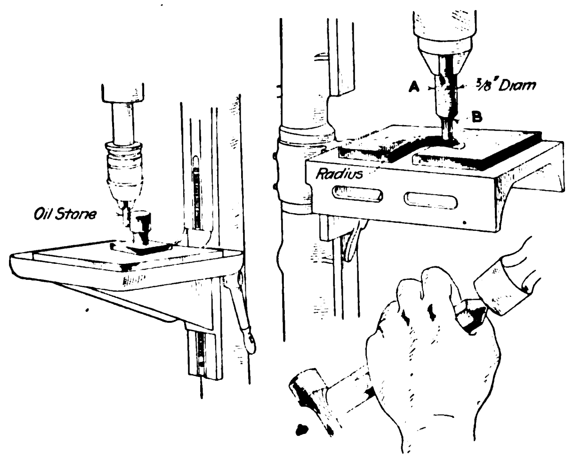
This bend is somewhat difficult and the resourcefulness of the tool maker is called upon to produce it in as simple a way as possible and with the fewest number of bends. The operation of this second fixture is the same as the first.

Each is intended to be held in a vise when in use.

Two Tool-Making Kinks

By Donald Baker

It often happens in fitting punches to dies that in some places the punch fits a little tight. The common practice is to stone off the high spots with an oil stone held in the fingers. A better way, and one that can be used in all places except sharp corners, is to utilize a short piece of round oil stone about $\frac{1}{4}$ in. in diameter or larger, held in the chuck of the drill press, as shown in



FIGS. 1 AND 2. TWO TOOLMAKER'S KINKS

Fig. 1, and run at a rather high speed. The base of the punch should rest on the drill-press table and should be slid against the revolving oil stone, when the high spots will be quickly reduced.

To do a nice job on stripper plates it is usual to round the exposed edges of the clearance holes through which the blanking punch passes. As these holes are generally irregular in outlin, the edges are as a rule broken by chipping and filing. A better way is to turn up a piece of $\frac{3}{8}$-in. drill rod as shown in Fig. 2 at *A*, with a radius and a short teat as shown at *B*; then taking a flat chisel which has had the cutting edge ground on a radius to correspond to the radius at *B*, teeth can be cut as shown in the same manner as cutting a file. After hardening, this tool can be used in a drill press, laying the work on the drill table and holding it against the cutter by hand.

The Iron for Malleable Castings is almost always melted in the air furnace or small openhearth furnace, as it has been found that the cupola cannot be depended upon to give metal of sufficient uniformity to insure successful malleableizing. The composition of the metal has to be kept within quite close limits, which vary in accordance with the size of the castings being made, and the manufacturer has to exercise much skill and ingenuity in designing his patterns and molds. The castings are packed in iron boxes, which are heated to a red heat in annealing furnaces of the ordinary type. They are annealed for several days, and test bars or castings in each box are tested in order to be sure that the process has been properly performed.

Design and Construction of Textile-Machinery Cams*

By Sumner B. Sargent

SYNOPSIS—The detailed steps in calculating and laying out a precision cam, such as is used in actuating the traverse motion of bobbin winders. The method shows how to accelerate the motion at the toe, speed the follow side, retard the stroke side and design several cams in a series from one set of calculations and drawings.

This article takes up the design of two cams representing a class that requires precision and where any error resulting in an unintentional irregularity in the cam's periphery will result in an error in the movement of the cam lever that will be multiplied, in effect, by the number of strokes the cam makes in a given period. One such class is bobbin-building cams on a textile spinning frame. A traverse device controlled by the cam travels from one end of the bobbin to the other end, distributing the yarn in a succession of even layers. In this device, through simple mechanism—usually a ratchet pawl and ratchet gear automatically actuating a screw feed—the stroke of the traversing device is gradually shortened, thus shortening the length of each succeeding layer of yarn on the bobbin. Usually this shortening of the traverse-motion stroke is uniform in length on each end of the bobbin, with a corresponding shortening in length of each succeeding yarn layer.

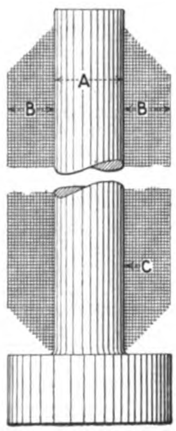


FIG. 1. SECTION OF BOBBIN AND WOUND YARN

This uniform shortening gives a tappered effect at each end of the bobbin. The complete bobbin is in appearance like Fig. 1. Here *A* represents the bobbin and the cross-hatched portions *BB* successive layers of yarn wound on evenly through the medium of a cam, cam lever and automatically shortening traverse device. This sketch indicates the degree of accuracy required for such a cam. Any error at *C* in winding on the first layer is repeated in the same spot in each succeeding layer; therefore the error is multiplied in effect by the number of the layers.

I have twice had occasion to design such cams, and designing them according to the principles that I have outlined have obtained what is called a "perfect cam." In the two shops where this result was obtained the custom had been to design the cams in the ordinary way and then, through repeated trials in operation, filing after each, finally "whip" the cam into acceptable shape.

It is sometimes required in this class of cams that the traverse motion shall move in one direction at a relatively fast speed and in the other at a relatively slow speed, in order better to bind the yarn on the bobbin. Owing to the fact that the yarn is delivered to the traverse motion at a uniform speed and the traverse motion moves at a different speed in each direction, the result will be that while the traverse motion is delivering 100 spirals of yarn wound on the bobbin in one direction of its stroke, it may in the succeeding layer of yarn have delivered only 60 spirals wound on the bobbin. The effect is to bind or tie the yarn on the bobbin. This result is accomplished by having the stroke side of the cam complete its movement in a different period of time from that allotted to the follow side of the cam.

This point is a convenient one to consider the problem of conserving power as much as possible in cam operation. Generally the stroke side of a cam uses more power than the follow side, and unless the cam is required to reverse, it is usually possible to save power by designing so that the stroke side is given the longer period of time in which to complete its operation. The cam considered in this article will be designed accordingly. It is supposed to have no dwell at either heel or toe, but to give a continuous movement in one direction or the other. While this is supposed to be the movement, there actually is a short period of dwell or inertia at both toe and heel when motion is reversing from one direction to the other. Therefore the cam must be "speeded up" at these two points and remain uniform in movement throughout the remainder of its stroke.

Let us assume that the cam has a stroke of 6 in. To demonstrate the possibility of uniformity in design let us also make a second cam of 5-in. stroke in both cases. The cam lever is to measure 12 in. from fulcrum to center of cam roll in both cases, and the cam roll is to be 1 in. in diameter. To conserve power let us determine that the stroke side of the cam is to operate in 200 deg. and the follow side in 160 deg.

In this class of cams there is another difficulty to overcome—there is always a certain length of yarn between the "bite" of the traversing device guiding the yarn on to the bobbin and the periphery of the wound bobbin. Consequently at the reversing points of the stroke there is a short period during which the traverse fails to guide the yarn positively either in an up or down direction, thus having a tendency to allow the yarn to pile at these points. This is another reason why the movement of the cam should be accelerated at these points. In these

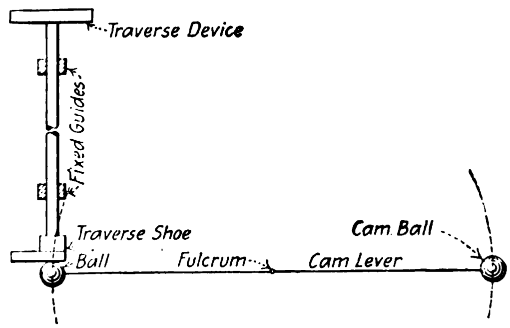


FIG. 2. DIAGRAM OF TRAVERSE DEVICE FOR BOBBIN WINDER

cams the amount of power used increases as the stroke moves toward the toe; therefore to accelerate when approaching the toe point more power will be consumed. I consider that it is better to accelerate the movement after passing the toe point, which brings it on the follow side. For the same reason it is better to speed up the heel of the cam on the follow side and not on the stroke side.

Laying Out the Cams in Detail

The traverse motion moves in a vertical direction in fixed guides, Fig. 2; and as a certain known timing of the movement in this straight-line direction is wanted, the graduations for our stroke can be laid off on a similar

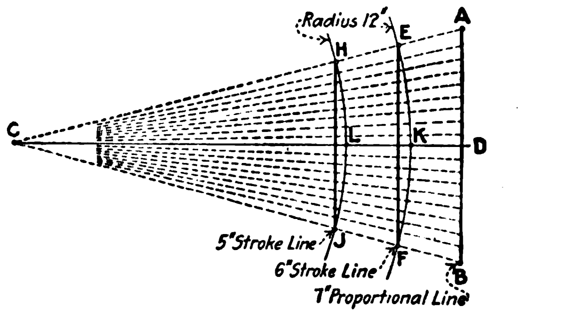


FIG. 3. DIAGRAM FOR DIVISIONS OF CAM LAYOUT

straight line and transferred to the arc representing our cam-lever movement. To accelerate the cam movement at the reversing points I consider it good practice that the first and last graduations on the follow side shall be 33⅓ per cent. longer than the intermediate graduations. It is also wise to use the proportional method of plotting the stroke, whereby all cams in this class may have the desirable uniformity of design to which I have previously alluded.[1] It is convenient to graduate the stroke into 18 divisions. As the first and last divisions of the follow side are to scale one-third longer than the intermediate spaces, it facilitates laying out to select a unit of scale measurement for the intermediate divisions that will be easily divisible by 3—say $\frac{3}{16}$ or ⅜ or ¾, etc.

If we use $\frac{3}{16}$ as the unit we will have for the proportional stroke line 18 (divisions) $\times \frac{3}{16}$ in. $+ \frac{1}{16}$ (33⅓ per cent. of $\frac{3}{16}$ in.) $+ \frac{1}{16}$ in. (33⅓ per cent. of $\frac{3}{16}$ in.) or $18 \times \frac{3}{16} + \frac{1}{16} + \frac{1}{16} = 3\frac{1}{2}$ in., the length of our proportional stroke line. This length line will answer, but I prefer to use a line longer than the actual cam stroke, for if one can work within 0.001 in. of accuracy this inaccuracy is less important on a 7-in. proportional stroke than it would be on, say, a 3-in. or 1-in. proportional stroke line. Therefore it is wise to use ⅜ in. as the unit of measure for intermediate spaces. We have $18 \times \frac{3}{8} + \frac{1}{8} + \frac{1}{8} = 7$ in., the length of the proportional stroke line.

Turning to Fig. 3, erect a 7-in. vertical line, marking off a ½-in. division at each end and ⅜-in. intermediate divisions. Bisect this line at right angles by the line *CD*, which represents the center of the stroke of the cams. From each division point on the 7-in. vertical line extend radial lines to *C*, then erect the 6-in. and 5-in. stroke lines. The radial lines cut the 6-in. and 5-in. stroke lines at points indicating the graduation divisions for those lines.

With a 12-in. radius, representing the 12-in. cam lever, and center on the line *CD*, swing arcs *EKF* and *HLJ*, representing the actual arcs described by the cam-lever roll. The divisions spaced by the radial lines on these arcs indicate the actual spacings for the cams. With a 12-in. radius (cam-lever length) describe the circle *A* of Fig. 4. After determining that the center of the cam strokes shall be 6 in. from the center of the cam hub, with a 6-in. radius swing the circle *B*, representing the center of the cam strokes. The circle *B* corresponds with the points *K* and *L* of Fig. 3.

Turning now to the stroke side of the cam, I consider it good practice to have the divisions of even length; so the 18 divisions are spaced on one of the arc lines in Fig. 4. If these divisions of movement were to be of other than even length—as, for instance, for a uniformly accelerated motion—we would resort to the method described in Fig. 3 to obtain uniformity of movement through the whole series of similar cams. As it is, the 200-deg. segment of circle *A*, Fig. 4, is divided into 18 even divisions and the arcs are swung as in the 160-deg. segment. Then, using the circle *B* to locate the center of the stroke, lay off the 6-in. stroke on one of these arcs, space out the 18 divisions as per Fig. 3 and swing each division mark on to its proper intersecting arc. Then swing the contact circles with the 1-in. cam ball, locating the periphery for the stroke side of the 6-in. cam. In a similar manner lay off the 5-in. cam on Fig. 4 with dotted lines, using the same arc lines and circles *B* to locate the center of stroke. Thus a charted layout like Fig. 3 will

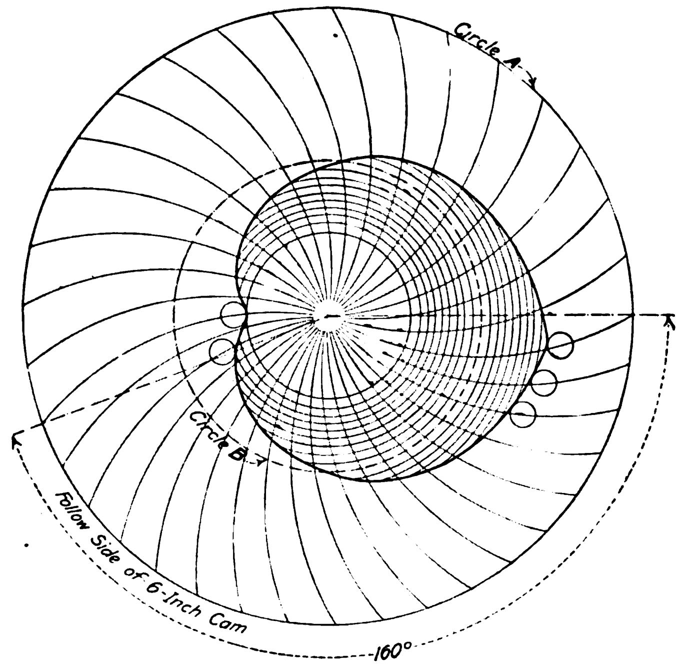


FIG. 4. COMPLETE LAYOUT OF BOBBIN-WINDING CAM

answer for numerous cams of varying lengths of stroke, and one like Fig. 4 will answer in the same way for a number of cams, provided the length of stroke is the only factor changed.

In all dimensions be careful to use a patternmaker's shrink rule and have the patternmaker prick through the tracing to transfer the periphery and center of the cam. All such cams should have cut or stamped in their side an arrow indicating the direction of movement and figures representing the stroke and length of cam lever, thus $\frac{200}{160}$ deg. ← $\frac{6}{12}$. The cam pattern and cam castings then tell their own story, without looking up drawings and details, which are sometimes hard to find.

[1]"American Machinist," Vol. 43, page 976.

Letters from Practical Men

Kink Used in Cutting File Teeth

Briefly speaking, the process of cutting file teeth consists of rapidly driving a chisel into the blank which is laid on a moving table, the table being "geared" for the proper pitch and moved through a nut and lead screw much as is the carriage of a lathe but with this difference —instead of the divided nut of the lathe, a single half-nut is used, which is provided with a handle and lifted out at the end of each cut, the table being returned by hand to the starting position ready for another blank.

For the heavier class of work these tables may weigh as much as 150 lb. They are V-shaped on the under side

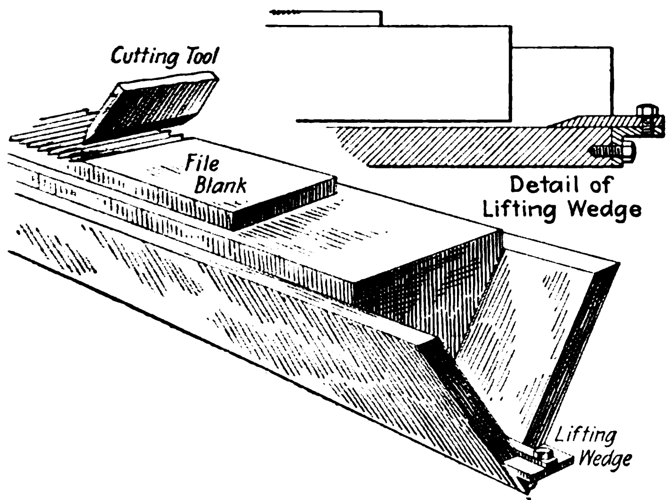


TABLE-CARRYING DEVICE OF FILE-CUTTING MACHINE

and slide in a V-bed just as a planer table runs in its ways. Though ample provision is made for lubrication, the weight of the table, its shape and the hammering it gets from a 100-lb. head at every blow force out the air between the sliding surfaces and unite the table and bed so closely, with the oil as a binder, that any movement of the table by hand must take considerable exertion. In shop parlance the bed is held fast by "suction."

The Madden & Morrison File Co., of Middletown, N. Y., makes great quantities of the largest sizes of files in use and for such the heaviest type of cutting machines is required. The difficulty of moving the beds was overcome by a simple device which is of sufficient general interest to describe, even though its application is a special one.

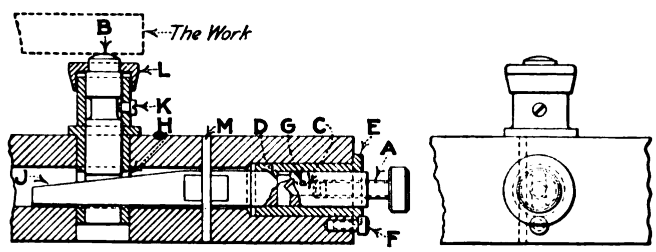
The table is given a fraction of an inch more travel than the length of the file being cut, and a trip is set to disengage the nut from the screw. In the triangular-shaped space, at the bottom of the V-bed and below the table, a wedge-shaped piece is secured near the rear of the machine. The table strikes this piece just as the last tooth of the file is cut and rides up on it during the fraction of travel before the nut is disengaged. This breaks the grip of the bed on the table, and as the latter is pulled back it rides on top of the oil film, which permits easy movement. At the end of each travel the "suction" is broken and the bed freed. The action and the result obtained are somewhat analogous to those in grinding in a valve. The illustration gives an idea of the relation of the parts and the construction. D. A. HAMPSON.

Middletown, N. Y.

Adjustable Wedge Stops for Jigs and Fixtures

Herewith is shown an adjustable wedge stop for jigs and fixtures. It is used mostly on mill and profile fixtures, and is designed to take care of variations of rough castings. The casting is set upon three stationary studs and clamped, care being used that the casting is not sprung in clamping. The adjustable wedge stop is then used by pushing in screw A until the contact pin B lightly touches the casting, after which the screw A is tightened. The screw contacts the pin C, which forces the pin D against the tool-steel bushing E.

The bushing is a snug fit in the body of the fixture and is held in by screw F. The pin G keeps pin C from



AN ADJUSTABLE WEDGE STOP

turning and coming out. The part H has a hole drilled and reamed the same diameter as the wedge J. The screw K prevents the contact pin B from coming out. The cover L keeps all dust out while allowing full freedom of the parts. The pin M holds the wedge J in place.

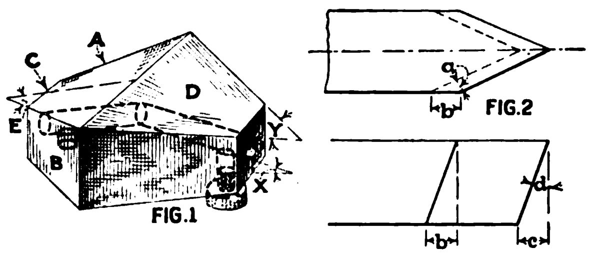
Dayton, Ohio. M. BASSETT.

Grinding Threading Tools

The sketch shows three views of a handy little grinding block, or jig, which I recently made for accurately grinding inserted threading tools on a surface grinding machine. It should prove useful to some of your readers engaged in the production of accurate screw threads, such as taps or screw gages. One end of the block is arranged for 55-deg. angles and the other for 60-deg. angles and can of course be modified to suit any other requirement.

The hole in which the thread tool is placed for grinding is at an angle with the top, to give clearance to the cutting edge. The bottom of the block is machined to the same angle. By setting the faces A, B, C and D successively on the magnetic table or chuck, the sides, top and a flat on the point may be ground. For a Whitworth or other rounded thread it is an easy matter to stone the corners off; for a Sellers thread, the correct flat may be ground while the tool is in the jig.

The angle X at which to set the hole to give the desired clearance to the cutting edge, and also the angle Y, may be determined as follows: Referring to Fig. 2, which gives a plan and a side view of the threading



FIGS. 1 AND 2. GRINDING THREADING TOOLS

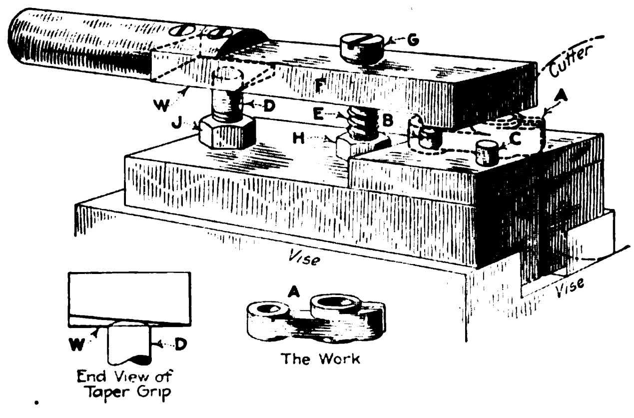
tool, the distance a = tangent of angle of clearance; $b = \dfrac{a}{\sin \frac{1}{2} \text{ thread angle}} = c \times \tan d - c$ = angle of hole in jig with top face.

The angle of the sides of jig may be determined in a like manner for angle E—that is, $\sin E = \dfrac{\sin \frac{1}{2} \text{ thread angle}}{\cos D}$.

London, W., England. J. MAY.

Wedge-Grip Milling Fixture

A vise milling fixture with a wedge arrangement for clamping is shown. The fixture is clamped between the vise jaws of a hand milling machine and is used to mill a clamping slot in work A. The clamp is shown in position as it is when the work is loaded and when it is



WEDGE-GRIP MILLING FIXTURE

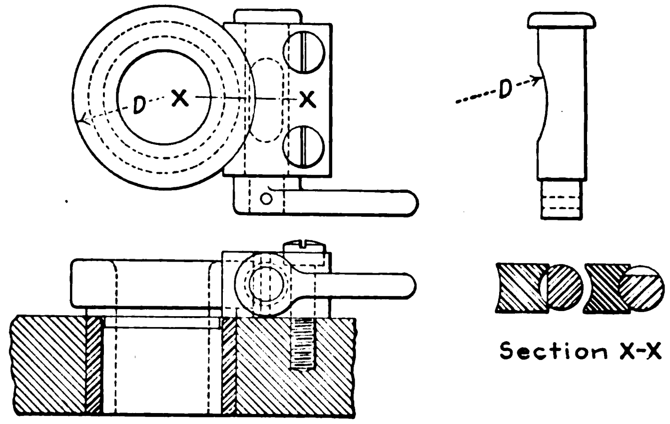
unloaded. After the work is located over pin B and against the pin C the clamp is simply swung over the work until the wedge part W tightens over stud D and over the work. The spring E holds the clamp F in an upright position. The studs D and G can be adjusted to take care of all wear and are locked by locknuts H and J.

Dayton, Ohio. M. BASSETT.

A Lock for Jig Slip Bushings

The illustration shows a rugged lock for small and medium-sized slip bushings. Its only limitation is the size of the bushing, for it will be seen that if the head of the bushing is too great in diameter, the principle of the lock cannot be correctly applied.

In this design the bushing is locked against rotation in both directions and is also secured against climbing up on the drill. This is accomplished by means of a pin which fits into a circular groove in the side of the bushing head when in the locked position as shown at the right in the section XX. This pin is milled out on one side to the same radius as the head of the bushing, so that when the lever to which it is fastened is raised to a vertical position, the relation between the bushing and pin is as shown at the left in the section XX. When the radius cut in the



PIN LOCK FOR SLIP BUSHINGS

pin and the head of the bushing register, the bushing may be withdrawn.

The successful application of this lock is in its use on small-sized bushings and in carefully fitting and hardening its parts. W. BURR BENNETT.

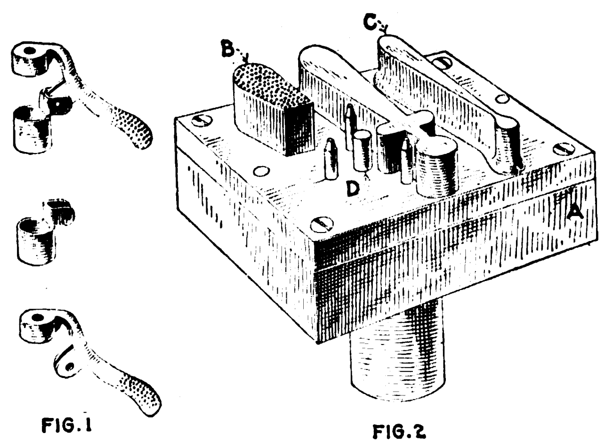
Bridgeport, Conn.

Making a Small Bottle Cap

The bottle cap shown is used in surgical-instrument work. The parts of the cap are shown in Fig. 1 and the dies for making it in the remaining illustrations.

The blanking punch and die are shown in detail in Figs. 2 and 3. The punch holder A carries the serrating punch B, the forming punch C and also the small punch D, which pierces the extra hole into which the stop E fits. This stop is shown on the stripper F in Fig. 3.

This illustration also shows the dies G, which are in two sections—one for blanking, piercing and serrating



FIGS. 1 AND 2. LEVER PARTS AND PUNCH FOR FIRST OPERATION

and the other for forming the lever. They are all set in the bolster H, I being inserted in the die and retained in position by the screw shown underneath it. A section of the bolster is shown at J, together with the screw K,

spring *L* and pad *M*. These keep the tension against the pad *M*, which travels in the blanking die and forces the blank back into the stock.

The section at *O* shows the screw *P*, spring *Q*, the pad *R* and the underpad *S*, which pushes the formed piece back into the strip of stock to be carried along out of the way of the tool. The pins *TT* in the pad *S* are

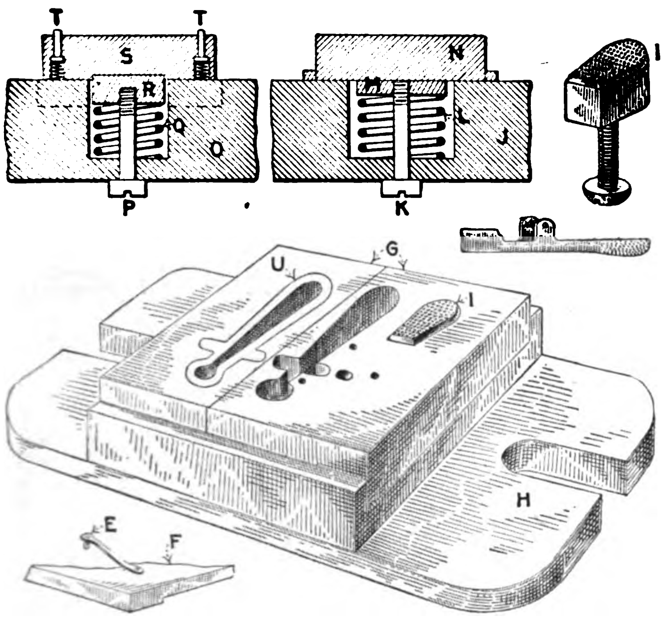
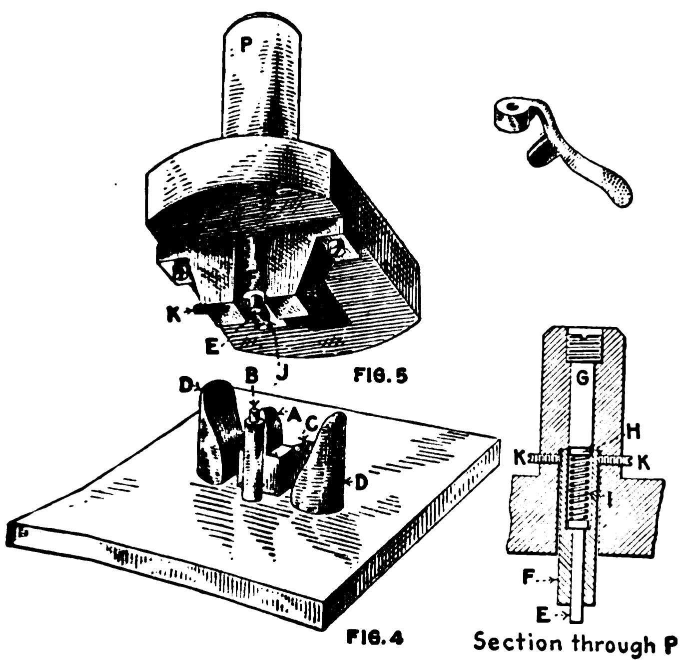


FIG. 3. FIRST OPERATION ON LEVER FOR BOTTLE STOPPER: SERRATE, BLANK, PIERCE AND FORM

shouldered and have springs under them in order to carry the formed piece above the rest, as shown at *U*. The stripper is milled just enough for the stock to pass through in order to prevent any distortion of the material.

Fig. 4 shows the dies used on the second operation, the bending of the lever being done on the shoulder *A*.



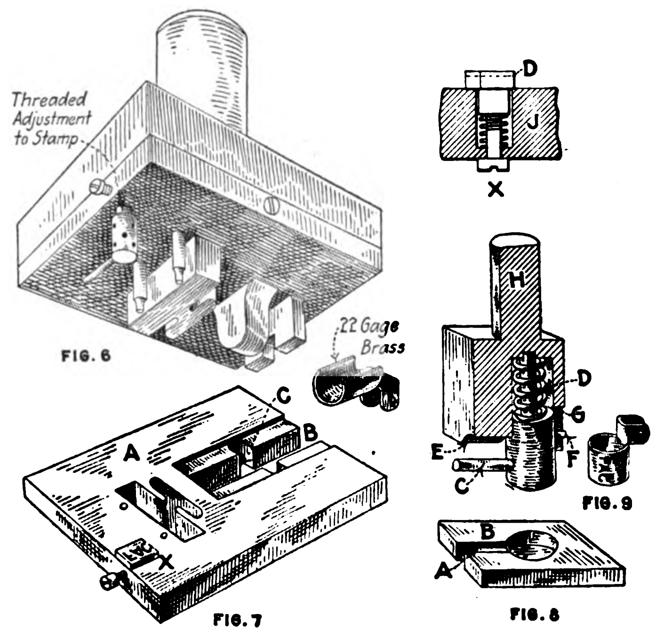
FIGS. 4 AND 5. SECOND OPERATION: PUNCH AND DIE USED IN BENDING THE LEVER

A shouldered stud *B* holds the end of the cap, as indicated by the light outline, while the handle is bent down over the form *C*. The two tapered studs *DD* are equidistant from the center of the stud *B* and are used in forming the ears, the taper forcing in the forming tools on each side of the lever.

In the punch shown in Fig. 5 *E* is a compression pin which travels in the cylinder *F*, the latter being fastened by the two screws shown. The long screw *G* in the shank of the holder presses against the plate *H*, which bears on the spring *I*, directly under the compression pin *E*. This retains the lever in position on the stud *E* during the bending operation.

The bending is not done on a full form, but simply at the shoulder by insert *J*, and the pierced end of the lever enters into cylinder *F* about $\frac{3}{16}$ in. The two pins *KK* engage on the tapered studs *DD*, Fig. 4, and press on the ears of the lever, bending them easily into proper position.

In Fig. 6 is the punch for the first operation on the collar, while Fig. 7 shows the forming die *A*, the blanking, standing and bolster being the same as on the lever and are therefore not illustrated. The die *A* is



FIGS. 6 TO 8. COLLAR PUNCH AND DIES

milled through as at *B*, but beyond the opening for the ears of the collar as at *C* it is milled merely to allow passage of the formed piece, which is carried along with the stock. A section of the bolster is shown at *J* and the pad on which the collar is formed at *D*, with the screw and spring tension beneath. The stripper and stop are built the same as on the lever die.

In Fig. 8 is shown the punch for rounding the stamped part of the collar while the piece is formed by the groove *E*. The sliding movement is governed by the pin *F*, which is in the pin *D* and works in the slot *H*. The results are particularly satisfactory, even though it is a comparatively small piece to handle. In Fig. 1 the pieces are shown full size. GEORGE F. KUHNE.

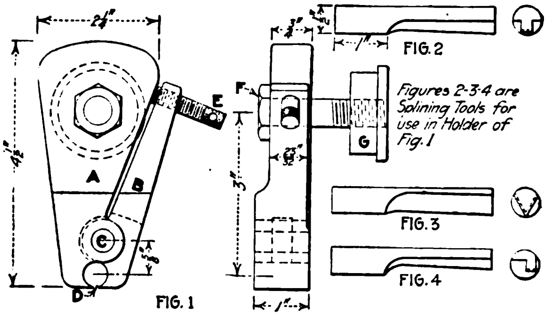
Rutherford, N. J.

Shaper Splining-Tool Holder

It is often difficult to spline out dies or similar work in a shaper with the tools at hand. For such work I use a tool holder such as shown in Fig. 1. The parts *A* and *B* are made of machinery steel and are jointed at *C* with a ⅜-in. pin. The tools are made of ½-in. drill rod, in-

serted in the opening at *D* and securely clamped by tightening the screw *E*, which has a knurled head and a cross-drilled hole. By slightly loosening the screw *E* the tool may be turned to any position.

This holder does away with the tool post, as it is secured to the clapper by the screw *F* and the nut *G*. This allows the use of very short, stiff tools, some of which are shown in Figs. 2, 3 and 4. The one in Fig. 2 is a strong, stiff tool for keyseating. The one in Fig. 3



SPLINING TOOLS AND HOLDER FOR SHAPER

is useful for planing square recesses, for by loosening the screw *E* of Fig. 1 it may be turned to the different positions necessary to work out all four corners.

Fig. 4 shows a special form of offset splining tool. I make the tools stiffer by hardening them clear up to the round shank and then drawing to a spring temper, almost to the cutting edge. H. M. DARLING.

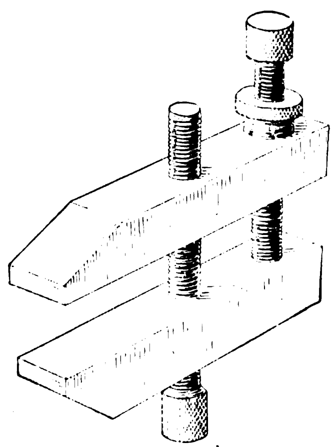
Greenfield, Mass.

⌘

A Toolmaker's Novel Clamp

The differential clamp shown in the illustration has proved to be quite successful.

The clamp screws of one set that we used had a 17-pitch thread, while the bushing was 16 pitch. The clamp



A TOOLMAKER'S NOVEL CLAMP

is adjusted by means of the screw and then tightened with the screw bushing, thus exerting quite a pressure.

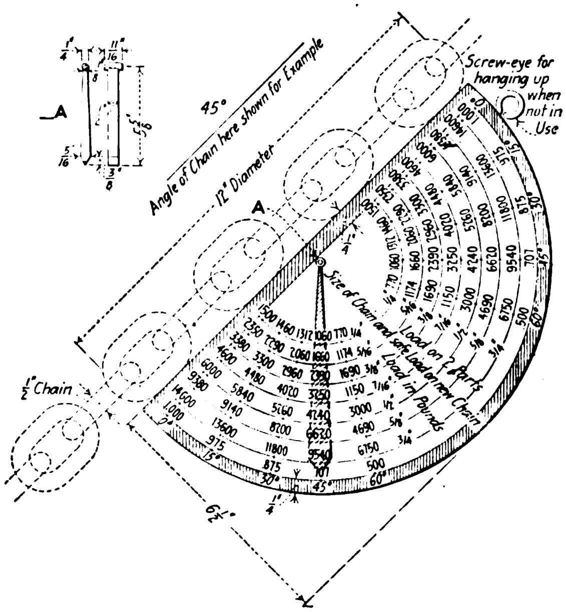
The same idea was successfully applied to some "C" clamps, the fingers being sufficient to tighten the clamps for any job. O. C. KUHRT.

West Haven, Conn.

Gage for Showing Safe Loads on Crane Slings

The illustration shows a gage by the use of which the safe load on a chain- or wire-rope two-part sling may be obtained for any angle of sling from the vertical to 60 deg., by either placing the gage against the sling, as shown, or holding it at a distance at such an angle that its upper edge coincides with the axis of the sling part. It is suitable for all the usual sizes of chain or wire rope, provided they are in good condition.

It is simply a light, seasoned-wood frame *A*, about a foot long (or any other desired size) and three-quarters of an inch thick, cut out on a jig-saw. In the center of



GAGE FOR SHOWING THE SAFE LOADS ON CRANE SLINGS

this frame is freely suspended a small, heavy pendulum. Transparent celluloid is put on each side of the frame, and on this are marked graduations for the safe loads—for chains on one side, for ropes on the other.

The very fact that such an instrument is in the shop and frequently used will lead the men to be more careful, give them a better idea of the effect of the angles on sling chains, and lead them to become better informed on the strength of such things and the weights of the pieces commonly lifted. F. W. SALMON.

Birmingham, Ala.

⌘

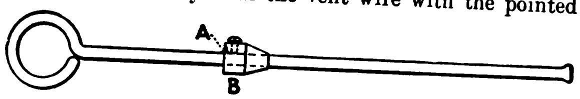
The Choice Between Steel and Malleable-Iron castings is dictated partly by their respective properties, partly by price and partly by the limitations of the processes by which malleable iron is made. As pointed out in a paper read before the International Engineering Congress, steel is, in its nature, a more homogeneous metal and therefore tougher and stronger than malleable iron. Moreover, castings of malleable iron are somewhat prone to actual porosity or sponginess at the center, especially in certain portions of irregular castings, so that for this reason also a steel casting is stronger and more reliable. Finally malleable iron can be made only into castings of quite light sections, whereas there is almost no limit to the size and weight of steel castings that can be produced. For uses where only a fair amount of strength and toughness is necessary, and the castings are therefore of light section, it often pays to buy malleable castings, because they are cheaper than steel.

Discussion of Previous Question

A Core-Venting Wire

The illustration in Vol. 42, p. 376, of a pointed vent wire is incorrect, for strange as it may seem, such a wire should be upset a trifle on the end so that it will push in easily. All skilled molders and core makers know this.

The vent wire with the upset end probably is pushed through more easily than the vent wire with the pointed



A CORE-VENTING WIRE WITH UPSET END

end, because there is less friction of the sand on the wire from the pointed end up.

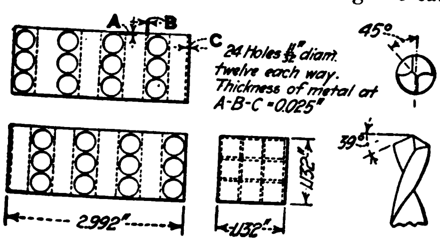
The illustration shows the tip of a vent wire as it should be upset for use. ROBERT E. NEWCOMB.

Holyoke, Mass.

Machinist Instruction in the Public-School System

Mr. Turbon, on page 956, Vol. 43, recommends that commercial machines be built by students. But the question is, What kind of machine could be designed that would require chipping, filing, grinding and scraping of a nature that would be a real benefit to the student?

These operations must be near the danger line of spoiling the machine parts (which may be very costly), or they would be of little or no value as instructional work. We therefore think it best during the early part



EXERCISE IN LAYING OUT HOLES

of the course to give the boy an inexpensive piece of material and make it valuable and important from the standpoint of the student. It is of value to the student because he knows his efficiency is measured and based entirely upon the time it takes to complete the exercise. You may say that this will encourage inferior workmanship, but this is not so if the exercises are properly designed.

For instance, the drilling exercise, shown herewith, is a cast-iron block carefully ground on all sides to dimensions. The student is required to lay off the holes with scale, square and scriber, then to center punch and drill through both ways. The metal remaining between the holes both ways is but 0.025 in. thick. This means that all conditions must be just right or the holes will run together and spoil the block.

There may be various causes for this misfortune, such as inaccurate layout, improper sharpening of the drill, drill not started central with punch marks, block resting on chips, etc. A student can be forewarned about all these troubles; but he looks lightly upon these warnings until he is forcibly convinced by the spoiling of a few blocks that hours are multiplying and that there is more to the apparently insignificant operation of drilling holes than he thought. He now begins to learn, and he settles his mind upon it and after considerable effort he finally succeeds in making a good block. He then finds that repeated failures have taught him the drilling lesson as well as the lesson of paying close attention to the advice given him by the instructor.

I use this example to emphasize the use of carefully prepared exercises for the beginners. I believe that the student can advance more rapidly and fit himself earlier for making actual machine parts by this method than by any other. E. H. KRIEDER.

Lancaster, Penn.

Attitude of Employers Toward Military Training

At the risk of seeming cantankerous, I want to reply again to Mr. Murphy's communication on page 1131, Vol. 43.

Any fear which he has that the employees of an establishment will take advantage of the full-pay-during-encampment privilege just for the sake of the outing would be dissipated if he would familiarize himself with present-day conditions in the National Guard. When employers grant this privilege, it is almost always accompanied—always should be accompanied—by the proviso that the men's proper service be certified by their company captain. This requirement is not at all a hardship on the company captain, and he is desirous of doing it to prevent any imposition on the part of any man, because the captain wants the employer's coöperation. He feels that he should have it; he feels that the militia merits it; and he does not intend that any one of his men shall impose upon his employer, to the detriment of the cordial relations between employer and militiaman.

The duties of the present-day militiaman are so exacting that his enlistment must be actuated by interest and enthusiasm of his own, which far outweigh the inducement of the ten days' pay from his employer. Furthermore he cannot enlist just for an encampment. The pay is a great stimulus, however; and of equally great importance is the interest which the militiaman feels is taken in his militia work by the employer, as shown by this very course—paying the man who is away at the encampment.

Mr. Murphy need not be concerned about the number of men who go to the Plattsburg camp, because those who

attend that camp are required to pay for their subsistence, etc., and as a rule are not drawn from the shop employees, as are the large number of militiamen whom we are discussing.

The militia comes a long way from being what it should be. No one realizes its defects and deficiencies more than the conscientious company commander. To fulfill properly the functions of company commander today requires an inordinate amount of time, which the officers generally take from their families, because they cannot afford to take it from their professional life. They are actuated by the keenest enthusiasm, and there is not the slightest doubt that they would fight with every resource at their command—which happens to be considerable—any attempt of any of their enlisted men to take advantage of the patriotic and public-spirited offer of the employer to give part or full pay during the annual military encampment.

Mr. Murphy is worrying over something which the militia officers do not need at present to worry over—that is, the militiamen from manufacturing concerns being so numerous that their annual leaves will cause financial disadvantage to their employers. If the number only were sufficiently large to cause this embarrassment, we should have a very much better militia, and we should also find some means of preventing the embarrassment. I regret to say that at the present time that is one thing we do not have to worry about. However, it is my impression that after any of our present annual military encampments the participants go back to their work with their working efficiency increased an amount great enough to more than offset the wages the employer has continued during the short absence.

The militia has been damned from hell to hackney, and no doubt has many times deserved it; but a new era has arrived, and we are making the fight of our lives for more cordial relations between the militia and the employer and for mutual understanding, both of which we think we are trying to merit.

PERCY E. BARBOUR,
Second Lieutenant 4th Co., C. A. C., N. G. S. M.
New York, N. Y.

Recording Our Failures as Well as Our Successes

I have read the editorial on page 872, Vol. 43, which impressed me as a timely note of warning and also as good advice. Most of us are extremely interested in reading of other fellows' failures; our own we bury deeply with all speed. Some of us, I fear, find a sort of unholy joy in recording others' failures, often to draw out ridicule, but even in this we may miscalculate the result of our exposures.

The old saw of Prof. John E. Sweet, "The man who never made a mistake is the man who never did anything," recalls a remark I once heard from the late Lord Kelvin, "From my failures have came my greatest successes." But how often do others waste time over these self-same failures through lack of knowledge of what has been tried out long ago! If as you remark, we could start where others have left off, an enormous saving would be effected, which would benefit the human race all around.

A few years ago I was calling upon a prominent engineer and inventor. Just at that time a specialty in competition with his own patented one was being put on the market. A company had been formed and everything looked promising from the outside for a profitable career. Naturally I spoke of this. My friend invited me through his office to his experimental room, and pointing to an object away in the corner, he said: "There's the 'Moon' Co.'s patent. It has been lying there for a good number of years. It was one of my failures."

I did not think very much of it at the time; but had my friend's failure been published, one company at least would not have passed from its birth to immediate death by liquidation. No one can benefit by happenings of this sort. Of course we have the type of man who considers everything he touches to be successful, no matter what others think. In all probability he is hopeless. But if men who have brought out something really successful would place on record the failures they were up against before the goal was reached, we would have some very interesting and instructive reading. Old readers will recall that something of this sort was not the least interesting part of the late Mr. Porter's reminiscences published in the *American Machinist* a few years ago.

One brilliant failure which happened in a shop is worth relating. One day while looking over the stores returns for the quarter, I was alarmed at the number of paint brushes which were being served out to the engineering department, despite the fact that we had a painting department. The method of issuing these brushes was by the foremen's orders signed by themselves, the boy clerks who wrote orders for material not being allowed to write requisitions for brushes. I at once gave directions to the stores that in future all orders for brushes must be accompanied by an old brush; and so long as this was carried out they could accept any signature without question, including the foremen's boy clerks.

It was not very long before I discovered what a lot of paint brushes are really necessary in an engineering department. I was called over by the foreman turner to see a job that had stuck when it shouldn't. It was a large steel valve casting. The man was engaged turning and screwing the body to receive a mild-steel flange already screwed. I found the flange about half an inch from its correct position and firmly "fired" on. I immediately found the cause, and in reply to my question, "Why didn't you put some red lead and oil on the screw, before trying the flange?" I was told, "I hadn't got a brush and I waited nearly half an hour while the laborer went round the shop trying to steal one, but he couldn't manage it."

"Well, why didn't you apply to your foreman, before being such an idiot?"

"He did," said the foreman, who produced an order for one paint brush signed by himself, at the same time informing me that the stores wouldn't accept it, and he was keeping it over to bring before me later on. This little incident was a costly affair, as in the end we had to turn off the flange to save the body.

There were numerous other proofs of my failure. Men were standing idly by while someone fetched a paint-shop boy to put a few dabs of paint inside something before it was closed up for dispatch. Many went out without the paint. But to cut the story short: I visited the stores to investigate and to think out the easiest way of "climbing down." I then found we were using far more brushes than ever, and the stores had the remains of a

previous brush or some part of it for every one issued. These I found were mostly of a pattern quite unknown to our order department. Some ingenious individual had separated one old brush in such a way that it had passed through for two new ones.

Possibly the unkindest cut of all was one foreman's telling me, when talking matters over, that all the boys were becoming humpbacked from going through the streets with their heads down, hoping to find the remains of a paint brush lying in the gutter.

My saving efforts on this occasion were without doubt a dismal failure, but the lesson learned has been worth the money it cost, if only as a guide in my future dealings with supply matters. F. P. Terry.

Belfast, Ireland.

Best Way To Do Certain Things

In Professor Sweet's article in the *American Machinist*, page 936, Vol. 43, on "The Best Way To Do Certain Things," his first example is "the best way to put a wheel or lever on the end of a shaft, particularly if it is one that has to be removed and replaced, is to put it on a fairly steep taper and fasten it by screwing a nut on the end of the shaft, and if it is something that must occupy a fixed position, a key will serve to locate it."

I don't know of any better way. Capstans are put on that way on turret lathes. On screw machines they are placed on the end of the shaft that runs through the sleeve in the saddle, engaging with the rack in the slide and operating it. But this matter of a fairly steep taper is one that leads to trouble in this instance, at least in my experience. Professor Sweet says "particularly if it is one that has to be removed and replaced." That means it is to go on, stay tight and come off easily, and that this "fairly steep taper" will give such a result.

The first consideration is that the capstans shall go on tight. They do that—I can testify to it—but they do not come off easily. I have frequently had to remove the slide from the saddle and remove the saddle from the machine, place it upon its side and drive the pinion shaft through the capstan. This upsets the thread upon the outer end and causes trouble when replacing the nut. Capstans are very often put on without a key, and the taper used is of so slight an angle that while it does not slip, it often sticks when it is to be removed, and it will not come off without something more than rapping.

Some years ago I used a Jones & Lamson lathe built before the days of the Hartness flat turret lathe. Upon the end of the carriage feed shaft instead of the usual cone and belt of those days there was a gear. The hole through this gear was of such a taper that it would slip if from any cause an unusual strain was put upon it, as by the belt. The end of the feed shaft had keyed upon its driving end a taper sleeve that fitted the gear. The stretching of the belt in a belt-feed lathe and its consequent slipping on the cone and stopping of the carriage are annoying, as anyone who has operated one of these lathes well knows. This gear connection of the Jones & Lamson people was intended to overcome such trouble, and my experience was that it did.

Somewhere between the taper of the gear on the feed shaft of this lathe, which could always be removed by the hand without rapping, and the taper used in the capstan hub of the screw machine or turret lathe there may be a taper of such an angle that it will not slip when tightened by a nut and will come off easily when the nut is removed. If there is not, a key should be used, as suggested by Professor Sweet.

A key is an additional expense, and the makers of these tools have preferred to use a taper that will not slip, and to let people who have to remove the capstan get it off the best way they can. A nut upon the end of the sleeve which will bear against the inside of the capstan hub will force it off however tight it may stick, without the usual pounding on the hub with a babbitt hammer or the trouble of taking off the slide and saddle, as shown in Fig. 1.

The machine that in my experience has been most abusively treated with the hammer is the profiling machine, and some milling machines have been a close second. The cutters and collets on the profiler and the arbors on the miller are usually driven into the spindles with a babbitt hammer. The tang of the cutter collet, or arbor, reaches to a slot cut through the spindle at a convenient point back of the lower, or front, housing for the insertion of a taper key to drive out the cutters, which frequently stick. In this way they are a source of trouble and cause a loss of time in removing.

Some makers have tried to overcome this difficulty by making the spindles hollow and using a long collar-

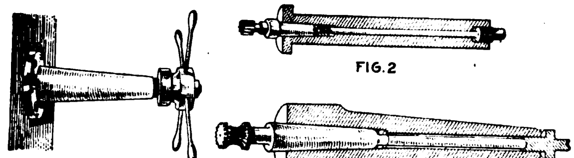


FIG. 2

FIG 1

FIG. 3

METHODS OF HOLDING PARTS

head bolt that reaches through the spindle. In the tang end of the cutter, or arbor, a hole is tapped. Into this hole the bolt screws and draws the cutter to its seat in the taper hole in the spindle. This method is good as far as it goes, but to remove the cutter you must slack the bolt and pound upon its head. Such treatment is bad for the thread in the cutter and on the bolt.

If the rear or upper end of the miller or profiler spindle were counterbored for a short distance and threaded with a pitch somewhat finer than that of the extreme end of the bolt which engages with the cutter tang at the opposite end of the spindle, the bolt could be screwed into the counterbored portion a certain distance and the cutter collet screwed upon its other end, which reaches a short distance into the taper hole at the other end of the spindle. Then by a few turns of the bolt the cutter would be drawn up to its seat in the spindle, and by unscrewing the bolt the cutter would be forced in the opposite direction and easily unscrewed from the bolt and taken out of the spindle. Fig. 2 shows this fastening.

The difference in the pitch of the threads on the two ends of the bolt will cause the cutter to be drawn to its seat in the lower end of the spindle at a more rapid rate than that at which the thread on the head end of the bolt retreats from the threaded counterbore in the upper end of the spindle. It is a differential screw and it has some pull to it.

The cutter can be screwed upon the lower end of the bolt while the bolt is held from turning until the cutter seats itself slightly, or as far as it can be turned with the fingers. Then with a wrench upon the bolt head the cutter can be finally tightened. This method ought to do away with the pounding.

When collets become stuck in spindles so badly that the spindle must be removed from the machine, the best way I have found to get it out is to cut a thread upon the collet head, run on a nut and draw the collet out. With a wrench on the put it can be done in less time and with less injury to the machine than by warming up and expanding the spindle and pounding it out.

The common practice with profiler and milling-machine spindles has been in days past to make the spindles solid. Then after chucking the taper hole for the cutter in the proper end of the spindle, a slot is put across the spindle at such a distance from its end that the tang of the cutter projects into this slot sufficiently so that by inserting a taper key in the slot and driving it in with a hammer the cutter is forced out of the spindle. The tang upon the cutter prevents it from turning around if it fits the slot into which it projects; but from the nature of the work of both machines, and perhaps more particularly the profiler, the cutter depends much more upon the fit in the taper hole in the spindle to keep it in place than it does upon the tang. Consequently the operator drives the cutter into the spindle with such force that in time the taper hole becomes enlarged, or bell-mouthed, as the metal wall surrounding the taper hole from the shape or taper must be thinner at the extreme end of the spindle than farther in. Accordingly it spreads at that point. When the distortion has become so pronounced as to prevent the cutter from holding, the spindle must be rebored or reamed. The bolt will do away with this trouble, which I found to be a very serious one. It means changing gages for the taper after the hole has been enlarged, and the annoyance of having two or three different sizes in the profiler spindles.

The bolt is used by manufacturers of profilers and has been for years. It is an excellent way of holding tools in a taper hole anywhere, but I have never seen a bolt that will remove the cutter as well as draw it in. Some collets are made with removable tangs, and with this form the only office of the tang is to present a surface for the taper key to rest on when driving the collet out of the spindle. Collets are used principally to reduce the cost of cutters by making the cutters with very much smaller shanks. As such cutters are usually small ones, the taper shank without the solid tang is sufficient to hold the cutter. The life of the collet is much longer than that of the cutter, so it is an advantage to have a removable tang in it. Tangs either solid or removable become bruised and broken from rough usage. The collet outlasts several of them. Running entirely through the collet is a hole made as large as possible without weakening the tang end of the collet or cutting away any of the taper hole in the other end.

It is sometimes convenient to remove the cutter without taking out the collet. A piece of tempered drill rod, placed in the hole through the collet, of such a length that it reaches from the end of the cutter to the end of the shank of the tang, raising its collar head slightly from the end of the collet, will do this. When the taper key is inserted in the spindle slot and driven in, it forces the tang shank against this piece of drill rod and against the cutter tang, driving it out of the collet and leaving the collet in the spindle. The collet shanks are ground, the tang end being scraped to fit a 60-deg. center. This enables the cutter to be sharpened while it is in the collet, causing it to run true. Fig. 3 shows a collet with a removable tang and cutter.

Springfield, Mass. J. P. POLAND.

Oxyacetylene Welding in 1913 and 1915

After reading the editorial on page 784, Vol. 43, I am prompted to add a few remarks on this important subject, for I am strongly in concord with your comments on the treatise referred to.

It is true, undoubtedly, that oxyacetylene welding methods have gone far beyond repair work. In fact it is a question if the process is used as extensively at the present time for repair work as in the manufacturing industries of the world. Personally I am decidedly of the opinion that if statistics could be obtained it would be found that the process is used far more extensively in the manufacturing industries than in repairing. The process has no limitations as to classes of metal—aluminum, brass, copper, iron and steel are welded with equal facility. The oxyacetylene method when employed on manufacturing parts is not only quick, but enables the operator to weld where it would be difficult or impossible to work by any other method. There are the further advantages of neatness and strength over the antiquated methods of soldering, brazing and riveting. It now affords one of the most powerful, valuable and economical methods of dealing with an immense variety of manufacturing operations, which can be carried out without any injurious effects upon the metal.

It is impossible to enumerate in anything like complete detail all of the various kinds of work now being executed in the metal-working industries, but the following will no doubt suffice to show that the flame-welding process is not confined to repair work. It is used at the present time in the construction of metal railway vehicles, automobiles, aëroplanes, bicycles, metal motor boats, petrol tanks for submarines, for torpedo boats, for motor vehicles and aircraft, boilers, retorts, evaporating pans, safes, cylinders, machine protection guards, castings impossible or difficult to mold by making in parts and uniting, pipe manifolds and connections of intricate forms, metal doors and furniture, casement frames, artistic metal work, sanitary and domestic articles, etc.

A. EYLES.

Manchester, England.

Electric or Blow-Pipe Welding of blow-holes and shrinkholes in steel castings is now a practice recognized in specifications. If the defect is not so located as manifestly to make the casting unfit for use, and if the defect is properly repaired, a welded casting is perfectly satisfactory. The defect, however, should be really eliminated, not simply plugged—as was pointed out in a symposium on iron and steel, presented before the International Engineering Congress. By opening a hole to the bottom with the flame or arc, much as a dentist prepares a cavity in a tooth for filling, and then filling it with metal that is welded to the partly fused walls of the hole, the casting can be made truly sound. The hardening effect of the high temperature and rapid cooling upon the steel adjacent to the weld, especially in medium and hard castings, and the stresses set up by the cooling of large welds make it essential in a great many cases that the casting be reannealed after welding.

Editorials

Another British Restriction

The hint that Great Britain, by royal proclamation, ;ht restrict the importation of other things than ma- ie tools was well founded. Dealing in optical instru- its is now to be controlled. A cablegram from the erican consul-general at London, dated Dec. 20, reads: Minister of Munitions prohibits all dealings without ise in certain optical instruments, including pris- ic binoculars, monoculars, telescopes, periscopes, and passes for reading and azimuth angle simultaneously sighting of object."

is understood that this does not prevent legitimate, blished importing. The firms carrying on such busi- , however, must obtain a license and subject them- s to Government regulations. The purpose in issuing proclamation is to put in the hands of the Minister unitions complete control of certain things that are ed in the production of war materials.

Perspective Illustrations in "American Machinist"

a narrow sense the illustrations in the pages of ical journals serve the same purpose as the head- in newspapers. Both attract attention. Both give iduality. Both are features intended to appeal to readers by the power to give information in a com- form. It is but natural therefore to find from year ar an increasing number of illustrations appearing pages of technical journals.

m a broader viewpoint the illustrations on the page led to convey technical information serve a more tant purpose than merely to attract attention and ndividuality. The reproduced drawing, sketch or graph is a means of conveying ideas, and is there- form of language. It is a form of expression that used widely in technical journalism and has tre- us possibilities for worth-while results. By no neans can information be presented in so compact , and from no other form of expression can ideas ıcts be grasped so quickly by the reader. If wishes to prove this statement to his personal tion, let him write a description of the geometric of an egg so that he will completely and unmis- describe the object to a man who has never seen id then set the result of his efforts alongside a encil sketch of an ordinary hen's egg. The mess s will promptly go into the waste basket or kitchen

ie language of engineering and shop drawing has us kinds and modes of expression, a heavy respon- is put upon the technical editor to select the t adapted to convey the information that is to be d to his readers. In the machinery-building field spective form has a number of advantages. By on, orthographic projections are puzzling—espe- hen reduced to a small scale for the purpose of reproduction—and halftones are apt to be obscure, due to the loss of sharpness in detail from engraving, and from the additional fact that photographs taken in dark machine shops are not apt to possess the clearness nec- essary for successful reproduction.

For these general reasons the *American Machinist* has continued to use more and more perspective drawings and sketches during the last two years. During 1915 a new form of perspective known as the "background perspec- tive," was adopted to show jigs, fixtures, punches and dies, die-casting molds and other small tools. The suc- cess of this form prompted further experiment, which has resulted in another form of perspective, known as the "flat-tone perspective." Examples of this new type ap- pear for the first time on pages 14, 24 and 25 of this issue.

Both of the processes have been developed by A. L. Ormay, chief draftsman of the Hill Publishing Co. They will be used freely in the *American Machinist* through- out the year 1916, particularly for presenting details, with the expectation that the essential points of jig, fixture, small-tool and machine-part design will be pre- sented in a clearer, more compact fashion than is possible by any other method.

Great Britain's Trade in 1915

The European war has clearly been the only factor of any importance in the economic position of the United Kingdom during the year that has just passed. An observer would have noticed apparently a remarkably prosperous condition of internal trading. As regards overseas trade, when imports and all exports are added together it will probably be found that the total is £100,000,000 (say $500,000,000) or more in excess of the total for 1914. But prices have risen, and the increase in the figures is in fact due to the imports. Export total values are down. At the moment of writing, it is somewhat difficult to make an estimate, but exports of British production should reach £385,000,000, plus ex- ports of foreign and colonial produce of about £100,000,- 000, or a slight increase on 1914. Unless a marked drop shows in the last week or so of the year, imports should reach £850,000,000, far in advance even of 1913.

Great Britain always has had on the surface a trade balance in the wrong direction. There are, however, the well-recognized invisible exports, important among which is the shipping industry. Although an unknown but extremely large proportion of the total number of British ships are employed on Government service, the increase in freight rates has been so high that the shipping gains will probably exhibit an increase. Of the three sides on which the influence of Great Britain in the European war is most important, namely, naval and military, finan- cial, and external trade, it is perhaps the financial that is causing the most thought. Expenditure is growing and for war purposes has now reached probably £5,000,000 a day. The income for the same purpose is about one-

quarter of this. Clearly the national debt increases. Great Britain in many ways is carrying on the war regardless of expense. In rate of expenditure she is easily ahead of all the other countries concerned, taken individually. but about one-third of the expenditure is in loans to British dominions and allies and therefore cannot be regarded as a dead loss.

According to the latest estimates the yearly income of the United Kingdom is about £2,500,000,000, while that of Germany is not very different, though the relative populations, say 68,000,000 of Germany against 46,000-000 of the United Kingdom, must be remembered. An effect of the war, however, has been to consolidate the British Empire, and here the total income for the past year has been estimated at something like £4,035,000,000. India is counted at £700,000,000, Canada at £350,000,000, Australia at £230,000,000, Crown Colonies, etc., at £150,-000,000, New Zealand at £55,000,000, and South Africa at £50,000,000. Up to a certain point, at any rate, Great Britain is paying for the war, and her figures as to overseas trade and treasury payments and receipts are available from month to month.

In Great Britain the adverse trade balance has decreased month by month, and in various ways, including some revision of the fiscal policy, attempts are being made to equalize the values of exports and imports. Considering the facts that the German, Austrian and other markets are not available, and that even before the recent army increase some 10,000,000 workers had been withdrawn from useful production, the figures available relating to overseas trading must be regarded as hopeful. Though it is the Englishman's privilege to grumble, there is no real pessimism as to the future.

Of course the cost of living and prices generally have advanced, and costs of production have risen ever since the outbreak of war. Some 4,500,000 workpeople, it has been estimated, have had their wages raised by something approaching a total of £40,000,000 a year. In many instances increased earnings are not being used with a view to the future; nevertheless savings have increased to about £600,000,000 a year. A remarkable feature of the British, and in fact of the whole European, situation is the extraordinary influence of the state as a stabilizer of conditions. In Great Britain the state has assumed complete control of the railways, Government insurance has been effected of commerce and even of property (against Zeppelin raids), the banks have been supported by the use of public credit, prices of various commodities have been regulated, foreign trade has necessarily been controlled, and in many respects in the engineering world an industrial revolution has been effected. Up to the beginning of December some 2,026 engineering establishments were directly controlled by the Government, a department deciding what work should be done and in what order. This has applied with particular force to the machine-tool industry, all the shops being engaged to the fullest capacity, while many firms that never dealt with machine tools save in the way of usage have been kept going as fast as possible on their production.

Machine-tool exports have fallen considerably both as regards quantity and total value, although values per ton have naturally risen. Total export values will probably not reach £800,000. Imports, even at the end of last November, almost touched the £2,000,000 mark, a value five times that of the same period of 1914.

It is beyond question that the present engineering output could not have been attained without the large increase in the employment of women on machining operations. Whole factories are being run solely by female labor, as regards machine work, and the initial conservatism which is inherent in almost all British people having been overcome, nothing but praise is heard as a rule for the efforts of the women, who seem happy at their work, partly perhaps because of the additional opportunities for social intercourse. In machine-tool work more particularly they have made a start, but not much more. Female employment in this branch is steadily growing, however, the women as a rule being given comparatively simple repetition work on the smaller machines, often leaving work requiring more skill for the men who take their places in the evening. No single type of machine tool can be recalled that is not being operated on these lines by British women.

In Great Britain the output of machine tools for home consumption is enormous, and in this respect at least the war has some advantageous features for the British engineering industry. Shops are being equipped with modern tools which in many cases are simplified to meet the present purpose only, but the construction leaves the addition of further parts in the future easily possible. A lathe intended, for instance, for what is known in England as "sliding" will not be fitted with a lead screw for screw-cutting purposes until later. In addition the machine-tool industry itself is revising its outlook, and firms that made many types of tools are contenting themselves, sometimes under Government direction, with one or two types, on which they have advantageously introduced more modern methods of manufacture. Thus the British machine-tool industry will probably at the end of the war be in a condition to give a good account of itself when the rebuilding and reëquipment of Belgium, northern France, parts of Russia and so on, must be undertaken.

Why Exact Comparisons Are Often Difficult

There are many fundamental truths which are hard to prove because we have no exact comparisons, nor can we have in many cases except by laboratory methods. We all know that a rigid building that prevents or absorbs vibration must give better results with cutting tools than one that allows the machines to weave, or change location on the floor. True, some machines have weight enough and are stiff enough to do good work even in a shaky building, but they are the exception.

Direct comparisons of this, however, are few and far between. For when we move from the old wooden shop to the new one of steel or concrete, or a combination of the two, we never arrange machinery in just the same way and usually speed up the line shaft or change the methods in other ways. And every change, no matter how slight, makes exact comparisons out of the question.

Every testing engineer knows that the only way to secure reliable results is to change one thing and only one thing at a time. In no other way can exact data be secured.

This condition explains why we are lacking in exact comparison in many shop matters, things which it often seems that we should know all about.

Shop Equipment News

Mechanical Planer Controller

Electric drive of a planer by means of a reversing ·tor is the most severe machine-tool drive of present-day ictice. Not only is a very special motor necessary, but control of this motor with regard to speed and ac- acy of reversal is very exacting. This difficulty has n solved in various ways in the past by the use of tractors and electrically controlled switches, and cur- t relays. The Cutler-Hammer Co., however, has made iechanical problem of this control, and a 48-in. by 't. Cincinnati planer equipped with its apparatus has ı in successful use for several months in the shop

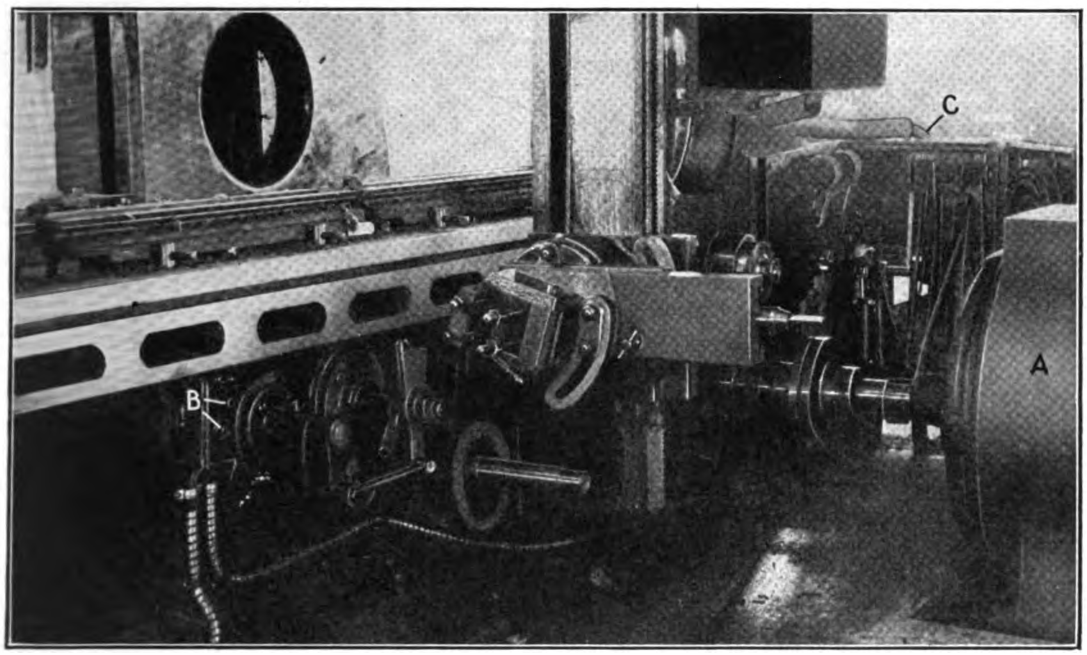


FIG. 1. GENERAL VIEW OF PLANER CONTROLLER APPARATUS

Triumph Electric Co., Cincinnati, Ohio. Among any advantages of the mechanically operated con- an important one is that being a mechanical device n a class of machinery easily understood by the operator and therefore likely to receive proper on from him.

setting and general arrangement of the apparatus ›wn in Fig. 1. Here the motor is shown at A and › push buttons for starting and stopping, at B. The part of the controller is contained in a rugged n box C, with doors on each side to protect the s. In the pictures the doors are shown open. The casing, is also shown in front and rear views in and 3 respectively. This controller is intended with an adjustable-speed compound interpole and it is arranged to cut out the compound field ie motor has come up to speed, and also to give adjustment to the cutting and return speeds. itroller box, or casing, contains two shafts, the which is called the "reversing shaft" and the he "accelerating shaft."

The reversing shaft is operated from the ordinary reverse gear and dogs of the planer through levers, shown at D Fig. 3, and it moves a short distance from the center in either direction. As this shaft rocks back and forth, a set of cams on it alternately close the motor circuits, thereby causing the motor to rotate in one or the other direction. Simultaneously the accelerating shaft is released so it is free to rotate through a certain angle, the speed of rotation being controlled by an air dashpot, shown at E, Fig. 2. As this accelerating shaft slowly turns, it moves another series of cams which close switches that short-circuit the armature resistance and the series field, and at last insert the shunt field resistance so as to bring the motor up to maximum speed.

In reversing the motor from one direction to the other, the shunt field is first strengthened so as to produce a dynamic braking action of the motor. The motor acts as a generator and feeds power back into the line. Then resistance is all inserted in the motor circuit, and when it has reached a sufficiently low speed, the armature circuit is reversed and the motor accelerated in the opposite direction. By proper setting of the various cams and proper adjustment of the dashpot, the reversing time can be adjusted in such a manner that the current surges on the motor are always kept down near the normal full-load current of the motor, even when reversing from high-speed-forward to the higher-speed-reverse. The commutation of the motor is at all times sparkless.

As mentioned above, the shunt field resistance of the motor permits independent adjustment for cutting and reversing stroke. This is accomplished by means of two field regulators which are mounted in the cover of the casing, as shown at F, Fig. 2. When conditions make it

advisable, these regulators may be mounted separately. Mounted as shown, however, they are easily accessible to the operator. The starting resistance is mounted in a separate frame, and in individual cases may be placed on top of the controller case, on the planer housing, or wherever most convenient.

In addition to the apparatus described above, there is a single-pole, double-throw solenoid switch. When

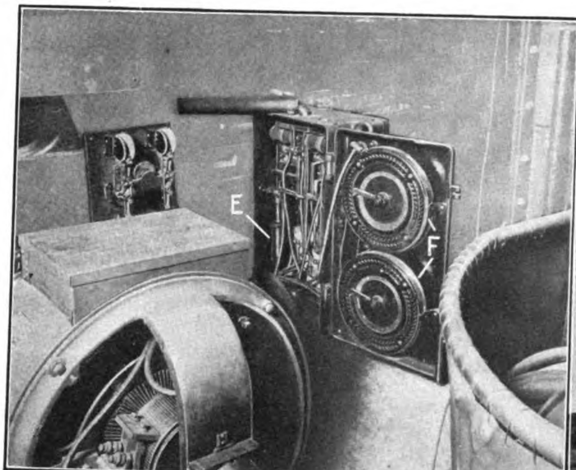


FIG. 2. FRONT VIEW OF MAIN MECHANICAL PLANER CONTROLLER BOX

energized, this solenoid switch completes the line circuit to the motor, and the planer may be operated. When the switch is deënergized, it completes a dynamic brake circuit of the motor and produces a quick stop. This is for the purpose of bringing the motor to rest quickly in case the line current should fail, or if the operator should wish to stop for any reason. Ordinarily the operator stops the motor by pulling the tumbler, which forms part of the regular planer reverse, to central position. The reversing shaft of the controller will return to the "off" position and disconnect the motor from the line. On the other hand, if very quick stopping with dynamic action is required, the operator pushes the stopping button in the two-button station mounted on the planer bed, and previously referred to at *B*, Fig. 1. This opens the solenoid circuit of the above-mentioned clapper-switch, thereby closing a dynamic circuit and bringing the motor to the desired quick stop. If the operator again desires to start the motor, he brings the tumbler of the operating mechanism to center, or "off" position, and pushes the other control button. This last action closes the solenoid switch connecting the controller to the power circuit, and it is then only necessary to throw the tumbler in the forward, or reverse, direction, to start up the machine.

On test, the equipment has shown that the minimum stroke at which the planer will operate is only limited by the setting of the table dogs, and by the use of properly designed dogs the cutting distance can be reduced to any required amount. The only attention this apparatus requires is the occasional filling of the grease cups which lubricate the bearing surfaces. As the controller is amply supplied with these cups, no other lubrication is required, and weekly or fortnightly inspection will keep the mechanism in perfect condition.

All-Metal Lift Trucks

The type of lift truck shown resembles closely the four-wheeled one described on page 38, Vol. 43. Several improvements, however, have been added. The lifting hook is made to release automatically, so as to permit the free use of the handle. The hydraulic check mechanism is so made that the platform may be easily lowered when empty, without the usual necessity of standing on it or

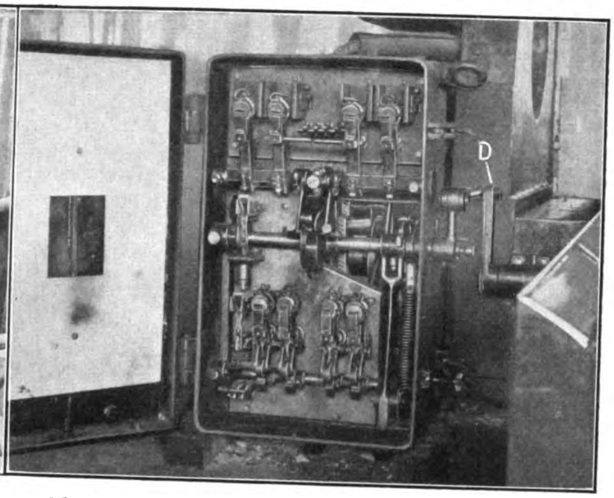
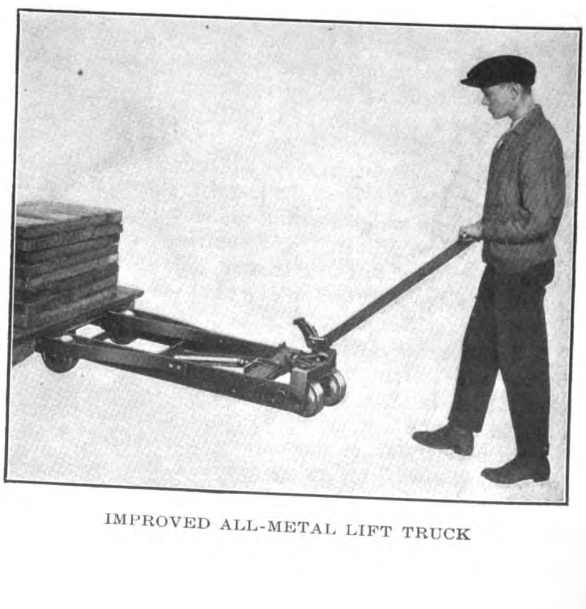


FIG. 3. REAR VIEW SHOWING SHAFTS AND LEVER CONNECTIONS FOR THE CONTROLLER

using a weight. The front wheels can be turned completely around with the platform in either elevated or lowered position. On account of the lever or handle being free, the truck can be easily guided under the wooden platforms at will.

The truck is of all-steel frame construction, and the bar-steel cross connections render the making of trucks of any width an easy matter. The wheels are equipped with roller bearings and are regularly furnished 6, 7 or 9 in. in diameter on any of the trucks, as ordered. These trucks weigh from 215 to 295 lb. net, and up. They are made by the Stuebing Truck Co., Cincinnati, Ohio.



IMPROVED ALL-METAL LIFT TRUCK

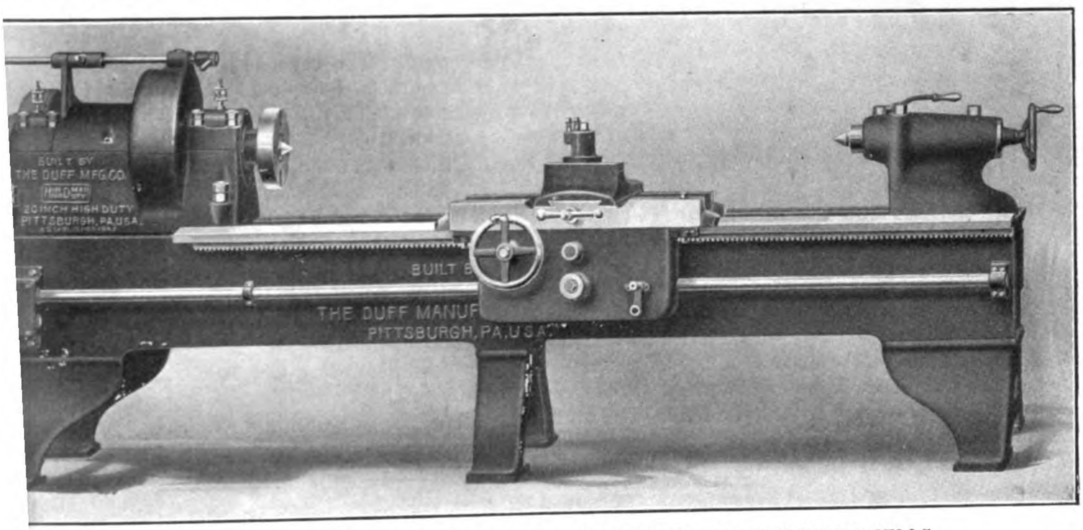
vy Manufacturing Lathe

ndman high-duty lathe shown, recently placed ırket by the Duff Manufacturing Co., of Pitts-an., was designed especially to meet the demand '-swing lathe of extreme power, for turning which are too small to put in larger lathes. ine was designed to be capable of turning any from the smallest up to 12 in. at approximately : cutting speed.

ve is by tight and loose pulleys with single belt main line; or a two-speed countershaft can be ng two changes of speeds with one change of he loose pulley is mounted on roller bearings. s so arranged that the motor can be bolted to can be arranged for either a gear drive or a in drive. The arrangement of the pulley also ıe motor to be bolted to the floor. The main ear on the spindle is 18 in. in diameter with ce, and it is made from a forged and rolled The pinion meshing into this gear is cut from r, carbonized, heat-treated and ground.

ıre three changes of speeds furnished by means ars—all of steel. The pinions of these change all carbonized, heat-treated and ground. The pinion of the set is made of vanadium steel. l changes are in the following ratios: 11 to 1, , and 18¼ to 1. The feeds regularly furnished anging from 0.020 to 0.100 in. in steps of 0.020 These changes are obtained by means of slip ilar to the speed changes. All of the feed gears ge gears are of steel of ample proportions to vy duty.

ıron is of the double-support type, and is with reversing mechanism. All gears are con-



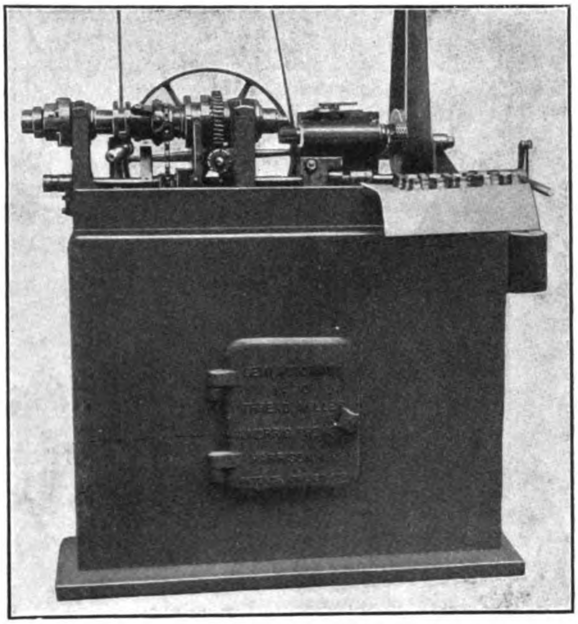
HEAVY-DUTY MANUFACTURING LATHE ESPECIALLY ADAPTED FOR TURNING SHELLS

ver ways, 20 in.; over carriage, 12 in.; distance between centers, 8-ft. bed, 40 in.; width of bed over ways, 20 in.; front spindle bearing, 5x7 in.; width of belt, 4½ in.; length of carriage, 30 in.

esh. The carriage is made heavy with wide ge bridge. The tool rest is made of a steel bed is of the box-type pattern, heavily re- is so arranged that it can be easily equipped t. The weight of the machine, with 8-ft. 5,000 lb.

Semiautomatic Thread Miller

The thread miller shown was designed especially for threading bronze primer bodies. The piece is held in a lever-operated spring chuck and advanced into position by a hand-operated cam, the work spindle being rotated by a worm and wormwheel acting through a jaw clutch. After the piece is chucked, the hand lever raises the cut-



SEMIAUTOMATIC THREAD MILLER

Overall dimensions, 48x12 in.

ter into the worm and starts the work spindle. On completion of the thread the cutter is withdrawn, and the work spindle automatically returns to its original position.

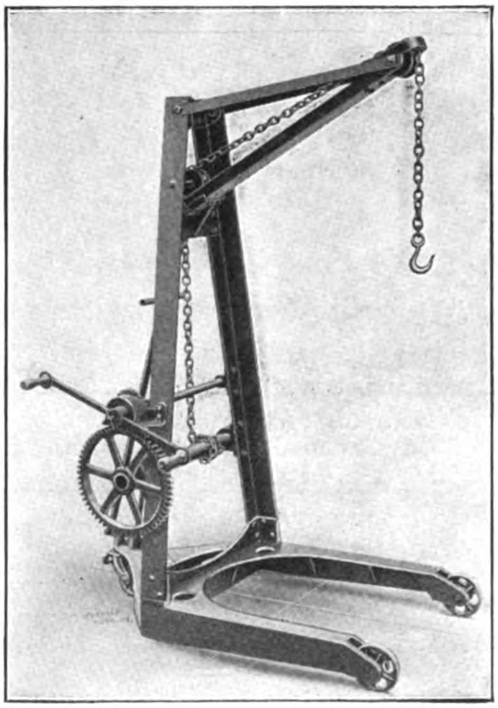
There is a graduated adjustment for depth of thread for use in setting the machine. The cutting time is 20

sec., which gives an average of over 100 per hour. The machine shown handles work up to 3 in. in diameter, and a larger one is also built on the same general lines to take work up to 10 in. in diameter and 30 in. long. It is made by the T. C. M. Manufacturing Co., Harrison, N. J.

Portable Shop Crane

The superstructure of the portable crane shown is made of steel in order to secure lightness. The base is of cast iron, with its braces, ribs and lugs cast integral and made sufficiently heavy to provide the necessary strength. The light superstructure and heavy base give the crane a low center of gravity.

The caster and the two front wheels support the base at three points so that twisting strains in passing over uneven floors are eliminated. Steering is accomplished by the caster in connection with the all-steel handle. The crane is locked by the hand nut, shown on the caster, which can be operated by the foot without stooping.



PORTABLE SHOP CRANE
Capacity, 1 ton; lift, 6 ft. 6 in.; overhang, 33 in.

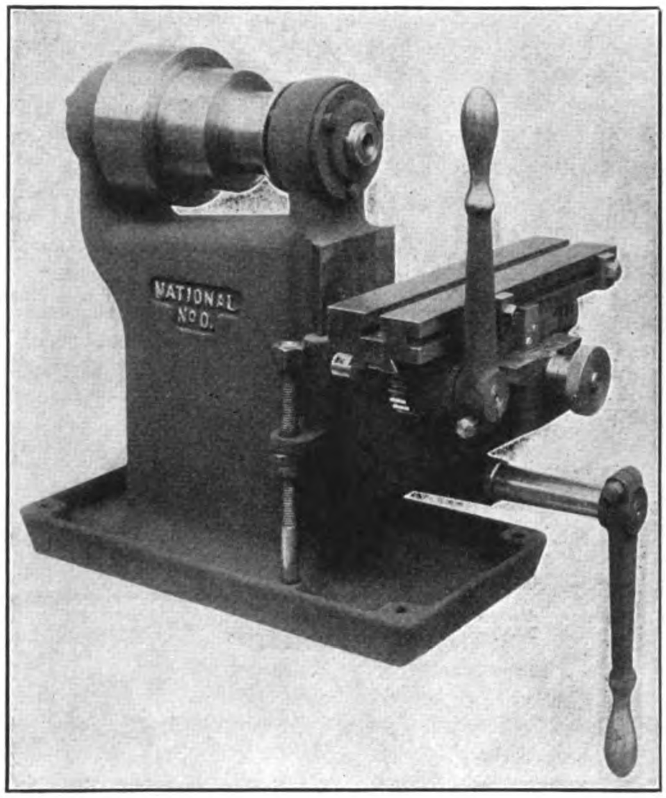
On the one-ton size shown, a single chain is used which automatically runs to the sheave pulley at the top and is out of the way of work under the crane. A bridge on the sheave-pulley casting prevents the hook from running off. The hook is drop forged of heat-treated steel with a large factor of safety. The chain winds on the drum singly.

This crane is made in several sizes by the United Engine and Manufacturing Co., Hanover, Penn.

Column or Bench Hand Miller

The machine shown is intended to be used either as a column mounted or a bench hand miller. It was designed to meet the demand for a small miller adapted for splining or milling small parts at high speed. Parts of rifles, revolvers, automatic machines, typewriters, sewing machines and the like can be machined with great rapidity.

The spindle is made of high-carbon steel, ground all over and mounted in ball bearings which are provided with dust-proof covers. All sliding bearings are unusually wide and provided with gibs which can be adjusted for wear. The crossfeed knob is graduated to read in thousandths. Both table and knee are provided with adjustable stops. The machine is provided with spindle speeds of 100 to 1,200 r.p.m. The height of the bench machine without column is 18 in., weight 175 lb.



COLUMN OR BENCH TYPE HAND MILLER
Working surface of table, 3⅜x13 in.; longitudinal feed of table, 6½ in.; vertical adjustment of knee, 5 in.

The machine is a recent product of the Bickett Machine and Manufacturing Co., Cincinnati, Ohio.

Copper Band-Turning Machine

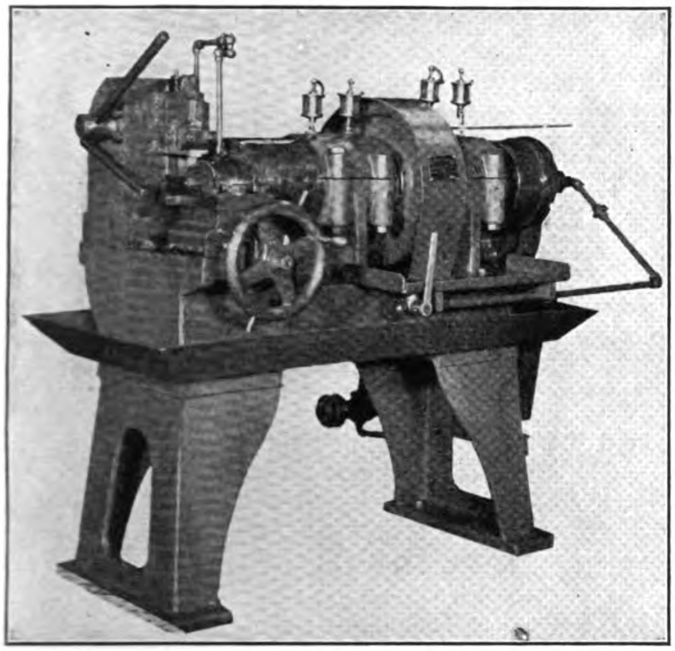
For the forming of copper driving bands on high-explosive and shrapnel shells, the Traylor Engineering and Manufacturing Co., Allentown, Penn., has developed the machine shown.

The positive opening and closing chuck, operated by compressed air, is used for holding the work. A valve and lever placed in front of the machine make it easily controlled. The chuck is positive and allows ready replacement of a shell in the machine. The forming of the copper band is done by two tools easily operated.

The machine is arranged for taking any shells, from 2 in. diameter up to and including 6 in. diameter. The operation of the machine is such that a roughing cut is first taken off, which brings the band down to size. The mechanism for taking this cut is so designed that it is not necessary to work to figures. Consequently high-class skill is not required. The finishing cut is operated by a lever on the back of the machine, and no gaging of any

kind is required to bring the band down to the proper diameter and form.

In the turning of the copper driving bands on 18-pounder high-explosive shells, the rate of production has been as high as two shells per 50 sec. This includes all of the necessary time required to take the shell off the



COPPER BAND-TURNING MACHINE

rack or floor, put it in the machine, turn up the band, remove the shell from the machine and put another one in its place. A fair average for this machine is 100 shells per hour, making it possible to turn out 1,000 shells per machine per 10 hours.

Friction Clutches and Pulleys

The aim in designing this clutch has been to avoid unnecessary weight, secure easy operation and maximum adjustment for wear, with simplicity of construction.

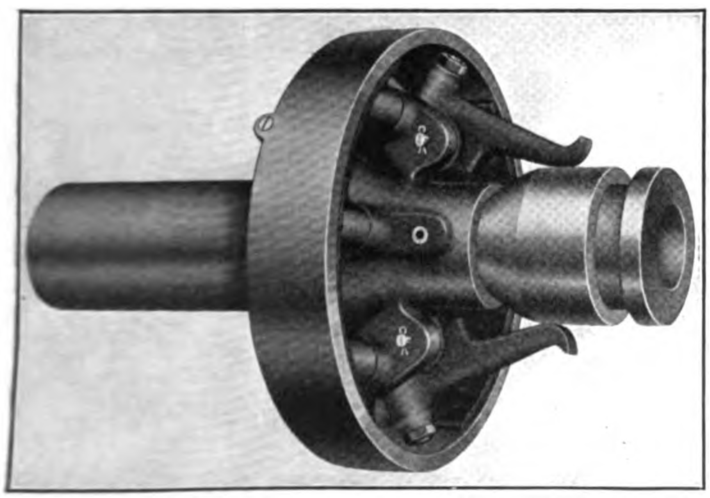


FIG. 1. EXPANDING FRICTION CLUTCH

Clutch sizes, 9 to 12½ in.; diameter, 1 3/16 to 2 3/16 in. shaft. Pulleys, 8 to 16 in. diameter, 3 to 6 in. face

The body is keyed to the shaft and held in position by a hollow setscrew. It carries two friction shoes which work on the inner surface of the rim of the hub, as

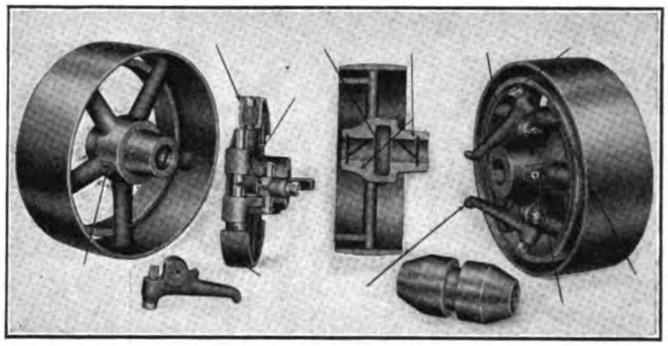


FIG. 2. PARTS OF FRICTION CLUTCH

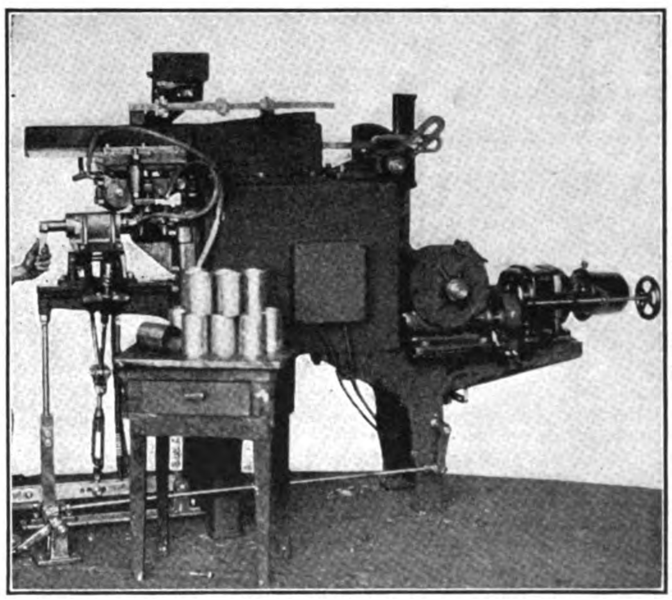
shown. These shoes are expanded by wedges in the ends of the arms, these wedges being easily adjustable. Springs hold the shoes away from the pulley when not in action and prevent any tendency to drag. Ample lubrication is provided by means of an internal reservoir.

Clutches range from 4 to 12 hp. at 100 r.p.m. They are made both as separate clutches and in complete countershafts by the Bicknell-Thomas Co., Greenfield, Mass.

Electric Seam Welder

The illustration shows a motor-driven electric seam-welding machine recently developed by the Toledo Electric Welder Co., Cincinnati, Ohio.

The machine is designed for rapidly welding cylinders made of sheet metal or lead-coated stock. The welded



ELECTRIC SEAM WELDER

surface is left smooth, permitting enameling or other finishing without any further preparation.

PERSONALS

Albert Vuilleumier, until recently assistant chief engineer of the Becker Milling Machine Co., has become works manager of the Standard Machinery Co., Mystic, Conn.

Thomas F. Fournier, chief engineer of the Becker Milling Machine Co., Hyde Park, Mass., has resigned to become general manager of the Standard Machinery Co., Mystic, Conn.

W. P. Cartwright has been placed in charge of the die room of the Buick Motor Car Co., Flint, Mich. Mr. Cartwright was formerly associated with the Anderson Forge and Machine Co.

Prices--Materials and Supplies

PIG IRON—Quotations were current as follows at the points and dates indicated:

	Dec. 30 1915	Dec. 3 1915	Jan. 2 1915
No. 2 Southern Foundry, Birmingham.	$14.50	$14.00	$ 9.50
No. 2 X Northern Foundry, New York	19.50	17.75	14.25
No. 2 Northern Foundry, Chicago	18.50	18.00	13.00
Bessemer, Pittsburgh	20.45	18.95	14.70
Basic Pittsburgh	19.95	17.45	13.45
No. 2X, Philadelphia	19.50	17.75	14.25
No. 2, Valley furnace	18.50	16.00	13.00
No. 2 Southern, Cincinnati	17.40	16.40	12.40
Basic Eastern Penn	18.50	17.50	13.50
Gray forge, Pittsburgh	18.20	16.45	13.45

METALS—Below are the present quotations with a comparison of practically a month and year ago:

MISCELLANEOUS METALS—NEW YORK

	Dec. 30, 1915	Dec. 3, 1915	Jan 2, 1914
	Cents per pound		
Copper, electrolytic (carload lots)	22.50	20.00	13.25
Tin	40.00	38.00	33.25
Lead	5.40	5.25	3.80
Spelter	18.00	17.50	5.85
Copper sheets, base	27.00	25.00	18.50
Copper wire (carload lots)	30.25	28.25	13.25
Brass rods, base	32.00	27.25	13.00
Brass pipe, base	36.00	32.00	15.50
Brass sheets	32.00	27.25	13.25
Solder ½ and ½ (case lots)	24.75	23.50	21.00

In St. Louis lead sells at 5.32½c. per lb. and spelter at 17.75c.

MONEL METAL—The following prices hold:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less than 500 Lb. of a Size and Over
	Mill Lengths 8 Ft. and Over				
Rounds—Squares	Cents per Pound				
1/4 — 7/16	31.50	32.00	32.50	33.00	36.00
1/2 — 11/16	31.25	31.75	32.25	32.75	35.75
3/4 to 1 1/8	31.00	31.50	32.00	32.50	35.50
1 3/16 to 2 7/8	31.75	32.25	32.75	33.25	36.25
Rounds 3 to 3 1/16	32.50	33.00	33.50	36.00	37.00
Squares 3	32.50	33.00	33.50	36.00	37.00
Rounds 3 1/8 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Squares 3 1/16 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Rounds—Squares 4 to 4 15/16	33.00	33.50	36.00	36.50	37.50
5 to 6 15/16	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than 1/8 in. thick.
Hexagon Bars two cents (2c) per pound over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

STANDARD PIPE—On carload lots f.o.b. Pittsburgh the following discounts hold:

	Black	Galvanized
¾ to 2-in. steel, butt welded	78%	63½%
2½ to 6-in. steel lap welded	77%	62½%
7 to 12-in. steel lap welded	75%	58½%

At this rate prices are as follows:

Diameter	Black (Cents)	Galvanized (Cents)	Diameter	Black (Cents)	Galvanized (Cents)
¾-in	2.53	4.19	5-in	34.04	55.50
1-in	3.74	6.30	6-in	44.16	72.00
1¼-in	5.06	8.39	7-in	59.50	98.77
1½-in	6.05	10.02	8-in	62.50	$1.03
2-in	8.15	12.55	9-in	86.25	1.43
2½-in	13.45	21.92	10-in	$1.03	1.70
3-in	17.59	28.68	11-in	1.16	1.92
4-in	25.07	40.87	12-in	1.27	2.10

NAILS—Wire nails f.o.b. Pittsburgh sell at $2.10; galvanized 1 in. and longer, $4.10, and shorter, $4.60. These prices are to regular customers and delivery is made at the mill's convenience.

ROLL SULPHUR in 360-lb. bbl. sells in New York at $2.15 per 100 lb.

STEEL SHEETS FROM JOBBERS' WAREHOUSE, NEW YORK

	Dec. 30, 1915	Dec. 3, 1915	Jan. 2, 1914
	Cents per pound		
No. 28 Black	3.15	3.15	2.60
No. 26 Black	3.05	3.05	2.50
Nos. 22 and 24 Black	3.00	3.00	2.45
Nos. 18 and 20 Black	2.95	2.95	2.40
No. 16 Black	2.90	2.90	2.35
No. 14 Black	2.80	2.80	2.25
No. 12 Black	2.70	2.70	2.20
No. 28 Galvanized	5.50	5.25	3.50
No. 26 Galvanized	5.20	4.95	3.20
No. 24 Galvanized	5.05	4.80	3.05

ZINC SHEETS—The following prices prevail:

Quantity	Cents per Lb.
Carload lots, f.o.b. mill	22.00
In casks, New York	23.00
Broken lots, New York	24.00

SEAMLESS DRAWN TUBING—The base price is 33c. for brass and 33c. for copper. For immediate stock shipment 3c. is added, which gives the following quotations in cents per lb.:

Diam., In.	Brass	Copper	Diam., In.	Brass	Copper
¾ to 3	36.00	36.00	5	42.50	42.00
3½	37.50	37.00	6	43.50	43.00
4	38.50	38.00	7	45.50	45.00
4½	40.50	40.00	8	47.60	47.10

OLD METALS—The following are the dealers' purchasing prices in New York:

Copper	Cents per Lb.	Brass	Cents per Lb.
Heavy and crucible	17.75	Heavy	11.50
Heavy and wire	17.25	Light	9.50
Light and bottoms	15.00	No. 1 yellow rod turnings	14.00
Lead		No. 1 red turnings	11.50
Heavy	4.50		
Tea	4.25	Zinc	11.00

COKE—Below are the prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Dec. 11 1915	Dec. 18 1915	Dec. 25 1915	Jan. 1 1916
Prompt furnace	$2.15@2.25	$2.50@3.00	$3.00@3.50	$3.00@3.50
Prompt foundry	2.90@3.25	3.25@3.75	3.50@4.00	3.50@4.00

STEEL SHAPES FROM JOBBERS' WAREHOUSE, NEW YORK

	Dec. 30, 1915	Dec. 3, 1915	Jan. 2, 1914
	Cents per pound		
Steel angles base	2.40	2.40	1.85
Steel T's base	2.45	2.45	1.90
Machinery steel (bessemer)	2.40	2.35	1.80

The above prices are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger.

WELDING MATERIAL (SWEDISH)—Prices are as follows:

Welding Wire

	Cents per Lb.
3/8, 11/32, 5/16, ¼, 7/32, 3/16	8.50
No. 8, 5/32 and No. 10	9.25
1/8	10.00
No. 12	11.00
3/32, No. 14 and 1/16	12.00
No. 18	14.00
No. 20	16.00

Special Welding Steel

1/8	33.00
5/32	30.00
3/16	28.00

Cast-Iron Welding Rods

	Cents per Lb.
¼ by 19 in. long	22.00
3/16 by 12 in. long	26.00
3/8 by 19 in. long	20.00
½ by 21 in. long	20.00

Vanadium Wire in Coils or Sticks

1/16	15.50
3/32	15.00
1/8	14.00
5/32	12.00
3/16 and larger	11.00

The above prices are subject to change according to quantity and shipment desired.

BAR IRON—Prices are as follows at the places named:

	Cents per Lb.
Pittsburgh, mill	1.80@1.85
New York	2.00@2.07
From storehouse, New York	2.40@2.50

SAL SODA—The quotations below are per 100 lb. at the places designated:

New York	$1.00
Philadelphia	.75

WROUGHT WASHERS—From New York warehouse the esent quotation is $5 from list price. At this rate the llowing prices hold:

Diameter, In.	Price per 100 Lb.	Diameter, In.	Price per 100 Lb.
[illegible]	$9.00	1 1/8	$4.30
[illegible]	7.20	1 1/4	4.20
[illegible]	6.40	2	4.10
[illegible]	5.50	2 1/4, 2 1/2, 2 3/4	4.00
[illegible]	4.80	3, 3 1/4, 3 1/2	4.20
[illegible]	4.40	3 3/4, 4, 4 1/4, 4 1/2	4.50

NUTS—On hot pressed square nuts $4 off list is allowed ıd on hexagon $4.20. At this rate, the following prices hold:

Hot Pressed Square Short Diam.	Per 100 Lb. Blank	Per 100 Lb. Tapped	Hot Pressed Hexagon Short Diam.	Per 100 Lb. Blank	Per 100 Lb. Tapped
1/2	....	$11.00	1/2	....	$16.70
[illegible]	$7.00	8.50	[illegible]	....	10.30
[illegible]	5.00	5.90	7/8	$5.40	6.40
[illegible]	4.00	4.70	1 1/4	4.20	4.80
[illegible]	3,50	3.90	1 7/16, 1 5/8, 1 11/16, 2	4.10	4.70
1 7/16, 1 5/8, 1 11/16, 2	3.40	3.80	2 1/16	4.20	4.90
[illegible]	3.50	4.00	2 3/8	4.50	6.30
[illegible]	3.80	4.40			

Semifinished nuts sell at 75% off list.

MACHINE BOLTS—From New York warehouse, on sizes rom 3/8 in. by 4 in. and smaller 70% off list is discounted; or larger and longer sizes 60% is allowed. These quotations re for bolts having square heads and square nuts. At this ate prices per 100 are as follows:

Length	Diameter 1/4	3/8	5/8	3/4	7/8	1 In.
1 1/2 in.	$0.51	$0.72	$2.08	$3.08	$4.20	$6.04
2 in.	.53	.77	2.23	3.30	4.48	6.40
2 1/2 in.	.56	.82	2.38	3.52	4.76	6.76
3 in.	.58	.86	2.53	3.74	5.04	7.12
3 1/2 in.	.61	.91	2.69	3.96	5.32	7.48

ALUMINUM—Quotations are as follows in ton lots:

	Cents per Pound
No. 1 virgin 98-99%	54.00 to 56.00
Pure 98-99% remelt	53.00 to 55.00
No. 12 alloy remelt	44.00 to 46.00

Jobbers usually charge 2c. per lb. over the above figures.

NICKEL—Manufacturers quote the following prices:

	Cents per Pound
Ordinary grade	45.00
Electrolytic	50.00

SWEDISH (NORWAY) IRON—This material sells at $4.25 base per 100 lb. f.o.b. New York. In coils an advance of 50c. is charged.

OILS—Prime winter lard oil sells at 92@96c. per gal. in 5-bbl. lots; cottonseed crude, f.o.b. mill, 54@54 1/2c.; and linseed, raw, in carload lots, at 61c.

COPPER BARS—The base price is 29c. per lb.

CARRIAGE BOLTS—On 3/8 by 6 in. and smaller 65 and 10% off list is allowed; for larger and longer sizes 60% off list is charged . At this rate the price per 100 is as follows:

Length	Diameter 1/4	5/16	3/8	7/16	1/2	5/8	3/4
1 1/2 in.	$0.32	$0.44	$0.60	$0.88	....	....	....
2 in.	.35	.48	.65	.96	....	....	....
2 1/2 in.	.38	.52	.70	1.04	$1.30	$2.30	$3.40
3 in.	.41	.55	.75	1.12	1.41	2.45	3.60
3 1/2 in.	.44	.59	.80	1.20	1.52	2.60	3.80

TIN PLATES—The following prices are in effect:

Coke tin plate, 14x20:	Price per 100 lb.
100-lb.	3.60
I. C. 107-lb.	3.75

Terne plate, 20x28:

Base Weight	Net Weight	Coating	Price	Base Weight	Net Weight	Coating	Price
100-lb.	200	8	6.60	I. C.	226	20	9.50
I. C.	214	8	6.90	I. C.	231	25	10.50
I. X.	270	8	8.70	I. C.	236	30	11.50
I. C.	218	12	8.20	I. C.	241	35	12.50
I. C.	221	15	8.70	I. C.	246	40	13.50

Crosses—90c. for each cross, added to price for I. C. 20x28. Pure palm oil process—Extras of $1 for 20x28. Odd sizes—Regular sizes are 14x20 and 20x28 only; other sizes 10c. extra, unless order 100 base boxes per item, for shipment in 50-lb. lots not over 60 days apart.

RIVETS—On this product the following discounts from list price are in effect:

	Discount
Steel tank, 7/16 and smaller	70%
Copper rivets	40 and 5%
Copper burs	12 1/2%

BABBIT METAL—In New York, quotations are as follows:

Grade	Cents per Pound
Best	55@60
Commercial	25@30

COTTON WASTE—In New York, the prices below hold:

	Cents per Pound
White	8.50@9.50
Colored mixed	6.50@8.00

WIRE ROPE—On this material the following discounts are for warehouse delivery, New York:

Galvanized	40 and 2 1/2%
Bright	55 and 2 1/2%
Special brands, bright	52 1/2%

COPPER SHEETS—Hot rolled 16 oz. (large lots) base per lb. is 27c.; cold rolled, 14 oz. and heavier, add 1c. extra per lb. to the above; polished takes 1c. per sq.ft. extra for 20 in. widths and under; add 2c. per sq.ft. for over 20 in.

ANTIMONY—For spot delivery on Chinese and Japanese brands, duty paid, 39.5c. per lb. is asked.

COLD DRAWN STEEL SHAFTING—To consumers requiring fair-sized lots the price at 30% off list.

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

Bids are being received by George Nelson Meserve 95 Milk St., Boston, Mass., for the construction of a 2-story, 100x100-ft. garage at Brookline, Mass., for Frank Turner.

The contract has been awarded for the construction of a 36x48-ft. testing plant at Clinton, Mass., for the Clinton Wire Cloth Co.

We have been advised that the G. W. Prentis & Co., Holyoke, Mass., manufacturer of wire, is in the market for special wire-drawing machinery. Noted Dec. 23.

We have been advised that the Lynnfield Chemical Co., Lynnfield, Mass., is in the market for crushers, pulverizers, acid mixers, etc. Noted Dec. 9.

The contract has been awarded for the construction of a one-story, 3x38x62-ft. machine shop at 25 New Derby St., New Bedford, Mass., for William E. Gove. Estimated cost, $3,000.

The Saco Lowell Shops, manufacturer of textile machinery, will construct a one-story, 112x144-ft. foundry at Newton Upper Falls, Mass.

The contract has been awarded for the construction of a 2-story garage at Sherbourn, Mass., for Henry G. Vaughn. Estimated cost, $10,000.

The contract has been awarded for the construction of a two-story, 50x70-ft. addition to the plant of the Stafford Iron Works, Inc., Worcester, Mass.

The Carl G. Westlund Co., 498 Millbury St., Worcester, Mass., manufacturer of split safety clutches for overhead motors, will enlarge its plant at Worcester.

Edward Radding will construct a 2-story garage at Springfield, Mass. Estimated cost, $20,000.

J. Joslin will construct a garage at Providence, R. I.

The Remington Arms-Union Metallic Cartridge Co. is constructing a 4-story, 60x240-ft. plant with 2 ells, 48x64-ft., at Bridgeport, Conn. Estimated cost, $100,000.

Plans are being prepared for the construction of four-story, 200x300-ft. factory and one-story power house on Park Ave., Hartford, Conn., for the Royal Typewriter Co.

MIDDLE ATLANTIC STATES

The Wickwire Steel Co., Buffalo, N. Y., will build an addition to its plant on the Niagara River.

Bids are being received by the American Radiator Co., Elmwood Ave., Buffalo, N. Y., and John E. Young, Arch., 30 North Dearborn St., Chicago, Ill., for an addition to its foundry. Estimated cost, $50,000.

Bids are being received for the construction of a two-story, 40x186-ft. factory for the Brockway Motor Truck Co., Corning, N. Y.

The Genesee Tractor Co., recently incorporated, will establish a plant at Hilton, N. Y., for the manufacture of tractors and special machinery.

The Salisbury Ball Bearing Corporation, Jamestown, N. Y., will equip a plant for the manufacture of ball bearings, machinery parts, appliances, etc.

The Simplex Magneto Co., Millbrook, N. Y., manufacturer of magneto parts, appliances for motors, etc., is establishing a plant at Millbrook. L. L. Lowry, 317 West 93th St., New York, N. Y., is interested.

The contract has been awarded for the construction of a 1-story, 75x100-ft. garage on Thomas St., New York, N. Y. (Borough of Brooklyn), for Adolph Gobel, Morgan Ave. and Rock St. Estimated cost, $15,000. Noted Nov. 11.

Plans have been prepared for the construction of a one-story, 40x80-ft. shop for the Nelson & Landgren Iron Works, 1220 60th St., New York, N. Y. (Borough of Brooklyn). Estimated cost, $3,500.

John C. Wandell, Arch., is preparing plans for a 2-story, 40x100-ft. garage on 40th St., New York, N. Y. (Borough of Brooklyn), for W. R. Thomas. Estimated cost, $15,000.

The contract has been awarded for the construction of a 2-story garage at Oyster Bay, N. Y., for Bertram G. Work, 15 East 51st St., New York, N. Y. (Borough of Manhattan). Estimated cost, $45,000.

The Rome Metallic Bedstead Co., Rome, N. Y., has leased a site on Anable St., Long Island City, New York, N. Y. (Borough of Queens), and will build a four-story factory.

Work will soon be started on the construction of a 1-story addition to the garage of William Rafferty, Merchants Bank Bldg., Syracuse, N. Y. Estimated cost, $12,000.

Plans are being prepared for the construction of a 2-story, 55x140-ft. garage at White Plains, N. Y., for the Scarsdale Estates. H. H. Brown, National Bank Bldg., Arch.

Work will soon be started on the construction of a 1-story, 49x90-ft. garage for Walter D. Blair, 1109 Broadway, Yonkers, N. Y. Estimated cost, $12,000.

Fire, Dec. 17, damaged the plant of the Magnolia Metal Co., Matawan, N. J.

Heller Bros., Newark, N. J., manufacturer of rasps and files, will build an addition to its plant on Verona Ave.

The W. H. Compton Shear Co., Newark, N. J., manufacturer of shears, has awarded the contract for the construction of an addition to its plant on Camden St.

The Simplex Motor Co., New Brunswick, N. J., has awarded the contract for the construction of two factory buildings. Estimated cost, $50,000.

The Hall-Hillsdorf Automobile Co., Perth Amboy, N. J., recently incorporated, plans the construction of a commercial garage and repair shop.

The Traytor Engineer Co., manufacturer of machinery, Allentown, Penn., contemplates an expenditure of $350,000 for additions to its plant.

It is reported that the Ford Steel Wheel Co., Butler, Penn., is in the market for steam hammers and other equipment.

The Carnegie Steel Co. has purchased a site adjacent to plant at Clairton, Penn., and will construct additions.

It is reported that the Cambria Steel Co., Johnstown, Penn., is in the market for steam hammers and other equipment.

The contract has been awarded for the construction of a 100x200-ft. brick plant for the American Car and Foundry Co., Milton, Penn.

The North Wales Machine Co., Inc., North Wales, Penn., manufacturer of machine tools, etc., is building a 60x160-ft. addition to its plant. J. W. King, Treas. and Mgr.

The Hale & Kilburn Co., Philadelphia, Penn., manufacturer of furniture, will build an addition to its plant for the manufacture of war munitions.

The Pennsylvania Taximeter Cab Co., Philadelphia, Penn., plans to construct a 10-story concrete garage on South Broad St. Estimated cost, $300,000.

The contract has been awarded for the construction of a machine shop at 27th and Smallman St., Pittsburgh, Penn., for Frank H. Rea. Estimated cost, $15,000.

Bids are being received by the Allegheny Express Co., Sandusky St., N. S., Pittsburgh, Penn., for a two-story commercial garage. Estimated cost, $15,000.

The Thurlow Steel Co., Thurlow, Penn. (Chester post office), has awarded the contract for a factory at Thurlow.

Bids are being received by T. J. Litzleman, Arch., 149 West Fourth St., Williamsport, Penn., for a one-story, 67x200-ft. factory for the Keystone Talking Machine Co.

Levering Bros., Baltimore, Md., manufacturer of sash weights, will construct a foundry and machine shop on Maryland & Pennsylvania R.R., off Wheatfield St., York, Penn.

SOUTHERN STATES

The Comas Cigarette Machine Co., Salem, Va., will construct a 120x140-ft. machine shop.

It is reported that the American Seamless Tube Co., recently organized, will construct a plant at Tiltonville, near Wheeling, W. Va., for rolling seamless steel tubes.

An addition will be constructed to the plant of the J. E. Moss Iron Works Co., Wheeling, W. Va. Estimated cost, $10,000.

J. T. Hamilton, West Palm Beach, Fla., will establish a machine shop at Okeechobee, Fla.

The Safety Brake Shoe and Manufacturing Co. will construct a plant at Birmingham, Ala., for the manufacture of steel brake shoes. W. L. Allen, Montgomery, interested.

The Parker Manufacturing Co. contemplates the construction of a foundry at Chattanooga, Tenn.

The Tennessee Stove Works, Chattanooga, Tenn., plans to build an addition to its plant.

According to press reports the Illinois Central R.R. plans the construction of a steel car plant at Nonconnah, Tenn. (Memphis post office). Estimated cost, $1,000,000.

Bids are being received by William B. Whitt, 13th and Winchester St., Ashland, Ky., for the superstructure of a two-story, 50x120-ft. garage. Estimated cost, $15,000.

T. W. Martin has purchased the plant of the Elkton Machine Co., Elkton, Ky., and plans to improve same.

MIDDLE WEST

The New York Central R.R. is in the market for a 42-in. car-wheel boring machine, double axle lathe, 400-ton double end wheel press and a 6-in. forging machine for its shop at Airline Junction, Ohio (Toledo post office).

The C. L. Dorer & Co. will build a 30x50-ft. addition to its foundry at Bellaire, Ohio, in the spring. C. L. Dorer is Pres.

It is reported that the Oesterlein Machine Co., Cincinnati, Ohio, has purchased a site at Camp Washington, Ohio, Cincinnati post office, and will construct a plant for the manufacture of tools.

The American Sheet and Tin Plate Co. is constructing a 1-story, 50x156-ft. plant at 1520 Henry Ave., S. W., Canton, Ohio. Estimated cost, $15,000.

A company is being organized which will probably be known as the Canton Stove Co., with a capital of $150,000, and will establish a plant at Canton, Ohio, for the manufacture of gas and gasoline stoves.

Plans are being prepared for the construction of a 2-story, 75x360-ft. plant for the Hercules Motor Manufacturing Co. at Canton, Ohio, for the manufacture of engines for automobile trucks, and tractors for aëroplane and marine purposes. H. H. Timken is Gen. Mgr. Noted Dec. 9.

The Oesterlein Machine Co. has purchased a site at Cincinnati, Ohio, and will construct a 2-story, 125x400-ft. foundry and machine shop in the spring. Estimated cost, $75,000.

Plans have been prepared for the construction of a 2-story, 65x85-ft. addition to the plant of the John Steptoe Shaper Co., manufacturer of machinists tools, at Cincinnati, Ohio. Noted Dec. 30.

The Allyne-Ryan Foundry Co. will construct 2 additions to its plant at Aetna Rd. and East 91st St., Cleveland, Ohio. Estimated cost, $15,000.

Bids are being received by Izant & Frink, Arch., 913 Illuminating Bldg., Cleveland, Ohio, for the construction of a garage at Cleveland Heights, Ohio (Warrensville post office), for R. S. Tyler.

The Ohio Metal Co. will build an addition to its plant at 1131 North Fourth St., Columbus, Ohio. Henry Loeb is Pres.

The Standard Manufacturing Co., Pittsburgh, Penn., will construct a branch factory at Columbus, Ohio, for the manufacture of enameled ware.

The Chicago & Illinois Western R.R. contemplates the construction of a roundhouse at Hamilton, Ohio. W. B. Clark, Chicago, Ill., is Pres. and Gen. Mgr.

Plans have been prepared for the construction of a factory on Front St., Ironton, Ohio, for the Ironton Incandescent Stove Co. Noted Dec. 30.

The Niles Car and Manufacturing Co., Niles, Ohio, manufacturer of interurban trolley cars, will also manufacture motor trucks and is in the market for equipment.

The Williamson Heater Co., Cincinnati, Ohio, will erect a foundry at Oakley, Ohio (Cincinnati post office).

The John O. Heinze Co., manufacturer of automobile self-starters, contemplates installing additional equipment in its plant at Springfield, Ohio.

The Rustler Manufacturing Co., manufacturer of sugar beet harvesting machines, will enlarge its plant at Springfield, Ohio.

The American Tool and Manufacturing Co., Urbana, Ohio, will move into a larger factory and install additional machinery.

The General Malleable Co. will establish a sheradizing plant at Warren, Ohio. E. T. Ward, J. E. Ward and H. R. Weldon are interested.

The Ohio Corrugating Works will build a second addition to its plant at Warren, Ohio, by day labor. They will be in the market for equipment about Feb. 15. Noted Dec. 23.

Plans are being prepared for the construction of a sheet-metal plant at Evansville, Ind., for the International Steel and Iron Co. Estimated cost, $70,000. Noted Dec. 30.

Plans are being prepared by L. E. Deutsch, Arch., for the construction of a garage on South Broadway, Gary, Ind., for M. Kahan. Estimated cost between $15,000 and $20,000.

The contract has been awarded for the construction of a 1-story, 75x164-ft. factory for Frank Betz & Co., manufacturer of surgical instruments, at Hammond, Ind. Estimated cost, $17,000.

The company which has taken over the assets of the Premier Motor Car Co., Indianapolis, Ind., plans to install additional machinery in the T. B. Laycook factory.

The Hoosier Post Co., recently incorporated, will build a 36x100-ft. factory at Terre Haute, Ind. Estimated cost, $2,500.

Kampe & Schill will construct a 20x48-ft. addition to its garage at Grand Rapids, Mich., to be used as a machine shop.

The Homer Furnace Co., Homer, Mich., will construct an addition to its foundry at Homer.

Bids are being received by C. A. Fairchild & Son, Arch., 150 South Burdick St., Kalamazoo, Mich., for the construction of a 1-story, 93x264-ft. and 52x90-ft. foundry at Kalamazoo for the Goodale Co. Noted Dec. 23.

The Gier & Dail Manufacturing Co., Lansing, Mich., manufacturer of cabinets, steel stamping, etc., will construct a factory at Lansing.

The Lansing Foundry Co. is constructing a 70x100-ft. addition to its plant at Lansing, Mich. Estimated cost, $10,000. Noted Dec. 23.

Plans have been prepared for the construction of the 4-story superstructure in connection with the plant of the American Ever-Ready Works, manufacturer of electrical novelties, at 37th St. and Ashland Ave., Chicago, Ill. Noted Dec. 23.

The contract has been awarded for the construction of a ırage at Chicago, Ill., for the Chicago Telephone Co., 212 'est Washington St.

The New York Central R.R. is in the market for a com- nation punch and shear machine with 48-in. stoke to punch ¾-in. plate and shear bars 1⅝- and 6-in. for its shop at nglewood, Chicago, Ill.

We have been advised that Rovtor Bros., 2230 South Wood t., Chicago, Ill., is in the market for a punch press and 1¼- ı. screw machine. Noted Dec. 9.

Fire, Dec. 19 damaged the plant of the Western Brass Manfacturing Co. at 21st St. and Marshall Blvd., Chicago, Ill. oss, $75,000.

Winslow Bros. Co., 1315 Carroll Ave., Chicago, Ill., manuıcturer of iron and brass works, has awarded the contract ɔr the construction of a 1-story factory at Chicago.

The contract has been awarded for the construction of a arage at 4868 North Clark St., Chicago, Ill., for C. Wright. :stimated cost, $30,000. Noted Dec. 30.

Bids are being received for the construction of a 1- and -story, 100x100-ft. foundry at Clearing, Ill., for the Chicago 'learing and Transfer Co. Estimated cost, $35,000.

The contract has been awarded for the construction of a ·lant at Galesburg, Ill., for the Coulter Disk Co. Estimated ·ost, $100,000. Noted Nov. 25.

The Geneva Foundry and Machine Co. will build a 55x100- t. addition to its foundry at Geneva, Ill.

The Burrill Manufacturing Co. is constructing a factory at Kankakee, Ill., for the manufacture of cement working im- plements and farm tools.

The contract has been awarded for the construction of a 1-story, 73x132-ft. garage at Fond du Lac, Wis., for J. W. Watson to be occupied by the Service Motor Co. Noted Dec. 30.

It is reported that the Chicago & Northwestern Railway Co. will construct its northern division car shops at Green Bay, Wis. W. H. Finley, Chicago, Ill., is Ch. Engr.

O. Johnson, 440 West Washington Ave., Madison, Wis., contemplates the construction of a garage at Madison.

Math Kurth, Waunakee, Wis., and A. J. Kurth, 418 West Miffin St., Madison, Wis., will construct a 1-story, 60x100-ft. machine shop at Madison.

Plans are being prepared by Herman J. Esser, 402 Camp Bldg., Milwaukee, Wis., for the construction of a 1-story, 100x200-ft. mill at Park St. and Eighth Ave., in Menomonee Valley, Milwaukee, Wis., for the Fitzsimmons Steel and Iron Co., Chicago, Ill.

The Henes Garage Co., recently incorporated, will establish a garage and machine shop at 276 26th St., Milwaukee, Wis.

August Struve will build a 56x100-ft. garage and repair shop at Ogema, Wis.

The Siverkropp Engine Co. is constructing a one-story, 50x100-ft. brick and steel factory and machine shop at Racine, Wis. Estimated cost, $5,000. Noted Dec. 9 and 16.

The Rice Lake Motor Co. will build a 1- and 2-story, 66x 132-ft. garage and machine shop at Rice Lake, Wis.

WEST OF THE MISSISSIPPI

Plans are being prepared for a 2-story building for the C. O. D. Cleaning and Dyeing Co., Davenport, Iowa. E. G. Holbrook, 51 Whitaker Bldg., Davenport, is Arch.

The Marks Hat Co., Des Moines, Iowa, will build a 2-story, 44x150-ft. addition to its factory at 213 Third St., Des Moines. Estimated cost, $20,000.

The Chase Packing Co. will soon start work on new packing plant at Faribault, Minn. Estimated cost, $200,000. Noted Nov. 11.

Fire, Dec. 18, destroyed the copper shops of the Sheffield King Milling Co., Fairbault, Minn. Loss $5,000.

Plans being prepared for a 2-story, 66x130-ft. factory for the Hugo Shirt Co., North Front St., Mankato, Minn. Estimated cost, $18,000. H. Gerlach, I. O. O. F. Bldg., is Arch. Noted Dec. 23.

Plans being prepared by Haugen & Newstrom, Iron Exchange Bldg., Minneapolis, Minn., for a one-story 100x290-ft. plant for the American Improved Seat Co., Hopkins, Minn. Noted Oct. 21.

Fire, Dec. 19, destroyed the plant of the E. E. Johnson Screen Manufacturing Co., St. Paul, Minn.

F. G. Leslie Co., St. Paul, Minn., manufacturer of paper, will construct a building at 248 East Fourth St., St. Paul, Minn., to replace its other building, recently destroyed by fire. Estimated cost, $250,000. Noted Dec. 16...

Press reports state that the Paxton Mitchell Co., Omaha, Neb., contemplates the construction of a factory at Seventh St. and Broadway, Omaha, for the manufacture of metals.

The Rice Sturtevant Motor Co., Kansas City, Mo., will build a machine shop and garage. Estimated cost, $16,000.

The Creolin Mfg. Co., Sedalia, Mo., will build a factory for the manufacture of disinfectants, etc., at Wichita, Kan.

Krakauer, Zork & Moye's Successors, Inc., El Paso, Tex., manufacturer of hardware, will build a three-story addition to its plant. Estimated cost, $50,000. Trost & Trost, El Paso, Tex., is Arch.

The Galveston Dry Dock and Construction Co., Galveston, Tex., will build a ship building and repair shop.

Plans have been prepared for the rebuilding of the Texas & Pacific Railway Co. shops, at Marshall, Tex., which were recently destroyed by fire. C. H. Chamberlin, Dallas, Ch. Engr. Noted Oct. 21.

The Crossley Bros. Auto Co., Beaver, Okla., will build a machine shop and garage. Estimated cost, $15,000.

The Rourte Manufacturing Co., Denver, Colo., purchased the factory and machine shop of the Hassell Iron Works Co., at Colorado Springs, and will install new machinery.

The Charpiot Safe Co., Denver, Colo., will build a factory for the manufacture of safes. Estimated cost, $5,000.

The Ford Motor Co., Denver, Colo., will build a four-story addition to its assembling plant. Estimated cost, $150,000. Charles Hendy, Jr., is Local Mgr.

WESTERN STATES

The Farmington Land Co. has purchased a site at First and Maine St., Farmington, Wash., and will construct a garage and machine shop.

The Beaver Motor Car Co. will construct a 32x70-ft. foundry at Gresham, Ore.

The Hodson-Feenaughty Co., Portland, Ore., is establishing a metal culvert and metal-tank works in connection with its present plant on East Yamhill St., Portland.

The St. Helens Shipbuilding Co. contemplates constructing an addition to its plant at St. Helens, Ore.

Plans are being prepared by Morgan, Walls & Morgan, Arch., 1136 Van Nuys Bldg., Los Angeles, Calif., for the construction of a 62x155-ft. garage and machine shop on Figueroa St., Los Angeles, Calif., for S. H. Van Nugs.

The contract has been awarded for the construction of a garage at Oakland, Calif., for C. P. Kiel, San Leandro, Calif. Estimated cost, $15,000.

The contract has been awarded for the construction of a 1-story garage at Bush and Pierce St., San Francisco, Calif., for A. Swan and Inez Cook Noble. Estimated cost, $15,000.

The Sixteen Gasoline Co. will build an oil refinery at Taft, Calif. Walter J. Wallace is interested.

CANADA

The contract has been awarded for the construction of an addition to the plant of the Canadian Cartridge Co., Ltd., Hamilton, Ont. Noted Dec. 30.

The Monarch Machine Tool Co., Hamilton, Ont., will occupy the factory at Ferguson and Young St., Hamilton, and will improve same.

The contract has been awarded for the construction of a garage at Kingston, Ont., for Angrove Bros. Estimated cost, $10,000.

The Wabash Railway Co., St. Louis, Mo., plans to enlarge its roundhouse and repair shop at St. Thomas, Ont. T. J. Frier, St. Louis, Mo., is Pur. Agt.

The Transcona Shell Co., Ltd., Montreal, Que., recently organized, has taken over the Transcona shops at Winnipeg, Man., and will install new machinery for the manufacture of small shells.

The Canada Copper Corporation, Greenwood, B. C., plans to improve its plant near Greenwood. Estimated cost, $2,000,000.

Fire recently damaged the garage on Pender St., Vancouver, B. C., of T. J. Roberts, 303 Pender St. Loss, $12,000.

GENERAL MANUFACTURING

NEW ENGLAND STATES

The Continental Asbestos Co. has taken over the plant of the International Asbestos Co., Bangor, Maine, and will enlarge same.

Fire, Dec. 21, damaged the building on Cambridge St., Boston, Mass., occupied by the Glenbrook Wine Co., National Rubber Co. and the Massachusetts Thread Works. Loss, $50,000.

Fire, Dec. 18, damaged the bottling plant of the L. Speidel & Co., at 51 Sleeper St., Boston, Mass. Loss, $15,000.

The West Boylston Co., manufacturer of cotton goods, will build a three-story, 120x160-ft. addition to spinning mill at Easthampton, Mass.

The Boston Electrolytic Oxygen Co., recently organized, will construct a plant at Everett, Mass.

The Commercial Chemical Co., New York, N. Y., is constructing a plant at Medford, Mass. Estimated cost, $250,000.

The contract has been awarded for the construction of a 3-story addition to the spinning mill of the Uxbridge Worsted Co., at Millbury, Mass.

The Sharp Manufacturing Co., manufacturer of yarns, will build a spinning mill at New Bedford, Mass.

The contract has been awarded for the construction of a 3-story, 45x100-ft. addition to the plant of the Emerson Shoe Co. at Rockland, Mass.

Plans are being prepared for the construction of a factory at Salem, Mass., for the Carr Leather Co.

The contract has been awarded for the construction of a four-story, 74x206-ft. oil plant at South Framingham, Mass., for I. Levinstein & Co., Inc., 74 India St., Boston. Estimated cost, $60,000. Noted Nov. 18.

Fire, Dec. 24, damaged the factory of the United States Whip Co. at Westfield, Mass. Loss, $7,000.

Fire recently destroyed the tannery on River St., Winchendon, Mass., of the Green & Hickey Leather Co. Loss, $50,000.

The Linehan-Conover Co., manufacturer of corsets, purchased the foundry at 1 Jackson St., Worcester, Mass., and will convert it into a five-story manufacturing building.

Plans have been prepared for the construction of a 3-story, 60x100-ft. addition to the plant of the New England Corset Co. at Worcester, Mass.

MIDDLE ATLANTIC STATES

The plant of A. V. Morris & Son, manufacturer of knit goods, Ft. Johnson, Amsterdam, N. Y., recently destroyed by fire with a loss of $100,000, will be rebuilt.

The Orrell Mills, Inc., Glendale, N. Y., manufacturer of worsteds, overcoatings, etc., is building a one-story, 45x72-ft. addition to its plant.

Fire, Dec. 26, damaged the plant of the H. W. Johns-Manville Co., manufacturer of asbestos, Lockport, N. Y. Loss, $75,000.

Bids will soon be received by Frank F. Ward, Arch., 203 Broadway, New York, N. Y. (Borough of Manhattan), for alterations to the factory of the Bishop Gutta Percha Co., 420 East 25th St. Estimated cost, $8,000.

An addition will be built to the plant of the International Acheson Graphite Co., Niagara Falls, N. Y. Estimated cost, $100,000.

An addition will be built to the plant of the Hooker Electrochemical Co., Niagara Falls, N. Y. Estimated cost, $100,000.

The E. I. du Pont Powder Co., Gibbstown, N. J., is building plant No. 2. Noted Nov. 25.

The contract has been awarded for the construction of a 4-story, 50x100-ft. factory for Battelle & Renwick, Jersey City, N. J., to be used as a saltpeter works.

The Butterworth-Judson Co., Newark, N. J., manufacturer of chemicals, will construct several large additions to its plant on Ave. R.

Plans are being prepared for a large addition to the plant of the Superior Ivory Button Co., Newark, N. J. Estimated cost, $25,000.

The Royal Rubber Co., Trenton, N. J., is building a new plant on Princeton Ave.

Fire, Dec. 21, damaged the woolen and worsted mills of the Thomas Kent Manufacturing Co., Clifton Heights, Penn. Loss, $1,000.

Fire, Dec. 21, damaged the mill of George W. Davis, manufacturer of yarns, 4416 Main St., Manayunk, Penn. Loss, $3,000.

The Keystone Reduction Co., Dover, Del., will establish a factory at Philadelphia, Penn., for the manufacture of chemicals.

The contract has been awarded for the construction of a chemical factory at 37th and Morris St., Philadelphia, Penn., for the Nitrogenous Chemical Co. Estimated cost, $12,000.

The contract has been awarded for the construction of a 3-story, 45x71-ft. reinforced-concrete dyehouse for E. Sutro & Sons Co., Thompson and Clearfield St., Philadelphia, Penn. Noted Dec. 2.

The National Rubber Co., Pottstown, Penn., has awarded the contract for a 2-story rubber factory. Estimated cost, $100,000. Noted Dec. 9.

SOUTHERN STATES

The Climax Spinning Co., maufacturer of yarns, Belmont, N. C., has awarded the contract for the construction of a 1-story, 127x531-ft. factory. Estimated cost, $60,000. Noted Nov. 11.

The Republic Cotton Mills, Great Falls, S. C., has awarded the contract for the construction of a 3-story, 133x400-ft. factory

C. H. Bishop and associates plan to construct a meat-curing plant at Ashburn, Ga.

The Eagle & Phoenix Mills contemplates an expenditure of $75,000 for enlarging its mills at Columbus, Ga.

The Swift Manufacturing Co., manufacturer of cotton, Columbus, Ga., will build an addition to its plant. Estimated cost, $10,000.

MIDDLE WEST

Work has been started on the construction of an addition to the plant of the American Hard Rubber Co. at Akron, Ohio.

Plans have been prepared for the construction of a factory at Akron, Ohio, for the Miller Rubber Co. Estimated cost, $12,000.

The contract has been awarded for the construction of a factory at 1025 Sweitzer Ave., Akron, Ohio, for the Star Rubber Co. Estimated cost, $30,000.

Bids will soon be received for the construction of an addition to the plant of Mersman Bros. & Brandt, Celina, Ohio. Estimated cost, $15,000. Noted Nov. 18.

Plans have been prepared for the construction of a plant on Cleneay Ave., Cincinnati, for the Ault & Wiborg Co. for the manufacture of dyes.

The Michigan Alkali-Huron Portland Cement Co. will construct a 125x287-ft. addition to its plant at Alpena, Mich.

The Compostone Co. plans to construct a plant at Fuller Station, Grand Rapids, Mich.

The De Pree Chemical Co. will construct a 4-story, 60x130-ft. addition to its plant at Holland, Mich.

The Kalamazoo Vegetable Parchment Co. has awarded the contract for the construction of a 1-story, 18x109-ft. and 75x104-ft. addition to its paper mill at Kalamazoo, Mich.

The contract has been awarded for the construction of a 2-story, 42x100-ft. paper mill at White Pigeon, Mich., for the Eddy Paper Co. Noted Nov. 11.

The contract has been awarded for the construction of a 2-story factory at Chicago, Ill., for the Black Products Co., 19 South La Salle St., Chicago, manufacturer of tar.

The General Chemical Co. is constructing six 1-story buildings at 123rd St. and Carondelet Ave., Chicago, Ill., for the manufacture of sulphuric acid. Estimated cost, $100,000. Noted Dec. 2.

Bids have been received for the construction of a 3-story, 50x50-ft. addition to the factory of the Payson Manufacturing Co., manufacturer of hardware specialties, at Chicago, Ill.

The contract has been awarded for the construction of a 1- and 2-story factory at Carrollville, Wis. (Otjen post office), for the Newport Hydro Carbon Co. Estimated cost, $100,000.

Bids will soon be received for the construction of the first unit of a plant at Eau Claire, Wis., for the Gillette Safety Tire Co. R. B. Gillette is Pres. Noted Dec. 16.

WEST OF THE MISSISSIPPI

The Cloquet Electric Co., Cloquet, Minn., will build an addition to its plant.

The Bardwell-Robinson Co., Minneapolis, Minn., will build a four-story addition to its plant, at Second and 24th St. for the manufacture of sashes and doors. Estimated cost, $50,000. L. J. Bardwell, Secy.

The Western States Coke Co., Minneapolis, Minn., has awarded the contract for building a new plant. Estimated cost, $2,000,000. Noted Nov. 18.

The Standard Oil Co. contemplates building a factory at Eighth and Monterer St., St. Joseph, Mo. Estimated cost, $125,000.

The Little Rock Pickery and Spinning Co., Little Rock, Ark., will build a factory for the manufacture of cotton linters. Estimated cost, $25,000. C. C. Cavanaugh is Pres.

Bids will be received until Jan. 10, for a mattress factory for T. B. Burnett & Co., Dallas, Tex. Estimated cost, $65,000. Noted Dec. 16.

Press reports state that Nelson Morris & Co., Chicago, Ill., contemplates building a packing plant at Dallas, Tex. Estimated cost, $75,000.

Contract has been awarded for the new factory for the Delta Sugar Co., Delta, Tex. Fred G. Holmes is Mgr.

J. Thomas Ward is organizing a company to build an auto tire and tube manufacturing plant at El Paso, Tex. Estimated cost, $200,000.

WESTERN STATES

The California Trojan Powder Co., Port Angeles, Wash., plans to construct a powder distributing magazine and shipping plant near Port Angeles.

The Carstens Packing Co. has awarded the contract for the construction of an addition to its plant at Spokane, Wash. Estimated cost, $50,000. Thomas Carstens, Tacoma, Wash., is Pres.

The Eugene Excelsior Co., Eugene, Ore., plans to install additional machinery in its plant on Sixth Ave., E., Eugene.

The Columbia Fireworks Co. will build a plant at Lents, Ore. M. H. Squires is Mgr.

The California Ripe Olive Co. plans to construct a fruit cannery at Oroville, Calif. William Wolf, 268 Market St., San Francisco, is interested.

CANADA

The Superior Barn Equipment Co. will establish a factory at Fergus, Ont.

The contract has been awarded for the construction of an addition to the packing plant of Charles W. Barber, Guelph, Ont.

Plans are being prepared for the construction of a factory at Listowel, Ont., for the F. W. Hay Shoe Co. Estimated cost, $15,000.

Classified Advertising

Positions Open
Civil Service Work
Employment Agencies
Labor Bureaus
Positions Wanted
Wanted
Agents and Salesmen
Contract Work
Miscellaneous
Educational
Books
For Sale
Business Opportunities
Proposals

The editors require more space for the good things they will give us this year. The Classified Advertising section appears therefore on page 229, 230, 231 of this issue and will in future appear in the same relative position in the paper.

American Machinist

Volume 44, No. 2
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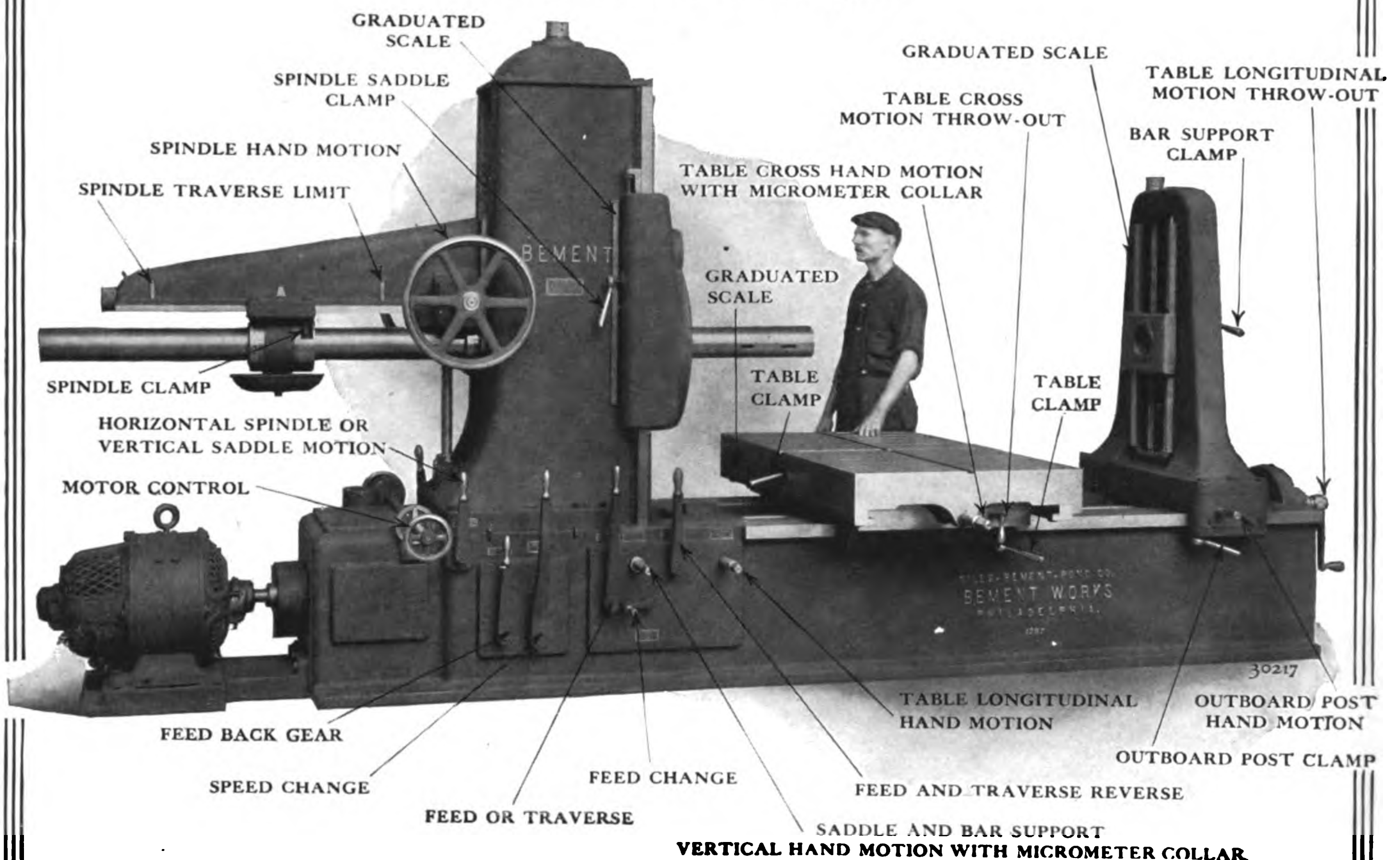
NEW YORK, JANUARY, 13, 1916

Price, 15 Cents
Contents, First Page
Advertising Index, Last Page

Spindle Within Column

Ideal Method of Support



Duplex-Control Borer, Driller and Miller

First Machine of This Type to Be Built with Spindle Located Within Column. No Distorting Strains on Spindle.

The thrust on spindle is taken on two V tracks, one on either side of spindle, which forms the ideal construction. This design eliminates entirely all distorting strains tending to throw spindle out of alignment.

Duplex Control

This feature fills a long-felt need on this type of machine and adds greatly to convenience of operation. The workman can stand on either side of machine, whichever is most desirable, and have the entire control within convenient reach.

Rapid Power Traverse

is provided for horizontal travel of spindle, vertical movement of spindle and boring bar outer support, and also for both longitudinal and cross travel of table. That is, both the boring bar and table can be quickly traversed by power in all directions.

Steel Driving Gears Running in Oil

All the driving gears are steel and run in an oil bath. The feed and traverse gears are lubricated by splash and pump systems.

We shall be pleased to mail you a 4-page circular giving detailed description.

Niles-Bement-Pond Company

111 Broadway, New York 25 Victoria St., London, S. W.

(*See page* 3)

American Machinist

L. P. ALFORD, *Editor*

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VOLUME 44 — JANUARY 13, 1916 — NUMBER 2

CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormay processes, protected by United States patent issued June 22, 1915, and another pending

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The Future of the Machine Tool Industry

By CHARLES E. HILDRETH,
General Manager, National Machine Tool Builders' Association
President, Whitcomb-Blaisdell Machine Tool Co.

IN the spring of 1912, before the semi-annual convention of the National Machine Tool Builders' Association, I stated that the depression which the industry was then in would continue until the year 1915.

Few agreed with me, the majority feeling that after four years of poor business it was incredible that it could last three years more.

I based this statement on no prophetic vision, but on a theory founded on the old law of supply and demand as indicated in the absolutely regular rise and fall of pig iron over a period of nearly one hundred years and conclusive evidence that our industry follows this basic metal very closely.

It is true the demands of the European War anticipated this return by several months. It is also interesting to note that though this enormous demand was felt by the machine-tool trade about October, 1914, pig iron was not influenced in the slightest degree until a larger factor entered and it began to rise in July, 1915. This, to me, is a very significant fact; in other words, our industry alone has no material influence on pig iron. It takes a return of general business to arouse it, and then it becomes our guiding factor.

To explain: Machine tools for a period of nine months were being made and shipped abroad in stupendous quantities, and the pig-iron market was not affected. Why? Because this demand was foreign, in no way emanating from the needs of our people. In fact during this nine months general business here was unusually depressed.

The great industries, such as agricultural, textile and mercantile, were all feeling the severe effect of the European nations' concentration on war munitions.

Now, however, these countries are beginning to consider the future, and already commissions are here contracting for all kinds of material for their upbuilding. This and the fact, according to my theory, that the time has arrived when we also must begin to replenish our depleted stocks are creating a demand on this fundamental ore that does make itself felt.

Pig iron has moved upward since July fully \$6 per ton and will continue until it tops at least \$30. This means only one thing—the decided and absolute improvement of general business independent of the war.

This great revival is the direct result of a seven year's depletion of all kinds of material. For seven years the railroads have bought only from hand to mouth. For seven years, every manufacturing plant with few exceptions has striven to produce with as little new equipment as possible. Only here and there have they entirely replaced the old carbon tools for modern high-speed machines.

Generally speaking, this country has been marking time for seven years, until its stock is so depleted that now, in order to feed, clothe and furnish luxuries for its hundred millions, the machine-tool industry must provide the means. For when you reduce it to the final analysis, there is not an article we eat, wear or have for luxury that is not primarily dependent on the machine tool.

As a partial consequence of the war, money is rapidly depreciating, or in other words, its purchasing power is falling and prices of commodities are proportionately advancing; yet no money is destroyed but is increasing, while that for which money exchanges is rapidly lessening in quantity.

The logical consequence of this disturbance in the relation of the quantity of money to the quantity of commodities is bound to stimulate the production of commodities of all kinds, or in other words, to stimulate all sorts of productive enterprises. This means simply that good business is to be the consequence, first, on account of the war; second, our own demands for a period of years.

Our statesmen must remember one thing, however—when this war is over, our industry will be in competition with four huge workshops and four big nations hungry for business, and we will do well to look to the defenses of our product for while we have filled these countries, present needs to overflowing, we have provided them with the means ready at hand to barter their products for the commodities they will require for their rebuilding at prices we can never hope to meet on our present standards without a civil revolution.

Our chief danger following the war is our low protection.

Manufacturing British 18-Pounder High-Explosive Shells--II*

By E. A. Suverkrop

SYNOPSIS—The processes through which the shell blanks have passed have, strictly speaking, been roughing operations in which merely sufficient care has been exercised to prevent the loss of work and material, but there has been no attempt to secure great accuracy. From now on a greater and increasingly greater degree of accuracy and care becomes necessary as the work advances toward completion, final inspection and acceptance.

Up to the first operation in this article the base of the shell blank is, with the exception of the center, in exactly the same condition as it was when it left the cutting-off machine. As previously stated, the bulk of the blanks are cut on cold-sawing machines, and as the exterior of the bar stock is not true the base is consequently not square with the now rough-turned body of the blank. The base must therefore be faced off square with the body, so that later operations can be satisfactorily carried out.

For the sixth operation short, heavy engine lathes are used. It may be mentioned that on all these operations the machine and chucks used are considerably heavier than is really necessary to handle the work, the object being to have ample rigidity and pulling power. The lathes are of 20-in. swing with 6-ft. bed and no tailstock. They are equipped with heavy combination chucks, as shown in Fig. 15. The roughing tool is mounted in the tool post. The operator just cleans up the base and does not use any gage. The scheduled output for this operation is 48 pieces per hour.

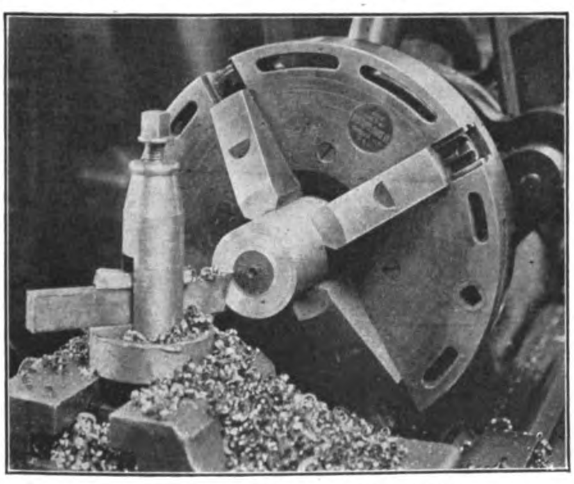


FIG. 15. FACING THE SHELL BASE

After the base has been faced, a boy restamps the heat number (which in the facing operation has been effaced from the base) where it was before. It is a simple matter for him to get the number correctly, for it will be remembered that the heat number is on the side of the shell, where it was stamped after the rough-turning operation.

After facing, the work is inspected for squareness with the body and also for length. As previously stated, the blanks are bought from a number of outside producers and are found to vary greatly in length. This variation in some cases runs as high as 3/8 in. From now on the operations, if not actually finishing operations, are more nearly allied to finishing operations. It therefore becomes necessary to bring the blanks to uniform length. Those blanks which, with the base squared, are of the correct length, pass direct to the boring and reaming operation. Those which are found by the inspector to be too long are checked and transferred by the truck gang to the length-facing operation.

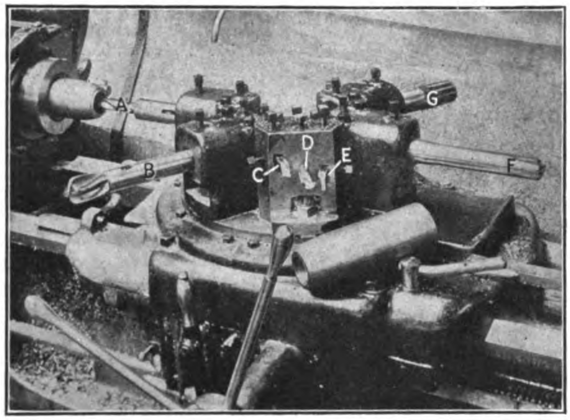


FIG. 16. FINISH BORING ON THE TURRET LATHE

The seventh operation is done on lathes of the same size and make as those used for facing the base. They are equipped in exactly the same manner, except that they have a stop in the chuck for the base of the blank.

The blank is chucked with the base against the stop in the chuck. The tool is an ordinary roughing tool, and with it the operator takes one or more cuts to remove the excess of metal from the nose of the blank. The length gage is the only gage used. This operation takes a little longer than the previous one, and 30 pieces per hour is the scheduled production. After passing inspection for length and being tallied to the credit of the operator, the truck gang takes the work to the boring and facing operation.

The eighth operation is the first of the finishing operations and consists in finishing the hole to diameter and depth, cutting the annular recess at the rear of the location for the nose thread, turning the check on the outside of the end and finishing the angle on the inside of the nose.

This is one of the jobs on which the turret lathe has been retained, and it requires altogether seven tools and five turret stations for completion.

The work is held in the regular Jones & Lamson collet chuck. The first tool used is the twist drill *A*,

*Previous installment appeared on page 1.

Fig. 16. The size of this drill is of no great consequence; any drill about 5/8 in. in diameter will do, as its work consists merely in removing the metal in the center to nearly the finished depth of the hole. The drill is carried in an ordinary socket in the turret.

The second turret station carries the reamer *B*, also shown in Fig. 17. It is in reality a four-fluted roughing

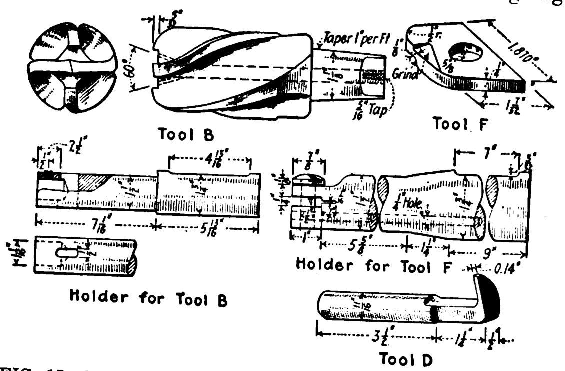


FIG. 17. SOME OF THE TOOLS FOR THE FINISH-BORING OPERATION ON THE TURRET LATHE

reamer that is provided with one pair of end-cutting lips to remove the metal at the end of the hole to the depth cleared by the twist drill. The same reference letters are, for clarity, used in the illustrations and in the operation sheet.

The third station of the turret carries three tools. The tool *C* turns the bevel on the inside of the nose. The tool *D* cuts the recess inside the shell at the point which will later be the extreme end of the thread. The tool *E* turns the check on the outside of the nose. It will of course be understood that the headstock is fed over for these cuts. The fourth station of the turret carries the finish-boring tool *F*, which is also shown in Fig. 17. This tool finishes the bore and faces the end of the hole. The

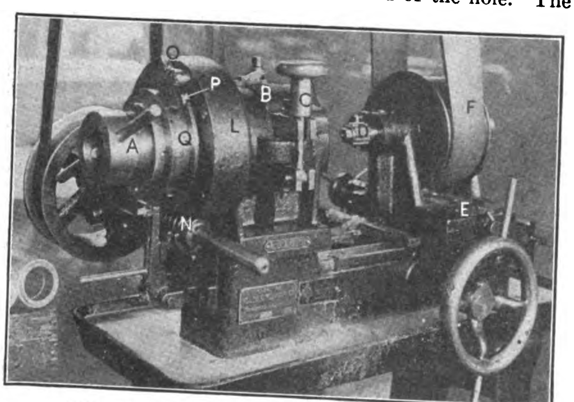


FIG. 18. NOSE THREAD MILLING MACHINE

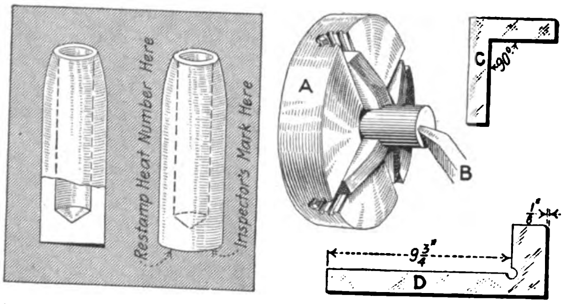
fifth station carries a Pratt & Whitney adjustable reamer that finishes to size the part of the bore which later will be threaded. This completes the eighth operation. The scheduled time is 10 pieces per hour. When the operator removes the finished work from the chuck he inverts it over an air jet, turns the air on and blows the chips out.

The inspector tests the work as shown in the eighth operation sheet. After passing inspection the work is marked as indicated, credited by the checker to the operator, and the truck gang delivers it to the next operation.

The ninth operation is threading the nose. In some shops this is done with collapsible taps, in others with solid ones; but in this shop it is done on Holden-Morgan thread-milling machines, one of which is shown in Fig. 18. While the principle of this machine is very old it is not commonly known, and a short description may be of interest.

The spindle of the machine is of sufficient size to take the shell inside it. The forward end of the hole in the spindle is conical, acts as a seat for the nose of the shell and centers it. At the rear end the hole in the spindle is threaded to accommodate the threaded plug *A*, Figs. 18 and 19. This plug at the forward end is also coned on the inside and performs the same office with regard to the rear end of the shell as the coned front end of the spindle does with regard to the nose of the shell; that is to say, it seats and centers the base of the shell.

The foregoing is the way in which the machine is supposed to work. No doubt good results could be obtained with it if the shells were accurately finished on



OPERATION 6: FACE THE BASE SQUARE WITH THE BODY
Machines Used—20 in. by 6 ft. engine lathes.
Special Tools and Fixtures—Heavy combination chuck A; roughing tool B.
Gages—Length gage D, square C.
Production—One man and one machine, 48 pieces per hour.
Note—Cutting compound used.
References—Fig. 16, and for inspector's mark, Fig. 10.

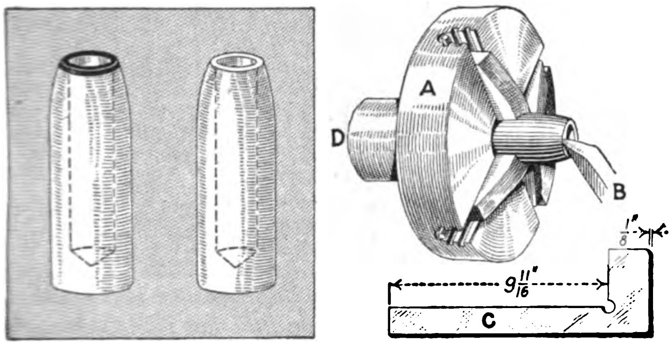
the outside before being chucked in the spindle. It must, however, be remembered that the rough-turned nose contour is one of the seating points in the spindle. Because of the rough nature of the work on the exterior of the nose, it was found that duplication in the threading operation was impossible. However, in the eighth operation the check on the outside of the shell was finished to accurate dimensions and concentric with the bore, so this was taken as a locating point for the forward end of the shell. The spindle of the thread-milling machine was arranged so that it would clear the shell contour *R*, as shown in Fig. 19, at *S* in the small broken section. A plate *T* was then screwed to the forward end of the spindle *S* and acted as a seat for the checked end of the shell. The other end of the shell was centered by the plug *A*, as previously described. This method has resulted in accurate work and very few discards.

The exterior of the spindle of the machine, with the exception of a short section about midway of its length, is a plain cylinder without flanges, so that it is free to slide endwise in the bearings at each end of the main head of the machine. About midway between the bearings the spindle has an external thread. This thread is of the same pitch and "hand" as the one it is intended to mill in the nose (or base recess) of the shell. Between the bearings is a half-nut *B*, which is fitted to a slot running from front to back of the machine at right angles to the

axis of the spindle, so that it has no side-play in relation to the head, that is to say, in line with the spindle axis.

This half-nut *B* is hinged at the back; at the front there are a swing-bolt and a nut *C* to clamp it in operation position in mesh with the thread *K*, Fig. 19, when it is desired to cut a thread.

The hob *D* consists of what is virtually a stack of disks of the shape of the standard Whitworth thread 14 pitch. In other words, it is a Whitworth screw without lead. In appearance, with the exception of having no lead, it is just like an ordinary hob, is fluted and has cutting clearance; in some cases, to afford extra chip space, it is provided with the type of teeth used on the Eccles tap. In length it is a thread or two greater than the length of the female screw it is to cut. It is mounted on the carriage *E*, which affords it lengthwise motion to permit it to be moved in and out of the hole in the nose, crossfeed to obtain the correct depth of thread, and clamps so that



OPERATION 7: FACE TO LENGTH

Machines Used—20 in. by 6 ft. engine lathes.
Special Tools and Fixtures—Heavy combination chuck A; roughing tool B; stop D.
Gage—Length gage C.
Production—One man and one machine, 30 per hour.
Note—Cutting compound used.
References—Set-up is similar to that shown in Fig. 15.

when located in cutting position it can be rigidly held. The spindle that carries it is driven by the belt *F*.

In order to avoid confusion, the same reference letters are used wherever possible in Figs. 18 and 19, which show the spindle, work and hob.

The spindle *G* carries the work *J*, as shown, between its conical forward end and the internally coned plug *A*. The midlength of the spindle at *K* is threaded 14 per in. right-hand Whitworth, and with it the hinged half-nut *B* is capable of engagement. Covered by the gear guard *L*, in Fig. 18, is a worm gear *M*, Fig. 19, which is driven by the worm *N*, Figs. 18 and 19. If the spindle *G*, with the half-nut *B* in engagement with the screw *K* on the spindle, be rotated in the direction of the single headed arrow, the spindle and inclosed work will travel in the direction shown by the double-headed arrow. As the thread *K* is 14 per in., one turn of the spindle will therefore advance the spindle and work $^1/_{14}$ in. to the right.

Assuming that the hob *D* has but one thread-shaped disk, a single thread would be cut on the inside of the nose by it. But the hob *D* is made up of a number of thread-shaped disks; and a single turn of the spindle accompanied by a uniform advance of one thread results in the cutting of a multiple of single threads, one for each thread-like disk, which on completion of the single turn of the spindle merge into each other and form one continuous thread. The worm *N* is readily disengaged from the wormwheel; on completion of the single turn necessary to complete the thread in the nose of a shell, it is automatically tripped and drops out of mesh.

It will be noticed that there is a pawl *O* at the rear of the gear guard *L*. There are also two oppositely disposed ratchet notches on the rim *Q*, which is secured to the spindle. When the operator starts to unscrew the plug *A* the pawl *O* is in the position shown in

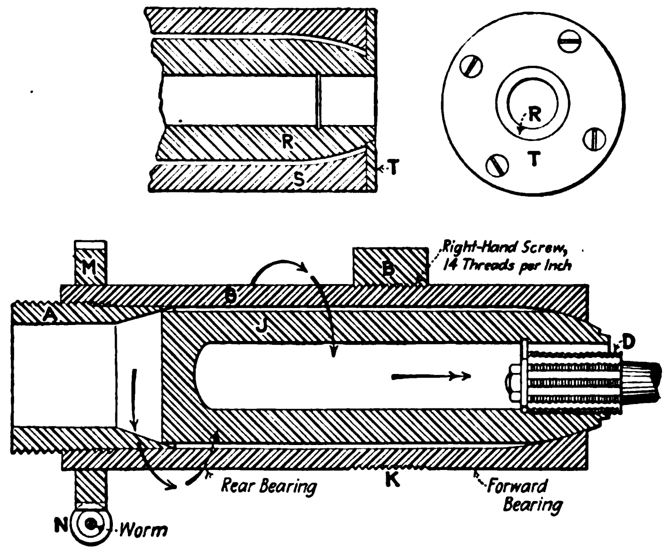


FIG. 19. SPINDLE OF NOSE-THREAD MILLER

Fig. 18. The tooth with which it is in engagement when in this position acts as a stop for the rotation of the spindle at the finish of the hobbing of the thread. The friction of the plug in the spindle is greater than the friction of the spindle in its bearing and in the half-nut *B*. Therefore when the operator turns the handles on the plug *A* in the direction necessary to unscrew it from

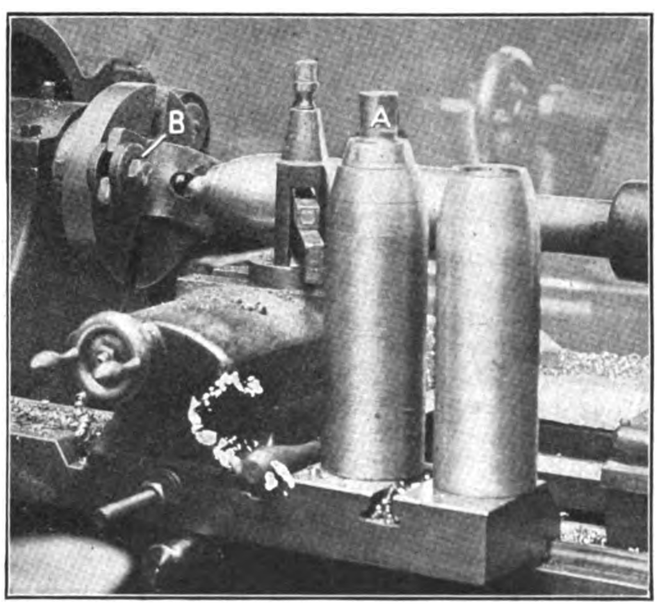


FIG. 20. FINISH TURNING THE BODY

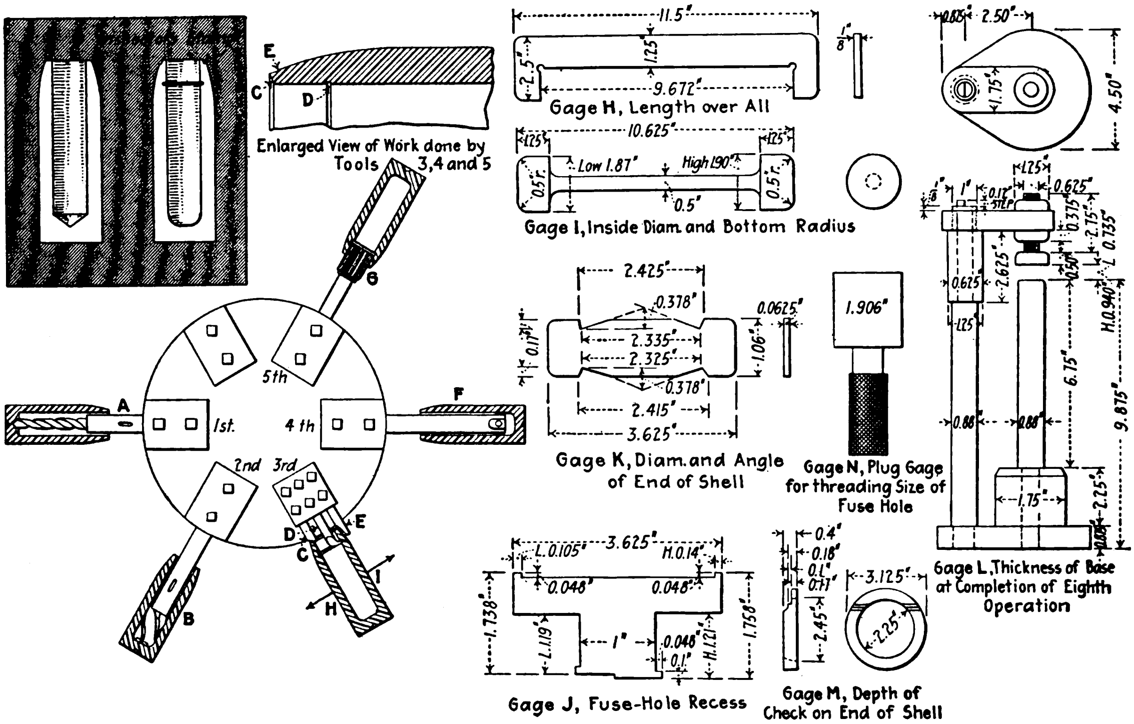
the spindle, this excess of friction between the spindle and the plug causes the spindle to turn with the plug. When nearly one turn of the spindle has been made the operator reverses the pawl so that it will drop into the notch *P* when it comes around, and hold the spindle. After the pawl has dropped into the notch *P*, further turning of the plug *A* releases it from the spindle. It is

then taken out and the work removed. The complete turn, in the reverse to cutting direction, thus taken by the spindle brings it back to starting position for the next thread.

Both slides of the carriage E are controlled by stops, and once these are set the operator merely has to place and remove the work. The cross-slide is set so that the hob cuts a thread 0.002 under size, the final sizing of the thread being done later with a hand tap.

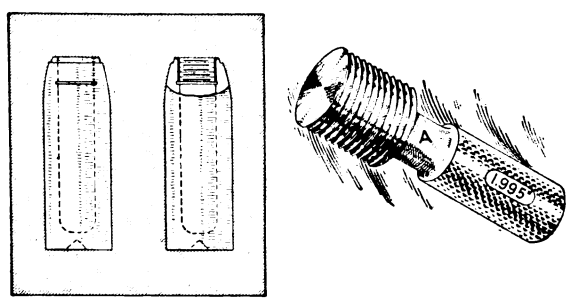
The operation of threading the nose of a shell is as follows: The pawl O is dropped into the notch, as shown in Fig. 18; the operator inserts a shell into the spindle; the plug A is screwed home, the pawl O holding the spindle against turning while the plug is screwed in tight. The carriage is then racked along the bed till it strikes the stop which determines the distance that the hob reaches inside the hole. The carriage is then locked in this position. With the hob rotating, the cross-slide is fed toward the operator till the cross-slide stop is reached. This signifies that the hob is cutting the full depth of thread. The cross-slide is clamped in this position. The pawl O is now lifted and the worm N raised to throw it into mesh with the wormwheel M and thus start the spindle rotating. As soon as the spindle starts, the pawl O is dropped, on the same side of the axis of the spindle as it is in Fig. 18; as the notch has by now passed, the end of the pawl rides on the rim of the flange Q until the spindle has made one complete revolution, when it again drops into the same notch in which it appears in Fig. 18 and stops the rotation of the spindle and contained work. The scheduled time for threading is 25 pieces per hour, but as high as 29 has been done.

The inspection is with a plug thread gage 0.002 in. under size, which must be a snug fit. There is no inspection stamp for this operation. The machines do excellent work, and out of 600 pieces inspected perhaps there will be one that is too loose and two or three that are too small. This latter fault is of course amenable to correction.



OPERATION 8: BORE, REAM, RECESS AT END OF THREAD, AND CHECK OUTSIDE

Machines Used—3x36 Jones & Lamson flat turret lathes.
Special Tools and Fixtures—Twist drill and holder A; roughing reamer B; beveling tool C; undercutting tool D; outside checking tool E; finish reaming and bottom forming tool F; sizing reamer G for thread space.
Gages—Gage H for length; gage I for inside diameter and bottom rad; gage J, fuse hole recess; gage K, diameter and angle of end of shell; gage L, thickness of base; gage M, depth of check on end of shell; gage N, plug gage for threading size of inside of nose.
Production—One man operating one machine, average 10 shells per hour.
Note—Cutting compound used.
References—Figs. 16 and 18, and for inspector's mark, Fig. 10.



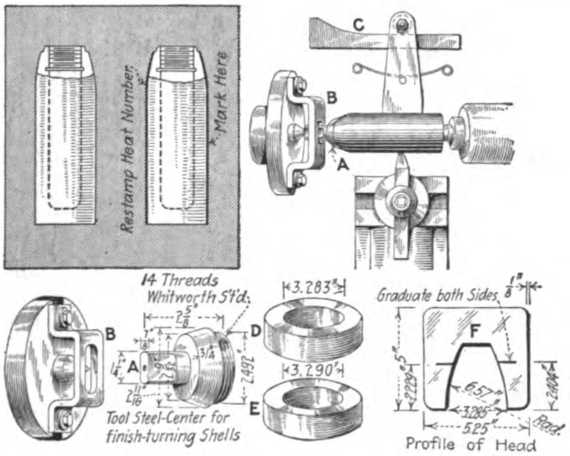
OPERATION 9: MILLING THE INTERNAL THREAD IN THE SHELL NOSE

Machines Used—Holden-Morgan thread millers.
Special Tools and Fixtures—None.
Gage—Plug thread gage A.
Production—One man and one machine, 25 noses threaded per hour.
Note—Cutting compound used.
References—Figs. 18 and 19.

After crediting to the operator by the checker, the truck gang conveys the work to the following operation.

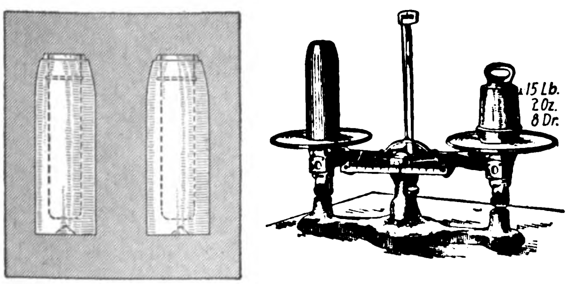
The tenth operation is finish turning, shown in Fig. 20. It is done on engine lathes of 16- and 18-in. swing, with 6-

and 8-ft. beds respectively. The threaded plug and driver *A*, shown in detail in the tenth operation sheet, is screwed into the nose of the shell. Secured to the driver plate of the lathe is the slotted female driver *B*, which receives the flattened end of the driver *A*. The base end of the shell is supported on the tail center. At the back of the lathe is a former similar to the one used in the fifth operation for rough turning the nose; but in this case the former is the full length of the work, and its nose end is toward the headstock. Each operator is supplied with several of the male drivers *A* and also with a vise, as shown in Fig. 5, to hold the shells while inserting and removing the drivers. As the cut is a comparatively long one the operator has ample time during the cut to place and remove the drivers from the work. Here, as in the roughing operation on the nose, the tool is fed to depth by the compound slide. One cut finishes the work. The scheduled time for finish turning is 20 pieces per hour. The operator uses a ring gage 3.290 in. in diameter, which he tries over each piece after it is turned. This is the high limit for diameter. After the piece is turned, a boy restamps the heat number on the shell in the position indicated in the operation sheet, taking it from the base of the shell.



OPERATION 10: FINISH TURNING THE SHELL BODY

Machines Used—Engine lathes, 16 and 18 in. swing.
Special Tools and Fixtures—Plug driver A; female driver B attached to small faceplate; former and roller C at the back of the lathe.
Gages—High and low body diameter gages D and E; profile of head F.
Production—One man and one machine, 20 per hour.
Note—Cutting compound used.
References—Fig. 20, and for location of inspector's mark, Fig. 10.



OPERATION 11: WEIGHING THE SHELLS

Machine Used—Ordinary weighing scales.
Special Tools and Fixtures—None.
Gages—None.
Production—One man and one set of scales can weigh about 100 shells per hour.
Note—About 10 per cent. of the shells are correct weight.
Reference—Fig. 21.

Diameter gages are used on the body, the limits being 3.280 and 3.290 in. respectively. The inspector also gages the shape of the nose with the contour gage. Passing shells are marked as required by the standard marking chart. The work is then credited by the checker to the operator, and the truck gang conveys it to the eleventh operation.

Up to this point in manufacture the shells have been kept as near as possible to the high limits. They now undergo the first weighing operation. The actual weighing is done by an employee of the shop, but the operation is under the eye of a Government inspector. The shells are weighed on ordinary scales, like that shown in Fig. 21, and the amount which they are over 15 lb. 2 oz. 8 dr. is chalked on the side of the shell in ounces and fractions, as shown in the illustration, and an amount of metal equal in weight to these chalked figures must be removed from the base in the twelfth operation.

The scales used seem to be standard for weighing shells, as one sees them in practically all the shell shops. It would, however, seem that this is an ideal job for an automatic scale which would give at a glance the exact overweight or underweight in ounces, and even drams if necessary. With the scale shown in the illustration there is always more or less manipulation of the weights before the weight is ascertained. It is reasonable to believe that one man with an automatic scale could easily weigh as many shells as two with the ordinary scales.

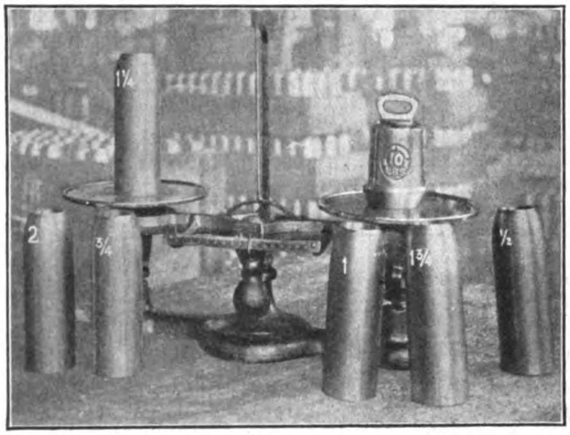


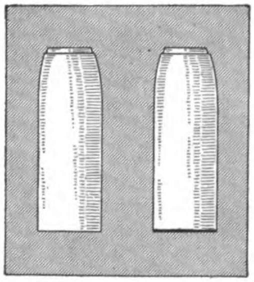
FIG. 21. WEIGHING THE PARTLY COMPLETED SHELLS

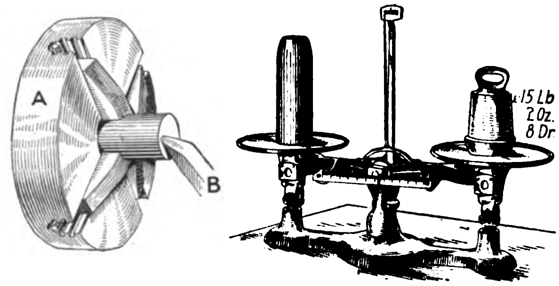
Ranged along the wall close to the weighing department are several 20-in. by 6-ft. engine lathes. They are similarly equipped to the ones used for facing the base, as shown in Fig. 15. They have heavy combination chucks and no tailstock. These are used to face off the excess of metal and bring the shells to the weight specified. One would imagine that the operators on this work would soon become so expert at guessing how much to take off that they would be able to bring the shells to exact weight in one cut. This is, however, not the case, as often several cuts are necessary to secure the weight.

While it is my job to record the operations that have been laid out by others, I venture to suggest that a dial indicator could be mounted in advance of the tool and be so graduated that it would specify the exact cut to take in order to remove a certain weight of metal.

The scheduled output on this facing to weight is 35 shells per hour. Having been adjusted to weight, the shells are taken by the truck gang to the next operation. Facing to weight is day's work, and the operation is not checked.

The first specifications covering the 18-pounder high-explosive shell required that all base plates should be threaded and screwed into the threaded recess in the base of the shell. Before assembling in place they were smeared with Pettman cement, and after they were firmly screwed into the base-plate recess they were riveted in place. This method of sealing the base end of the shell gave more or less trouble. Too much Pettman cement prevented the plates from seating properly. The riveting often resulted in loosening threads which without riveting were a good snug fit. For these reasons the new type of base plate was devised. Both types of base plates are shown in Fig. 3, and the illustration need not be repeated. By referring to this illustration it will be observed that a vertical flange is necessary to provide sufficient metal for riveting over to hold the new type of base plate. The thirteenth operation is one which is necessary with this new base plate only. Those shells which have the threaded base plate do not undergo it.





OPERATION 12: FACE TO CORRECT WEIGHT

Machines Used—20-in. engine lathes without tailstocks.
Special Tools and Fixtures—Combination chuck A; facing tool B.
Gages—The scales act as gages for this operation.
Production—One man and one machine, 35 shells per hour.
Note—This is a complementary operation to operation 11 and the equipment is similar to that shown in Fig. 15.
Reference—None.

The work is done on 20-in. by 6-ft. engine lathes. No tailstock is used. The arrangement is as shown in Fig. 22. The shell *A* is gripped in a heavy combination chuck, the nose of the shell bringing up against a stop. Owing to the fact that the shells in the twelfth operation have, in order to bring them to specified weight, been turned slightly varying lengths and will therefore not all project an equal distance from the chuck, some sort of self-accommodating gage is in this operation a manufacturing necessity. The gage *B* fulfills the requirements, is simple in construction and produces results that are sufficiently accurate. The part *B* is secured to the tool slide. Hinged to the top of it is the member *C*, which can be swung out of the way if desired. The forward end of *C* is slotted to accommodate the roller *D*. The angular tool *E* is ⅛ in. nearer the chuck than the roller *D*, thus gaging a cut ⅛ in. deep irrespective of the length of the shell.

The operation of turning the "face angle" (for riveting) is as follows: A shell is chucked, then the operator brings the carriage toward the chuck till the roller *D* touches the face of the base of the shell. With the carriage held in this position the angular tool *E* is fed across the face of the work till the stop is encountered. The scheduled time for this operation is 50 pieces per hour.

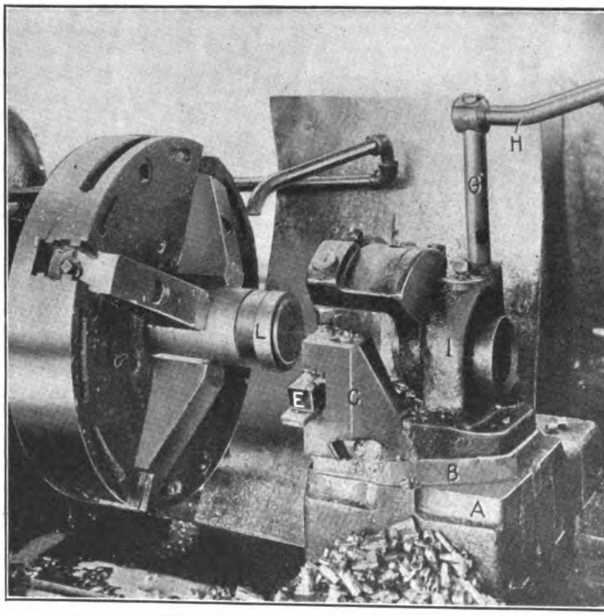


FIG. 23. ROUGH GROOVING FOR THE DRIVING BAND

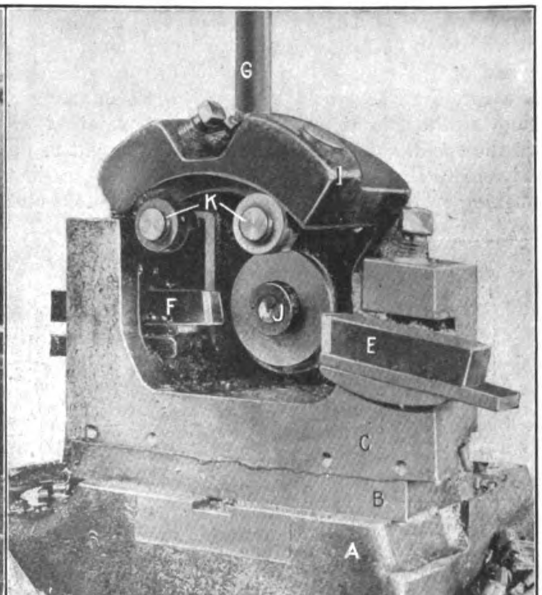
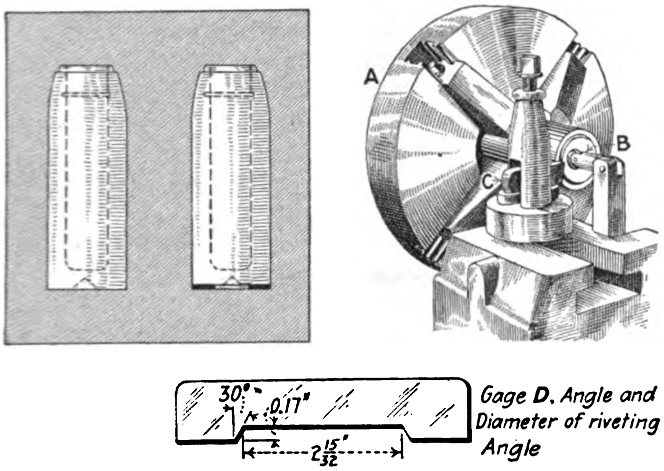


FIG. 24. ROUGH GROOVING TOOLS

The shop inspection for the thirteenth operation consists in gaging the riveting angle with a sheet-steel gage. Having passed inspection, the work is checked and credited to the operator, and the truck gang transfers it to the next operation.

The fourteenth operation is rough turning the groove for the wave and rounding the edge of the base. This work is done on 20-in. by 6-ft. engine lathes with a special set-up of tools, as shown in Figs. 23 and 24. Similar reference letters will be used wherever possible in these two illustrations in order to avoid confusion.



OPERATION 13: TURN THE RIVETING FACE ANGLE ON THE BASE OF THE SHELL

Machines Used—20-in. engine lathes without tailstocks.
Special Tools and Fixtures—Combination chuck A; compensating gage B; angular tool C.
Gage—Angle gage D.
Production—One man and one machine, 50 shells per hour.
Note—Cutting compound used.
Reference—Fig. 22.

Mounted rigidly on the cross-slide of the lathe is the block *A*. It is connected with the crossfeed screw, but for the purpose of crosswise adjustment only. Once the block *A* is set in the correct position, the crossfeed handle is removed and the gib screws are set up hard to prevent shifting. Rigidly secured to the top of *A* is the fixture *B*. Sliding crosswise on *B* is the member *C*, which carries at the front the rough groove-forming tool *E* and at the back the edge-rounding tool *F*, which is shown in Fig. 24. The sliding member *C* is provided with a rack that is engaged by a pinion on the lower end of the shaft *G*. A lever *H* controls the movement of the slide *C*. Rigidly secured to *B* is the member *I*, which acts as a housing for the shaft *G* and also carries the stop *J* and rollers *K* that bear on the plain part of the shell behind the groove and prevent it from lifting during the grooving operation.

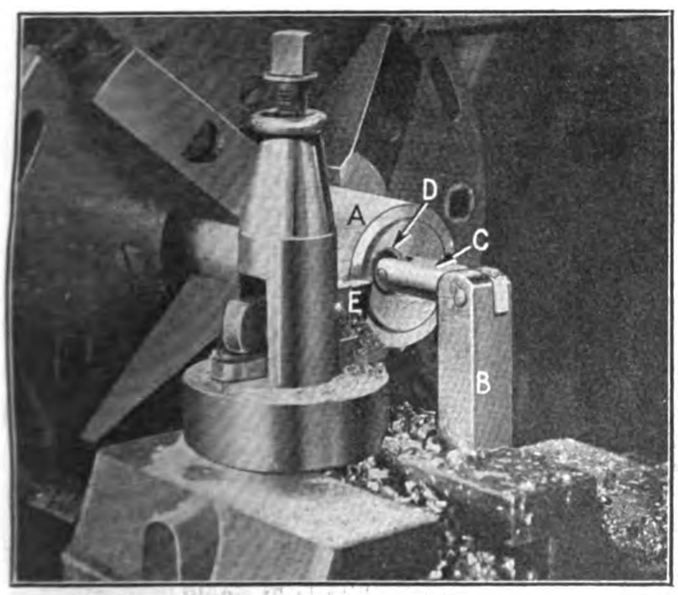
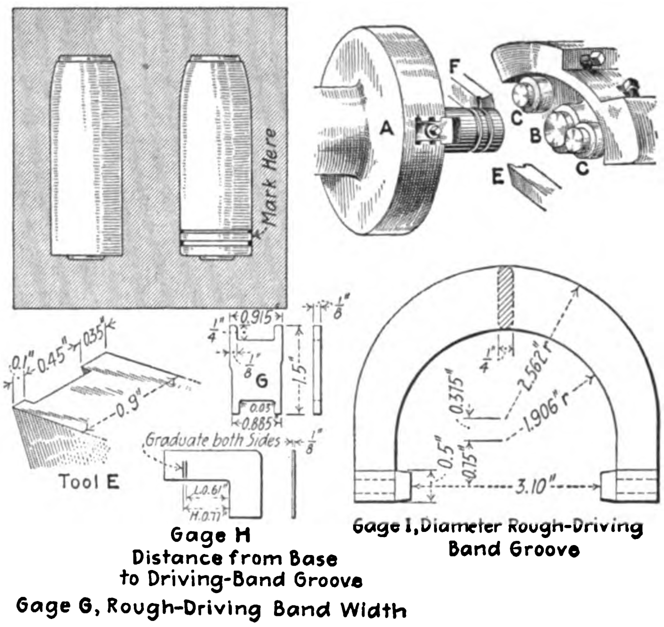


FIG. 22. TURNING THE RIVETING ANGLE

The operation of cutting a groove is very simple. The shell is chucked, and the carriage is brought forward till the stop *J* bears on the base of the shell, thus determining the distance from the base to the groove. The carriage is then clamped, and the operator pulls the lever *H* toward him till the stop for the grooving tool is reached. He then pushes it away from him till the stop for the edge-rounding tool is encountered. The first movement roughs the groove, and the second rounds the edge of the base. The carriage is now unclamped and run back and the work removed.



OPERATION 14: ROUGH TURN DRIVING BAND GROOVE AND ROUND EDGE OF BASE

Machines Used—20-in. engine lathes without tailstocks.
Special Tools and Fixtures—Combination chuck A; fixture on saddle holding the stop B and rollers C; cross-slide carrying the grooving tool E and edge-rounding tool F.
Gages—Rough driving band groove gage G; distance from base of driving band, gage H; gage for diameter of driving band groove I.
Production—One man and one machine, 35 shells per hour.
Note—Cutting compound used.
References—Figs. 23 and 24.

The scheduled time for the fourteenth operation is 35 pieces per hour. The shop inspection covers the diameter of the driving-band groove in the rough, the limits for which are 3.090 and 3.110 in. However, but a single gage is used here, 3.100 in. in diameter. The distance from the base to the driving band is between 0.73 and 0.77 in., but the high limit alone is used. The width of the driving-band groove in the rough, is between 0.885 and 0.915 in.

After inspection the shell is marked as specified in the standard marking sheet, shown in Fig. 10, the checker makes the necessary entry of credit to the operator who has done the work. The next move is up to the transportation department and consists in trucking the work to the succeeding operation.

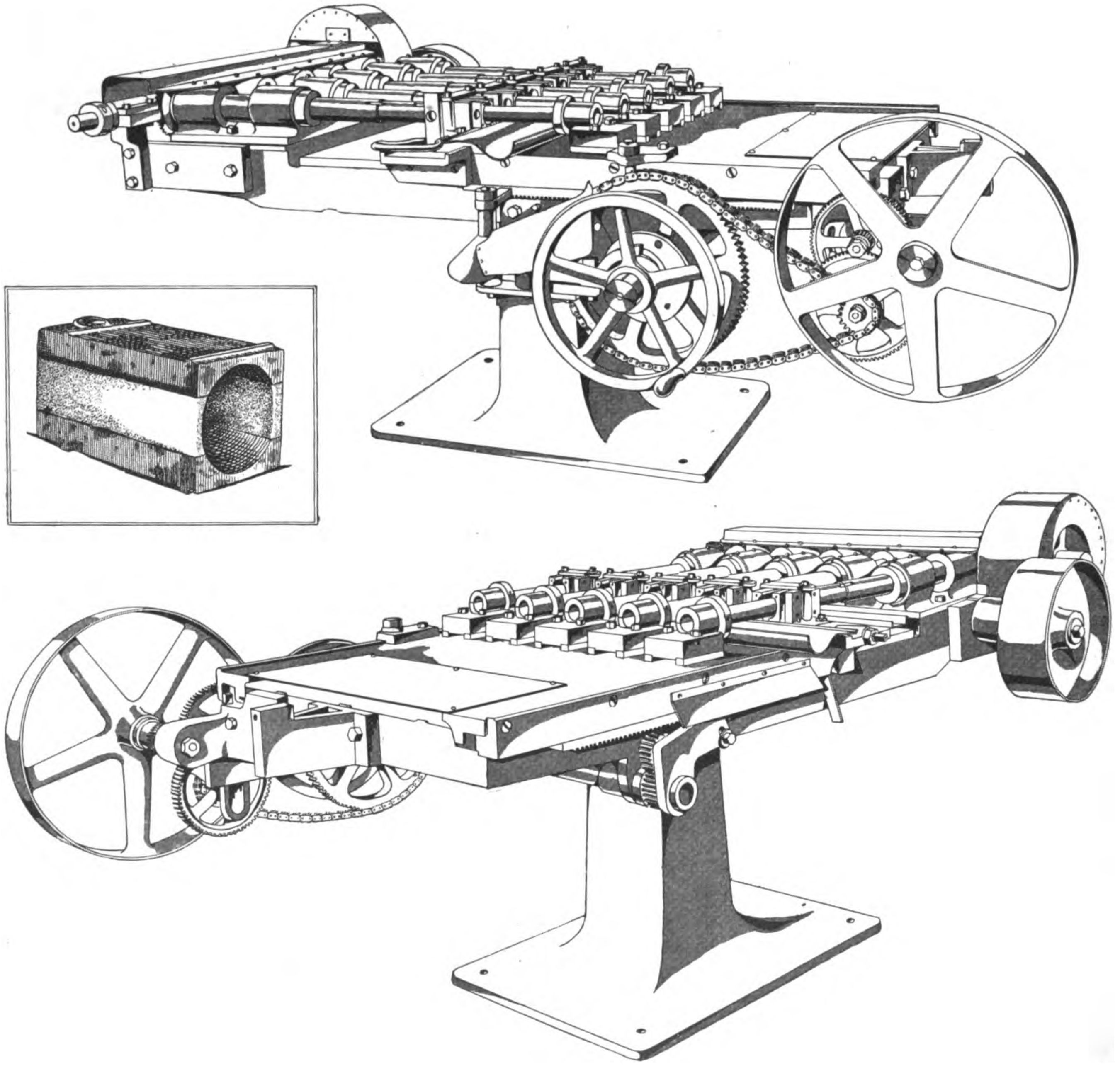
(To Be Continued)

Special Machine for Boring Magneto Pole Boxes

In the manufacture of magnetos the pole box represents a part on which rapid production is necessary in order to maintain the high output now so common in this class of manufacture. Too meet these conditions the Henricks Magneto and Electric Co., Indianapolis, Ind., has designed and manufactured a special machine, shown in the illustration, for boring pole boxes.

These parts are made of two cast-iron shoes with babbitt filling pieces, the fixture used when uniting or pouring them being shown in Vol. 43, page 1065, and five spindles on the machine, each 4¼ in. long. The pilot ends of the spindles are 1¼ in. in diameter and 3 in. long. The guideways of the spindle bearings are ¾ in. wide and 5½ in. long.

The feed of the machine is by a rack of ⅜-in. pitch, with a 1¼-in. face. The driving pulley is 11¾ in. in diameter and has a 4-in. face. It operates the machine through 4-pitch tooth gearing with 2½-in. wide faces. The shafts on which these gears are mounted are 1⅜ in. in diameter. The large gear driven by the driving pulley revolves at 73 r.p.m., and the spindles operate at 39 r.p.m. The feed of the machine is 1 in. per minute, and the average production of boxes bored is 30 per hour.



SPECIAL MACHINE FOR BORING MAGNETO POLE BOXES ON A HIGH-PRODUCTION BASIS

a dimensioned detail on page 1066. The base of the machine measures 22x30 in., with a flange of ¾ in. The column of the base is 9x7 in., and it stands 21 in. high from the floor to the under side of the table.

The table measures 31x37 in. and is made of metal 1 in. thick. The f[illegible] pulley is 18½x2¼ in. wide and operates throu[illegible] pitch silent chain. There are

This machine is an excellent example of the design of a multiple-spindle special machine tool intended to produce a single part under the most advantageous conditions. The result of the design is a machine which bears no resemblance to any standard machine tool, yet it probably represents the highest type of development for the purpose for which it was constructed.

Getting "Into" the Small Shop

By John H. Van Deventer

SYNOPSIS—Some customers have developed highly efficient ways of working up a fictitious credit, with the object of "putting one over" on the small shop when the time is ripe. This article relates one such instance, which had the effect of closing the doors of a small marine repair shop. Incidentally it introduces the reader to Dave Hope, the Knight-Errant Machinist.

"Rivet a washer on the end of your cold chisel, Sonny!" Dave Hope addressed this bit of advice to the new apprentice, whose hand was swollen to twice its natural size as the result of well-intentioned but misaimed hammer blows. The lad has passed the stage of looking for left-hand monkey-wrenches and of being sent from machine to machine in search for the key of the big planer, and was now learning the rudiments of chipping. Dave Hope's repair shop was a good place in which to learn this art, for there were plenty of castings to chip, and hardly any two of them were alike. Incidentally it was a great privilege for a boy to learn his trade in Dave's shop, for its owner was a real "all around" machinist, and an apprentice trained by him was able to use both head and hands when he stepped out of his time.

It will not be amiss to introduce Dave to you with a description of the man and a brief outline of his checkered career, for it is my hope to be able to recount from time to time during the year some of the most interesting of his adventures in small shops. Please overlook the single grimy finger that he extends you in greeting, and grasp him by the hand, for I know that *American Machinist* readers will not hesitate because of the signs of honest toil that are upon it.

Dave is one of those men whose age it is hard to tell from his appearance. The youthful expression of his face seems to contradict the evidence presented by his white hair and mustache, and his tall, somewhat spare figure is as active as that of a man of 30. He started to serve his time in a railroad repair shop when a boy of 12, in the days when a railroad-shop apprenticeship meant a much more varied experience than it does at present. A few years of knocking about the country followed this, during which he carefully avoided the big "manufacturing shops," for Dave, as he says himself, "never did have a liking for doing the same thing twice."

Dave Hope, the Knight-Errant Machinist

One fairly large repair shop in the West Virginia coal fields held him for 18 months—not because Dave was beginning to settle down, but because he had a good paying job as foreman, and board was cheap. He was beginning to get the "shop of his own" idea, and this seemed like a good chance to get the necessary money to start with. It was while here that Dave Hope's hair turned gray, due to being caught by a "fall" while directing the installation of a receiver on an air line in the lower level. Three days in darkness after the safety lamps burned out left their physical effect upon him, but seemed to make no impression on his spirit; or if any, it was to strengthen his disregard of danger or obstacles standing in the way.

Then began his adventures with small shops of his own—many of them, but one shop at a time—most of them disastrous financially, for Dave is no "captain of industry," but rather a "knight-errant machinist" who loves to venture where those seeking more substantial return fear to tread. And while he has attended the obsequies of more defunct plants than any other man of my acquaintance, the funeral services are scarcely over before you find Dave installed in another shop in which he does what he pleases in the way that suits him best. While these many changes have kept him rather poor in pocket, they have made him rich in experience and character, and as a curious result he has a sort of camp following among those who work for him. Thus as I leaned against the bench and heard him deliver the foregoing words of advice to the apprentice, I could pick out among those working about the shop, faces which I had seen both in his shop in Philadelphia and in the one in Kansas City, where our acquaintance began.

The Kind of Experience That Sticks

"That kid with the sore thumb is getting experience," remarked Dave. "We all get it that way, and it's the only way that seems to stick. Life is a series of bumps from the time you slide off the first step till you hit the bottom landing. It's all in getting used to it. You can even get so you like it, as the boy did who had the measles three times. Sometimes it's a money loss, sometimes a machine won't work as you expect, and sometimes a disappointment in human nature. The hardest kind of a bump is when a man you trust goes back on you. I've had a number of such experiences, and while I can look back now and see the funny side of them, the sore spot lasted much longer than it did with the ordinary kind of bumps.

"Maybe it will interest your readers to hear of a lesson I learned about extending credit. I hope other small-shop owners may profit by it, and that it will help some of them to avoid paying the price that I did for this kind of experience.

"If you've been along Long Island Sound during the summer season, you've noticed what a slew of motor boats and steam yachts there are dotting the bays outside of the summer-resort towns. I noticed this about nine years ago, and also that about five boat owners out of seven seemed to have trouble with their motors when they got 50 ft. away from the dock. Of course this wasn't to be wondered at. Many of the owners were clerks from the city who knew as much about taking care of an engine as that green apprentice boy does about swinging a hammer. The boats were mostly hand-me-downs; not merely second hand, but seventh or eighth hand, and in addition the gasoline that those alongshore dealers worked off on that bunch of innocents was so weak that it could hardly run even when the can was turned upside down.

"I didn't have a shop just at that time, and the idea struck me that here was an opportunity that a good mechanic might turn to advantage. This was before the automobile became common, remember, and there were not many machinists in those days who understood the

kinks and troubles of small gasoline motors. At least those that I found in the existing shops along the waterfront didn't know much about them, judging by the work they turned out.

"After looking about for a week or so, I ran across a place that looked good to me. The shop stood up on posts at the water's edge and had a dock of its own. The equipment was nothing to brag about, consisting of two lathes in fair condition, one of 16-in. and one of 18-in. swing, a more or less dilapidated gap lathe built up to swing 48 in., a shaper that had seen better days, a pipe threader and two upright drills. I guess what really attracted me to the place more than anything else was seeing a small boy catch three fine flounders in quick succession from the end of the dock. It looked to me like a good place for a fisherman to locate!

"It was about the middle of June that I came into possession. I managed to get enough cash together to make a satisfactory first payment and started in to get some of the money back. Reddy Burke, that you see over there on the miller, was with me, and so was Sandy McPherson, the fellow with his back turned to us, who is fitting a key at that bench. People were just getting their boats out and quite a bit of overhauling was to be done. A good many of them came to us because they knew we couldn't do any worse by them than the other shops and might possibly do better.

"At first most of the work was on small motors, one and two cylinders, ranging from 4 to 20 hp. We turned out good work on these, and the reputation brought us some of the larger boats and a better grade of work along with it. There was one boat that we couldn't touch. It was the largest craft that anchored at the port, a 90-ft. steam yacht with twin triple engines. It seems that in this world what you can't get is what you want most, and it bothered us a lot to see the work on that boat go to a fellow a quarter mile up the bay, especially as we knew what sort of mechanic he was. The 'Alice,' that was her name, made regular trips across the sound and carried passengers back and forth from the shore resorts on each side.

Alice, Where Art Thou?

"Business kept up pretty good, and by the end of July we had taken in enough over and above expenses to make the second payment on the shop. At this rate we would be clear before the end of the season. Any reasonable man ought to have been satisfied with that, but in spite of it our fingers itched to get hold of the 'Alice' and get a chance at work that was really worth while.

"One afternoon about four, we were all busy in the shop when somebody hailed from the end of the dock. I started out to find what was wanted and saw a short stout fellow climbing out of a dinghy that was tied to one of the spiles at the landing platform. When I got a look at his face I saw that he was Captain Skinner of the 'Alice.'

"'Anybody here that understands high-pressure feed pumps?' he asked.

"It took me about two minutes to explain to the captain that there were three men in our shop who knew more about high-pressure feed pumps than any six that he could find if he offered a reward for them anywhere in the United States. I don't know whether he believed it or not, but he was up against it, so Sandy went out in the dinghy, taking his tool kit with him.

"He turned up again in an hour and a half with some samples of mush that had clogged up the discharge check valve and prevented the pump from doing its work. 'Nothing the matter with the pump,' said Sandy. 'The trouble was with the last butcher that overhauled it and put in cold-water packing!'

"Captain Skinner came to us to have his work done after that, and while all the jobs were small ones, it made us feel pretty good to think that the 'Alice' had had to come to Hope's Marine Repair Shop at last. Nobody could have been any better pay than the captain; he never questioned a bill and settled each one within ten days.

"After the middle of August, work slacked up a bit. Most of the boats would be put up after Labor Day, and the owners were beginning to cut down expenses and get along with motors that would run at all, just as nowadays you see a fine lot of decrepit auto tires displayed in the fall. We hadn't figured on this, and it hurt us more than I cared to admit.

A Job That Looked Like a Life-Saver

"It looked like a life-saver when, the day after Labor Day, Captain Skinner turned up with a three-weeks' job for us on the 'Alice'—nothing less than a complete overhauling of the twin triple engines and all of the auxiliaries. The three of us moved over to the 'Alice' next day with our tool kits, and settled down to three weeks of the hardest work we ever did. All of us had corns on our backs from working in the engine pit.

"At the start of the third week Captain Skinner asked me to try to finish up by the coming Saturday morning. As there was some work waiting for us at the shop, we decided to work overtime nights so as to be sure to clean up by Friday night. By Thursday noon we saw that we would finish within the limit, but we were all three so tired out and short-tempered that we had to invent new cuss words to pay our respects to each other, having exhausted all of the ordinary ones.

"Friday night we turned her over to the captain, everything shipshape and better than new. I figured that there was close to a thousand dollars' worth of time and material on that job, and it was worth every penny of it. The captain wanted to give her a trial spin Saturday morning and insisted that I go along with him to see that everything was all right; but in view of all of the work waiting at the shop this was impossible, so I told him to try her out with his own crew. I was sure of the job and knew it would be all right. I handed him the bill for the work, and he said he would settle next evening if nothing went wrong.

"We went to work at 6 o'clock next morning to catch up with the accumulated work. At 8 o'clock one of the boys looked out of the window and said that steam was up on the 'Alice.' At 8:30 she began to move, and we all rushed to the window to give her a wave for good luck. On she went down the bay toward the outlet, looking as pretty as a picture and making a good two knots more than she had been capable of before we overhauled her. She rounded the headland, and we went back to work feeling that we had done a good job.

"We had; but so had Captain Skinner, for that was the last we ever saw of the 'Alice'!"

Improvements on Shell Tools

By J. H. Moore

One firm that has been turning out a considerable quantity of 18-lb. British shells has experienced trouble in getting the shell base correct as to size and finish, the inspectors being very particular on this point. To make sure that all are similar, the company has designed and built what might be termed a special-purpose grinder,

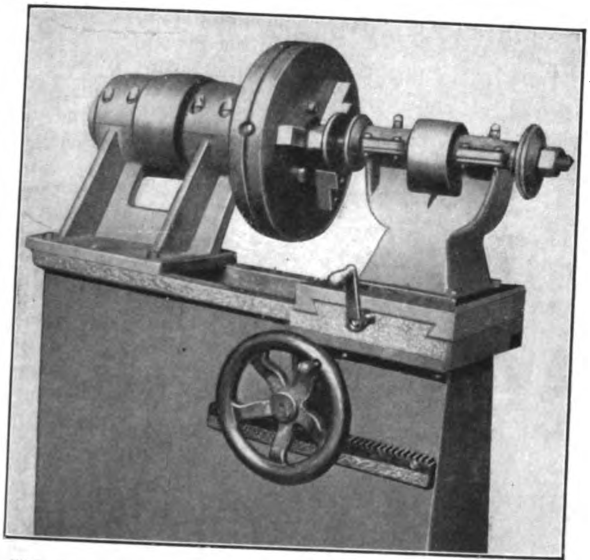


FIG. 1. SPECIAL GUIDE FOR GRINDING SHELL BASES

shown in Fig. 1. The universal-type chuck grips the shell quickly and accurately. The small grinder head is fitted to a sliding apron and holds the wheels that grind both the diameter and the bottom of the shell base. The apron has movement in both directions.

A type of mandrel or boring bar used on the inside work of the shell is shown in Fig. 2. Three operations are done by it—the finishing of the powder-chamber bottom, the facing of the powder-chamber shoulder and the facing of the shell to length. The cutter *A* finishes the bottom of the chamber. Slot *B* shows where the cutter to finish the shoulder goes in, while the four slots *C* show where the cutters for facing off the length are placed. The two last-mentioned cutters have considerable adjustment, and this fact will be appreciated by those

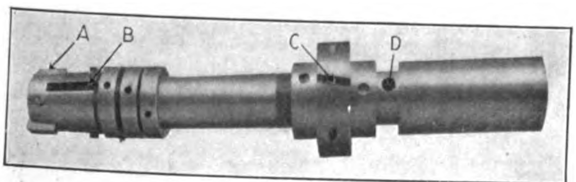


FIG. 2. BORING BAR OR MANDREL FOR COMBINED SHRAPNEL-SHELL OPERATIONS

who have figured on this kind of work. The hole *D* is internal oil feed; and as the bar is hollow, all cutters are well supplied with lubricant.

A handy chuck for shrapnel plugs, which is both quick and extremely accurate, is shown in Fig. 3. The chuck jaws are shown at *A* and are in four parts. A small spring is placed between each jaw. The body *B* is threaded internally and screws on a hub on the flange *C*. The jaws are tapered 18 deg. This is found to be ample to work satisfactorily. To give double driving power to this chuck, a square plug with a round shank is placed

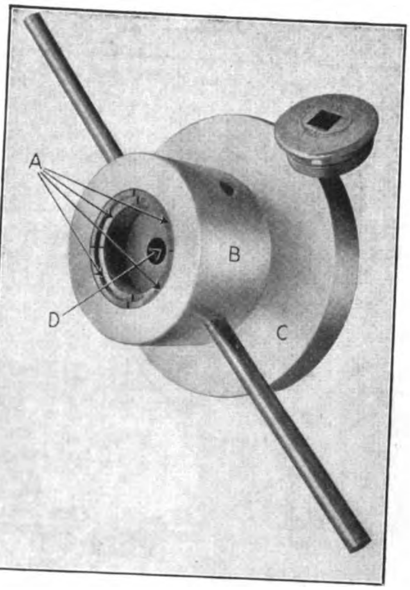


FIG. 3. CHUCK FOR SHRAPNEL PLUGS

in the hole *D*. This plug engages with the square hole in the shrapnel plug and so drives both from this hole and from the outside shell diameter, which is grasped by the chuck.

Conditions of the Machine-Shop Labor Market are shown in a recent report of the New York State Department of Labor. In commenting on manufacturing conditions in general the report states that the greatest improvement was shown by the metal-working industry, which has gained strength all summer, from May to September; and in each month from May to September the industry has shown increasing strength compared with the corresponding months of 1914. The largest increases were shown by concerns manufacturing firearms and automobiles and parts; rolling mills showed but slightly less important gains. The manufacture of brass, copper and aluminum goods, although somewhat less active than in August, showed still in September far greater strength than a year ago. September showed marked improvement also among the group of concerns manufacturing typewriters, instruments and appliances. The only branch of the metal-working industry which is not operating at least as actively as in 1914 is that of fabricating architectural and structural iron.

The Resharpening of Files has only within recent years become commercially successful, according to a paper presented before the International Engineering Congress by E. R. Norris, reviewing generally machine-shop equipment, methods and processes. A sand-blasting apparatus is being used with success for file sharpening by several large manufacturing establishments. This apparatus consists of a sheet-iron chamber provided with uptake, settling tank, slurry mixing-tank, slurry overflow pipe, air agitating pipe and slurry projector. A door gives access to the inside of the chamber. The slurry projector is inclined to the horizontal at an angle of 25 deg., and the nozzle extends slightly within the chamber. This projector consists essentially of a bronze body to which are fitted steam pipe, slurry suction-pipe and nozzle. The steam supplies sufficient water for the slurry. The files are sharpened by being held in the slurry jet in such a manner as to expose the backs of the file teeth to the cutting action of the sand. After the file has been sharpened, it is cleaned and dried by the steam, after the slurry supply has been cut off by a foot lever. Success in file sharpening depends on the skillful selection of the files to be sharpened, maintenance of the correct angle between files and jet while sharpening, and the selection of a suitable sand.

Machining a Two-Sheet Rotary-Press Side Frame

By Robert Mawson

SYNOPSIS—The operations and small tools followed and used in machining a printing-press side frame. The rough casting is first milled on the pads on the outside. Then follow a second milling, boring and drilling operations.

Printing presses are made in comparatively small numbers. The economic effect of this fact is to limit jigs and fixtures to those that are simple in design and construction, and where possible to those that are of such a nature that a number are used in machining one part. The jigs and fixtures shown in this article are from the shop of the Woonsocket Machine and Press Co., Woonsocket, R. I. They are used in manufacturing the side frame of a two-sheet rotary printing press.

The type of the jigs and fixtures shown is what is often called "outside templets." This means that they are simple in construction, inexpensive in first cost and yet produce interchangeable work of the necessary accuracy.

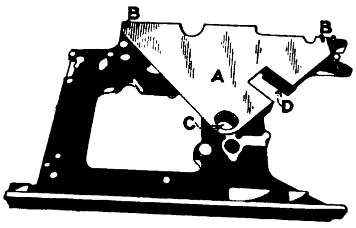


Fig. 2

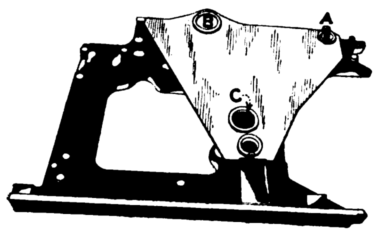


Fig. 3

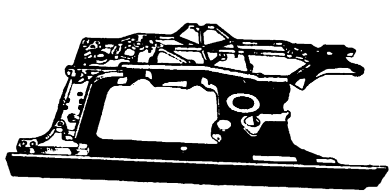


Fig. 4

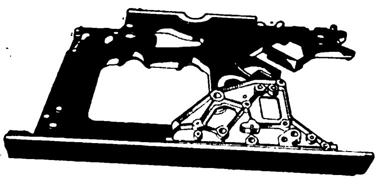


Fig. 5

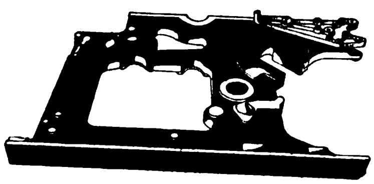


Fig. 6

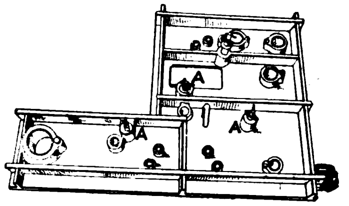


Fig. 8

FIGS. 1 TO 8. PRINTING PRESS SIDE FRAME JIGS AND FIXTURES SHOWN IN PLACE ON THE WORK

FIGS. 2 AND 2-A

Operation—Milling 45-deg. surface to suit gear-bearing box on frame, Fig. 1.

The templet A is placed on the casting, which is fastened to the milling-machine table and adjusted by two screws B until core C is central; the stock left on each side of slot D is surface-machined; slot, using upper edge, the outside face of the bosses and the base, using a 4-in. end mill, operating at 60 r.p.m. and with feed of 0.03 in. per revolution.

FIGS. 3 AND 3-A

Operation—Boring large holes for gear boxes on frame, Fig. 1.

The templet is placed on the casting, located by hardened plates which fit in the machined 45-deg. slot.

Holes Machined—One $4\frac{1}{2}$-in. bore and ream A; one 8-in. bore and ream B; one 6-in. bore and ream C; one $4\frac{1}{2}$-in. bore and ream D.

FIGS. 4 AND 4-A

Operation—Drilling 34 holes in frame, Fig. 1.

The jig is located by two plugs which fit into reamed holes.

Holes Machined—Three $1\frac{1}{32}$-in. drill; one 1-in. drill and ream; three $\frac{7}{8}$-in. drill and ream; three $\frac{3}{4}$-in. drill and ream; one $\frac{21}{64}$-in. drill; two $\frac{7}{8}$-in. drill for 1-in. U.S.S. threads; one $\frac{11}{16}$-in. drill for $\frac{3}{4}$-in. U.S.S. threads; two $1\frac{5}{8}$-in. drill and ream; two $1\frac{13}{32}$-in. drill for $1\frac{1}{2}$-in. U.S.S. tap; two $2\frac{1}{4}$-in. drill and ream; five $\frac{5}{8}$-in. drill and ream; one $1\frac{1}{4}$-in. drill and ream; two $1\frac{9}{32}$-in. drill; one $\frac{7}{8}$-in. drill and ream; one $1\frac{1}{2}$-in. drill and ream; three $\frac{13}{16}$-in. drill for $\frac{7}{8}$-in. U.S.S. threads; one $1\frac{3}{8}$-in. drill and ream.

FIGS. 5 AND 5-A

Operation—Drilling 12 holes in frame, Fig. 1.

The jig is located by a circular plug set in a bored hole and finished; the jig rests on top of the frame.

Holes Machined—One $1\frac{9}{32}$-in. drill; one $1\frac{3}{8}$-in. drill and ream; one $\frac{3}{4}$-in. drill and ream; three $\frac{5}{8}$-in. drill and ream; one $1\frac{5}{8}$-in. drill and ream; one $\frac{3}{8}$-in. drill and ream; one $\frac{29}{32}$-in. drill; one 1-in. drill and ream; one $1\frac{1}{2}$-in. drill and ream; one $\frac{3}{4}$-in. drill and ream.

FIGS. 6 AND 6-A

Operation—Drilling 16 holes in frame, Fig. 1.

The jig is located by a large plug; filling in finish-bored hole; two setscrews tightened to hold it rigid.

Holes Machined—One $\frac{3}{4}$-in. drill and ream; one $\frac{3}{4}$-in. drill; two $\frac{31}{64}$-in. drill; one $1\frac{7}{8}$-in. drill and ream; one $1\frac{3}{4}$-in. drill and ream; one $\frac{7}{8}$-in. drill and ream; four $1\frac{5}{32}$-in. drill; two $\frac{7}{8}$-in. drill and ream; one $1\frac{1}{2}$-in. drill and ream; two $\frac{27}{32}$-in. drill.

FIGS. 8 AND 8-A

Operation—Drilling holes in face of plate cylinder cap, Fig. 7.

The casting is located by a circular plug set in a hole previously reamed. It is held in position with the hook bolts A. All milling has been done in previous operations.

Holes Machined—Five $\frac{7}{16}$-in. drill; two $1\frac{3}{8}$-in. drill and ream; two drill and tap with No. 14-20 threads; four $\frac{11}{16}$-in. drill; one $\frac{5}{8}$-in. drill; two $\frac{57}{64}$-in. drill.

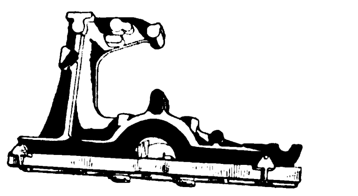


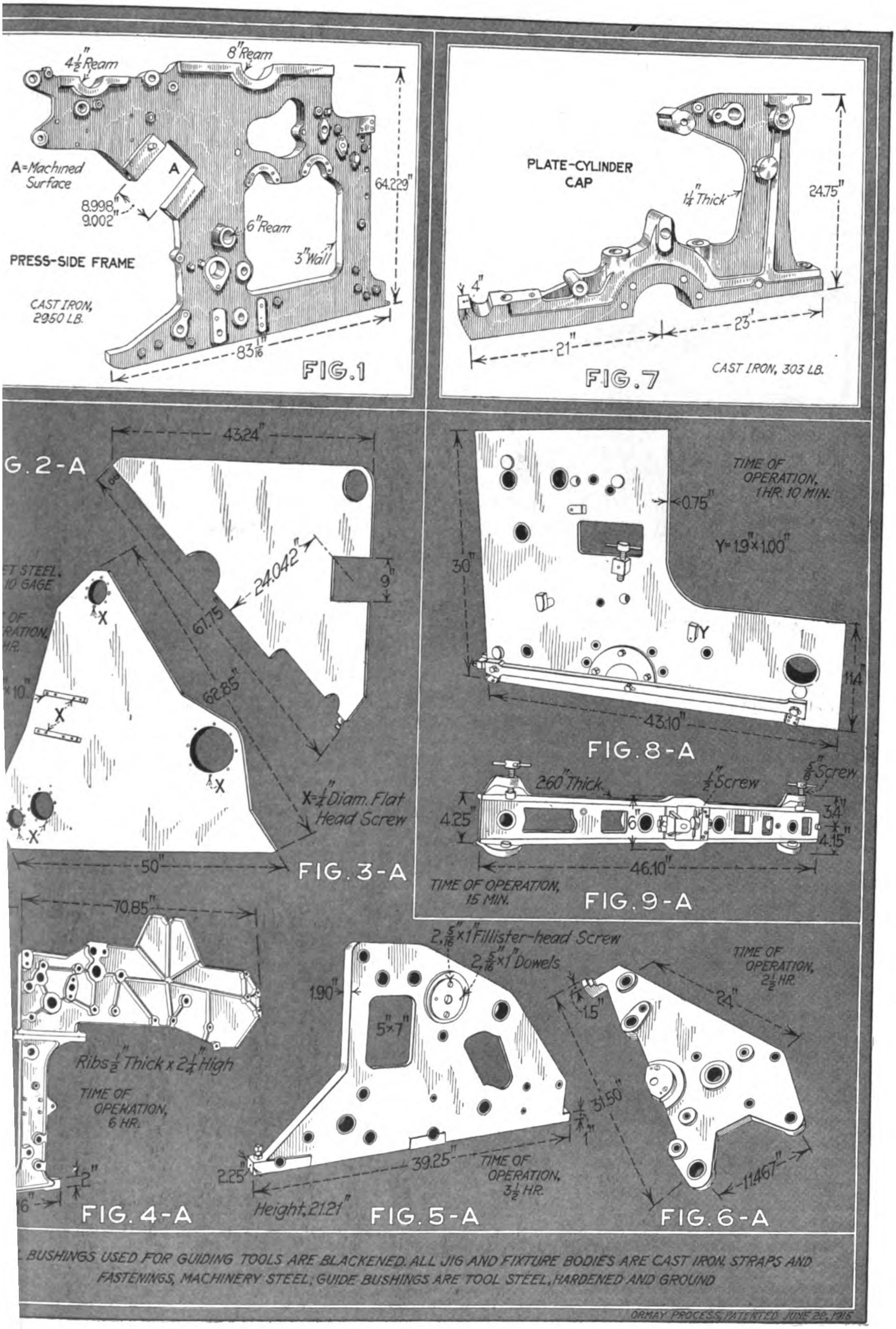
FIG. 9. DRILL JIG FOR JOINT SURFACE

FIGS. 9 AND 9-A

Operation—Drilling holes on joint surface, Fig. 7.

The jig is placed on the milled surface, located by a stop and held in position with screws on the sides.

Holes Machined—Four $1\frac{9}{32}$-in. drill; one $\frac{1}{2}$-in. drill.



DETAILS OF JIGS USED IN MACHINING PRINTING-PRESS SIDE FRAMES

A Rotary Printing Press

On page 56 is printed the first of a series of articles describing the tools and methods used by the United Printing Machinery Co., Woonsocket, R. I., when manufacturing the press shown on this page.

This machine will print any size of sheet between 29x42 in. and 46x66 in. The press has one plate cylinder *A* and one impression cylinder *B;* the plate cylinder takes two forms and the impression cylinder has two impression surfaces. As there are two automatic continuous feeders *C,* the press will print in one revolution two sheets at a speed of 2,500 per form per hour, or a total output of 5,000 sheets per hour.

The press has two distinct deliveries *D,* the sheets printed by each form being delivered separately on lowering piles at *E.* The distribution consists of eight form rollers, four 8-in. vibrators *F* and five intermediates.

The adaptability of the press is quite extensive, covering the following combinations: Two forms, one to back up the other; two forms to work and turn; two duplicate forms; two entirely different jobs, providing the ink is the same.

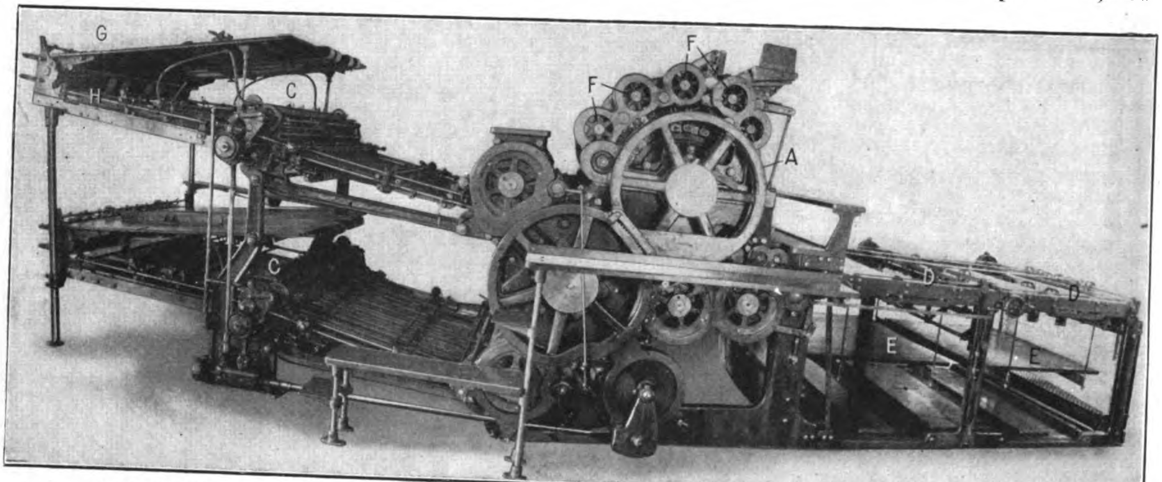
The feeder used on the press is quite interesting, operating somewhat as briefly described. The device automatically feeds the sheets to the machine. It is continuously loaded from above, the paper being placed on the supply table *G.* The paper is drawn from this board to the lower board *H* by passing around the drum. After it is drawn to the proper position on the lower board and the machine is put in operation, the bank of paper is kept in the proper position automatically.

When the machine is started, the combing wheels are lowered and comb the paper forward to the sheet controlling trips. There are two of these that engage the front edge of the sheet, thus bringing it square. Should the front edge of the sheet reach the trips on one side before the other, the opposite wheel will continue to comb until the sheet is brought square.

When the edge reaches the trips, the comb wheels ride up on the comber foot, which acts as a clamp and stops the sheet from advancing farther. A clamp then descends on the bank of paper in the rear of the top sheet and holds the bank in position while the top sheet is withdrawn. With the bank held as described, the combing wheels and feet are lifted and the drop rolls engaged to forward the sheet on the conveyor to the press.

Just before the front edge of the sheet reaches the drop guides the speed of the sheet is checked by rolls grasping the rear end and bringing it gently to the guide without crowding. After the sheet reaches the drop guides a feeler determines if it is in position; if so, the sheet will be engaged by the press grippers and print. If, however, it is not in the correct position, the feeler will automatically trip and stop the feeder.

There is also a device located on the conveyor of the feeder which will allow only one sheet to pass at one time. If more are fed forward, the device will automatically trip and stop the feeder, thus preventing both spoiling of sheets and damage to the form.



A TWO-SHEET ROTARY PRINTING PRESS WITH HIGH-SPEED AUTOMATIC CONTINUOUS FEED

Principal Uses for Tungsten Steel, according to a paper read before the International Engineering Congress, are for magnets for magnetos in the manufacture of hacksaws, to some extent, and for special tool steels. Tungsten is seldom used in engineering construction steels and then usually in combination with chromium. The accompanying table shows the typical engineering alloy steels and their tensile properties for the same heat-treatment draw-back temperature. This is in all cases 600 deg. C. (about 1,100 deg. F.). The specimens in most cases were heat-treated in the form of inch rounds and were machined after treatment.

TABLE OF PROPERTIES OF ALLOY STEELS

Carbon, per Cent.	Manganese, per Cent.	Nickel, per Cent.	Chromium, per Cent.	Vanadium, per Cent.	Elastic Limit, Lb. per Sq.In.	Tensile Strength, Lb. per Sq.In.	Elongation in 2 In., per Cent.	Reduction of Area, per Cent.
0.27	0.55	...	...	...	49,000	80,000	30	65
0.27	0.47	...	...	0.26	66,000	98,000	25	52
0.36	0.42	...	...	...	58,000	90,000	27	60
0.34	0.87	...	...	0.13	82,500	103,000	22	57
0.45	0.50	...	...	...	65,000	96,000	22	52
0.43	0.60	...	...	0.32	96,000	122,000	21	52
0.47	0.90	...	...	0.15	102,000	127,500	23	58
0.30	0.60	3.40	...	...	75,000	105,000	25	67
0.33	0.63	3.60	...	0.25	118,000	142,000	17	57
0.30	0.49	3.60	1.70	...	119,000	149,500	21	60
0.25	0.47	3.47	1.60	0.15	139,000	170,000	18	53
0.25	0.50	2.00	1.00	...	102,000	124,000	25	70
0.38	0.30	2.08	1.16	...	120,000	134,000	20	57
0.42	0.22	2.14	1.27	0.26	145,000	161,500	16	53
0.36	0.61	1.46	0.64	...	117,600	132,500	16	58
0.36	0.50	1.30	0.75	0.16	140,000	157,500	17	54
0.30	0.50	...	0.80	...	90,000	105,000	20	50
0.23	0.58	...	0.82	0.17	106,000	124,000	21	66
0.26	0.48	...	0.92	0.20	112,000	137,000	20	61
0.35	0.64	...	1.03	0.22	132,500	149,500	16	54
0.50	0.92	...	1.02	0.20	170,000	186,000	15	45

Notes on Small-Tool Design--III

By Carl D. Wilder

SYNOPSIS—This article treats of small cutters and tools other than the standard ones ordinarily carried in stock. Points, determined from actual experience covering many years in the toolroom, are given for the proper construction of these tools.

Small-tool design is an important item in connection with the design of jigs, but it is often overlooked, because it is so easy to concentrate most of the attention on the jig itself. The illustrations presented are typical of small tools other than standard reamers and mills. It is impossible to give detailed dimensions for these or to do more than deal with the general principles underlying the design, since in most cases they are of special size and dimensions to suit special purposes.

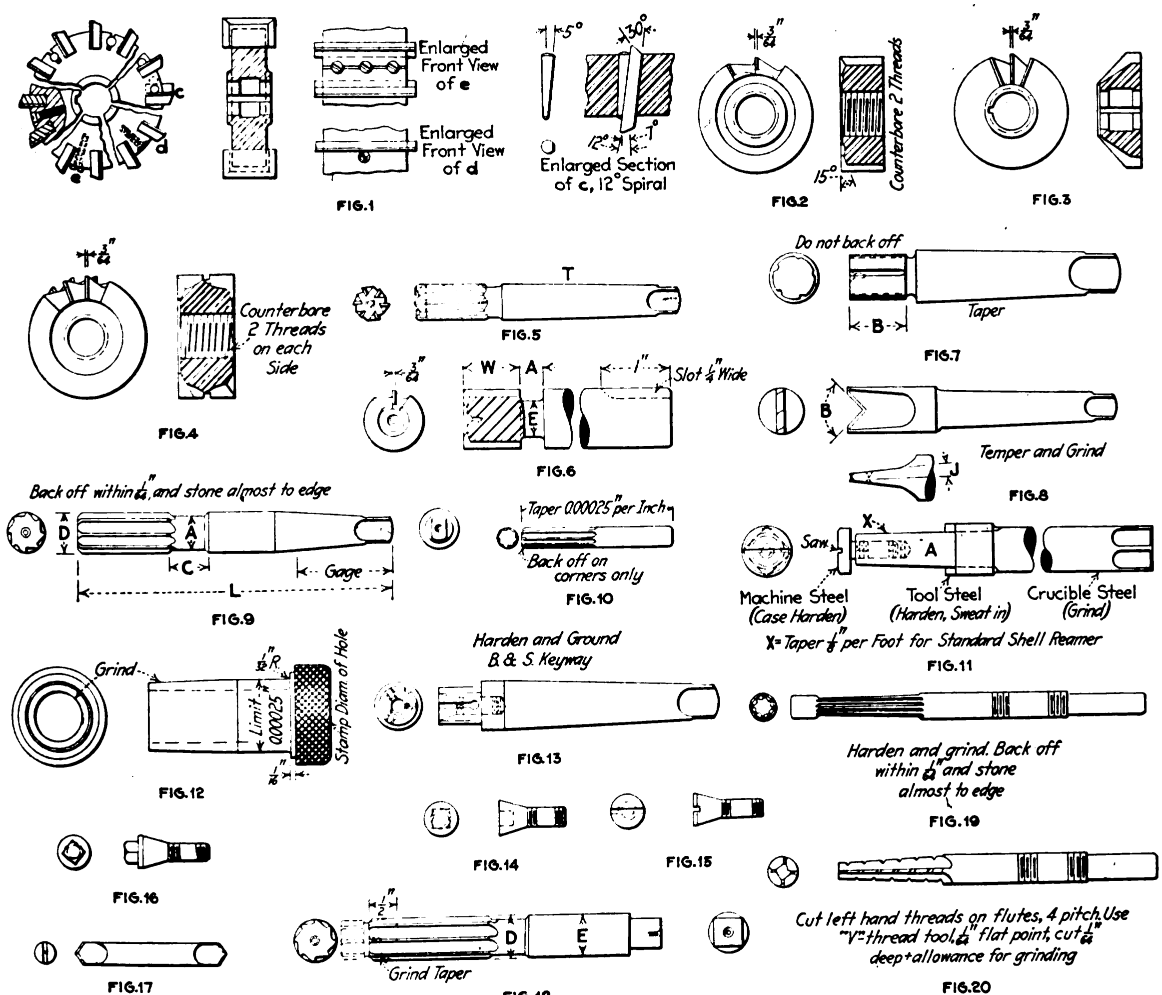
In assembling gangs of milling cutters on arbors it is well to adopt certain standards for the diameter of hole, diameter of hub, and the like. These may run as follows: Diameter of hole, $\frac{7}{8}$ in., 1 in., $1\frac{1}{4}$ in., $1\frac{1}{2}$ in., $1\frac{3}{4}$ in. and 2 in.; diameter of hub, $1\frac{3}{8}$ in., $1\frac{1}{2}$ in., 2 in., $2\frac{1}{4}$ in., $2\frac{1}{2}$ in. and $2\frac{3}{4}$ in.

The width of the land can be from $\frac{3}{64}$ in. up to 6 in.; diameter of cutters, $\frac{1}{16}$ in. for cutters from 6 in. to 7 in. in diameter and $\frac{5}{64}$ in. on all that are over 7 in. in diameter. The backoff of the lands can be from 5 to 7 deg. The thickness of material between the bottom of the gash and the top of the keyway must be at least $\frac{3}{8}$ in.

An old rule that gives good results for milling cutters is: "Ten teeth for the first inch of diameter and four teeth for each additional inch." For roughing cutters the rule is: "Eight teeth for the first inch and two for each additional inch." The Pratt & Whitney formula gives a larger number of teeth. If N equal the number of teeth and D the diameter, the formula is $N = 2\frac{1}{2} D + 12$ for face mills and $N = 3.1 D + 11$ for side mills.

Make all cutters as small in diameter as possible, and have arbor and collar clear all obstacles by at least $\frac{3}{16}$ in.

To cut straight teeth on face mills use an ordinary 60-deg. angular cutter. To cut spiral teeth, use a cutter 12 deg. on one side and 48 deg. on the other. The points



A VARIETY OF SMALL CUTTERS AND TOOLS FOUND ESPECIALLY USEFUL

of the cutter teeth should be rounded so as to leave a fillet at the bottom of the gash.

Make all face mills over 3/4 in. face, spiral. To bring the thrust against the spindle and prevent loosening of the arbor, for right-hand cutters use left-hand spiral and for left-hand cutters use right-hand spiral. Side mills may be cut spiral when the benefit from the shearing cut overbalances the ill effect of the slight negative rake which is given the teeth.

Solid cutters over 4 in. in width should be made in sections to interlock, because the risk in hardening is too great to permit the use of longer ones.

Make all side and face mills over 6 in. diameter of the inserted-blade type. In Fig. 1 are shown different ways of securing the teeth. Two teeth per inch of diameter is a good average for these large mills. In cutters over 8 in. in diameter the body may be made of cast iron, but below this size and below 2-in. face the body should be of machine steel. The body may be as thin as 3/4 in. if the pin binder shown at C is used.

Cutters of this style may be made by drilling and reaming the holes and driving the pins in place. The slots are then milled and the pins are already slabbed. It is a simple, cheap and effective way to secure the blades.

The thickness of inserted blades should run from 5/16 in. to 1/2 in., according to the size of the cutter, the depth of the chip and the feed which it is expected to take. The depth of the cutter blades should be from 1 1/4 in. to 1 1/2 in. in the body, and they should project from 5/16 in. to 3/8 in. above the body and not less than 3/16 in. on the side. The side and top angles may each be 30 deg.

Butt Mills and Angular Cutters

Threaded butt mills are driven by the thread only and depend for their true running on being forced against the collar of the milling arbor. When possible, it is better to shorten the thread and have a portion of the hole reamed to fit a straight part on the arbor, which adds to the bearing.

A good, strong construction for heavy angular cutters is shown in Fig. 3. The angle is well backed up, and cutters of this type should be used for heavy cuts wherever possible. Grooving cutters which cut on the face only should have the sides slightly concaved, about 1/2 deg. in extent, something like a saw, to prevent binding or dragging. Instead of concaving the whole side of the cutter, as has been the custom of cutter makers, there should be left a hub flush with the sides of the teeth, thus allowing its use in gangs without danger of springing the arbor.

Double-end butt mills, such as shown in Fig. 4, can often be used to advantage. Their construction and use are obvious.

Stem milling cutters for roughing and high-power end mills should have four teeth for mills which are 1 in. or less in diameter and an additional tooth for each 1/4 in. above that. For general work the following table is a guide to the number of teeth on end mills:

Diameter, in.	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1
Teeth	6	8	8	8	8	8	10	10	10	10	10
Diameter, in.	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2			
Teeth	12	12	12	14	14	14	16	16			

Spiral teeth give the same negative rake on the end of a mill as on the sides of the side mills. The angle of the spiral is usually about 8 or 10 deg., but it may be as high as 20 deg. for cam milling. The angle at which to set the index head when cutting the end teeth of end mills may be found from the following formula, when N is the number of teeth to be cut, V the included angle of the sides of the fluting cutter and W the angle at which to set the index head:

$$Cos\ 2 = \frac{360}{N}\ cotan\ V$$

Center-cut end mills, such as shown in Fig. 5, are often necessary to cut into the surface of work and then feed along, as is done on dies and similar work. The teeth are given clearance only on their inside ends. They are coarse for convenience in making and to enable them to take heavy cuts. Four teeth should be used up to 1/2-in., six teeth to 1 1/4-in. and eight teeth for 2-in. diameters. A special type of end mill for cutting cam tracks is shown in Fig. 6. It is made to be held as close to the work as possible. The length of cut W is not over 1/2 in. more than the depth of the track to be cut. The neck A is very short, and E is just small enough so that the teeth can be milled. On such a cutter it is best to use a positive drive with 1/4 in. key.

Teazels and Fish-Tail Cutters

In Fig. 7 is shown what is known as a teazel. It is used to follow the cam cutter just described. It does not cut, but is used as a burnisher to smooth the track which has been cut about 1/1000 in. small. The length B on the teazel must be left very hard.

The fish-tail cutter shown in Fig. 8 is used in the Pratt & Whitney spline miller, and does the work of an end mill, but more rapidly and at less cost for cutters. The angle B is about 90 deg. and J is about 3 deg.

A reamer suitable for use through the bushing of the jig is shown in Fig. 9. The space F is for a bearing in the bushing. It must be from one-half of a thousandth to a full thousandth inch under size. The other dimensions must of course be made to suit the job for which it is to be used. The flutes are not tapered at all, but must be beveled on the cutting edge as shown. They should be backed off within 1/64 in. and stoned almost to the edge. The dimension D should be made about 3/10000 in. over size, but marked to size.

A cheap and effective dowel-pin reamer is shown in Fig. 10. The teeth are backed off on the corner bevel only and have a taper of only one-quarter of a thousandth on the length B, which is given for clearance. There should be two sets of these—one for the part into which the dowel drives and the other set for the part into which it is to press. These reamers can be used in jigs through bushings if desired.

The arbor shown in Fig. 11 and the bushing in Fig. 12 are used together with a shell reamer for align reaming. The hole in the bushing fits the shank of the arbor and the straight portion of the bushing fits the standard reamed hole in the casting. The flutes next to the neck are cut clear through and relieved on the bevel, so that it can be machined with a draw cut. The two holes to be aligned are rough-reamed 0.005 in. under size. The reamer is assembled on the bar and drawn back through one hole, while the shank is guided by the bushing, which is centered in the other hole by its taper part. The operation is then reversed for the other hole, guiding

the shank this time by the bushing which will fit the hole just reamed, and feeding the reamer either way, as is most convenient.

An expansion arbor of the type shown in Fig. 13 for milling cutters may be made to employ any one of the styles of expanding screw shown in Figs. 14, 15 and 16. One that can be adjusted by a square-end wrench is shown in Fig. 14. An adjustment by screwdriver is possible of the one shown in Fig. 15. None of the screws projects beyond the cutter. A screw that can be adjusted by any wrench is shown in Fig. 16, but the projecting square is likely to be in the way very frequently.

When spotting with a twist drill it is frequently found that the drill goes too deep. With the special spotting drill shown in Fig. 17 there is no danger of this occurring, as it can cut only on the point. It has no flutes, which is an advantage in using a drill of this kind through a bushing. It is often used through a slip bushing and followed by a twist drill without a bushing, and then by a reamer running in the same slip bushing as the spotting drill.

Guide Used with Standard Reamers in Jigs

No one thing causes more loss of time than the lack of the proper reamers for the particular job in hand. The commercial hand reamer may be adapted to tool work as shown in Fig. 18, where the dotted line at *M* shows a guide. This takes the place of the usual taper given the end of hand reamers. In length the guide should be from one to one and a half times the diameter and from 0.005 to 0.010 in. smaller than standard size, up to reamers of 1 in. in diameter, and from 0.012 to 0.015 in. smaller for larger diameters. The flutes run out to the guide as shown; but they are not backed off. There should be a short taper from the groove between the guide and the reamer which allows for grinding. The shanks of such reamers should be from 0.001 to 0.001½ under size, and the corners of the square for the wrench should be turned down even smaller, so that possible burrs from the wrench will not spoil the hole if the reamer is passed clear through the work. The fluting should be done with the cutters set a trifle ahead of the center of the reamer, so as to give a slight negative rake. A slight staggering of the flutes, not more than 2 deg. either way from an even division, is helpful in reducing the tendency to chatter. Sometimes the pilots for hand reamers are threaded—18, 14 or 32 threads per in., with a sharp *V* thread to help feed the reamer into the work. Care should be taken that the pilot is enough below size so as to make sure that these threads are cleaned out by the reamer.

Proportions of Small Finishing Reamers

The lands of the cutting edges should be $\frac{1}{32}$ in. wide for small reamers, $\frac{1}{16}$ in. for reamers 1 in. in diameter and $\frac{3}{32}$ in. for those still larger. Flat relief is suitable for roughing reamers, but a rounded or eccentric relief is preferable for finishing reamers, as it causes them to cut more smoothly. A guide to the number of flutes in reamers is shown in the following table:

Diameter, in.....	$\frac{1}{16}$	$\frac{1}{8}$ to $\frac{1}{2}$	$\frac{9}{16}$ to $1\frac{1}{8}$	$1\frac{1}{4}$ to $1\frac{1}{2}$	$1\frac{5}{8}$ to $2\frac{1}{4}$	$2\frac{1}{2}$ to 3	4
Number of flutes.	4	6	8	10	12	14	16

This table is practically standard for all styles of reamers.

Roughing and finishing reamers for use in jigs are shown in Figs. 19 and 20. With reamers made with curved shanks for stop collars and the guide for the finishing reamer as shown, it is possible both to rough-ream and finish-ream work in jigs for taper pins. On account of the extreme accuracy required in making the tools, it is usually more costly to do so than to rough-ream in the jig and finish-ream in the assembling. The stop collars may be split collars or may be two solid collars used as check nuts. The reamers shown in Figs. 19 and 20 are made in two parts and sweated together, so that when the reamer part breaks the rest is not lost.

Four-Spindle Centering and Drilling Machine

The machine here shown was made to center simultaneously both ends of detonator gaine bodies, and then by shifting the position of the heads, to drill a hole in each end at the same time. Fig. 1 shows the machine in centering position, and Fig. 2 shows it in drilling position. The construction of the machine is such that it may readily be adapted to other work of various diameters and lengths. It may also be made with two opposing heads instead of four, where the requirements call for a machine of that type. The machine is entirely self-contained, as it carries a tight and a loose pulley and may be belted direct from the drive shaft, or it may be motor driven if desired. The single lever control makes it possible to turn out high-speed accurate work at a very rapid rate.

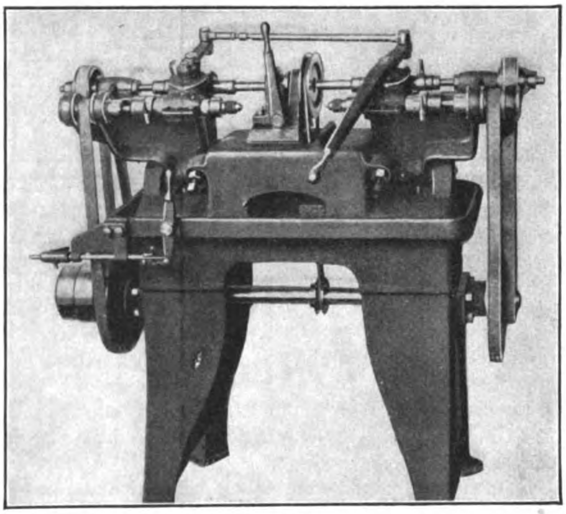


FIG. 1. SPINDLES IN CENTERING POSITION

The cast-iron heads carrying the spindles are keyed to a shaft running lengthwise of the bed, so that they move in unison. Adjustable stops on each side serve to register the spindles central with the work when the heads are swung over against them. Each spindle is carried in a sleeve with a rack cut in it, similar to that of an ordinary drilling machine. A gear meshing with these racks is set down between the spindles of each head. The gear in the right-hand head is connected direct to the operating lever; but the one at the left is connected by means of a supplementary pinion and a segment, in order to cause the spindles to move in a direction opposite to the opposing ones as the yoke-connected levers are moved by the hand

lever. It will be readily seen that as one pair of opposing spindles moves in, the other pair moves out, and vice versa. It will also be seen that the same lever that feeds the spindles in or out is used to swing the heads over against the stops, forward or back.

ARRANGEMENT AND CONTROL OF THE DRILLING SPINDLES

The drilling spindles are made of a special high-grade steel, ground and carefully fitted. These spindles run in annular bearings inside the steel sleeves. Each is taper bored to hold a No. 1 drill chuck. The spindle pulleys are of aluminum and are mounted in two annular bearings each. The spindles are graduated and provided with adjustable stop collars. The direction of rotation makes it necessary to use right- and left-hand drills in the respective spindles. Each spindle has a longitudinal travel of 2 in.; the maximum distance between the chucks is 8¼ in.; the distance from the center of the spindles to the bed is 4¼ in., and they run at a maximum speed of 10,000 r.p.m.

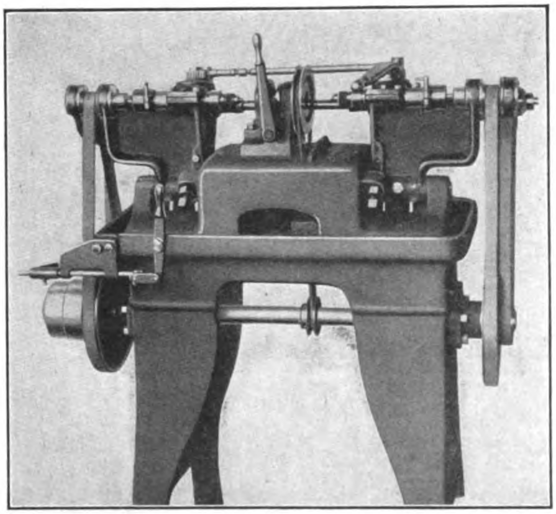


FIG. 2. SPINDLES READY FOR DRILLING

The centering spindles are of special steel and run in bronze bearings. Ball thrust bearings are provided at front and rear. They are bored for No. 1 Morse taper shanks. The travel is the same as that of the drilling spindles, but the maximum speed is 1,500 r.p.m.

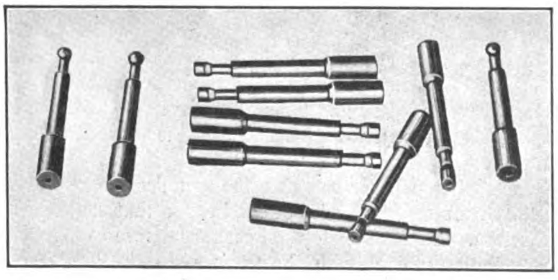


FIG. 3. PINS CENTERED AND DRILLED IN THE MACHINE

The revolving work chuck is carried on a special bracket mounted between the spindles, as shown. The chuck is of the split-collet type operated by means of a lever, shown in front. By using this type of chuck, work may be inserted or removed without stopping. The chuck is driven by means of a round belt from a grooved pulley on the main-drive shaft underneath the bed. This chuck has a maximum speed of 750 r.p.m.

A number of the gaine bodies drilled in this machine are shown in Fig. 3. The tapered shoulder on one end serves to locate the piece in the chuck as the small end is gripped in the collet operated by means of the lever. A hole 1⅛ in. deep is drilled in each end with a No. 30 drill.

All bearings in this machine are provided with oil cups. The oil pan is cast integral with the bed. The shaft underneath the bed runs in annular bearings at a maximum speed of 1,500 r.p.m. The machine stands 42 in. from the floor to the center of the spindles. It occupies a floor space of 24x48 in., weighs approximately 550 lb. and is made by W. P. Kirk, 336 West Fourth St., Cincinnati, Ohio.

Present Conditions in Russia

The economic conditions of Russia have been considerably disturbed, but not shattered, during the present European war as a direct consequence of preventing export of produce and raw materials. Only two ports are now open to Russia, namely, Vladivostok on the Pacific and Archangel on the White Sea. The latter is closed, more or less, during the four winter months, although powerful ice-beakers are expected to operate in an effort to keep the channel open as late as possible and to open it earlier in the spring than usual.

There remains in northern Finland the railway to Sweden and Norway, giving traffic connection with the allies as well as with friendly and neutral countries. This is extensively used, so that the domestic railways and interior waterways are not able to clear the wharves, docks and storage places from congestion and from the constantly arriving freight, principally of war material.

The transportation facilities have proved absolutely inadequate, and great hardship is suffered in many places from the lack of wood, coal and oil for fuel and power. Prices of food and the prime necessities of life are high, even in such places as are fairly well provided with good roads, railway and water connections. The Central Government is doing its best to ameliorate conditions, but as every energy is directed toward active prosecution of the war itself, it is practically impossible to carry out satisfactorily these humanitarian purposes.

Credit is needed by the Russian merchant importing American goods, but not to the extent in the value of the merchandise nor on such long terms as he was accustomed to obtain from both Austria and Germany.

Today Russia is absolutely offering to Americans enormous concessions of varying character in European Russia, Siberia, Asiatic Russia, the Trans-Caspia, Turkestan and the Caucasus, upon the most liberal terms. These concessions include railways, both steam and electric, urban, interurban, or practically transcontinental, bridges, canals and locks, transportation on interior waterways, utilization of the Empire's enormous water-power, mines, dredging operations—both harbor and internal waterways, mines, industrial, manufacturing, or public-service plants; and virtually everything in any way allied to economic development or improvement.—W. Aisenman in *American Industries* for December.

Pressed Steel in Manufacture of Electric Motors

By C. W. Starker*

NOPSIS—A description of the hot- and cold-king processes used in making the pressed-steel 's of electric motors. These processes include ıking, rolling, drop forging, press forging and ting. The parts are frame rings, end rings, ɜ, feet, bedplates, end brackets, brush-holders bearing shells.

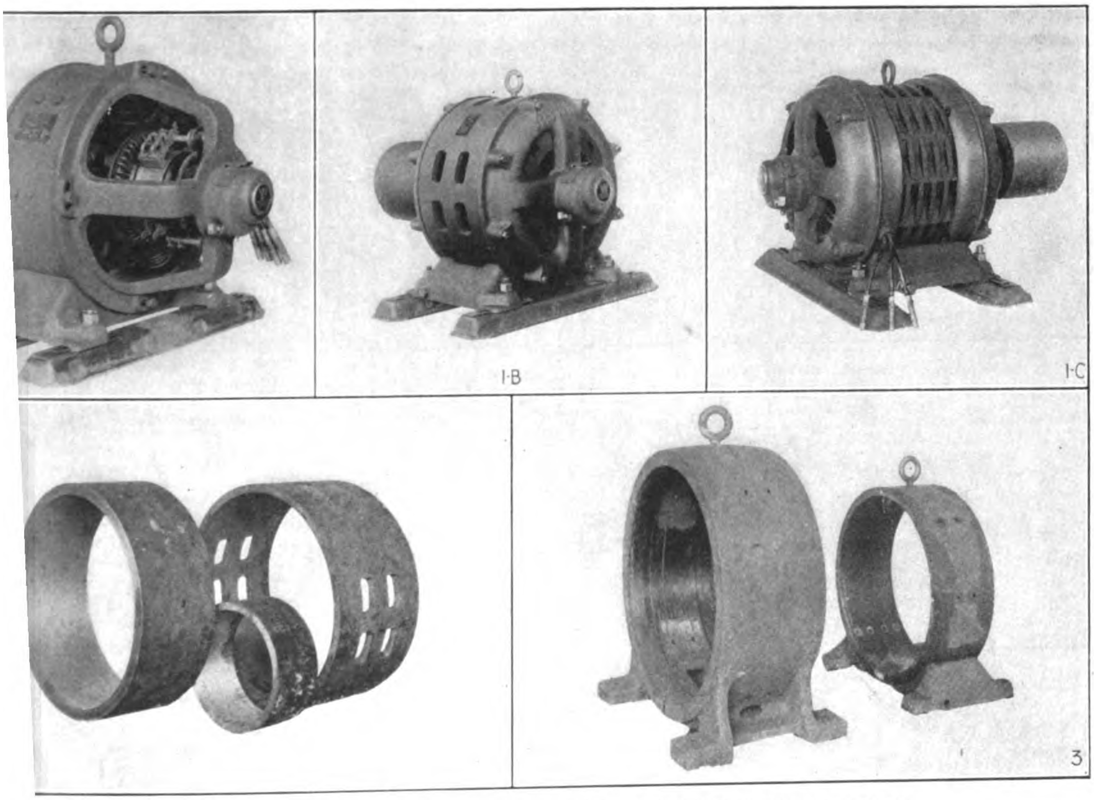
several years past in practically every industry as been a marked tendency to employ sheet steel l or pressed to shape where formerly cast material ɜd. In fact we may recognize in this tendency those natural steps of advancement in the art of ıaterials that consist in going from a material easy in and easy to work, but of inferior grade, to ıiring a greater degree of development for its utili-

For examples we need not go very far. Buildings dges formerly made of wood progressed to stone n to structural steel. Many household articles are ɔp forged or pressed from steel plate after having ırough the successive steps of development from wood to cast iron, from cast iron to malleable iron and finally to steel. Things which at first glance do not seem to lend themselves readily to pressed-steel construction, like a freight car or a bathtub, are now manufactured under the press.

In all these cases the new method has given a more durable product, more accurate duplicates and if made in sufficient quantities, a cheaper though better output. It is true that the more perfect the product the higher will be the demand for quality in the machine tools, materials and human skill behind it. While woodwork requires only simple tools, and castings require furnaces and molding machines, steel plate and wire require rolling mills for their production, and steam hammers, forging presses and dies to work them to the desired shape.

I do not need to call attention to the extensive application of pressed steel in the automobile industry, but the application of this material in the manufacture of electric motors has thus far not been described in detail in a technical journal, although it is now more than five years since a pressed-steel motor was first worked out by the engineers of the Westinghouse Electric and Manufacturing Co. At that time this design was quite a departure in motor manufacture and attracted considerable

ıstrial engineer, Westinghouse Electric and Manufac-:o., East Pittsburgh, Penn.



FIGS. 1-A TO 3. PRESSED-STEEL MOTORS AND ROLLED-STEEL FRAME RINGS

.-A—100-hp. motor with rolled-steel frame and pressed-steel feet and slide rails. Fig. 1-B—50-hp. motor ınd slide rails and pressed-steel, rolled-steel frame. Fig. 1-C—10-hp. motor with pressed-steel frame, feet, and bearing brackets. Fig. 2—Complete pressed-steel electric motor rings. Fig. 3—Comparison of cast-iron ·steel motor frames of same capacity

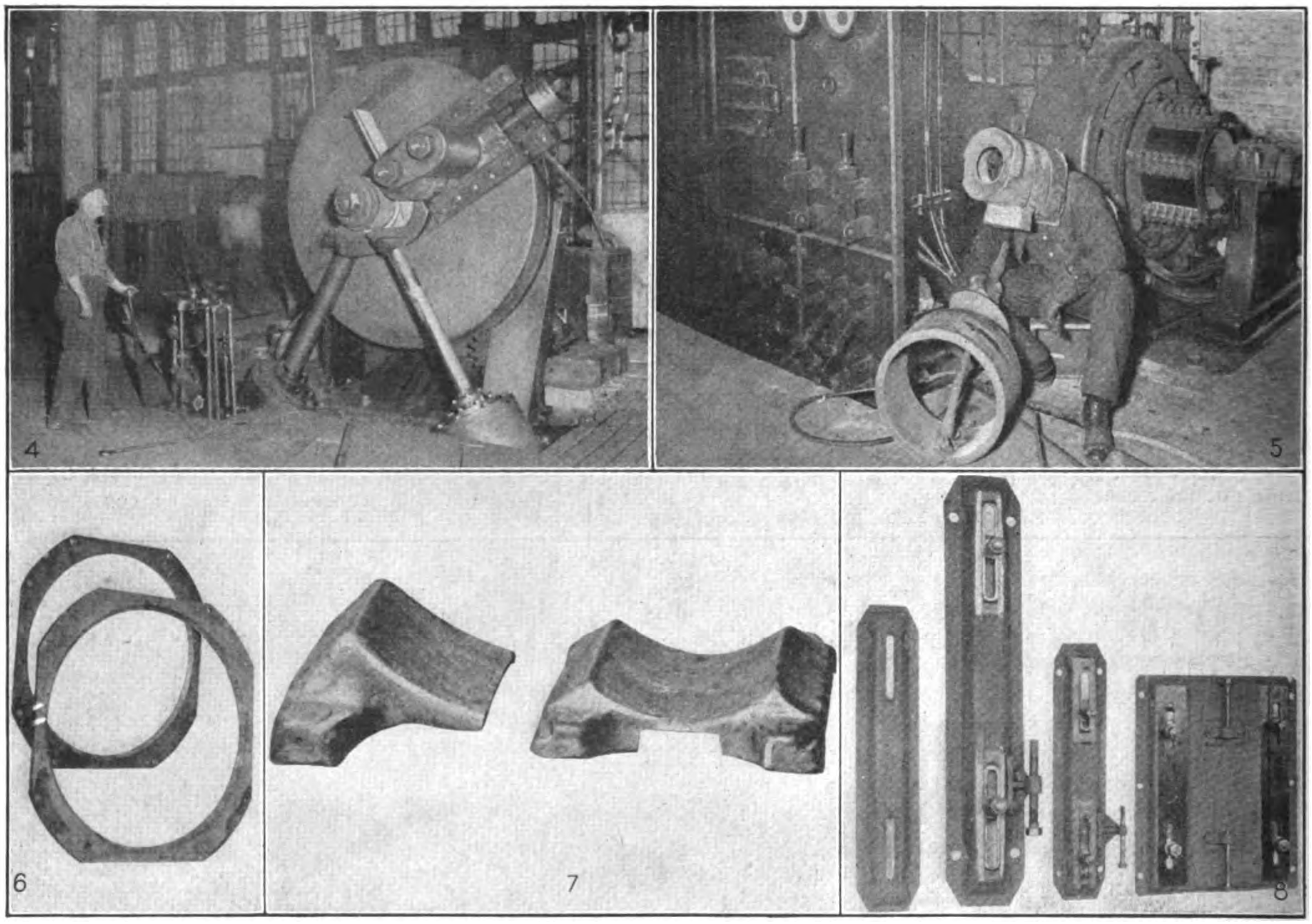
attention. Since then perhaps a hundred thousand such motors, both for alternating current and direct current, have been put in service and have proved successful even under trying conditions, such as steel-mill work. In this article a short description of the construction and manufacturing processes used in building these motors will be given.

A Few Types of Pressed-Steel Electric Motors

Motors of this type are shown in their finished form in Fig. 1. Their principal mechanical parts of steel design consist of a frame or yoke with feet, brackets carrying the bearings, slide rails, or bedplate, for adjusting the belt tension, and minor parts as end plates, brush-holders, bearings, etc. All of these parts are now made under the press from steel plate, thus giving a better and more economical product in large-scale manufacture.

The frame rings, which in the case of a direct-current motor carry the magnetic flux and in the case of an alternating-current motor serve as a casing for the primary laminations, are in both cases made from a hot-rolled steel slab. Such rings are shown in three different sizes in Fig. 2. For direct-current motors it has long been recognized that cast iron makes a heavy and bulky yoke, as a large cross-section is required for the magnetic flux. Cast steel is better, but a good grade is expensive, and as with every steel casting, there is the danger of blow-holes. These motors now have a yoke made from hot-rolled steel plate, which has the same high magnetic characteristics as the punchings used in the armature and is free from structural imperfections. The cross-section may therefore be small and the yoke lighter in weight. The relative size of a finished cast-iron frame compared with a rolled-steel frame is shown in Fig. 3, which compares a cast-iron and a rolled-steel frame for a motor of the same capacity.

These frame rings are rolled from straight slabs on a machine especially designed for this purpose, shown in Fig. 4. This machine is driven by an electric motor, and the rams are operated by water. The manufacturing process is substantially as follows: The slabs from which the rings are to be rolled are first sheared to correct length to make a perfect joint when formed to a circle. Next they are heated in a furnace located near the rolling machine. The heated slabs are then formed to the desired diameter by rolling. This process takes but a short time in the hands of a well-trained crew, although the rings are rolled accurately to gage. On the rolling machine, rings can be rolled to any desired diameter within the machine's capacity by using different mandrels.

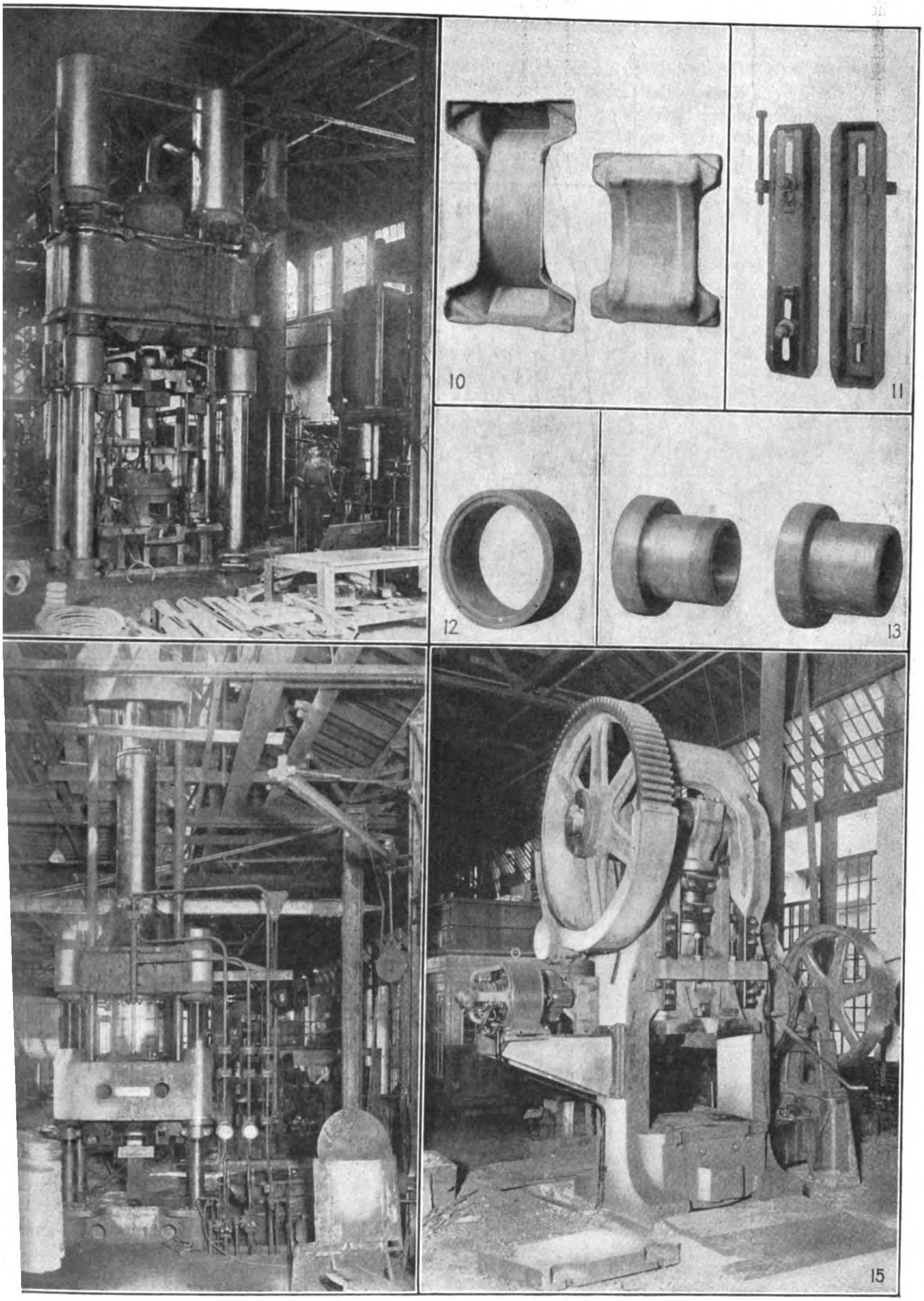


FIGS. 4 TO 8. FORMING FRAME RINGS AND DETAILS OF FEET AND RAILS

Fig. 4—Special machine for rolling steel motor frames. Fig. 5—Welding joint in rolled-steel motor frame rings. Fig. 6—Motor end plates made by bending steel bar on edge. Fig. 7—Drop-forged-steel electric motor feet. Fig. 8—Pressed-steel slide rails and bed plate for small motors

At the present time this process is used for the ring frames of motors up to 200 hp., requiring rings up to 3 ft. inside diameter, with a maximum thickness of up to 2 in. and a maximum width of about 17 in.

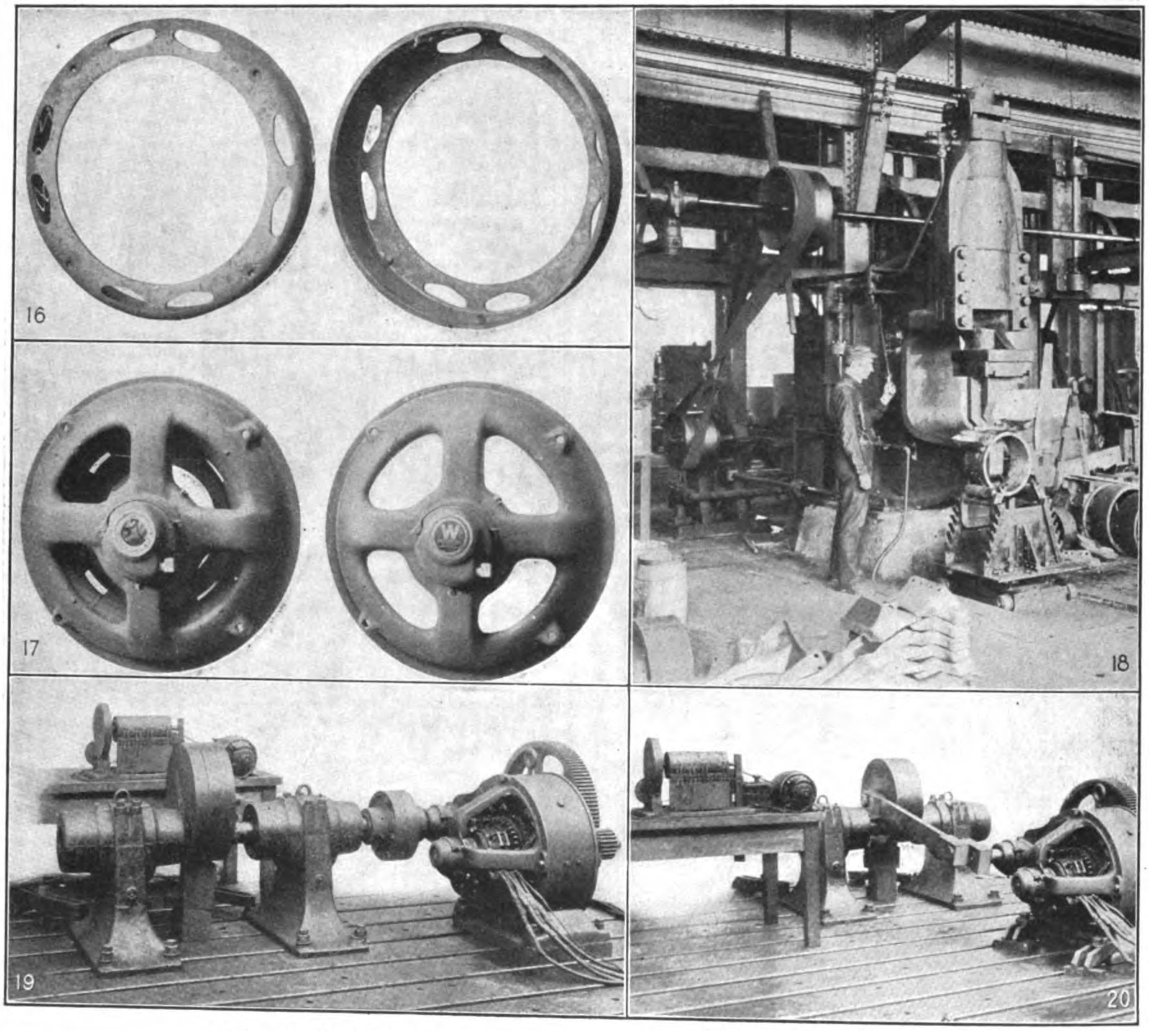
After rolling, the frame rings are welded at the joint, whenever this is required for magnetic reasons. This weld-



FIGS. 9 TO 15. FORGING PRESSES AND SOME OF THE PARTS PRODUCED

-1,000-ton steam-hydraulic forging press. Fig. 10—Pressed-steel feet for large motor. Fig. 11—Pressed-steel or large motor. Fig. 12—Squirted frame ring for small motor. Fig. 13—Squirted commutator bushing—rough l. Fig. 14—540-ton double-acting forging press. Fig. 15—Large motor-operated eccentric forging press

ing is done by the electric-arc welding process, Bernardos' method. A view of the welding plant is shown in Fig. 5. This view shows the converter set in the rear and the switchboard. In actual operation the frame rings rest on a steel plate. One terminal is connected to this plate while the other one leads to the carbon electrode of the welding tool manipulated by the operator. The arc is drawn from the carbon to the motor frame, rapidly raising the metal to the melting point. Additional material to



FIGS. 16 TO 20. STEEL END BRACKETS AND TESTS OF THE MOTOR
Fig. 16—A pressed-steel motor end ring. Fig. 17—Pressed-steel end brackets for electric motors. Fig. 18—100-ton hydraulic riveting press. Fig. 19—Eccentric load test on 15-hp. pressed-steel motor. Fig. 20—Oscillator test on 15-hp. pressed-steel motor

fill the joint is supplied, if needed, by a soft-iron rod held in the arc.

For purposes of ventilation it is sometimes desirable to have holes in motor frames. The frame ring, shown at the right in Fig. 2, has 16 such ventilating holes. They are punched cold before bending, in any thickness of plate that is used at the present time.

It should be understood that this rolling process is not intended to change either the thickness or the length of the material, but is only a bending operation.

Another product of this rolling machine is the set of end plates, shown in Fig. 6, which are made from a hot-rolled steel bar and used at the ends of the primary laminations of alternating-current motors. They are manufactured in large quantities by a process quite similar to that described in connection with the frame rings. Being made of a material superior in structure to any cast material, they are comparatively thin. This gives them the advantage of taking up less space in the motor, thereby reducing the amount of inactive copper in the windings and the danger from short-circuits between the end plates and the winding. These steel end plates also are unbreakable. Breakage is a serious factor in the manufacture of cast-iron parts, and an item of expense which frequently is under-estimated. If a break does occur, it usually happens after the shrinkage strains in the casting are released by removing the hard outer crust of the casting, that is, after the casting is machined and a considerable amount of labor has been spent upon it.

Two different designs of pressed-steel motor feet used in the smaller motors are shown in Fig. 7. They are made either in halves or in one piece. Both kinds are shown. A high-grade quality of steel plate is used, 1/4 to 1/2 in.

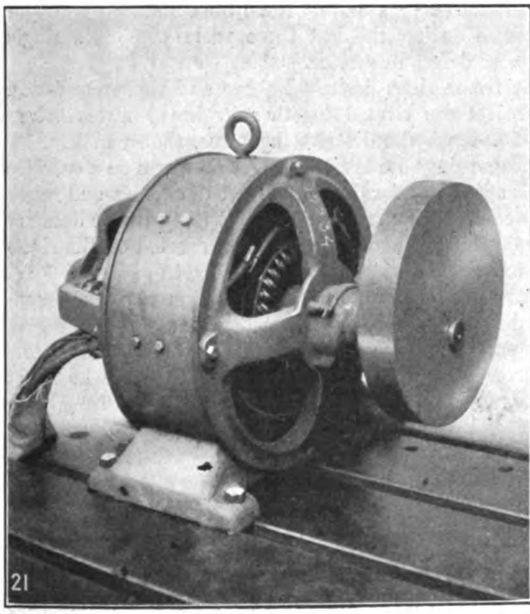
thick, depending upon the size of the motor. This plate comes from the mill in large sheets, which are cut into squares of the proper size on a 110-in. motor-driven shear. For each different piece to be pressed or forged, the developed shape necessary to produce the desired final result is determined by continued experiments, and the blanking dies are then made for punching out the blanks. These blanks are heated and forced to the proper shape, as shown in Fig. 7, by one or two blows of a 2,000-lb. drop hammer. With a given blanking and forging die every foot will of course be a duplicate of every other. All fitting, trimming and removing of unnecessary stock are therefore avoided, a point which greatly aids in rapid manufacture.

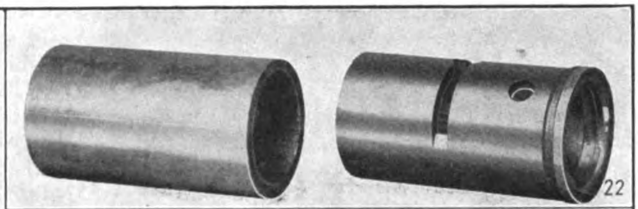
Drop-Forging Slide Rails for Electric Motors

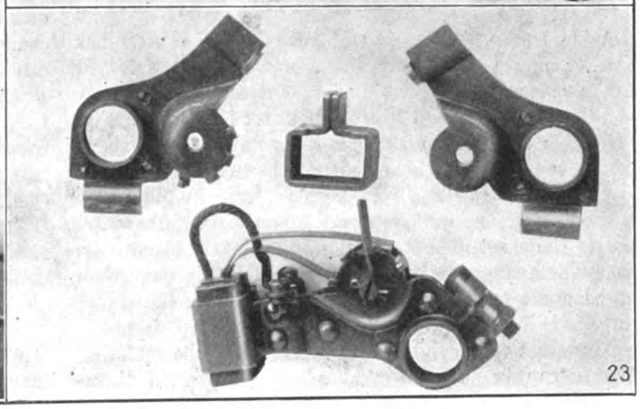
Another product of this hammer is shown in Fig. 8—pressed-steel slide rails used under the motors to adjust the belt tension. To the left the rough forging is shown as it comes from the forging department, then one of the medium-sized and one of the smaller-sized rails in finished form, and finally one of the smaller pressed-steel bedplates made in the same way as the rails and similar to the pressed-steel foot described above. All of these rails are made from heavy steel plate amply strong for ceiling suspension of the motor and with ample floor area for use on a soft foundation. The pressed-steel rail or bedplate, compared with cast iron, has among others the advantage of being stronger and unbreakable for a lower weight. In castings a crack occasionally occurs which is hard to detect and may pass by the inspector. It is possible that the faulty material is not discovered even by careful inspection until some accident has occurred, particularly with a motor suspended from the ceiling.

The drop-forging method described above has in the last few years found a serious rival in the hydraulic press. The drop hammer, though a handy and simple machine suitable for a great variety of forgings, has its limitations, especially as to the size of forging and the thickness of material that can be worked. The hydraulic press with its slow and steady pressure is preferable to the hammer for some kinds of pieces. While hammer blows affect practically only the surface of the forging, the hydraulic pressure penetrates to the core, even of thick forgings, resulting in a denser and more homogeneous material in the finished forging. Quicker and better work is possible for the reason that one stroke of the press produces the same results regarding reduction of section as five or six blows of the steam hammer; and under the press the hot steel more readily fills the impressions in the die. Absence of shocks, therefore less danger of breaking piston rods or dies, the possibility of a lighter foundation and less expensive dies, easier work for the men and lower power consumption are also points in favor of the press.

A 1,000-ton, high-speed steam-hydraulic forging press installed for the manufacture of large pressed-steel parts for electric motors is shown in Fig. 9. This press is of the four-column type and designed on the Davy principle. The installation consists of the press proper, with the main cylinder in the center, two steam lifting cylinders on top, the steam-hydraulic intensifier with the controlling gear, and finally the storage tank, which appears at the left. This tank is known as the prefiller and serves as a receptacle for the water, which is used repeatedly. Sufficient air pressure is supplied at the top of the tank to force the water into the cylinder. A steam pressure of about 150 lb. per sq.in. is used in the cylinder of the intensifier. By the action of this cylinder a hydraulic pressure of 5,500 lb. per sq.in. is produced behind the plunger. The actual forging work is done by the main cylinder, which produces with the hydraulic pressure mentioned a total pressure of 2,000,000 lb., with a possible increase to 2,400,000 lb. The lifting cylinders referred to serve







FIGS. 21 TO 23. ANOTHER TESTING ARRANGEMENT AND SMALL STEEL PARTS
Fig. 21—Eccentric load test on 30-hp. pressed-steel electric motor. Fig. 22—Pressed brush-holder and parts—may be either brass or steel. Fig. 23—Babbitt-lined steel shell bearing made of tubing

the purpose of raising the heavy cast-steel press head that holds the upper part of the die. The most interesting part of this press is the control, which is effected by a single lever for all movements, whether actuated by the steam or by the hydraulic pressure. The press head follows the movement of this lever, both as to speed and length of stroke, so that high speed and short strokes may be obtained, or as slow speeds as may be required in a particular case. Up to 150 strokes per minute may be made with this press, so that the output in forging and punching is limited only by the rapidity with which the work can be fed into the machine.

Two different sizes of large pressed-steel double feet for motors are shown in Fig. 10. They are hot pressed from steel plate ½ in. thick and in floor dimensions of about 2½x4 ft. Those familiar with this class of work will appreciate the difficulties that had to be overcome before producing a deep and intricate forging of this kind. The forming is done without any hammer blows or noise, by moving a single lever.

A large-sized pressed-steel rail made on this press, $\frac{7}{16}$ to ½ in. in thickness and in lengths up to 6 ft., is shown in Fig. 11. Pressed-steel bedplates, of the design shown in Fig. 8, are also made on this press and can be forged up to 6 ft. in length. Before pressing, all of these parts are blanked out as described above. This blanking can also be done on this press, although of course it may be done on other equipment of smaller size.

Piercing, or Squirting, Process of Forging Electric-Motor Parts

Aside from this forming of the plate, the press has another important function in the manufacture of forged motor parts by the piercing, or squirting, process. A small frame ring 8 to 12 in. in diameter is shown in Fig. 12. This piece is squirted from a solid block of steel; that is, the steel block is heated and placed in a cylindrical die, then by exerting a very high pressure in the center of the block the material is forced up uniformly all around and to the exact diameters determined by the size of the die. These rings are squirted about a foot high and then sawed apart to give the proper width of the individual ring.

New cases where this press and especially the squirting process can be used to good advantage present themselves frequently. A commutator bush in its rough-forged and in its finished form is shown in Fig. 13. It is made by the same method as the small frame ring just described, by piercing a solid steel block. This process has opened up entire new fields of manufacture, for not only is it possible to obtain sound and dense material superior to the steel casting heretofore used for parts which are required to stand severe strains, but this new process is also in most cases more economical. In quantity production it would tax the capacity of the best molding machine operated by the fastest molder to compete with the press that forms a large commutator bush with a single squeeze by the movement of a single lever.

Further equipment for the manufacture of pressed-steel motors is shown in Figs. 14 and 15. The one shows a 540-ton double-acting hydraulic press, the other a slightly smaller motor-operated eccentric press. Both may be used for making such parts as pressed-steel end shields, shown in Fig. 16, which are used on the smaller sizes of alternating-current motors—the so-called frameless type—and serve as a means for securing together the primary laminations and for protecting the winding. These end shields are made from ¼- to ⅜-in. thick hot-rolled steel plate in varying diameters and different widths of flange. After forming, the center and the vent holes are punched out in a separate operation.

These presses are also used in the manufacture of pressed-steel bearing brackets, an example of which is shown in Fig. 17. This is an interesting piece of pressed-steel work and perhaps as fine an example as can be found of how far it is possible for pressed steel to take the place of complicated castings. Note particularly the doubled-up rim of this bracket, which gives it great rigidity, and also the flanged part around the housing. These housings are simple castings inserted into the bracket under the press while the bracket is hot, and in such a way that the housing makes its own hole and the flange shrinks to the housing. The housing has a rim on the inside that presses against the inner side of the bracket forging. Numerous tests were made at the time this bracket was first designed to show how reliable the shrink fit is, in resisting both a pushing and a turning force. Some hundred thousand of these brackets have been put in service during the last three years without a single failure or defect in service.

The frame rings described above and the pressed-steel motor feet are riveted together by heavy rivets driven on a 100-ton hydraulic riveting press, shown in Fig. 18. The frame rings are brought under the press on a carriage that is adjustable for different frame diameters, and raised or lowered by compressed air so that the pressure does not come on the carriage. The pressure exerted on the rivets can be varied to suit the size of the rivet.

Numerous running tests of the severest nature, continued for over two years previous to the marketing of these pressed-steel motors, and many thousands of motors in successful daily service have established the fact that even excessive stresses are safely transmitted through the frame and foot without any deteriorating effect on the riveted joints made by this continuous-pressure riveter.

Endurance Tests on Pressed-Steel Motor Frames, Bases and Other Parts

A short description of some of these endurance tests may be of interest to those of the readers who use riveted joints in their work. Fig. 19 shows a test motor back geared to a heavy eccentric weight and reversing every 12 sec. This test was continued for a year and a half, day and night, and showed no effects on the rivets or any other part of the motor. In Fig. 20 the eccentric weight is mounted directly on the motor shaft, tending to produce a strong rocking motion and severe strains on the bearings and frame construction. The oscillator test, Fig. 21, is still more severe, but also failed to have any effect on the motor aside from normal wear of brushes and commutator. This test is arranged so that the eccentric weight does not make a complete revolution but oscillates both ways from the vertical center line. During the several months' run most of the auxiliary parts broke in turn: the driving rods, countershaft and their bearings had to be replaced, but no parts of the pressed-steel motor. These tests and other modifications such as chain-driven eccentric weights, etc., were carried on for years on both the alternating-current and the direct-current motor of pressed-steel construction.

As related in a way to the pressed-steel work used on these motors, which forms the subject of this article, the pressed-steel brush-holder, shown in Fig. 22, and the steel shell bearing, Fig. 23, may be referred to in a few words. The former is pressed from heavy cold-rolled sheet steel or sheet brass, the halves and the brush-holder boxes being riveted or spot-welded together. The bearing shown is one of the simplest types of the solid oil-ring type. It is obtained by drawing steel tubing through a die on the draw bench in 8- or 10-ft. lengths until the proper diameter and wall thickness are obtained. The shell is then tinned on the inside, lined with babbitt and the necessary machining and grinding operations performed. A bearing of this type is both light and rigid, and has met with remarkable success in operation since 1907.

The success of this pressed-steel idea as applied to industrial motors of all classes has been so complete that the design of a pressed-steel motor for street-car service, admittedly one of the most trying applications, was undertaken about two years ago.

Steel Car Straightener and Railroad-Shop Kinks

Editorial Correspondence

The growing use of steel cars has necessitated many changes in railway shops, as their repair is an entirely different proposition from handling wooden cars. Whenever a steel car gets into a wreck, the plates buckle instead of splintering, as is the case with wood, and instead of replacing broken sides and ends it is often possible to straighten them so as to be perfectly serviceable without renewing any of the sheets.

Straightening, however, is not an easy job, unless considerable pressure can be applied. This in the average shop means special blocking of various kinds, all of which consumes considerable time. After experiencing all these difficulties, Mr. Paxton, superintendent of motive power of the El Paso & Southwestern Ry., decided to build a permanent straightening frame at El Paso, Tex., as shown in Fig. 1. The machine consists of six frames erected over one of the yard tracks, tied together at the upper corners and braced across the top, and the pressure applying devices. There are of course suitable foundations under the columns on each side. Now when a damaged car comes in for repairs, it is run inside this frame, and pressure can be applied on both sides at almost any point desired. Any intermediate points can be covered by merely moving the car back or forth on the track. This, in other words, is a permanent "old man."

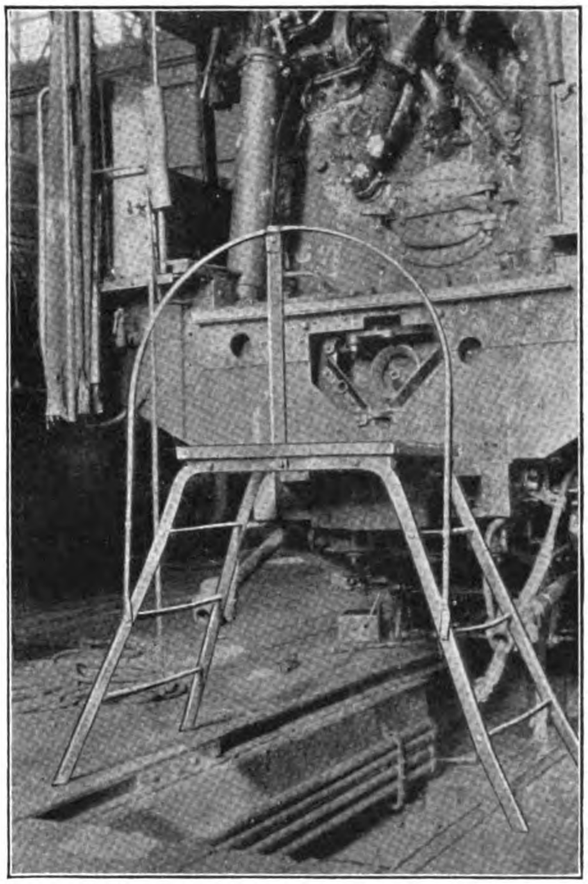


FIG. 3. SAFETY LADDER FOR ERECTION SHOP

Some of the straightening screws can be seen projecting from the columns, which are adjustable for height to any desired point. In addition to the screws, hydraulic jacks of any power required can be placed between the uprights and the car sides, so as to secure all the pressure that may be necessary.

Another interesting development of these shops is the method of utilizing old boiler flues for making pilots, or cowcatchers. One is shown in Fig. 2. It is all ready to go in place on a locomotive. These pilots are quite easily made by cutting the old tubes to the proper length, flat-

FIG. 1. STRAIGHTENING DAMAGED STEEL CARS

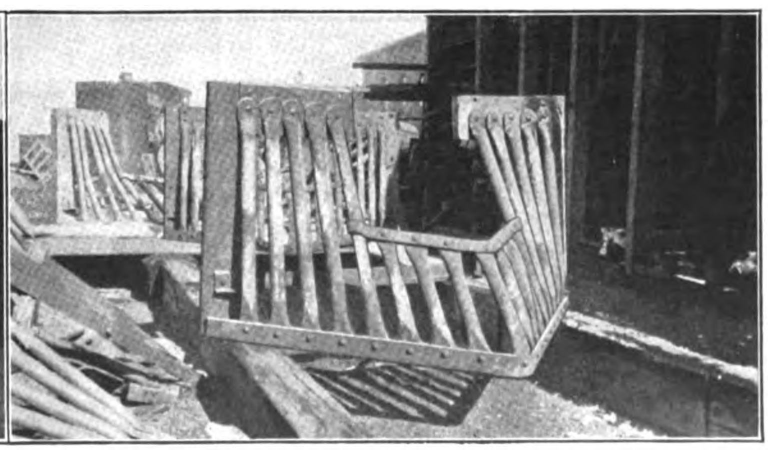


FIG. 2. PILOTS OF DISCARDED BOILER FLUES

tening the ends and riveting them up, as shown. They have proved quite satisfactory in actual service.

Fig. 3 shows a very neat form of safety ladder for climbing up into the cabs of locomotives in the erecting shop. The ladders are made up of metal, with the exception of the platform at the top, and are very easily handled. As can be seen, they straddle the track over

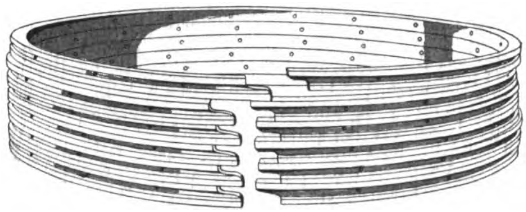


FIG. 4. GROOVED PISTON RINGS

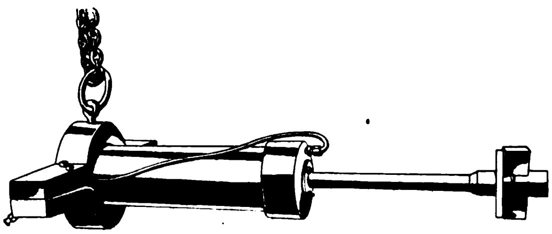


FIG. 5. HYDRAULIC BUSHING EXTRACTOR

the pit and fit up close to the locomotive cabs. They are provided with a safety handrail and are a vast improvement over many of the makeshifts which we too often find in small railway shops.

The type of piston ring used is seen in Fig. 4, which shows a pile of six rings ready to be put into their pistons. The type of joint will be noted, as well as the facts that they have half-round grooves in the center and that small holes are drilled from the bottom of these grooves to the inside of the ring. This is done both to equalize steam pressure and assist in better lubrication.

A portable hydraulic press for pulling cylinder and piston-valve bushings is shown in Fig. 5. It requires no explanation, being suspended from the crane in any desired position.

Feed Mechanism for Boring Bar

By M. R. Bowerman and Thornton Hayes

Last summer it was found necessary to bore out the cylinder of the Corliss engine in the power plant of the Kansas State Agricultural College. The cylinder is 16x48 in. in size. A portable boring bar of the traveling-head type was obtained from Kansas City. The feed mechanism, however, was missing, and it was necessary to improvise a method for obtaining a uniform, slow feed. The feed screw for actuating the boring head lay in a groove in the bar. The feed mechanism shown in the illustration was schemed out. Arrows show the direction of turning.

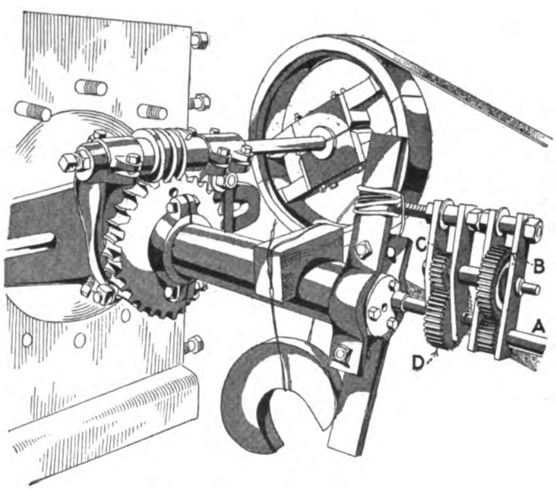
The feed screw has a right-hand thread, 13 pitch. In order to get a forward feed of the tool with a right-hand rotation of the boring bar, the feed screw must make a relative left-hand turn of one-fourth revolution for each rotation of the bar. After a little scheming the arrangement of four gears shown was built up and found to work satisfactorily. The gears are change gears from a lathe. Four bars of flat steel, a long threaded bolt and two short pipe nipples make the frame. Two bars clamped to the boring bar drive the mechanism.

Shaft *A*, with a 24-toothed gear keyed to it, is held stationary and is central with the boring bar. *A* is clamped to a trestle, fastened to the floor. Gear *B* has 48 teeth and turns with *C*, which has 24 teeth. *D* has 48 teeth and is keyed to the feed screw of the bar.

The weight suspended from the wood block shown is used to reduce the vibration and chattering. The right-hand worm and wheel are driven in the direction shown, by a 4½-hp. motor running at 1,400 r.p.m. The bar turns at about 10 r.p.m. The far end of the bar is supported by a bushing in the stuffing-box.

To analyze the action of the mechanism, imagine that the boring bar and feed mechanism receive one complete turn, right-hand, as a locked unit. Then, holding the boring bar still, rotate the gear on *A*, left-hand, one turn to its original position, since it is to remain still. In doing this the feed screw is turned one-fourth revolution inside the bar, which amount is to be its turning relative to the bar for each rotation of the latter. Or, what is the same thing, rotate the small gear once, left-hand, holding the rest of the mechanism still. This, clearly, gives the same relative motion as would be obtained by turning the entire mechanism once, right-hand, about the small fixed gear.

In taking the last cut, it was desired to increase the feed, and two 36-toothed gears were substituted for *A*



FEED MECHANISM FOR BORING BAR

and *B*, doubling the feed. In using other combinations, it is necessary of course to maintain the sum of the teeth of any pair a constant.

The mechanism proved entirely successful, required only material already at hand and was very easily adjusted to the boring bar.

On the Erie R.R., at Hornell, N. Y., the tools are dressed in the forge shop and ground on a Sellers tool grinder in the toolroom. In the accompanying table are given the angles used for all round-nose tools, except those for brass.

Material	Rake, Deg.	Clearance, Deg.	Side Slope, Deg.
Cast iron and tool steel	8	6	14
Machine steel	8	6	22
Tire steel	5	6	9

Lubricating-Oil Testing Machine

By W. B. Slaughter, Jr.

SYNOPSIS—A machine designed for commercial work where various bearings must be used with different degrees of clearance. Thus means for quickly assembling and disassembling are a feature. The coefficient of friction is readily obtained by entering the observations from the machine on a chart.

Following is a description of a machine for testing lubricating oils designed for use in the testing laboratories of Los Angeles County, California. Its principle of operation differs but slightly from that of the typical testing machines on the market, but the manner of applying the load and reading the results presents some new features. The necessity of calculating the coefficient of friction from the results of each test has been eliminated, thereby increasing the speed and decreasing the labor connected with the tests. With this machine all lubricating oils used in the county power plants, road-working machinery, shops and automobiles are tested. The contracts for lubricant for these purposes are let after an exhaustive investigation with this machine, and a notable saving over the old method of buying is made.

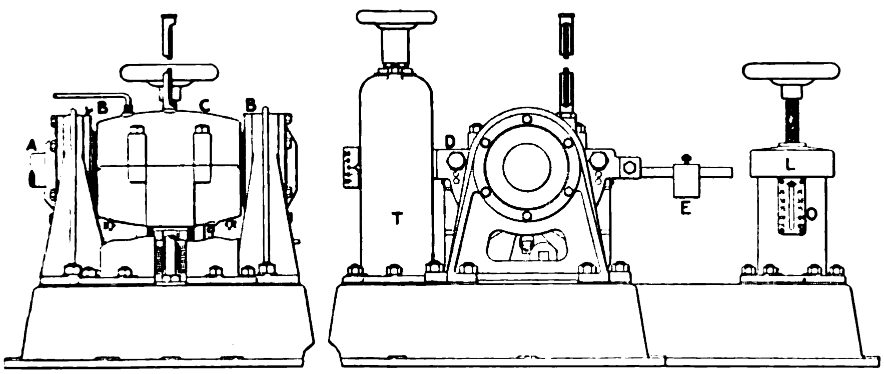


FIG. 1. ELEVATIONS OF LUBRICATING AND TESTING MACHINE

In general, the machine consists of a motor-driven shaft upon which rides an accurately machined bearing. Loads giving bearing pressures equivalent to those attained in practice are applied to this bearing, while a measured quantity of the lubricant to be tested is fed to the journal and distributed by means of suitable scoring in the surface of the bearing. As the journal is rotated at a known rate of speed, the force of friction acting at a tangent to the shaft tends to revolve the bearing in the direction of travel of the journal. By the magnitude of this torque, or tendency to rotate, the moment of friction is determined. From this the value of the coefficient of friction can be calculated. As previously stated, the peculiar value of the machine in question lies in its method of applying the load, the reading of the torque developed and the absence of calculations in finding the coefficient of friction.

Fig. 1 shows the side and end elevations of the apparatus. The fundamental parts consist of the shaft *A* mounted on two ball bearings *BB*, upon the journal of which is a waterjacketed bronze bearing box *C*. The load is applied to the bearing and journal through a system of knife-edged levers by the mechanism *L*. The force of friction, acting tangentially on the bearing, causes a tendency to rotate in the direction of the shaft motion, which tendency is transmitted through the beam *D* to the reading mechanism *T*. A thermometer well allows the rise in temperature during the test to be ascertained by means of a standard calibrated thermometer, and provision is made to retain the oil used for the purpose of retesting if desired. The bearing is balanced about the axis of the shaft by the adjustable counterweight *E*. The load-applying system is balanced in the same manner.

Since several bearings, representing various commercial conditions, with different clearances on the journal for different lubricants, are used, special attention was given to the matter of disassembling. By the scheme adopted, the shaft and bearing can be removed without interfering with the load-applying system or the torque-reading apparatus. This is accomplished by removing the cap screws *F*, Fig. 2, and the caps *GG*; while unscrewing the nut *H*, thus exposed, leaves the shaft free to be slipped out toward the left. The bearing can now be lifted from the yoke *R*, Fig. 3, and another one substituted. The load-applying system is shown in Fig. 3. The screw *I*, actuated by the handwheel *J*, compresses the spring *K*, which in turn reacts upon the lever *L* through the knife edge *M*. On the spring seat *N* is a pin extending through a slot in the housing, and indicating on plate *O*, Fig. 1, the deflection and therefore the load applied. The lever *L*, Fig. 3, reacts upon the yoke *P*, which transfers the load to the two columns *QQ* bearing against the supporting saddle *R*. All joints are knife edges. This construction allows free rotation of the bearing without disturbing the vertical direction in which the load acts. It will be noted that no motion is transmitted through the lever *L*. It does not back away from the spring as

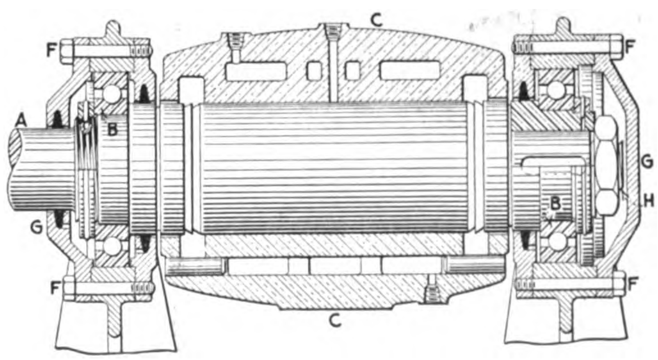


FIG. 2. DETAILS OF SHAFT AND BEARING

the load is applied, which makes the graduation of the plate *O* a simple matter. This plate is graduated by test to read directly in pounds per square inch of projected area of the bearing.

The bearing, resting in the saddle *R*, transmits its rotation to the beam *D* through dowel pins. Fig. 4

shows two views of the torque-reading mechanism, in which the beam *D*, by its downward motion, stretches the tension springs *SS*. This motion also causes the pointer on the beam to fall below the zero line of the dial. By means of the handwheel *T* the screw *U* can be turned

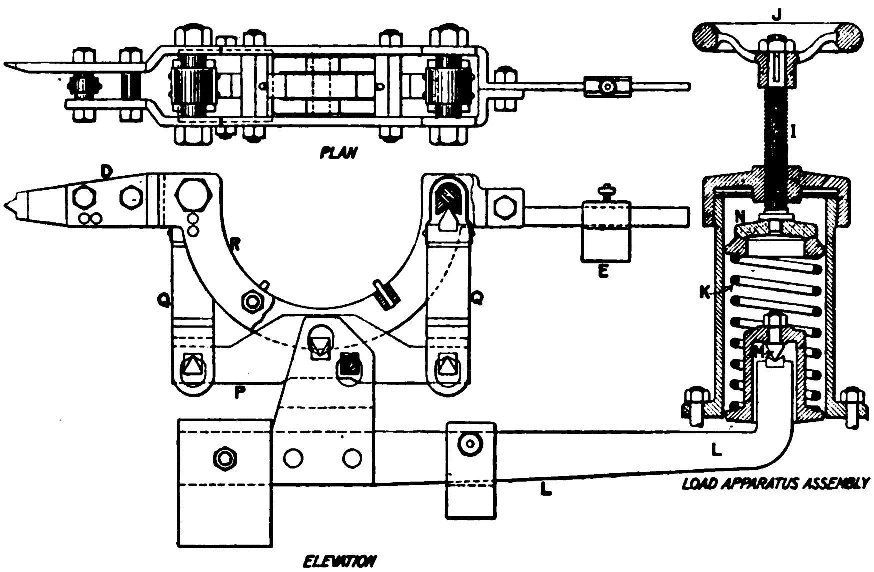


FIG. 3. DETAILS OF BEARING CRADLE AND LOADING MECHANISM

up, putting more and more tension in the springs *SS*, until this tension equals the downward force exerted upon them by the beam *D*. Still turning upward on the screw brings the pointer of the beam opposite the zero line of the dial again. When this condition has been reached (in practice the pointer oscillates over the dial equal distances either side of the zero, like the beam of a sensitive

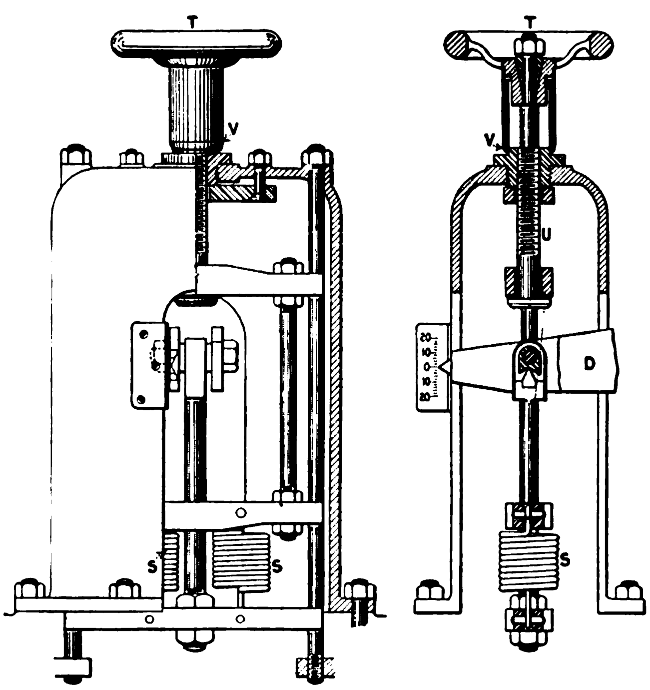


FIG. 4. DETAILS OF TONGUE-MEASURING MECHANISM

balance), equilibrium has been established and the deflection of the springs *S* can be read by means of a micrometer device *V* mounted under the handwheel. These springs having been calibrated by test, the deflection registered gives us immediately the force acting upon them.

To obviate the labor of calculating the value of the coefficient of friction for each test, a chart was made (see Fig. 5) by means of which it is possible to obtain this value directly, knowing the load applied to the bearing and the deflection of the torque-reading springs as registered by the micrometer. This chart is merely the formula

$$M = \frac{4f}{\pi} Pr,$$

plotted to rectangular coördinates, where

M = Moment of friction in inch pounds;
f = Coefficient of friction;
P = Load on the bearing in pounds;
r = Radius of journal in inches.

The abscissas are graduated to read in terms of the micrometer readings and the ordinates in terms of the coefficients of friction. The curve was plotted with five values of *P*, corresponding to the major divisions of the plate *O*. Intermediate values are determined by

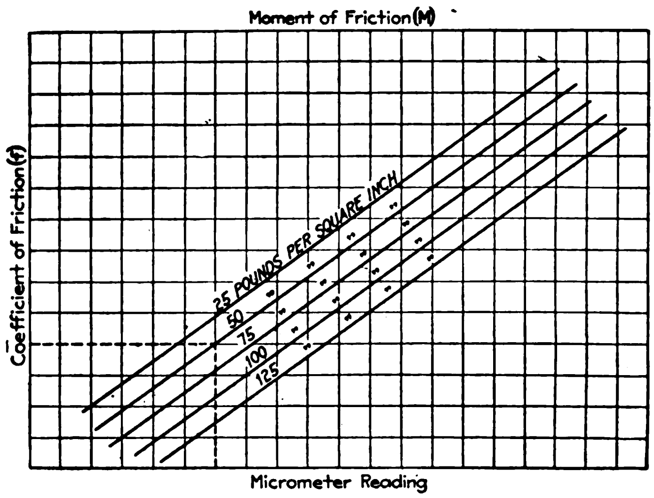


FIG. 5. METHOD OF PLOTTING CHART FOR USE WITH MACHINE FOR TESTING LUBRICATING OILS

interpolation. It is evident that any reasonable degree of accuracy can be obtained by the simple method of making the micrometer sufficiently finely graduated.

Variations in the Properties of steel castings are due (1) to variations in the composition of the steel, (2) to the annealing or heat-treatment to which the steel is subjected and (3) to the soundness of the casting. It was pointed out in a symposium on iron and steel read before the International Engineering Congress that the last of these may be summarized in the familiar saying, "A casting is always a casting"—by which the "initiated" mean that it may always contain hidden blow-holes or shrinkage cavities that cause or aid its failure when least expected. The gases that are liberated from solidifying steel of course cause blow-holes in ingots as well as in castings, but by the time the ingot is reduced to the rolled or forged shape these holes are at least closed up, if not partly welded—and they are generally so located as to be least harmful to the finished piece. In the case of castings the gas from the metal, and the steam and gas set free from the sand mold may cause blow-holes that cannot be detected by surface inspection of the piece.

Letters from Practical Men

A Crankpin-Turning Fixture

The crankpin-forming fixture shown has effected a remarkable saving in time over the single tooling method of finishing crankpins. In rapidity it compares very favorably with the best grinding practice, while the initial cost is low.

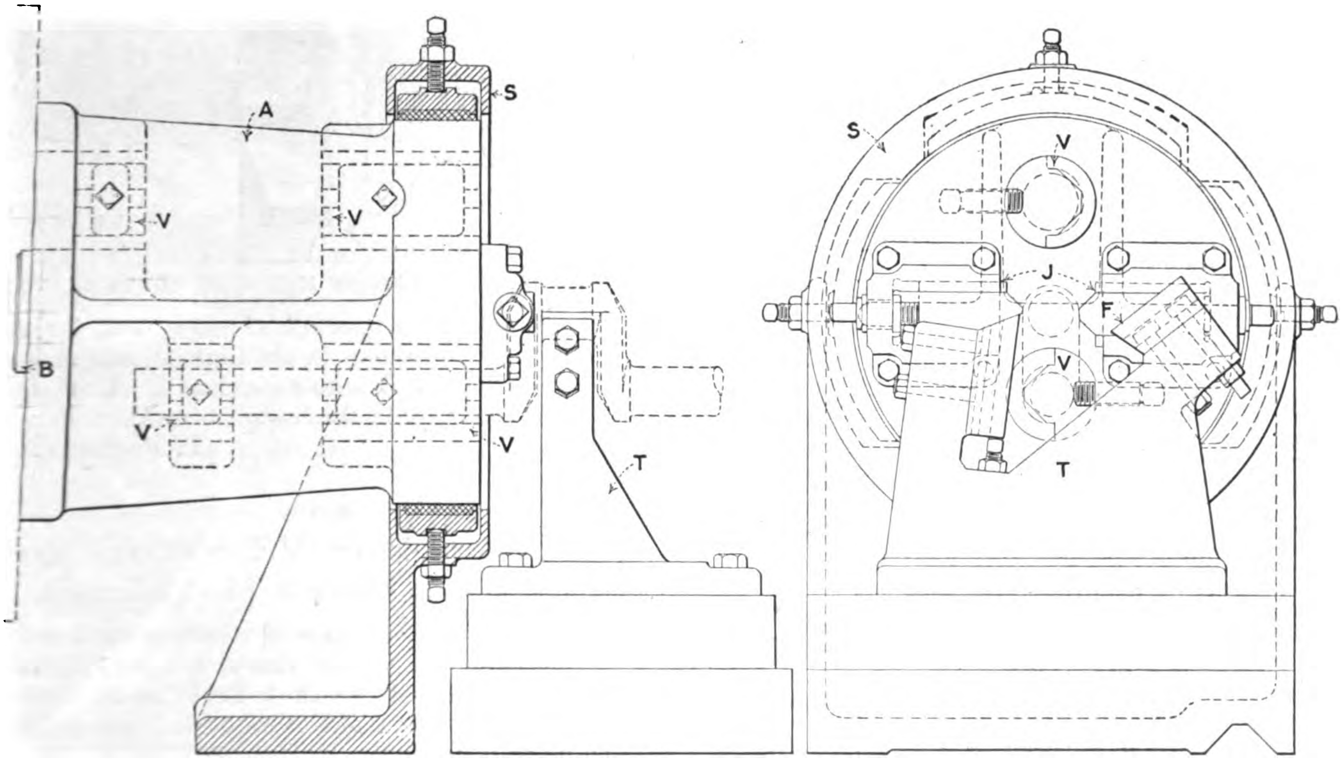
The main casting or faceplate extension *A* consists of two plates connected by a double channel section bolted to the faceplate of the lathe and centered by the boss *B*. The outer plate forms an outboard bearing of substantial width, finished after having been bolted in place. Through this bearing and suitable bosses in the casting, holes are bored at center distances conforming to the throw of the cranks. The same fixture is used for two sizes of cranks, the holes being bored at 180 deg. Fitting in each hole is a pair of V-blocks, one for each end of the shaft. The V-blocks are made from tool-steel bushings, bored to approximately the shaft diameter at each end and relieved about $\frac{1}{16}$ in. in diameter to within 3/8 to 1/2 in. of the ends. The outside diameter is roughed down to within grinding limits of the holes bored in the main casting. One-half the bushing, or rather to within 1/8 in. of center, is then shaped off and the V-block shaped out, the bore at each end giving the required tangent. The V-block is then clamped tightly on a mandrel of the same diameter as the crankshaft and the outside turned to the size necessary for a good fit in the casting. The 8 in. projecting over the center is allowed for calipering. The V-block is then held in place by machine screws tapped into the back. This provides a very accurate, as well as economical, method of alignment.

The crankshaft line bearing is roughed out to within $\frac{1}{16}$ in. of finished size and the shaft forced into the V-blocks by a setscrew on each end, the V-blocks serving as a driver.

On the outside of the outboard bearing is a steadyrest *S*, planed to fit the ways of the lathe and clamped down. The inside diameter is cored to within 1/4 in. of the diameter of the bearing. Four babbitt-lined shoes fit into cored slots in the steadyrest casting, and are scraped to fit the outboard bearing. They are adjustable for wear and pressure by four setscrews and bear in cored spots in the center of each shoe. This prevents the fixture from lifting under heavy cuts and serves to dampen out any vibration or chatter.

On the outer face of the outboard bearing are bolted two faceplate jaws *J*, of hardened steel. Both are made adjustable for different sizes of crank cheeks, although it is seldom necessary to loosen but one if the forgings are at all uniform. These are made as low as possible.

The tool post *T* bolts to the carriage in place of the compound rest, and is of as heavy a section as clearance permits. The roughing tool is on the operator's side and is of high-speed steel. In the back side is milled a T-slot, aligned by a gib in the tool post and carrying two substantial bolts. The tool is further supported by a jack from below, giving easy adjustment for wear and grinding. The tool has 7 deg. clearance and 20 deg. rake, all grinding being done on the face.



A SIMPLE CRANKPIN-TURNING FIXTURE FOR RAPID PRODUCTION

The finish-forming tool *F* is directly opposite, but at a 45-deg. angle, to keep the cutting edge as close as possible to the point of support. This tool is of carbon tool steel, as it takes off but 0.005 to 0.007 in. It must be kept honed to a fine edge. On account of the light cut, it was found unnecessary to provide a rear support. The tool is held in place by two bolts in a T-slot, but is not gibbed to the tool post. The outer bolt has an eccentric head, and has a square milled below the nut. The object of this is to allow the tool to be squared with the crankpin, as a slight variation will result in a tapered pin. The roughing tool is squared by the setting of the tool block on the carriage and the finishing tool adjusted until the crankpin is of uniform diameter.

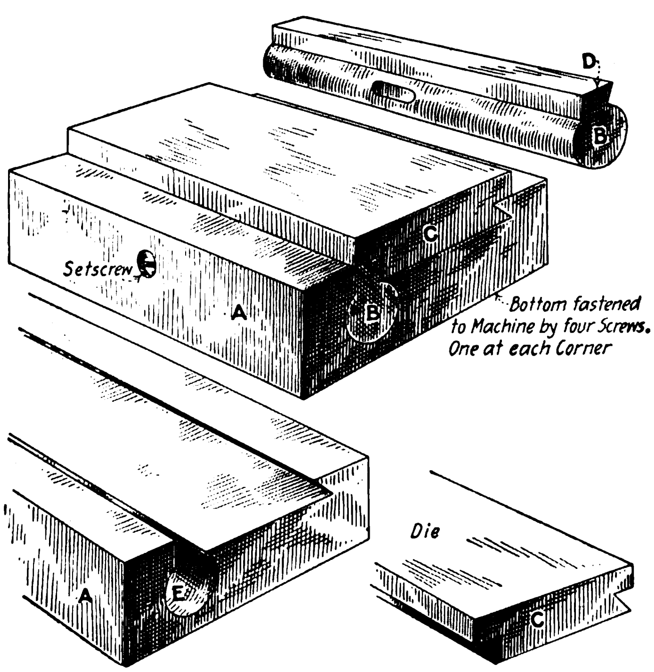
The lathe is provided with a two-speed countershaft, giving a roughing speed of about 15 ft. per min. and a finishing speed of 40 ft. A copious supply of cutting compound is forced over the work, serving also as a lubricant for the steadyrest. Higher cutting speeds would be possible, but are hardly necessary, as the time from floor to floor runs from 5 to 7 min. The roughing tool will run 40 or 50 cranks between grindings if any care is used in getting under the scale, while the finishing tool requires only an occasional honing. The line bearings are roughed and finished between centers, using a roller follow-rest. The total time on a 3½-in. throw, crank 1¾ in. diameter, ends 13½ and 14½ in. seldom runs over 30 min. H. E. McCray.

Charles City, Iowa.

A Convenient Die Slide

The die head illustrated herewith was designed in order to make an electrically heated die head, with the heat as near the die as possible, yet permitting the dies to slide easily in and out of the head while hot.

A is the head held to the machine by four screws, one at each corner. The bottom, made of cast iron, is cored



A CONVENIENT DIE SLIDE

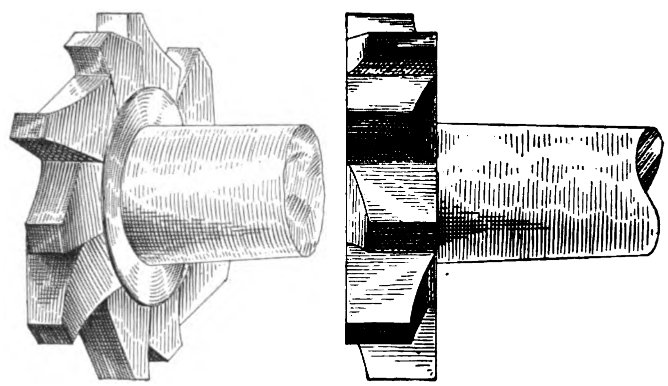
out to receive the heating wires. *B* is the gib with which to hold the dies shown at *C*. It is made of steel bar stock and is practically finished in four cuts.

A piece of stock about an inch longer than the finished gib is centered, put on the dividing head in the miller and machined with a concave cutter. Two cuts finish the round, front and back faces of the binding lip *D*. The top of the gib is finished with an end mill making three cuts. The fourth cut saws the end off, which leaves the gib finished with the exception of a flat for the screw that forces the lip *D* against the die. This screw bears on the gib a little above the center of the round, and the method outlined allows the use of a screw that is not continually wearing out. The gib slides into the drilled hole *E* and is held in place by a fillister-head screw. Leroy Q. Presby.

Melrose, Mass.

Increasing the Chip Space in Woodruff Keyway Cutters

It has been my experience that the cutters usually supplied to cut Woodruff keyways do not have sufficient chip room to clear themselves and take a good cut. If made like the cutters supplied for standard T-slots, they



RELIEVING WOODRUFF KEY SLOT CUTTERS

will cut much faster and leave a smoother seat for the key. We do this, as shown in the illustration, by cutting away alternate teeth with an end mill. It costs a little more, but it pays in the amount of work that will be turned out. P. Petrenar.

Rockford, Ill.

Preventing Rod Vibration on Automatic Screw Machines

Brass rod of square or hexagonal shape, when used in automatic screw machines and run at a speed suitable for this material, is apt to make a lot of noise. What is worse, it will usually suffer more or less abrasion of the corners when, as is usually the case, it is supported in a length of iron pipe. If the rod is even slightly bent the troubles are increased.

It was to overcome these difficulties that we made a set of carriers like Fig. 1. This carrier is simply a shell or bushing about 2 in. in diameter and 6 in. long with bushings ½ in. thick driven and pinned in each end. These bushings are broached out about 0.010 in. larger than the size of rod they are to be used with.

Before fastening the bushings into the shell we riveted in the flat springs as shown by sketch, using four springs for square rod and three for hexagonal, the object being to hold the carrier on the rod when it was slipped over the outer end.

As a guide for these carriers we provided a length of tobin bronze tubing and took precautions to keep it in line with the spindle of the machine. This worked very successfully on rod from 3/4 in. to 1 1/4 in. across flats, running at about 900 r.p.m.

Later, however, when we tried the same method with rod of the section and size shown at Fig. 2, running 1,200 r.p.m., we found ourselves strictly up against it on account of vibration caused by the rod being out of balance. Bracing the pipe rigidly did not help matters much, but when we clamped several hundred pounds of iron on the pipe at each support the rod ran as quietly as any round rod could.

We next took another machine at the same speed, 1,200 r.p.m., and replaced the regular pipe holder with solid

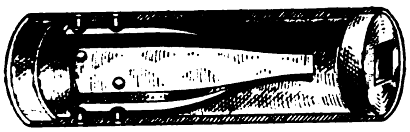


FIG. 1

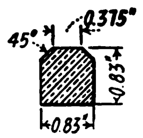


FIG. 2

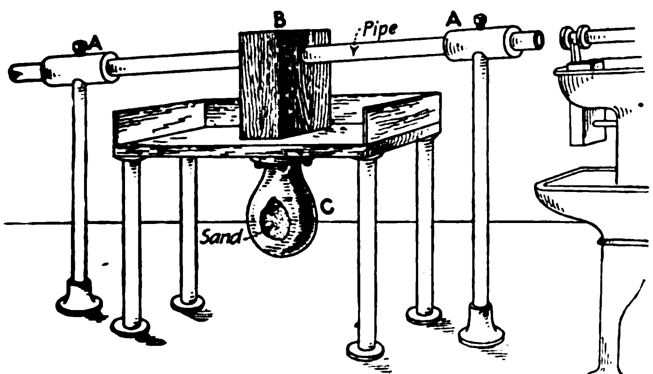


FIG. 3

ELIMINATING ROD VIBRATION

castings 6 in. in diameter by 12 in. long, *AA*, Fig. 3. The result was that these heads remained practically motionless while the pipe vibrated at least 1/2 in. between the heads, more in fact than seemed possible. A heavy bench stood just under the pipe, so the wood block *B* fitting the pipe closely was bolted to the bench, but little improvement resulted.

Having a discarded pump air chamber, we filled it with sand and bolted it to the table as at *C*, directly under the block *B*. This proved a solution, reducing the vibration to almost nothing.

The appearance, however, of this array of inertia material was not exactly ornamental, and it would be interesting to know how others have overcome these troubles.

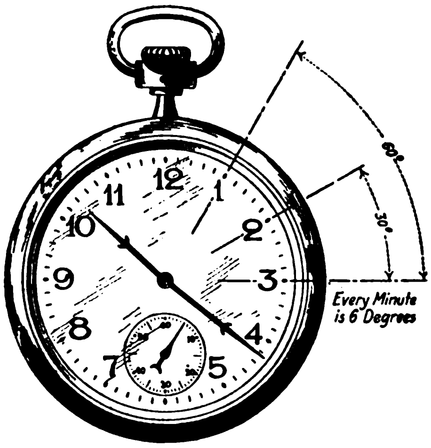
RAYMOND GRANT.

Norwich, Conn.

Watch Face as Protractor

During my past summer vacation in the backwoods it happened one day that I wanted to lay off approximately an angle of 60 deg. It also happened that my watch was lying on the table in my rustic quarters, and by chance I suddenly realized that its face would serve as a reasonably good protractor. The accompanying illustration shows what I mean.

At the time it struck me as rather odd that I had never before seen a "protractor" in a watch face. On my return to civilization I amused myself by asking about every other person I met if he had ever used a watch as a protractor or ever heard of such a thing. I kept this up for several weeks and asked scores of people, engineers and professional men, and with the exception of one young civil engineer who had used the watch face to judge roughly an angle in the field, I did not meet one man to



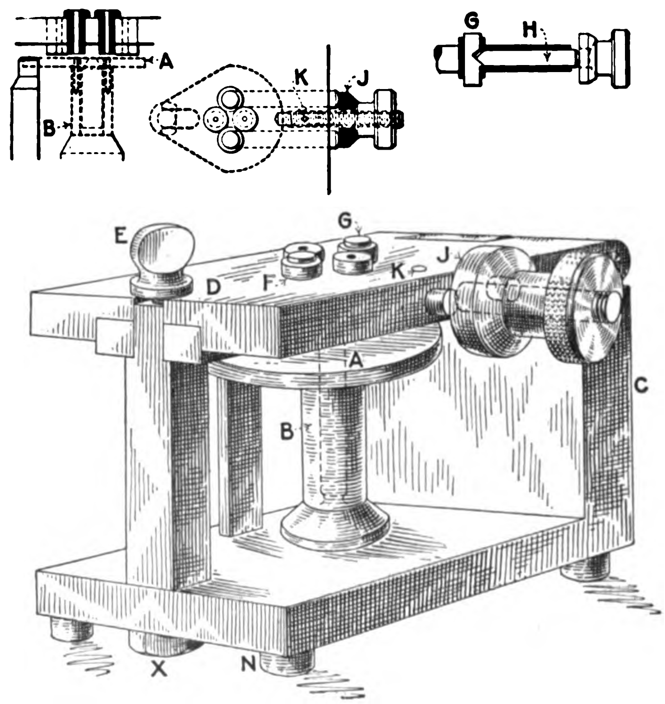
USING WATCH FACE AS A PROTRACTOR

whom the whole idea was not a sort of amusing surprise. I do not suggest for a moment that the "discovery" is of great value, but it was a source of momentary convenience to me, and perhaps it is worth passing along. With a little care it is possible to lay off any required angle within a very small margin of accuracy.

Pittsburgh, Penn. GEORGE H. FOLLOWS.

A Feather Pinning Jig

The piece for which this jig was made is a 1/8-in. cold-rolled steel punching fitting on a cold-rolled steel hub *B*. The piece *A* must be located on the hub and



FEATHER PINNING JIG

pinned. The jig is made with a machine-steel forging *C* and a lid *D* held down by the thumbscrew *E*. The bushings *F* carry the pins *G* and have a 45-deg. angle

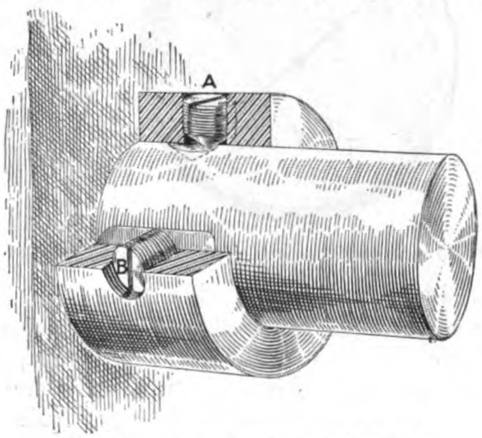
milled in them. The pins *H* fit in the angles and are worked by a nut and floating washer *J*.

The screw *K* is threaded its full length and screwed into the lid and bottoms in the threaded hole. A small pin *K* is used to keep the screw from coming out, the threads taking all the thrust. B. H. RICHARDS.

Dayton, Ohio.

Adjustable Thrust Collar

The collar shown is made of the desired dimensions with screws to suit. The screw at *A* is pointed at the same angle as the spot in the shaft. The spot is placed a little in advance of the center line of the screw. The screw *B* has a flat point that seats on a flat spot on the shaft.



ADJUSTABLE THRUST COLLAR

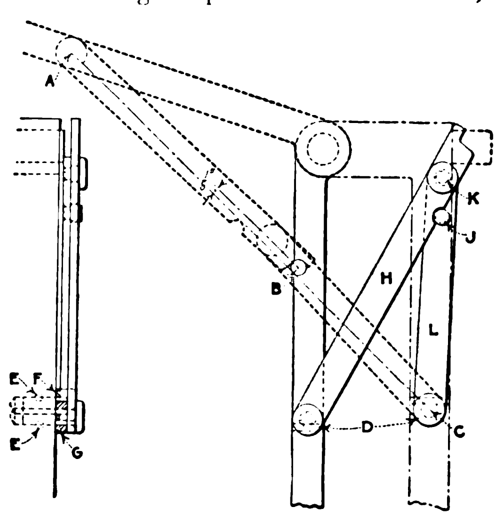
To take up end play where this collar is used, screw in *A*, which moves the collar to the desired position. Then bind it with screw *B*.

I have found this a simple means of adjustment.

Ilion, N. Y. HAROLD E. GREENE.

Hinge Lid Stop for Large Jigs

A lid stop for large jigs is shown herewith. The full line shows the hinge stop when the lid is down, and the dotted line shows its position when the lid is up. It will be noticed that points *A*, *B* and *C* are not in line and that point *B* is 1/8 in. from a line drawn from *A* to *C*. This is done so as to enable the lid to be closed without touching the hinge.



HINGE LID STOP FOR HEAVY JIG

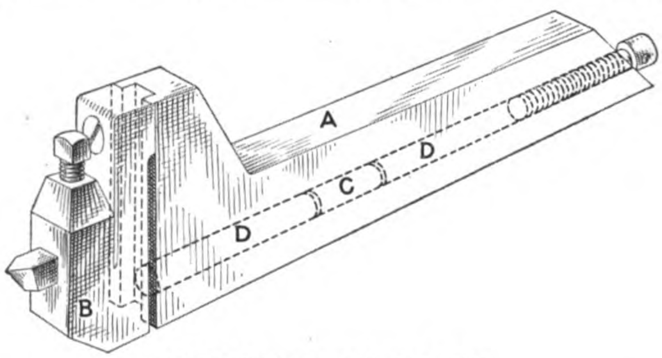
All the parts are made of cold-rolled steel case-hardened. The holes drilled in the lid and body of the jig are a snug fit for studs *D*, which are held in place by pins *E*. The spacing collars *F* and *G* keep the hinges from striking the jig and also each other. The half-round cut in hinge *H* is merely a clearance cut for stop stud *J*. The stop stud *J* and the stud *K* are driven and riveted in hinge *L*. M. BASSETT.

Dayton, Ohio.

Spring Threading Tool Holder for Square Bits

Although the *American Machinist* has shown a number of spring threading tools in the past, another good one may not come amiss.

The tool shown is almost self-explanatory. It consists of a shank *A* and a tool head *B*. The tongue on the tool head works in the slot in the shank head and prevents the tool from deflecting sideways when large threads are being cut. The tension screw through the shank can be set up to give the desired spring; or by taking out the leather buffer *C* and bringing the two rods *D* together and against the tool head, it becomes a solid tool. WILLIAM C. BETZ.

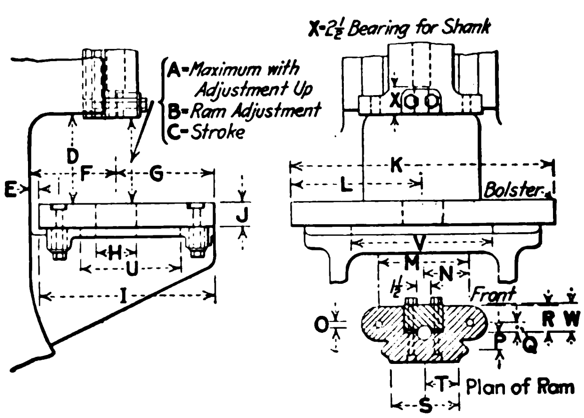


THREADING TOOL HOLDER

New Britain, Conn.

Data for Punch Presses

In the illustration are shown data on punch presses that may be found useful by designers in making punch and die tools to be used on No. 4 and No. 5 Adriance presses. There are also supplied data required by the designer regarding the minimum and maximum sizes of tools which can be used in operating.



DATA FOR PUNCH PRESSES

Hartford, Conn. W. F. O'CONNER.

Discussion of Previous Question

Manufacturing Rifle Cartridges

I have read with interest the article on "Manufacturing Rifle Cartridges," Vol. 43, page 881, and I must object to several things.

For a modern shop how crude is the metal reel used in Mr. Smith's Fig. 5! Nearly all press manufacturers build a sheet-metal reel that is practical, to say nothing of being graceful, for a price that would almost put this one out of consideration.

Personally I should not want to wind sheet metal 0.080 in. thick with an opening much less than 3 in. in diameter instead of almost nothing, as he has shown in operation 1. In this operation we see a strip of metal $2\frac{5}{8}$ in. wide planned for anything but economical blanking. The established width for the wall between blankings in sheet-metal work must be equal to the thickness of the metal blanked, except in very thin stock. I have allowed a maximum wall width, one and one-half times the thickness, and by economical location of the punchings I get two blanks across the width of a strip of metal $2\frac{5}{16}$ in. wide, three rows of blanks from a $3\frac{3}{8}$-in. strip and four rows from a $4\frac{3}{8}$-in. strip. The minimum of 0.080 in. wall width could have been used instead of 0.120 in. with a further saving.

This layout for blanking is shown in Fig. 1 herewith. There would be some difference in the amount of scrap at the end of a day's run between the two methods. If two rows of blanks are to be cut, punches would be set as indicated by circles, marked 1 and 2, Fig. 1; if three rows, as at 1, 3 and 4; and if four rows, as at 1, 3, 4 and 5. The finger stop for the feed of the metal is set in the first circle to the left of the punch, that is, farthest to the right.

It will be noted from Mr. Smith's operation 1 that the four blanks are cut in one die. Even with a wall of $\frac{1}{4}$ in. at the cutting edge of the die, I do not see how his dies can stand up as long as he specifies. Not only is the wall thin, but making more than one die out of one piece of steel to be hardened is very impractical.

In hardening, the dies cannot but change their shape somewhat, and the problem of getting the punches and dies to line up properly is quite difficult. The stripper is about as well designed as the die itself. What would happen should the plunger used for stripping the shell from the drawing punch turn around 180 deg.?

I now refer to Fig. 2 herewith, in which A is the die. It will be noted that there is as generous a radius between the blanking diameter and the drawing as their respective diameters will allow, which makes the shell draw easily. The bottom of the die is relieved as shown. The time required to cut this relief is almost nothing, and you have formed as simple and positive a shell stripper as could be desired. The shell is bound to expand some as soon as it has passed through the die, which will prevent it from going back up through the die with the drawing punch.

At B is a steel die holder in which the dies are held by retaining rings C screwed into B. The outside of the die and the inside of the ring are both tapered 10 deg. so that the die is drawn securely down on the die holder. At D is an ordinary stripper for the blanking die; at E, the blanking die; and at F, the blanking-die holder, a steel drop forging shown in detail in Fig. 3. The drawing punch G has a vent hole which Mr. Smith does not show, and shells will surely stick to the end of the punch unless there is some way of getting air to the end of the punch to relieve the vacuum held by the pressure of the punch on the metal. In large work a spring plunger is added to the end of the punch to help separate the shell from the blank. There is a slot cut on opposite sides of the upper end of the punch to suit a holder on the upper gate of the press. This allows a condition of practical floating, in that the holders may be clamped in position

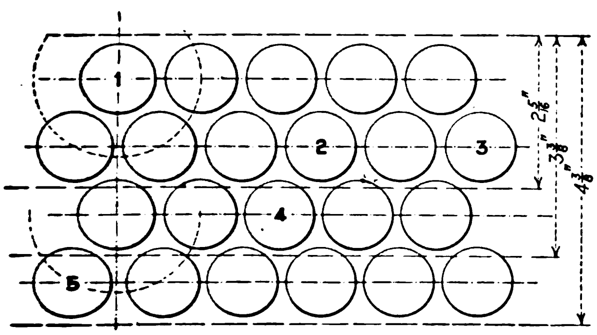


FIG.1

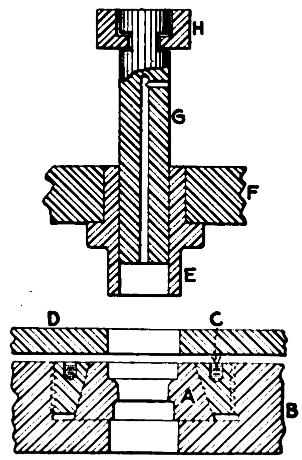


FIG.2

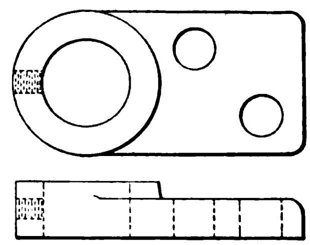


FIG.3

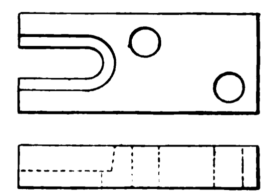


FIG.4

FIGS. 1 TO 4. DETAILS OF BLANK SPACING, METHOD OF STRIPPING SHELLS AND PUNCH AND DIE HOLDERS

Fig. 1—Layout for blanking rifle cartridge-shell blanks. Fig. 2—Blanking and cupping die for rifle cartridges. Fig. 3—Blanking-die holder. Fig. 4—Floating drawing-punch holder

and the holes for *F* and *H* tapped in their respective punch-holder plates. The detail of the floating drawing punch holder is shown in Fig. 4.

In dial-feed presses the dial is generally so designed that the shell is located upright, so that no locating of the shell in the drawing die is required as Mr. Smith has shown in each redrawing operation except the first one. This saves materially on the stroke of the press.

Uptodate gages are being shown in nearly every issue of *American Machinist,* and I fail to see why any company should use such a crude gage as is shown on page 887.

The table herewith arranges the details of the six operations shown in Mr. Smith's article, to which I have added the minimum number of strokes of the press that each shell could be drawn with, for 110 r.p.m. is a pretty

PRESS PRODUCTION TABLE

Operation No.	No. of Machines	No. of Tools per Machine	Time, Hr.	Production	Stroke of Press	Life of Die in Number of Blanks
1	1	4	10	250,000	110	2,500,000 3,000,000
2	2	2	10	200,000	100	1,000,000 1,500,000
3	2	2	10	200,000	100	1,500,000 2,000,000
4	2	2	10	200,000	100	2,000,000
5	2	2	10	200,000	100	2,000,000
6	2	2	10	200,000	100	2,000,000

good speed to run a heavy geared cam drawing and blanking press of the type illustrated by Mr. Smith. I should say that 100 r.p.m. was pretty high to run a dial-feed drawing press with a stroke of 2½ in. at least, but I would like to be shown before I believe that a press can draw the same number of shells per minute with a 6¼-in. stroke.

The life of the die for operation 6 is one-third more than the life of the die for operation 2, yet the wear from friction is nearly five times as great. I question whether the difference in the reduction in the thickness of the walls of the shells will give this difference in the life of the dies.

It is my opinion that Mr. Smith must have been misinformed regarding the speed of presses, the design of modern blanking and drawing dies and the life of the dies.

J. W. Maynard.

Hartford, Conn.

Counting the Number of Teeth in a Wheel

On page 1044, Vol. 43, Mr. Fletcher tells us how to count the teeth of a gear wheel. His suggestion hit me so squarely in the neck that I went through my shop, and I did not find anyone who had not had the same trouble, counting around two or three times to get the count right. When I told them to mark a space and to count around from it, they all saw the point.

John E. Sweet.

Syracuse, N. Y.

Suggestions from Employees

I have read with great interest the editorial on "Suggestions from Employees," appearing on page 1001, Vol. 43. From my own experience I agree with the statement, "No shop has ever yet worked the system in a strictly fair manner."

I have worked in several shops where the system has been installed. In one my suggestion was approved by the superintendent and disapproved by the foreman. It was tried, proved a success, and after a couple of months I received a liberal reward. But after that I was slighted by the foreman, and the best thing for me to do was to leave.

In another shop we did not have a suggestion box. The employees had to give the suggestions to the general foreman. He seemed to be very fair at first; but afterward he told the employees, when they suggested something, "That is the way we make them in England and later on we are going to make them that way here." (The firm had several branches in Europe.) Later the suggestion box was installed and opened only by the president of the firm.

On a certain article an operation had to be performed on the vertical miller. I suggested to the general foreman that it could be done on the drilling machine. He told me that they had tried it in England, but it would not work. I put this suggestion into the suggestion box and received an order from the superintendent to proceed with the tools and fixture for the drilling machine. It proved a success and reduced the cost of production to about 40 per cent. of what it was before; but soon after this I had to look for another job, because the firm moved to another town and laid off nearly all of its employees.

So after about three years of faithful service I asked for a reference, which was given to me and which winds up like this: "Owing to the moving of the factory to another town, we are compelled to discharge him." That was the only reward I received for that suggestion.

I think it would be advisable to keep secret the name of the suggester from the general foreman and foreman unless they have been proved to be broad-minded and fair men.

Charles Gutman.

Chicago, Ill.

A New Design for Reducing Gears for Aero Propellers

Although now in Great Britain, a refugee of war from Belgium, I am a Russian, and have spent more than twenty years, half of my life, in the drawing offices of Russia, France, Germany, Belgium and finally, because of the war, in Great Britain.

Mechanical draftsmanship has been for me the periscope through which I looked at life. And though I have often been bored with it, I hold the conviction that mechanical manifestation is one of the most important in life. In my own experience, every time I was ordered to search and to invent, I was happy and enjoyed my work more than anything else.

My last experience as designer here in Great Britain, which I am to relate, and which may be of interest, was in aëro-engine work. I was confronted with the problem of designing a device for reducing the speed of the propeller shaft, the engine being of 250 hp., 12-cylinder, inclined at 60 deg. and running at 1,200 r.p.m. The propeller had to be in line with the crankshaft and be driven at a speed of about 550 r.p.m.

Epicyclic gearing was tried, but it could not be made small enough. I finally came to the idea of a stationary pinion as a means of reduction, and the whole device took the shape shown herewith.

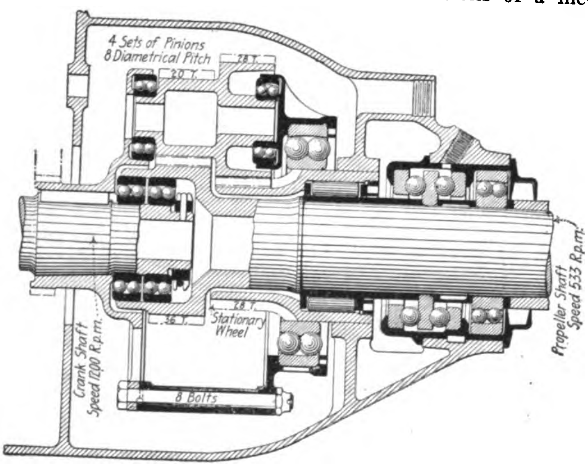
The stationary pinion has 28 teeth and is held firmly in the crank case by two long bolts going through the case and over the top of the pinion. The propeller shaft

passes through the stationary pinion and runs on ball-and-roller bearings. It carries a gear of 36 teeth running on internal ball bearings forced on the end of the crankshaft of the engine. It meshes with a 20-tooth pinion. Four sets of stepped, or cluster, pinions run around the stationary pinion, being held in a cage keyed on the end of the crankshaft and guided on large ball bearings on a stationary pinion. One set is shown at the top. The result of this combination as regards the reduction of speed may be expressed as follows:

$$36 : 16 : : 1{,}200 : 533$$

Thus the propeller shaft will make 533 r.p.m. with the motor at 1,200 revolutions.

I have read that the chief difference between an American and a European constructor will be shown at once if both are given the choice of two solutions of a mechanical problem, one of which is already in practice and the other quite new. The European will choose the old one so as to profit by past experience, while the American, confident of his own judgment, will jump at a new idea.



REDUCING GEARS FOR AERO PROPELLERS

So it proved to be in the present case, for when submitted for official approval my idea was criticized and rejected as being new. I believe my idea of the stationary pinion is good, and I hope also that some American will take it, think about it and design some better and more practical device for the benefit of the mechanical world, not forgetting to credit a Russian mechanical draftsman with the idea. MICHEL BALKACHINE.

Dumfries, Scotland.

Useful Relation Between the Squares of Numbers

Referring to Mr. Olds' communication in the *American Machinist*, Vol. 43, page 1126, on a simple method of obtaining the difference of two squares, a still simpler relation is:

$$a^2 - b^2 = (a + b)\ (a - b)$$

Mr. Olds' problem then becomes:

$$701^2 - 679^2 = 1{,}380 \times 22 = 30{,}360.$$

Elizabeth, N. J. DONALD M. LIDDELL.

On page 1126, Vol. 43, D. S. Olds shows an easy method of obtaining the result of the expression $a^2 - b^2$, by expanding it. It seems to me that an even easier method is to use the factors $(a - b)\ (a + b)$. As the results of the addition and subtraction can be set down directly, there is only one multiplication to perform, against two in Mr. Olds', besides the other operation. Moreover this expression is easier to remember, being only the product of the sum and the difference.

Rochester, N. Y. S. E. CORY.

Europe as Market for American Machinery After the War

On page 861, Vol. 43, appears an article by F. C. Cornet, on "Europe as a Market for American Machinery After the War." In the same issue is an editorial on this subject, on page 871. On these articles I should like to comment; and I will premise my remarks by stating that as an English engineer I have been, during a long period of years, and am still, a purchaser and user of American machinery, and in common with most English engineers bear tribute to the general excellence of your productions which, like good wine, need no blush.

The tenor of the article, in anticipating further remunerative trade arising from the war, is couched in terms which are offensive in their deductions and remind one of those ghouls who speculate at a bedside as to what a relative will leave, before breathing has ceased.

As a regular reader of the *American Machinist* and one who has closely followed and admired its straightforward and dignified policy, I feel sure that you would not willingly create a false impression on this side, and therefore I desire to comment on two aspects of the article.

Mr. Cornet may have an extensive knowledge of some parts of northern France and Belgium, but possibly he will allow one who also knows the districts in recent years to say that his statements and conclusions as to engineering practice, the standard of home life and the methods of commercial routine do not apply in a general way to the districts named and are exaggerated or much overdrawn. His statements regarding the "Old Country," as to office routine, are absolutely untrue in a general, or even a very limited, sense. Conversant as I am with every town and city of the United Kingdom, I say that Mr. Cornet was either grossly misled by someone who "pulled his leg," or else has adorned his tale, by writing that (a) clerks in a large office earned an average wage of 16s. to 17s. per week, and (b) that not one of them had ever seen a typewriter, and that (c) the head clerk after 34 years' service only received £80 per annum. There is much that is good in Mr. Cornet's article, and it is a pity that such misstatements should have been allowed to spoil it.

The second aspect on which I desire to comment is this: That it is not, in Great Britain or Europe, looked upon as good form to discuss, during a quarrel, the possible favorable outcome for oneself that may arise from the probable exhaustion of the combatants, and it is hardly in good taste that such a discussion should appear in a journal that caters for and has received a considerable amount of support in Europe and Great Britain.

In the midst of a wave of abnormal and profitable trade arising from the war, the Allies would better respect some Americans if they acted and spoke more modestly as to the reasons for their present prosperity in

stead of continuously harping on the dollar that is and the dollar that is to come.

Speaking for my own country, let them try to appreciate the absolutely disinterested reason or duty that led us to take our part in the war; let them also try to appreciate the spirit of a nation that, having already half a million of casualties in the field, is prepared to face three or four times as many for no ulterior benefit, but because we always have stood and always shall stand to our bond. Let them also realize that in our organized effort to win the war we deliberately sacrifice our trade and discount our future prospects.

The realization of our efforts and sacrifice will, I believe, make our cousins see that after all it is only the self-respect or the soul of a nation that counts, and that the present time is not one for any neutral nation publicly to weigh up or estimate future profits arising from the misfortunes of others.

We have no necessity for the active help of any others than our present allies, and we shall finish this job in a manner which will prevent a recurrence for another hundred years; Europe after that settlement will be a better place to live in. Further, we are not afraid of any start that the present circumstances gratuitously give to any of our competitors; all we say is that for any benefits you are now reaping, be modest and do not shout about them. We appreciate and value not only the vast volume of American opinion that is favorable to and wishes success to the Allies, but the material help that your large concerns have been able to render.

Permit me to conclude that, as one who has very many friends among American engineers, my one object in writing at such length is to correct for the benefit of the few the impressions and erroneous deductions in the article in question, which I feel sure are not held by the great majority of Americans, and to wish sincerely that the very pleasant relations that exist between American and British engineers may continue and grow in accord.

London, England. HERBERT A. JONES.

[Mr. Jones, in the preceding letter, shows first, that he has failed to read Mr. Cornet's article carefully, and second, that he fails to understand the American attitude and viewpoint in regard to the increase of business due to the war. In his third paragraph he quotes three comments from Mr. Cornet and states in substance that they do not apply to conditions in the United Kingdom. Here he falls into error, for Mr. Cornet was discussing the situation in Belgium and northeastern France, not in Great Britain.

In his second paragraph he states in substance that the American attitude, as indicated by the article that he is discussing, reminds him of "one of those ghouls who speculate at a bedside as to what a relative will leave, before breathing has ceased." Nothing could be farther from the facts, and again Mr. Jones must be charged with careless reading. In the last paragraph of the editorial to which he refers are these sentences:

"The allies of Belgium, who would naturally have the first privilege of extending help in this rebuilding, will unfortunately have similar conditions to meet at home. The enemies of Belgium will be barred by hatred. Thus, American engineers must play a big part in this work of reconstruction."

This indicates the duty which Americans feel toward the rest of the world in an endeavor to keep things going while the producing nations of Europe are prevented from carrying on their usual tasks. This attitude is succiently summed up in the opening paragraphs of the "Report of the Chief of the Bureau of Foreign and Domestic Commerce." He writes:

"The world situation as it exists today is for this country [United States] one of opportunity and one of obligation. Our opportunity lies in the fact that the business community is aware of the existence of foreign markets, sees the advantage of securing them, and is now positively desirous of doing an export business. The European War has advertised foreign trade to the American business man. The mere fact that our chief competitors are at present otherwise engaged is of merely temporary interest. The obligation which rests upon our business opportunity is to fill, for the time being, the rôles in the world's markets voluntarily laid aside by the other great nations of the world. We must supply to the newer countries raw materials, manufactured goods, finances and most important of all, enterprise. Of no less importance, we must supply a market for the products of our new customers. The obligation of our present situation is as great as the opportunity, for we have in our power the well-being of many other nations."—Editor.]

Repairing a Broken Crankshaft

In reference to Mr. Miller's remarks regarding crankshaft repairing, on page 254, Vol. 43, I must say that I was sorry to see that the illustrations had been wrongly shown. The mistake made the crankpin appear to be conical. When I noticed the error in print, I thought it was so obvious that no one would be led astray and consequently did not trouble to correct it.

I very much appreciate the remarks on "Objections to Welding Crankshafts," but should another case come my way I should feel inclined to try my luck once more.

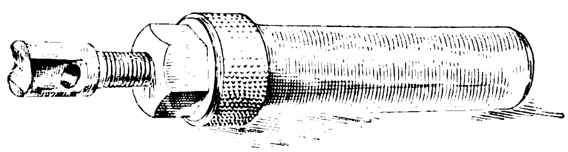
As to Mr. Miller's further remarks on welding, I wish to take this opportunity to thank him for having added a fair amount of useful information on a comparatively new and interesting subject. H. HELLFRITSCH.

Stockport, England.

Adjustable Stop for Automatic Screw Machine

In the past several adjustable stops for the automatic screw machine have been shown, and while many of them represent improvements, unnecessarily complicated design is often found in these devices.

Herewith is shown the best adjustable stop that I have ever seen for the automatic screw machine. The stop



ADJUSTABLE STOP FOR AUTOMATIC SCREW MACHINE

was used on the No. 0 Brown & Sharpe screw machine and gave perfect satisfaction. Its construction is very simple. The face is spot drilled to allow clearance for teat of stock left by the cutting-off tool.

Harrisburg, Penn. JOHN HOFFMAN.

Editorials

Reasons for Finding Costs

Truth, essential truth, has never before been revealed in such clearness to men of this generation as during the year just passed. Both new truths and sidelights on old truths have been disclosed. National aspirations, racial ambitions and commercial envies are now evident to all who read and reflect. And in the realm of smaller affairs some of the controlling forces of industry are now recognized as they have never been recognized before.

The beams from one of these sidelights have illuminated the matter of pricing machines. We may have fondly believed that selling prices depend upon costs, for we have been told this over and over again and have been given a wealth of supporting arguments and a score of illustrations in an attempt to prove the truth of the statement. But when we see a tremendous increase in price, which in a single case has carried one machine from $550 to $1,600, we question the direct relationship between the probable increased cost and the actual increased selling figure. The first may have increased 25 per cent.; the latter has gone up nearly 200 per cent.; and this is no isolated example.

Thus the truth is revealed to us that selling prices rest on other things than cost. To be sure, some observers have always held this. Some have said that the selling price for a machine is fixed by the builder's competitors. Others have said that the price is whatever the traffic will bear. So far as the present situation is concerned, the latter statement seems to be true. The prices of machines in this country have advanced in keeping with the desperateness of the needs of European and domestic buyers.

When we have reached this conclusion, the question naturally follows, What are the reasons for finding shop costs? It is commonly supposed that they are obtained to fix prices. But if prices are largely governed by factors other than costs, there must be some less apparent reason for cost finding, if cost finding is worth while.

The practice of some progressive firms gives us a tip as to the more important reasons for establishing and maintaining expensive cost departments. Among these are: To govern policy and to control costs. To sum up, with an attempt to arrange them in order of importance, we now have these three reasons: To control costs; to govern policy; to set prices. The first comprehends improvement in manufacturing efficiency and the elimination of waste. The last is of far less importance than either of the others.

If prices are set by what the traffic will bear or at what a manufacturer can sell for with profit under competition, it follows that shop costs must be sufficiently below those prices to return a proper manufacturing profit. Whether they are or not, governs the policy of continuing in that line of business, dropping out or so modifying the methods of manufacture or sales as to put the business on a satisfactory basis. Before details of policy can be worked out, the costs must be known.

Once a definite business policy has been decided upon, based upon possible cost, it follows that the assumed cost must become a reality, else the business will run toward the rocks. Here is where the necessity for control of costs enters. And this in turn is probably the most important function of cost keeping.

In any shop a few most pertinent questions can now be asked: Is the cost-finding system operated in such a fashion that it supplies information, first, to control costs; second, to determine policy; and third, to assist in setting selling prices? If it does not do all three of these in a satisfactory manner, it is not meeting its responsibilities and should be reconstructed. The too frequent situation—where the cost department merely accumulates "records," which are late in being compiled, lacking in vitality and left unused from year to year—has no excuse whatever for being. A healthful treatment for such a situation would be to send the records to the boiler furnaces, discharge all the help, dust the place clean and begin over again. There have been cases where just such drastic action has been taken, with final results that were profitable.

Influence of the Automobile on Machine-Tool Design

The direct and indirect influences exerted by the automobile on machine tools during the past ten years are seldom realized. They have all been in the direction of improvement. A brief résumé of automobile manufacture of a decade ago is interesting and affords an opportunity for reflection on the development of our present-day high-grade metal-working machines.

Ten years ago most of the high-grade automobiles were made abroad—chiefly in France and Italy. In their production toolroom methods were used—long, tedious boring and reaming operations were the rule and laborious laying-out was everywhere in vogue. The motor and transmission gears were hardened, often singly, and then "run in." A train or pair of gears was placed on studs that could be gradually brought nearer together until the correct pitch centers were found for as silent running as it was then possible to obtain.

The machining of the cylinders was a similar slow process. They were usually bored with a single-pointed tool and then reamed with a multiple-edged tool. In many cases the bores were finally lapped by hand, using a long cast-iron cylinder or drum charged with abrasive material. This process was continued until the more or less inaccurately bored holes were straight and cylindrical.

In those earlier days firms in this country followed like methods when making what was known as high-grade—another term for high-priced—cars. It is true that there were also medium-priced cars, but these were usually about as noisy as a threshing machine that needs oiling and general overhauling. It was at about this time that the American public, appreciating the value

of the automobile, demanded a car as easy running and silent as the expensive foreign product of the millionaire. At this stage of the development of the industry the machine-tool builder's help was epoch making.

He designed and made the machine tools which have produced a medium-priced automobile with the ear-marks and possibility of satisfaction of the high-grade and high-priced cars, whether of foreign or domestic manufacture. In step with him came the special tool designer developing jigs, fixtures, gages, cutters and the like, so that the parts for these new vehicles could be produced to the best advantage. One of the problems—that of machining circular parts in parallelism—was solved by special types of lathes and automatics. Another problem—that of producing a satisfactory finish—was overcome by grinding parts so that the surfaces are both smooth and true. For this purpose several new types of grinders have been evolved.

The miller has also kept pace in the onward stride for better machine tools, so that surfaces are now machined quickly, smoothly and to interchangeable contours. The gear cutter—planer or hobber—has enabled the manufacturer to produce gears with any proportion and shape of tooth desired. He can now turn out all the gears in a set with a certainty of having the same tooth outline and thus interchangeability in their manufacture.

The advent of high-speed steel and its effect in increasing production are too well known to require comment here. But hardening furnaces, pyrometers and heat-treating devices have added their quota to the success of the movement that the newer steels initiated.

Briefly, as a result of these and other developments, shafts, pins, studs and other cylindrical parts are now produced without bothersome suboperations such as filing. Holes are bored so that shafts fit for their entire length, and the former slow operation of scraping to obtain a satisfactory bearing is seldom resorted to. Cylinders are machined and ground so that the piston has an equal bearing pressure for the entire length of the bore. The tedious cut-and-try lapping method of final finishing is now a thing of the dark ages of automobile building. Gears are machined, hardened and made ready for use without any running-in being necessary. By the use of special machines and small-tool devices—jigs, fixtures and others—parts are now produced more quickly and cheaply than ever before and with complete interchangeability.

As a final assembled product we now have automobiles not only in the medium-priced but also in the low-priced class which for ease of manipulation and silence in operation compare most favorably with the high-grade, high-priced cars of a decade ago. An old adage says, "Necessity is the mother of invention." The people of this country needed automobiles that they could pay for and enjoy. The machine-tool builders supplied the means for producing them. The high-grade machine tools of today owe the stimulus for their development in great measure to the need for the motor car.

To a similarly high degree the automobile industry has left its mark on the development of the now common alloy steels. Many of these steels, possessing qualities of strength and durability which were almost undreamed of before the automobile sprang into commercial existence, owe their very conception to motor-car service.

An Industrial Responsibility

The importance of industry, the vital need of engineering direction and even the overshadowing of financial matters by manufacturing requirements in warfare were emphasized at the banquet of the Society of Automobile Engineers. Secretary of the Navy Josephus Daniels pointed to the record of England. In the early days of the war the British nation congratulated itself on having at the head of the imperial finances such a strong, able man as David Lloyd George. His success in mobilizing the financial resources of the British Empire is known to all. But as the war progressed, a greater need appeared—the need for munitions and army supplies. So acute was this need, so overpoweringly essential were the physical means for carrying on the war that David Lloyd George was transferred from his important post as head of the British Exchequer to the more important, newly created position of Minister of Munitions.

No other fact or event of the present great struggle emphasizes so strongly the part that the regulation of manufacturing plays in modern war; for when manufacturing control is put ahead of financial direction, the importance of the former has received super-emphasis.

Maj.-Gen. Leonard Wood also addressed the automobile engineers and their guests and drew an illuminating comparison between the army, with the organized forces of industry behind it, and the edge and the back of the blade of a cutting tool. He likened the army to the keen edge which meets and attacks whatever is to be cut or severed, is worn away in the process, perhaps even nicked and broken, and must constantly be renewed by repeated sharpenings. He then likened the stiff, strong, heavy back of the blade, which supports this keen cutting edge and makes its use possible, to the organized forces of industry behind the army. And he expressed keen gratification that the initial steps are being taken to organize American manufacturing and American engineers behind the United States Army. He also expressed the hope that we shall some day have an advisory board for the army doing the same work that is projected by the Naval Advisory Board.

When great reliance is placed upon an individual or an industry, an equal degree of responsibility goes with it. The army and the navy of the United States are relying upon the machine shops and other plants capable of producing war materials and supplies so to plan and organize their efforts as to provide all of the support that the cutting edge may need to be prepared to meet a possible national emergency.

If this plan is to meet a successful issue, it will mean not only hard work on the part of the military officials but painstaking and conscientious effort on the part of the American engineer and manufacturer. In the last analysis, the success or failure of the scheme of mobilization of American industry toward preparedness must find its solution in the detail endeavors of many thousands of individuals scattered throughout the country.

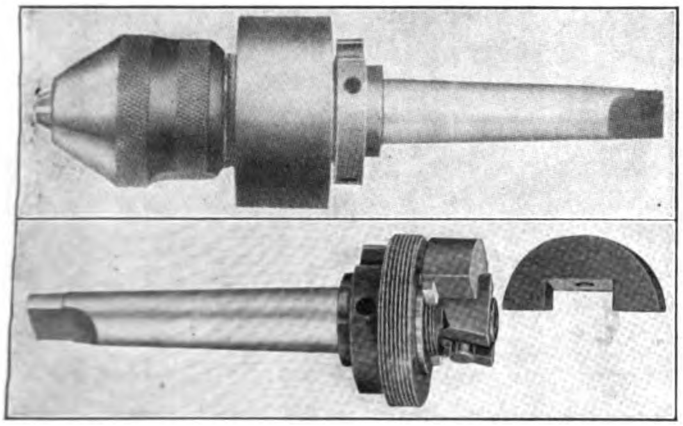
It is not enough to make careful plans; these must be backed up by the elaboration of detail so that every possible emergency is anticipated. Ways and means must be discovered to overcome the difficulties which experience has shown nations meet at such a time. American machine shops will not shirk the duty.

Shop Equipment News

Friction Tap Chuck

In the design of the tap chuck shown, compactness was the primary object, so as to permit convenient application to multiple-spindle drilling and tapping machines.

As indicated in the illustration, the tap is held to its work by friction. A disk of friction fiber is split in two and fitted around a beveled center piece. A chamber, just under the jaws of the chuck, goes over the split disk, and the halves of the disk are forced against the inner surfaces of the chamber by drawing the beveled center piece down toward the shank, forcing the halves apart. This friction grip may be tightened or loosened to suit any tapping job by turning the adjusting nut. No special tool is required for this, as a file, nail set or some other simple tool will answer the purpose.



FRICTION TAP CHUCK
Capacity in range of five sizes, ⅛ to 1 in.; diameters of shanks, ½ to 1½ in.

The jaws of the chuck not only grip the round shank, but at their base hold the squared end also, thus minimizing the twisting strain.

This chuck is a recent product of the Bicknell-Thomas Co., Greenfield, Mass., and is made in five sizes with either straight or Morse taper shanks.

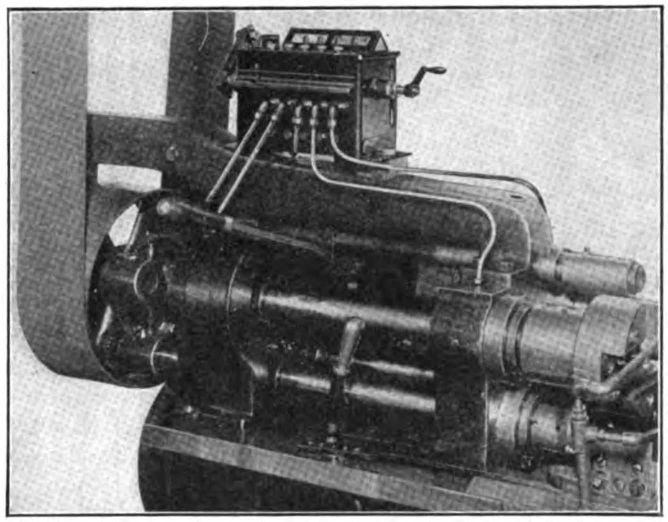
Valveless Force-Feed Machine Lubricator

The advantages claimed for the type of lubricator shown are that the supply of oil to each bearing can be exactly regulated to its requirements with no loss while the machine is at rest, only one receptacle instead of many to attend, and a positive supply that is not easily interrupted through any foreign substance.

The method of application is apparent from the illustration. All of the important parts of the lubricator are entirely visible. Each feed has its individual adjustment by means of the buttons placed conveniently on the top. The adjustment can be made either very fine or to pump several drops each stroke of the plunger, and it remains as set. The barrel is made of close-grained gray iron. Into the barrel is fitted a hardened-steel plunger finish-ground to an accurate fit, each barrel and plunger being thus individually fitted.

The barrel contains the ports and passages that are alternately opened and closed for the intake and discharge of oil by the rotating plunger. This action of the plunger renders the use of valves wholly unnecessary, and as it is positive, there is no "slip" or failure of the pump to deliver any oil that is fluid enough to be forced by atmospheric pressure through the suction passage in the barrel, which is straight and only ⅛ in. long.

The lubricators are furnished in either ratchet or belt drive. The lubricator delivers oil irrespective of the direction in which the pulley turns. The reduction of the belt drive is 44 to 1.



FORCE-FEED MACHINE LUBRICATOR
Capacity, 6½ pints

The ratchet wheel and pawls have a face 1 in. wide and are made of steel. They operate constantly in oil, as do all the moving parts, which it will be observed are inside the tank.

The lubricator shown is made in a variety of sizes, in either single or multiple units, by the Madison-Kipp Lubricator Co., Madison, Wis.

Hydraulic Drawing Press for Forming Cylinders

The extreme pressure, varied conditions and hard service to which the casing of a Prest-O-Lite dissolved-acetylene cylinder is subjected demand that the cylinder be manufactured so that it will stand up well under such usage and have no leakage after the cylinder is filled and put in service. A seamless tube or shell was accepted as the best construction for the cylinder, and a hydraulic press, shown in Fig. 1, was designed and built by the Hydraulic Press Manufacturing Co., Mount Gilead, Ohio, to meet the requirements.

The working speed of the main ram is sufficiently slow to do good work, while the auxiliary pullback cylinders are proportional so that the upward stroke of the main ram is approximately ten times the speed of its downward stroke. In this manner no time is lost by slowing up the actual drawing operation, but considerable time is gained on the complete operation. The press has a total pressure capacity of 800 tons and is of the inverted type, all of the cylinders being located in the head of the press. Between the movable platen and the base of the press a plain ring with babbitted bearings working on the strain rods is operated by two small side rams. This is called the blank holder, and during the initial drawing operation it grips and holds the disk of steel in place in the circular recess located in the lower and stationary platen of the press. The lower platen has through its center a hole which has a large recess at the top for receiving the female cupping dies through which the steel disk is forced. The press has two sets of auxiliary cylinders. One set returns the main pressure ram when the drawing or cutting operation is completed; the other set operates the blank holder which grips the steel disk as it is forced downward into the cup-forming die located in the die-ring holder of the lower platen. The two rams working from the side cylinders which operate the blank holder are $8\frac{1}{4}$ in. in diameter and have a run of 66 in. The main pressure ram has a diameter of 22 in. with a run of 78 in. The press has a working space of 78 in. The cylinder of the main ram which operates the movable platen to which the mandrel is attached and the cylinders of the two rams operating the blank holder are connected to the same pipe line.

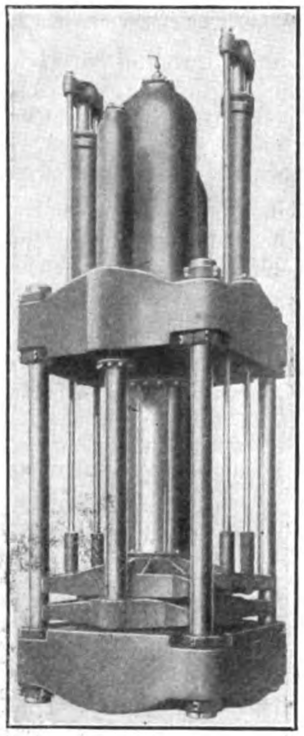


FIG. 1. HYDRAULIC DRAWING PRESS

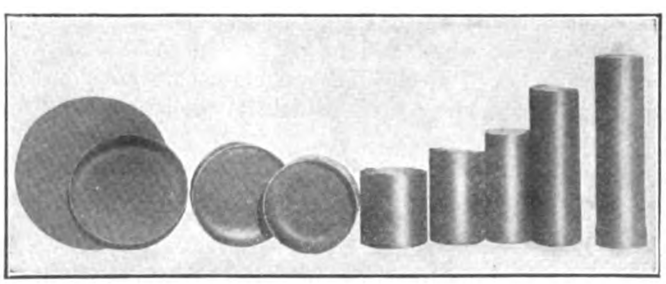


FIG. 2. CUPPING OPERATIONS ON HYDRAULIC DRAWING PRESS

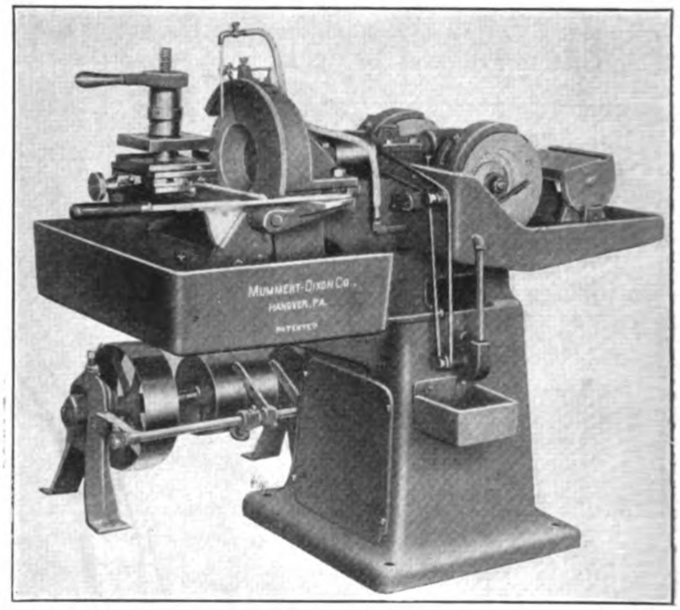
On this press are accomplished five complete cupping and drawing operations by which this plain steel disk, 42 in. in diameter, is reduced to a cup 17 in. in diameter and 25 in. deep. The first five cups, in Fig. 2, show the operations performed on the press. The remaining drawing operations are performed on a smaller press having a longer stroke of the ram.

Face and Tool Grinder

It will be observed that the machine shown is of the combination type designed for a double purpose.

On one end of the machine are mounted a coarse and a fine oilstone for stoning edge tools. The arbor carrying the two oilstone wheels is driven from the upper arbor through a set of hardened-steel spiral gears running in an oil-tight case. Ring oilers and phosphor-bronze bearings are used.

The other end of the machine is fitted with a face-grinding wheel for general work. Provisions are made for directing the oil through a suitable nozzle to this wheel, thereby keeping the work cool and the stone clean and sharp. The oil is caught by the pan under the table and returned to the oil reservoir. The vise is so constructed as to grip readily a wide variety of work. It is mounted on a slide that is moved back and forth by a hand lever on the slide table. The table can be adjusted and firmly clamped at any angle relative to the face of the grinding wheel.



OILSTONE FACE AND TOOL GRINDER

Drive pulley, 4 in. in diameter by $3\frac{1}{2}$ in. face; 2 hp. is required; speed of upper and lower arbors, 1,200 r.p.m. Oilstones, 10x2-in. face, cupped; cylinder wheel, 10x3-in. face by 2 in. thick.

The work is fed to the wheel by a micrometer screw feed connected to the slide. The slide is provided with T-slots for fastening work when the vise is not used.

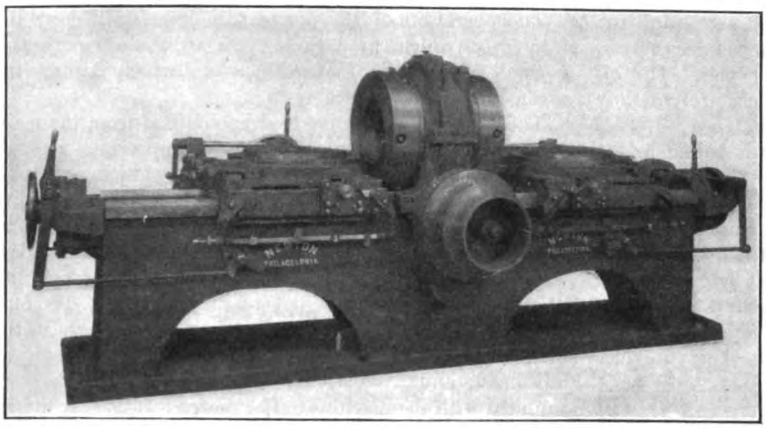
The machine is a recent product of the Mummert-Dixon Co., Hanover, Penn.

Special Boring, Turning and Facing Machine

Although the machine shown was specially designed by the Newton Machine Tool Works, Philadelphia, Penn., for boring, turning and facing a rear-axle automobile member, it is expected to be applicable to other classes of work.

The machine has individual cross and longitudinal saddle feeds, with positive turret feed stops giving four positions to the longitudinal and two positions to the crossfeed. The turrets have circular adjustment with six stations.

The spindle head carries a three-jaw universal chuck on each end. The drive to the spindle is through a large bronze spiral gear and hardened-steel pinions from a four-step cone. Power for all saddle motions is taken from the main pulley shaft through a gear-speed box having a 5 to 1 range and giving a change without removal of gears. All motions are independently clutched with hand levers, and release is effected by dogs on the saddles engaging stops. The turrets are accurately grooved to facilitate interchange of tool holders.



BORING, TURNING AND FACING MACHINE

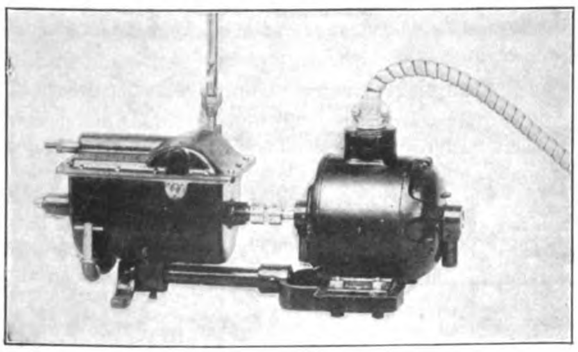
Internal chuck capacity, 12 in.; turrets, 18 in. diameter; maximum distance between centers, 16 ft. 6 in.

Other special classes of work for which this machine is particularly designed are the simultaneous trimming of closed ends and cutting excess length from open ends of shells up to 12 in. in diameter, and also contour-boring the interior.

Power and Speed Controller

The illustration shows a power- and speed-regulating controller recently developed by the Speed Controller Co., 257 William St., New York, N. Y. It is shown coupled to a $\frac{1}{12}$-hp. motor for motor control.

The device constitutes a complete machine in itself and is used for automatically limiting to, or reducing an excess of speed or power to, an exactly predetermined amount. It is centrifugal in action.



SPEED-CONTROLLING DEVICE

The centrifugal portion of the controller is essentially a high-speed governor of special design, in which the parts are quick-acting and sensitive to minute changes in speed. The transfer of power from the governor shaft to the secondary or indicating shaft is made directly and positively without waste of motion. The operating parts, being in continuous motion and in a state of exact balance, are ready at all times to respond to changes in velocity. Special means are provided to reduce friction in the centrifugal and other parts to extremely small amounts.

While sensitiveness and accuracy have been attained, the parts have been designed with a wide margin of safety as relates to their mechanical strength and durability.

This controller is also made in a double-acting type designed to perform its functions directly or to be used as a relay—operating an electric motor, an oil pump or other auxiliary device in overcoming heavy mechanical resistance. It is also adaptable to certain forms of remote control where its motor can be started and run continuously from the manual control point at three fixed speeds, at one of which the controller will be inactive at its adjusting shaft; at one higher speed it will produce motion in an attached apparatus in a certain direction, and at a lower speed the motion will be communicated in a reverse direction.

Heavy-Duty Cutting-Off Lathes

In the illustrations are shown two forms of high-speed heavy-duty cutting-off lathes especially designed for cutting off and facing shrapnel and high-explosive shells.

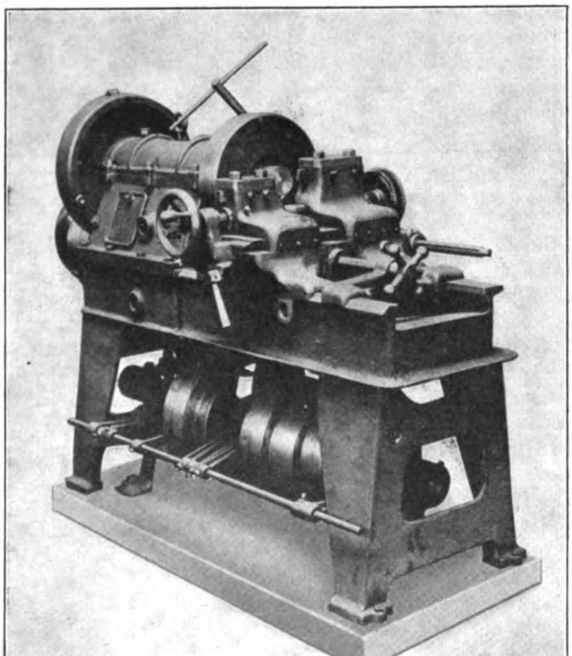


FIG. 1. SHELL CUTTING-OFF AND FACING LATHE

Capacity, 1½ to 3½ in.; speed of countershaft, 320 r.p.m.; diameter of tight and loose pulleys for 4-in. belt, 14 in.; motor, 3 hp.

The machine shown in Fig. 1 was designed for shrapnel shells. The general construction will be clear from the illustration, from which it will be observed that the design follows that of the pipe lathe.

The front part of the bed is cast with a solid bottom on an angle, which acts as a drip pan and catches all the cuttings, allowing the oil to drain off into the deep recess, from which it filters through to the oil well. The oil trough, around the outside edge of the bed, prevents any oil or cuttings dropping on the floor.

The spindle rests in a headstock that is bolted to the bed of the machine and doweled to prevent getting out of line. The spindle journals are of large diameter and wide face, fitted and scraped to an accurate bearing. The gears are of wide face, the ratio being 3¾ to 1, while the drive pinion is of steel. All gears are protected by gear covers.

The cone pulley at the rear of the machine is of large diameter, will take a 3½-in. belt and is supported on the outer end by a heavy bracket bearing. This provides three bearings for the drive shaft, which is only about 40 in. long, making a very compact and steady drive.

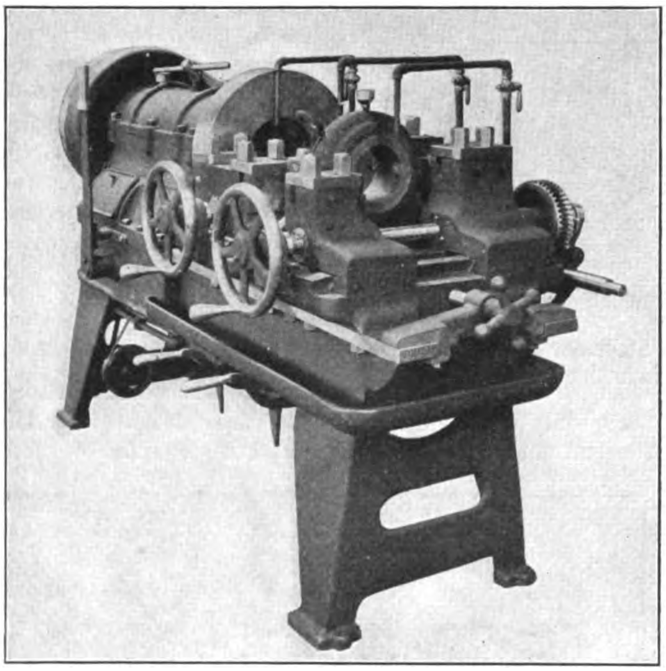


FIG. 2. HEAVY-DUTY CUTTING-OFF LATHE
Capacity, 6¼-in. stock; single-drive pulley, 16x6 in.; horsepower required, 25

The chuck is of the universal self-centering type. The table is rigid, having long bearings on the bed, and is made gibbed so that it can be set and locked; or if a small amount of travel is required, it can be obtained by just leaving the carriage slack enough so that it can be moved forward, or backward, by operating the handwheel. In this way the whole cutting-off carriage and adjuster can be set and locked at any place required on the bed.

The cutting-off blocks are fitted on the carriage with a taper slide and gibbed, the rear block which takes the upward thrust having about 1½ in. more bearing than the front. In the front block is an adjuster bush which is screwed in or out by a pin wrench. This permits rapid adjustment of the tools to each other. The tool slots in the cut-off blocks are ¾x1½ in., so that either a tool holder or any size tool steel can be used.

The feed screw is 1$\frac{7}{16}$ in. diameter and has a bearing at each end of the carriage. On the operating side there is a handwheel for quick return, and on the rear end of screw is a bronze wormwheel for the power feed. The crossfeed screw is protected by a sleeve to prevent cuttings from dropping on the screw where exposed between the blocks.

The operation of the power feed is controlled by the feed lever, which, by a third turn up or down, operates a small cam, under worm housing, which throws the worm into mesh, or vice versa.

The drive for the power feed is obtained from the main drive shaft, on which there is a three-step cone.

The machine shown in Fig. 2 is a triple cutting-off lathe especially designed for cutting up ingots for high-explosive shells. Similarity of design with the machine shown in Fig. 1 will be noticed. Increased rigidity is provided. The spindle, which is 9 in. in diameter with an 8- and a 7½-in. bearing, front and rear respectively, has four speeds. Two of these are obtained by clutch gears in the machine, which are operated by the lever at the operator's left hand, and two through the two-speed countershaft supplied with the machine. The power feed is gear driven direct from a large steel gear on the spindle, and the cutting speed can easily be increased or decreased by changing the gear on the feed shaft and adjusting the idle gear to suit. The clutches on the rear of the feed screw are operated by means of a fulcrum and lever handle, which passes right under the bed of the machine and comes up under each handwheel.

The machines shown represent recent additions to the line made by John H. Hall & Sons, Brantford, Canada.

Automobile Show of 1916

The sixteenth annual Automobile Show was held at the Grand Central Palace, New York, N. Y., on Dec. 31, 1915, to Jan. 8, 1916, inclusive. Over 90 different manufacturers of gasoline and electric vehicles had automobiles on exhibit, and over 250 makers of accessories also used show space. There were quite a number of motors partly cut away to show the construction of the cylinders, operation of the valves, path of the gases and other features of motor design, and the trend followed in design is worth noting.

One of the first noticeable facts is the lowering in price. A year ago the average price of the cars shown was over $2,000; this year it has dropped to $1,600. Most of the motors are now being made with block cylinders and unit power plants.

Increase in Number of Multi-Cylinder Motors

This year sees an epoch in multi-cylinder motor development. Eight- and twelve-cylinder motors are now quite common, and more sixes than fours are shown.

The wheel bases average slightly shorter than those exhibited at last year's show. The average S. A. E. horsepower rating is slightly lower, as the cylinder bores are smaller in diameter. The ratio, bore to stroke, is approximately the same as last year.

The speeds of the motors, however, have increased, this being made possible by the decrease in the weight of the parts; an increase in motor speed therefore develops an actual higher horsepower than recorded by the S. A. E. formula. The tires average smaller in diameter but larger in cross-section.

Left-hand steering and control are now used on over 85 per cent. of the cars, which is quite a noticeable change

from four years ago when only 25 per cent. were so equipped. The Franklin is now the only air-cooled automobile at the show. The selection type of gear set is used on over 90 per cent. of the cars, the friction drive getting more scarce than ever.

There are two important reasons—one apparent, the other obtained by investigation—to account for the marked decrease in the price of automobiles. It cannot be said that the cars are being made with either cheaper material or cheaper labor. The first reason is the reduction in the number of chassis models carried per motor. The automobile manufacturer has made a careful analysis and those models which were called for the least, or which did not give the highest satisfaction as regards service, have been dropped and the public is reaping the benefit.

The second reason is the advent of scientific handling of parts in the assembling departments—the result of similar thought to what was formerly exercised only in the machine shop to prevent lost motion.

A Few Special Features in Design

There were some rather novel systems of springs shown, including examples of rear transverse springing, where the two springs are different in length so that the upper, being the shorter, has a faster period of vibration than the lower. The effect is that the shock to the car is reduced. Another type of spring is mounted quite high and normally almost flat; another is a cantilever spring with the center clip well forward, these features being intended to produce an easier riding car.

The Fergus, a foreign car, has very distinctive lines and features. One is the provision for adjustment of the brakes; another is that the springs are inclosed in a pressure bath of oil. Simplicity of design and rigidity of the parts are apparent.

The Marmon has a distinctive feature in its aluminum motor, the pistons and cylinder castings being made of an aluminum alloy, and the cylinder bores fitted with linings of a harder metal. The body and gear set also show new features. The idea evidently of the entire automobile design is to reduce weight and still retain strength by the use of the lighter alloys.

Screw Machine Consolidation

The National-Acme Manufacturing Company has acquired the plant of the Windsor Machine Co. of Windsor, Vt. The present intention of the company is to continue at all three plants—Cleveland, Montreal and Windsor—along the lines heretofore followed.

For the purpose of providing funds for an extension at Cleveland about completed, for contemplated improvements at Montreal, and to provide in part for the purchase of the Windsor property, it is proposed to increase the capital stock of the company at a special stockholders' meeting called concurrently with the regular annual meeting to be held on January 20.

After All Machines Have Been Safeguarded wherever possible and tools have all been carefully inspected, there will still be the possibility of injury. Every foreman of a machine shop should call the attention of the operators or those under his direction to this possibility and encourage them in the practice of reporting unsafe conditions on machines or small tools. He should try to see to it that each one takes the necessary precautions to prevent injury to himself or a fellow-workman.

PERSONALS

Russell Huff, consulting engineer of Dodge Bros., was elected president of the Society of Automobile Engineers at its annual midwinter meeting in New York, Jan. 5.

Charles E. Blake, for many years associated with the Richardson-Phenix Co., Milwaukee, Wis., has been placed in charge of the company's recently established Boston office.

Paul R. Ketzer, formerly connected with the Watson-Stillman Co., has been appointed Eastern sales manager of the Metalwood Manufacturing Co., Detroit, Mich., with headquarters in Philadelphia, Penn.

J. W. Shepherdson has resigned as assistant general superintendent of the Central Iron and Steel Co., Harrisburg, Penn., in order to join the engineering division of the Morgan Construction Co., Worcester, Mass.

George Paterson, general superintendent John Goodison Thresher Co., Sarnia, Canada, has resigned, having accepted the position of general superintendent with the National Manufacturing Co., Brockville, Canada.

Martin G. Sperzel has resigned his position as sales engineer for the Standard Roller Bearing Co., Philadelphia, Penn., and has accepted a similar position with the Royersford Foundry and Machine Co., Royersford, Penn.

A. F. Blouin, for eight years ceramic engineer of the Abrasive Material Co., Philadelphia, Penn., and factory manager of the Cortland Wheel Co., Cortland, N. Y., for five years, has been appointed factory manager of the Springfield Grinding Co., Springfield, Mass.

OBITUARY

William Turner Lewis, second vice-president Mitchell-Lewis Motor Co., Racine, Wis., and one of its founders, died on Dec. 30, aged 75 years.

Carles Cooke Scaife, president of the William B. Scaife & Sons Co., Pittsburgh, died Dec. 30 at his home in that city, aged 72 years. Mr. Scaife was a native of Pittsburgh, and was identified with the business for over 50 years.

Ole N. Troolen, whose "steam-engine investigations" thesis, written at the University of Wisconsin in 1907, attracted international attention, and is now incorporated in engineering handbooks, died in Brookings, S. D., on Dec. 21, 1915. Mr. Troolen was in his thirty-fifth year.

BUSINESS ITEMS

The H. W. Caldwell & Son Co. has opened a sales and engineering office at 711 Main St., Dallas, Tex., in charge of J. C. Van Arsdell.

The Allied Machinery Co. of America, 55 Wall St., New York, announces a change of address by its Paris office. The Paris office and showrooms are now located at 19 Rue de Rocroy. The new quarters are in the vicinity of the Gare du Nord and in the center of the machinery district.

The Bullard Machine Tool Co., Bridgeport, Conn., is building a concrete and steel addition to its plant to cost about $100,000. It will be 268 ft. by 50 ft., first story having two crane sections, second and third stories to be machine rooms, and in the fourth story will be the main offices of the company, drawing room and shop executives' offices.

The Springfield Grinding Co. has been organized to manufacture a complete line of grinding wheels, with headquarters at Springfield, Mass., and factory at Chester, Mass., covering 100,000 sq.ft. of floor space. The plant is fully equipped and under the direction of Factory Manager A. F. Blouin, for eight years ceramic engineer of the Abrasive Material Co., Philadelphia, and for five years factory manager of the Cortland Wheel Co., Cortland, N. Y. The following are the directors and officers: Dwight O. Gilmore, president, is also president of the Hampden Savings Bank, Springfield, director of the Union Trust Co., Springfield, also director of the Chapman Valve Co., Indian Orchard, Mass.; A. D. Robinson, vice-president, and who will devote his whole time to the general management of the company; C. J. Wetsel, treasurer, is also treasurer of the Van Norman Machine Tool Co., Springfield, Mass., and until recently treasurer of the Baush Machine Tool Co., Springfield; Charles G. Gardner, secretary, is a member of the law firm of Gardner, Gardner & Stoddard, Springfield; Frank Page, director, is president of the National Equipment Co., Springfield, Mass., and president of the Van Norman Machine Tool Co., Springfield, is a director of the Springfield National Bank and is president of the Springfield Board of Trade. The product will be sold under the trade-mark of "Maxf."

Prices--Materials and Supplies

PIG IRON—Quotations were current as follows at the points and dates indicated:

	Jan. 7 1915	Dec. 10 1915	Jan. 7 1915
No. 2 Southern Foundry, Birmingham	$15.00	$14.00	$ 9.50
No. 2 X Northern Foundry, New York	19.50	18.50	14.25
No. 2 Northern Foundry, Chicago	18.50	18.00	13.00
Bessemer, Pittsburgh	21.95	19.45	14.70
Basic Pittsburgh	18.95	18.45	13.45
No. 2X, Philadelphia	19.75	18.25	14.25
No. 2, Valley furnace	18.50	17.50	13.00
No. 2 Southern, Cincinnati	17.90	17.40	12.40
Basic Eastern Penn	19.50	18.00	13.50
Gray forge, Pittsburgh	18.45	17.95	13.45

MISCELLANEOUS METALS—NEW YORK

	Jan. 7, 1915	Dec. 10, 1915	Jan. 2, 1914
	Cents per pound		
Copper, electrolytic (carload lots)	24.00	19.75	13.25
Tin	41.00	37.25	33.25
Lead	5.90	5.25	3.80
Spelter	18.00	15.00	5.85
Copper sheets, base	30.00	25.00	18.50
Copper wire (carload lots)	30.00	28.25	14.25
Brass rods, base	35.00	27.25	13.00
Brass pipe, base	38.00	32.00	15.50
Brass sheets	35.00	27.25	13.25
Solder ½ and ½ (case lots)	26.50	23.50	21.00

ST. LOUIS

Lead .... 23.87½ Spelter 40.87½

MONEL METAL—The following prices hold:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less than 500 Lb. of a Size and Over
	Mill Lengths 8 Ft. and Over				
Rounds—Squares	Cents per Pound				
[illegible]/16 — [illegible]/32	31.50	32.00	32.50	33.00	36.00
[illegible] — [illegible]/16	31.25	31.75	32.25	32.75	35.75
[illegible] to 1[illegible]	31.00	31.50	32.00	32.50	35.50
1 15/16 to 2[illegible]	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3 [illegible]/16	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3½ to 3 15/16	32.25	32.75	33.25	35.75	36.75
Squares					
3 1/16 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4 15/16	33.00	33.50	36.00	36.50	37.50
5 to 6 15/16	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than ¼ in. thick.
Hexagon Bars two cents (2c) per pound over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

STANDARD PIPE—

	Discount			
	Black		Galvanized	
	Jan. 7, 1916	Jan. 7, 1915	Jan. 7, 1916	Jan. 7, 1915
¾- to 2-in. steel butt welded	77%	81%	62½%	72½%
2½- to 6-in. steel lap welded	76%	80%	61½%	72½%

At the above discounts, the net prices follow:

Diameter, In.	Cents			
	Black		Galvanized	
	Jan. 7, 1916	Jan. 7, 1915	Jan. 7, 1916	Jan. 7, 1915
¾	2.65	2.20	4.31	3.15
1	3.91	3.24	6.37	4.67
1¼	5.29	4.38	8.62	6.30
1½	6.33	5.25	10.31	7.55
2	8.51	7.05	13.88	10.15
2½	14.04	11.70	22.52	16.70
3	18.36	15.25	29.45	21.80
4	26.16	21.80	41.97	31.00
5	35.52	29.60	56.88	42.20
6	46.08	38.40	73.92	54.60

SAL SODA—The quotations below are per 100 lb. at the places designated:

New York	$1.00
Philadelphia	.75

ANTIMONY—For spot delivery on Chinese and Japanese brands, duty paid 43c. per lb. is asked.

STEEL SHEETS—

Black	Cents per Pound — Sheets from Warehouse, New York		
	Jan. 7, 1916	Dec. 10, 1915	Jan. 8, 1915
No. 12	2.90	2.70	...
No. 14	3.00	2.80	...
No. 16	3.10	2.90	2.35
Nos. 18 and 20	3.15	2.95	2.40
Nos. 22 and 24	3.20	3.00	2.45
No. 26	3.25	3.05	2.50
No. 28	3.35	3.15	2.60
Galvanized			
No. 24	5.05	4.80	3.05
No. 26	5.20	4.95	3.20
No. 28	5.50	5.25	3.50

ZINC SHEETS—The following prices prevail:

Quantity	Cents per Lb.
Carload lots, f.o.b. mill	22.00
In casks, New York	23.00
Broken lots, New York	24.00

SEAMLESS DRAWN TUBING—As we go to press, the base price is 35c. for brass and 35c. for copper. For immediate stock shipment 3c. is added, which gives the following quotations:

Diameter, In.	Cents per Pound			
	Copper		Brass	
	Jan. 7, 1916	Jan. 8, 1915	Jan. 7, 1916	Jan. 8, 1915
¾ to 2½	38.00	20.00	38.00	16.00
3	38.00	21.00	38.00	17.00
3½	39.00	21.50	39.50	17.50
4	40.00	22.00	40.50	18.00
4½	42.00	23.00	42.50	19.00
5	44.00	24.00	44.50	20.00
6	45.00	27.00	45.50	23.00
7	47.00	29.00	47.50	25.00
8	49.10	31.00	49.60	27.00

OLD METALS—The following are the dealers' purchasing prices in New York:

Copper	Cents per Pound		
	Jan. 7, 1916	Dec. 10, 1915	Jan. 8, 1915
Heavy and crucible	18.50	16.50	11.00
Heavy and wire	18.00	16.00	10.75
Light and bottoms	15.50	14.00	9.75
Lead			
Heavy	4.75	4.50	3.30
Tea	4.50	4.25	...
Brass			
Heavy	12.50	11.50	8.00
Light	10.00	9.50	6.75
No. 1 yellow rod turnings	12.50	12.00	...
No. 1 red turnings	12.00	11.00	...
Zinc	12.00	10.00	3.90

COKE—Below are the prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Dec. 18 1915	Dec. 25 1915	Jan. 1 1916	Jan. 8 1916
Prompt furnace	$2.50@3.00	$3.00@3.50	$3.00@3.50	$3.25@3.50
Prompt foundry	3.25@3.75	3.50@4.00	3.50@4.00	3.50

STEEL SHAPES FROM JOBBERS' WAREHOUSE, NEW YORK

	Jan. 7, 1915	Dec. 10, 1915	Jan. 9, 1914
	Cents per pound		
Steel angles base	2.50	2.40	1.90
Steel T's base	2.55	2.45	2.10
Machinery steel (bessemer)	2.50	2.40	2.05

The above prices are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger.

TURNBUCKLES—On sizes smaller than 1¼ in. diameter, 50% off list is charged, and on 1¼ up to 2 in. diameter 40%. At this rate prices follow:

Size	In.	Size	In.	Size	In.
⅜	$0.20	⅞	$0.375	1½	$0.90
7/16	.21	1	.44	1⅝	1.05
½	.225	1⅛	.50	1¾	1.20
⅝	.25	1¼	.75	1⅞	1.35
¾	.315	1⅜	.828	2	1.59

The above prices are for buckles having right and left stub ends and with openings between the heads emasuring 5½ in.

ROLL SULPHUR in 360-lb. bbl, sells in New York at $2.15 per 100 lb.

COTTON WASTE—In New York, the prices below hold:

	Cents per Pound
White	8.50@9.50
Colored mixed	6.50@8.00

COPPER BARS—The base price is 31c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows:

Welding Wire	Cents per Lb.
3/8, 11/32, 5/16, ¼, 7/32, 3/16	8.50
No. 8, 5/32 and No. 10	9.25
⅛	10.00
No. 12	11.00
3/32, No. 14 and 1/16	12.00
No. 18	14.00
No. 20	16.00

Special Welding Steel	Cents per Lb.
⅛	33.00
5/32	30.00
3/16	28.00

Cast-Iron Welding Rods	Cents per Lb.
¼ by 19 in. long	22.00
3/16 by 12 in. long	26.00
⅜ by 19 in. long	20.00
½ by 21 in. long	20.00

Vanadium Wire in Coils or Sticks	Cents per Lb.
1/16	15.50
3/32	15.00
⅛	14.00
5/32	12.00
3/16 and larger	11.00

The above prices are subject to change according to quantity and shipment desired.

WROUGHT WASHERS—From New York warehouse the present quotations for round plate washers is $5 from list price. At this rate the following prices hold:

Diameter, In.	Price per 100 Lb.	Diameter, In.	Price per 100 Lb.
9/16	$9.00	1½	$4.30
¾	7.20	1¾	4.20
⅞	6.40	2	4.10
1	5.50	2¼, 2½, 2¾	4.00
1⅛	4.40	3¾, 4, 4¼, 4½	4.50
1¼	4.80	3, 3¼, 3½	4.20

Cast-iron washers are $2.25 per 100 lb.

CARRIAGE BOLTS—On ⅜ by 6 in. and smaller 65 and 10% off list is allowed; for larger and longer sizes 60% off list is charged . At this rate the price per 100 is as follows:

Length	Diameter ¼	5/16	⅜	7/16	½	⅝	¾
1½ in.	$0.32	$0.44	$0.60	$0.88	....	....	....
2 in.	.35	.48	.65	.96	....	....	....
2½ in.	.38	.52	.70	1.04	$1.30	$2.30	$3.40
3 in.	.41	.55	.75	1.12	1.41	2.45	3.60
3½ in.	.44	.59	.80	1.20	1.52	2.60	3.80

MACHINE BOLTS—From New York warehouse, on sizes from ⅜ in. by 4 in. and smaller 70% off list is discounted; for larger and longer sizes 60% is allowed. These quotations are for bolts having square heads and square nuts. At this rate prices per 100 are as follows:

Length	Diameter ¼	⅜	⅝	¾	⅞	1 In.
1½ in.	$0.51	$0.72	$2.08	$3.08	$4.20	$6.04
2 in.	.53	.77	2.23	3.30	4.48	6.40
2½ in.	.56	.82	2.38	3.52	4.76	6.76
3 in.	.58	.86	2.53	3.74	5.04	7.12
3½ in.	.61	.91	2.69	3.96	5.32	7.48

Bolts, 1⅛ and 1¼ in. by 3 in. and up to 12 in. take 50% off list. On longer lengths a special pound price is quoted.

With cold-punched square nuts 50% is discounted from list, with hot-pressed hexagon nuts up to 1 in. by 30 in. 50 and 10%; up to 1 in. diameter, cold-punched hexagon nets 50%.

Buttonhead with hexagon nuts sell at 50% off list, as do hexagon head with hexagon nuts.

TAP BOLTS—The following are for delivery from New York warehouse, the present discount being 30% from list. These are for tap bolts with hexagon heads:

Length of Screw	Price per 100 — Diameter ¼	5/16	⅜	7/16	½	⅝	¾	⅝	1
1½	$0.77	$0.88	$1.04	$1.23	$1.54	$2.31	$3.23	$4.62	$6.16
1¾	.81	.93	1.09	1.30	1.62	2.40	3.35	4.77	6.35
2	.85	.97	1.08	1.37	1.69	2.49	3.47	4.93	6.55
2¼	.89	1.02	1.20	1.44	1.77	2.58	3.58	5.08	6.73
2½	.93	1.07	1.26	1.52	1.85	2.68	3.70	5.24	6.93
2¾	.96	1.11	1.31	1.58	1.93	2.77	3.81	5.39	7.12
3	1.00	1.16	1.36	1.65	2.00	2.86	3.92	5.54	7.32
3¼	...	1.21	1.41	1.72	2.08	2.96	4.04	5.70	7.51
3½	...	...	1.47	1.79	2.16	3.05	4.16	5.85	7.70
3¾	...	...	...	1.86	2.23	3.13	4.27	6.00	7.89
4	...	...	...	...	2.31	3.23	4.39	6.16	8.09

ALUMINUM—Quotations are as follows in ton lots:

	Cents per Pound
No. 1 virgin 98-99%	54.00 to 56.00
Pure 98-99% remelt	53.00 to 55.00
No. 12 alloy remelt	44.00 to 46.00

Jobbers usually charge 2c. per lb. over the above figures.

WIRE ROPE—On this material the following discounts are for warehouse delivery, New York:

Galvanized	35 and 2½%
Bright	50 and 2½%
Special brands, bright	52½%

BABBIT METAL—In New York, quotations are as follows:

Grade	Cents per Pound
Best	55@60
Commercial	25@30

COPPER SHEETS—Hot rolled 16 oz. (large lots) base per lb. is 28c.; cold rolled, 14 oz. and heavier, add 1c. extra per lb. to the above; polished takes 1c. per sq.ft. extra for 20 in. widths and under; add 2c. per sq.ft. for over 20 in.

OILS—Prime winter lard oil sells at 94@98c. per gal. in 5-bbl. lots; cottonseed crude, f.o.b. mill, 55c.; and linseed, raw, in carload lots, at 66c.

COLD DRAWN STEEL SHAFTING—To consumers requiring fair-sized lots the price is 25% off list.

TIN PLATES—The following prices are in effect:

Coke tin plate, 14x20:	Price per 100 lb.
100-lb.	3.75
I. C. 107-lb.	3.90

Terne plate, 20x28:

Base Weight	Net Weight	Coating	Price	Base Weight	Net Weight	Coating	Price
100-lb	200	8	6.90	I. C.	226	20	9.70
I. C.	214	8	7.20	I. C.	231	25	10.70
I. X.	270	8	9.00	I. C.	236	30	11.50
I. C.	218	12	8.40	I. C.	241	35	12.50
I. C.	221	15	8.90	I. C.	246	40	13.50

Crosses—90c. for each cross, added to price for I. C. 20x28. Pure palm oil process—Extras of $1 for 20x28. Odd sizes—Regular sizes are 14x20 and 20x28 only; other sizes 10c. extra, unless order 100 base boxes per item, for shipment in 50-lb. lots not over 60 days apart.

NUTS—On hot pressed square nuts $4 off list is allowed and on hexagon $4.20. At this rate, the following prices hold:

Hot Pressed Square Short Diam.	Per 100 Lb. Blank	Tapped
½	....	$11.00
9/16	$7.00	8.50
11/16	5.00	5.90
⅞	4.00	4.70
1¼	3,50	3.90
1 7/16, 1⅝, 1 13/16, 2	3.40	3.80
2 3/16	3.50	4.00
2⅜	3.80	4.40

Hot Pressed Hexagon Short Diam.	Per 100 Lb. Blank	Tapped
½	....	$16.70
11/16	....	10.30
⅞	$5.40	6.40
1¼	4.20	4.80
1 7/16, 1⅝, 1 13/16, 2	4.10	4.70
2 3/16	4.20	4.90
2⅜	4.50	6.30

Semifinished nuts sell at 75% off list.

On cold-punched square nuts, $3.50 from list is deducted, and on hexagon, $4.50. At this rate the following prices hold:

Bolt	Cents per Pound — Square Blank	Square Tapped	Hexagon Blank	Hexagon Tapped
¼	16.50	18.50	22.50	25.00
5/16	14.50	16.00	19.50	21.50
⅜	11.00	12.10	14.00	15.60
7/16	10.50	11.40	13.50	14.80
½	7.80	8.50	9.50	10.50
9/16	7.80	8.40	9.50	10.40
⅝	6.50	7.00	8.00	8.70
¾	6.20	6.60	6.90	7.50
⅞	6.10	6.50	6.60	7.20
1	6.10	6.50	6.60	7.20

RIVETS—On this product the following discounts from list and prices are in effect:

	Discount
Steel tank 7/16 and smaller	70%
Tinned	70%
	Price per 100 Lb.
Button heads, ¾, ⅞, 1 in. diam. by 2 in. to 5 in.	$4.00
Cone heads, above sizes	4.10
	Extra per 100 Lb.
1⅛ to 1⅞ in. long, all diameters	0.25
⅝ in. diameter	0.15
½ in. diameter	0.50
1 in. long and snorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

COACH OR LAG SCREWS sell at 70 and 10% off list. At this rate the following prices hold:

Length	Price per 100—Conical or Gimlet Point — ¼ and 5/16	⅜	7/16	½	9/16 and ⅝	¾	⅞	1
1½	.61	.73	.85	1.01	...	...	...	...
2	.66	.80	.94	1.11	1.62	...	...	...
2½	.715	.87	1.02	1.21	1.755	2.48	...	...
3	.67	.94	1.11	1.30	1.89	2.67	4.05	...
3½	.82	1.01	1.20	1.40	2.025	2.86	4.32	5.94
4	.88	1.08	1.28	1.50	2.16	3.05	4.59	6.29
4½	.93	1.15	1.37	1.595	2.295	3.24	4.86	6.64
5	.985	1.22	1.455	1.69	2.43	3.43	5.13	6.99
5½	1.04	1.29	1.54	1.79	2.565	3.62	5.40	7.34
6	1.09	1.36	1.63	1.89	2.70	3.81	5.67	7.695

BOLER TUBES—From Pittsburgh the following are the less-carload basing discounts for lap-welded boiler tubes:

Size	Discount	Size	Discount
1¾ and 2 in.	57%	3½ to 4½ in.	66%
2¼ in.	54%	5 and 6 in.	59%
2½ and 2¾ in.	60%	7 to 13 in.	56%
3 and 3¼ in.	65%		

Above discounts apply to standard gages and to even gages not more than 4 gages heavier than standard. For long tubes charge 10% net extra as follows: 1¾ in. size over 18 ft. and not exceeding 22 ft.; 2 to 3 in. sizes over 22 ft. and not exceeding 24 ft.; 3¼ to 13 in. sizes over 22 ft. and not exceeding 25 ft.

NICKEL—Manufacturers quote the following prices:

	Cents per Pound
Ordinary grade	45.00
Electrolytic	50.00

BAR IRON—Prices are as follows at the places named:

	Cents per Lb.
Pittsburgh, mill	1.95@2.00
New York	2.10@2.15
From storehouse, New York	2.40@2.50

NAILS—Wire nails f.o.b. Pittsburgh sell at $2.10; galvanized 1 in. and longer, $4.10, and shorter, $4.60. These prices are to regular customers and delivery is made at the mill's convenience.

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

The contract has been awarded for the construction of an addition to the plant of the United Injector Co., manufacturer of steam forges and electrical supplies, 23 Water St., Boston, Mass.

Press reports state that the Simplex Wire and Cable Co., Cambridge, Mass., contemplates the construction of a new factory building.

The contract has been awarded for the construction of a 2-story, 59x60-ft. addition to the cotton mill at Fall River, Mass., of the American Printing Co. Estimated cost, $8,000.

The R. B. Phillips Co., Liddlesex St., Lowell, Mass., is equipping a plant for the manufacture of munitions.

An addition to be used as a machine shop is being constructed to No. 3 plant of A. D. Ellis & Sons, Monson, Mass.

The Saco Lowell Shops, manufacturer of textile machinery, is building a 1-story, 112x144-ft. foundry at Newton Upper Falls, Mass. Noted Jan. 6.

William E. Gove, 254 Lafayette Pl., Salem, Mass., will construct a 1-story machine shop on New Derby St.

The Yankee Farm Tractor Co., recently incorporated, will construct a factory at Westfield, Mass., for the manufacture of tractors. E. R. Pendleton, Pres.

The Carl G. Westlund Co., Worcester, Mass., manufacturer of split safety clutches for overhead motors, plans to construct an addition to its plant on Millbury St.

The Swiss Cleaning Co., Providence, R. I., will construct two factory buildings.

The contract has been awarded for the construction of a 5-story, 50x260-ft. machine shop at Bridgeport, Conn., for the Bullard Machine Tool Co. Noted Nov. 18 and Dec. 30.

The Fafnir Bearing Co., New Britain, Conn., is building an addition to its plant.

Work will soon be started on the construction of an ammunitnon plant for the Marlin Fire Arms Corporation, Willow and Nicoll St., New Haven, Conn.

Plans are being prepared for the construction of a factory at Plainville, Conn., for the Rockwell Drake Co., manufacturer of ball bearings.

MIDDLE ATLANTIC STATES

The contract has been awarded for the construction of a 2-story, 100x185-ft. factory for the Ward-Leonard Electric Co., Bronxville, N. Y. Estimated cost, $35,000.

The contract has been awarded for the construction of a 2-story addition to the plant of the Pierce-Arrow Motor Car Co., 1661 Elmwood Ave., Buffalo, N. Y. Estimated cost, $12,000. Noted Dec. 23.

Plans are being prepared by John C. Wandell, Arch., 5 Court Sq., New York, N. Y. (Borough of Brooklyn), for a garage on Lexington Ave. for Henry C. Heissenbuttel. Estimated cost, $20,000.

Plans have been prepared by William Higginson, Arch., 17 Park Row, New York, N. Y. (Borough of Manhattan), for a 3-story factory at Long Island City, N. Y. (Borough of Queens), for the Degnon Realty and Terminal Improvement Co., 30 East 42d St., Manhattan, to be leased by the Rome Metallic Bedstead Co., 149 Broadway, Manhattan.

The McKinnon Chain Co., North Tonawanda, N. Y., will construct an addition to its plant on Fillmore St.

Plans are being prepared by Russell & King, Arch., Snow Bldg., Syracuse, N. Y., for a factory for the Dynetto Electric Co. Estimated cost, $4,000.

The contract has been awarded for the construction of a 2-story munition plant for the Cannister Co., Phillipsburg, N. J. Estimated cost, $20,000.

The Colburn Machine Tool Co., Franklin, Penn., will construct a 1-story factory in the spring. Estimated cost, $10,000.

The Weimer Machine Co., Lebanon, Penn., has awarded the contract for the reconstruction of its shops recently destroyed by fire with a loss of $100,000. Noted Nov. 25 and Dec. 30.

William Cramp & Sons Ship and Engine Building Co., Philadelphia, Penn., is in the market for machine tools.

The contract has been awarded for the construction of an addition to the plant of the General Smelter Co., Richmond and Westmoreland St., Philadelphia, Penn.

Fire, Jan. 2, destroyed the factory of John M. Melloy & Sons, 1419-21 Spring Garden Ave., Philadelphia, Penn., manufacturer of sheet metal. Loss, $100,000.

Simon & Arnold, Philadelphia, Penn., will construct a 1-story, 110x120-ft. garage on Wayne Ave.

The J. S. Thorn Co., Philadelphia, Penn., iron and metal workers, will construct a 2-story, 80x225-ft. factory and office building on Allegheny Ave. Estimated cost, $25,000.

According to press reports the Clairton Steel Co. will enlarge its plant at Pittsburgh, Penn.

Fire, Jan. 2, destroyed the garage of J. S. Seaman, 151 Roup St., Pittsburgh, Penn. Loss, $15,000.

An addition will be built to the plant of the Light Manufacturing Co., Pottstown, Penn., manufacturer of automobile motors.

The Shenango Machine Co., Sharon, Penn., will build an addition to its plant on North Water St.

The contract has been awarded for the reconstruction of the Alice Furnace of the Valley Mold & Iron Co., Sharpsville, Penn.

Duhring, Okie & Ziegler plan to construct a 3-story, 160x200-ft. garage at Wilmington, Del.

Bids are being received by W. C. Nichols, Arch., Oxford Bldg., Washington, D. C., for the construction of a 3-story garage for the Mt. Pleasant Garage Co. Estimated cost, $30,000.

SOUTHERN STATES

The Richmond & Rappahannock River Ry., Richmond, Va., has awarded the contract for the construction of a workshop and supply department.

The contract has been awarded for the construction of a 2-story, 120x140-ft. machine shop at Salem, Va., for the Comas Cigarette Machine Co. Estimated cost, $30,000. Noted Jan. 6.

The contract has been awarded for the construction of two continuous two-mill rolling mills at Weirton, W. Va., for the Phillips Sheet and Tin Plate Co.

A. A. Wood & Sons Co., manufacturer of tools, Atlanta, Ga., plans to construct a foundry and would be glad to receive prices and catalogs of equipment.

The St. Louis, Iron Mountain & Southern Ry. will construct a machine shop at Monroe, La.

The McNaughton Grate Bar Co., Maryville, Tenn., plans to enlarge its foundry.

R. B. Hume, Scott St., Covington, Ky., will construct a large garage on Fifth St.

Revised plans are being prepared by F. J. Manley, Arch., 601 City National Bank Bldg., Lexington, Ky., for a 1-story garage at Harrodsburg, Ky., for Gentry & Hayden. Estimated cost, $10,000.

Plans are being considered by the Kentucky Wagon Manufacturing Co., Louisville, Ky., manufacturer of wagons and implements, for equipping its plant for the manufacture of automobiles.

MIDDLE WEST

The contract has been awarded for the construction of the first unit of the plant of the Hercules Motor Manufacturing Co., Canton, Ohio, for the manufacture of engines, tractors, etc. Noted Dec. 9 and Jan. 6.

Plans are being considered by the Rath Metal Products Co., Chillicothe, Ohio, for the enlargement of its plant.

Press reports state that a company to be known as the Fahnestock Manufacturing Co., has been organized at Pittsburgh, Penn., with a view to constructing a molding foundry at Cincinnati, Ohio.

The Mal-Gra Castings Co., Cincinnati, Ohio, has purchased the plant of the Scott Stove and Furnace Co., Cincinnati, and will enlarge same. J. W. Brown, Cincinnati, and M. H. McLean, Covington, Ky., are interested.

The plant of the G. A. Schacht Motor Truck Co. is being moved from Spring Grove Ave. to Gest and Evans St., Cincinnati, Ohio, to increase its manufacturing facilities.

We have been informed that the John Steptoe Shaper Co., manufacturer of machine tools, Cincinnati, Ohio, will soon be in the market for a horizontal boring machine, 3-in. flat turret lathe and 2-in. flat turret lathe for the proposed new addition to its plant. Noted Dec. 30 and Jan. 6.

The Allyne-Ryan Foundry Co., Aetna Rd. and East 91st St., Cleveland, Ohio, is building 2 additions to its plant. Estimated cost, $15,000. Noted Jan. 6.

Vincent Geraci, 806 Woodland Ave., Cleveland, Ohio, has been granted a permit for the construction of a 1-story garage at 1312-16 Woodland Ave., estimated to cost $10,000.

The Globe Machine and Stamping Co., 1250 West 79th St., Cleveland, Ohio, will build an addition to its plant at 1245 West 78th St. Estimated cost, $10,000.

The H. A. Lozier Co., Cleveland, Ohio, will construct a new automobile factory. H. A. Lozier and Frank H. Ginn are interested.

Plans are being considered by the McIntyre Manufacturing Co., Columbus, Ohio, manufacturer of internal combustion engines, for the enlargement of its plant.

Plans have been prepared for the construction of an addition to the plant of the Solar Metal Products Co., Columbus, Ohio.

The Lima Steel Casting Co., Lima (Lima post office), will enlarge its plant at East Lima, Ohio.

The Seneca Wire and Manufacturing Co., Fostoria, Ohio, will enlarge its plant. Estimated cost, $10,000.

The Whitaker-Glessner Co., Portsmouth, Ohio, is having plans prepared for the construction of a series of cold-rolling sheet mills at New Boston (Portsmouth post office).

The Newport Rolling Mill, Newport, Ohio, will build an addition to its plant.

The Farrell-Cheek Steel Foundry Co., Sandusky, Ohio, plans to enlarge its plant.

The Doehler Die-Casting Co., New York, N. Y. (Borough of Brooklyn), and Toledo, Ohio, has awarded the contract for the construction of its new factory buildings at Toledo. Noted Nov. 11.

The Republic Iron and Steel Co. has awarded the contract for No. 5 Bessemer stack near Hazleton, Youngstown, Ohio.

Plans have been prepared for an addition to the plant of the American Steam Pipe Co., Battle Creek, Mich.

The Four Drive Tractor Co., Big Rapids, Mich., is building a factory and will require all tools and machinery for the manufacture of tractors, trucks and motor vehicles. Estimated cost between $7,000 and $8,000. Noted Dec. 30.

R. J. Tower plans to construct a motor truck factory at Greenville, Mich.

The Menominee Electric Manufacturing Co., Menominee, Mich., has increased its capital stock from $600,000 to $1,000,000 and will improve and enlarge its plant.

An addition will be built to the plant of the Piston Ring Co., Muskegon, Mich.

The Independent Stove Co., Owosso, Mich., will build an addition to its plant.

An addition is being built to the plant of the Sparat Foundry Co., Sparta, Mich.

The Wagner Automobile Co. will construct a garage at A and Jackson St., Belleville, Ill. Estimated cost, $14,000.

F. A. Bennett, 5844 Broadway, Chicago, Ill., will construct a 2-story brick factory for the manufacture of metal specialties. Estimated cost, $6,000.

Plans are being prepared by Alfred S. Alschuler, Arch., 28 East Jackson Blvd., Chicago, Ill., for a 3-story, 42x150-ft. building at 27 North Jefferson St., Chicago, Ill., for Manning, Maxwell Moore, to be used as a machinery house.

The Ryan Car Co. will construct a 1-story addition to its plant at 13,500 Brainard Ave., Chicago, Ill. Estimated cost, $10,000.

Carl A. Schlorff, 8023 South Peoria St., Chicago, Ill., has purchased a site at Berkeley Ave. and 52d St., on which he will construct a public garage. Estimated cost, $35,000.

The Western Steel Car and Foundry Co., 136th St. and Brandon Ave., Chicago, Ill., will construct a 1-story brick foundry. Estimated cost, $3,500.

The contract has been awarded for the reconstruction of the plant of the Felker Manufacturing Co., manufacturer of steel culverts, well casings, etc., Marshfield, Wis., which was recently destroyed by fire. Noted Dec. 23.

Bids are being received by Herbst & Hufschmidt, Arch., 721 Caswell Blk., Milwaukee, Wis., for a 5-ton electric traveling crane for the factory and machine shop of the Advance Engineering Co., Milwaukee. Noted Nov. 25 and Dec. 2.

Bids are being received by Herbst & Hufschmidt, Arch., 721 Caswell Blk., Milwaukee, Wis., for a 5-ton electric traveling crane for the Jaeschke Bros. Foundry Co., 3026 Locust St., Milwaukee, Wis. Noted Dec. 16.

The Universal Machinery Co., 1916 St. Paul Ave., Milwaukee, Wis., is building a machine shop.

The Wisconsin Iron and Wire Works, 186 East Water St., Milwaukee, Wis., has purchased a site at Booth and Franklin St., on which it plans to construct a new factory. George H. Norris, Pres.

A 2-story addition will be built to the machine shop of the Minneapolis Machine Co., Sheboygan, Wis.

Plans are being prepared by Charles L. Lesser, Arch., 599 71st Ave., West Allis, Wis., for the construction of a machine shop, public garage and factory building for the O. M. Carter Automobile and Machine Co. at 51st and National Ave., West Allis.

WEST OF THE MISSISSIPPI

City of Duluth, Minn., will build a municipal garage and repair shop at 120th Ave. and London Rd.

The Minnesota Manufacturing Association, North St. Paul, Minn., is building a plant for the manufacture of mechanical conveyors for mills and foundries. Estimated cost, $25,000.

The Hamline Manufacturing Co., St. Paul, Minn., will build an aëroplane factory at 1591 Almond Ave. Estimated cost, $50,000.

The contract has been awarded for the construction of a 1-story garage at 1701 McGee St., Kansas City, Mo., for J. D. Goodard, Kansas City. Estimated cost, $18,000.

The A. Geisel Manufacturing Co., Second and Clark Ave., St. Louis, Mo., manufacturer of enamel ware and stove implements, will rebuild its factory which was recently destroyed by fire. Noted Dec. 23.

Work will soon be started on the construction of shops for the International & Great Northern R.R., San Antonio, Tex. Noted Oct. 28.

WESTERN STATES

The Rhodes Harvester Co., Moscow, Idaho, recently incorporated with $50,000 capital stock, will construct a plant at Moscow for the manufacture of a combined harvester. William M. Rhodes, interested.

Plans are being prepared by Morgan, Walls & Morgan, Arch., 1134 Van Nuys Bldg., Los Angeles, for a 1-story automobile repair shop for J. A. Graves to be leased by the Electric Equipment Co., 315 West 12th St., Los Angeles, Calif. Estimated cost, $10,000.

Plans are being prepared by A. C. Martin, Arch., 431 Higgins Bldg., Los Angeles, Calif., for the construction of a garage and machine shop for Thomas Clark, Nordhoff, Calif.

H. Freeman, Pasadena, Calif., will construct a commercial garage and machine shop on North Fair Oaks Ave.

We have been informed that work will soon be started on the construction of a garage and machine shop at 12th and K St. for the Meister-Leavitt Co., Sacramento, Calif. Estimated cost, $45,000. Noted Dec. 2v.

Robert Brunig will construct a 1-story machine shop on Brannan St., San Francisco, Calif.

E. M. Faure, Van Nuys, Calif., plans to construct a commercial garage and machine shop at Van Nuys.

CANADA

The Grand Trunk Railway System is rebuilding its machine shop at Sebastopol and Leber St., Montreal, Que., which was recently destroyed by fire. Noted Dec. 30.

Fire recently damaged the plant of the Pritchard & Andrews Engraving Co., 269 Sparks St., Ottawa, Ont. Loss, $3,000.

The Canadian Northern Ry., Rideau, Ont., plans to construct repair and car shops and roundhouse. A. J. Hills, Toronto, Gen. Supt.

The Canadian Metal Co., Ltd., plans to construct an addition to its plant on Fraser Ave., Toronto, Ont. Estimated cost, $25,000.

The Universal Tool Steel Co. will construct a 1-story brick addition to its plant on Dufferin St., Toronto, Ont. Estimated cost, $7,000.

Wright & Co., 30 Mutual St., Toronto, Ont., is in the market for an electro-plating dynamo.

GENERAL MANUFACTURING

NEW ENGLAND STATES

Fire, Jan. 3, destroyed the plant of the Rockingham Box Co., Salem, N. H. Loss, $40,000.

Fire, Jan. 3, destroyed the plant of the Southern Berkshire Marble Co., Ashley Falls, Mass. Loss, $100,000.

The Stevens Linen Mills, Dudley, Mass., will construct a 5-story, 50x100-ft. knitting mill.

The Chandler Oilcloth Co., East Taunton, Mass., will construct a 2-story, 85x125-ft. manufacturing building at East Taunton.

Bids are being received by the Paul Whitin Manufacturing Co., Northbridge, Mass., for the construction of a 4-story brick addition to the spinning mill. Estimated cost, $50,000.

The contract will soon be awarded for the construction of a 3-story, 100x195-ft. addition to the spinning mill of the Otis Co., Ware, Mass. Noted Nov. 18.

A 1-story, 45x72-ft. addition is being built to the plant of the Orrell Mills, Inc., Glendale, R. I., manufacturer of worsteds.

The Rosemont Dyeing Co., East School St., Woonsocket, R. I., will build a two-story, 55x67-ft. dye house at Woonsocket.

C. R. Makepeace & Co., Arch., Providence, R. I., will prepare plans for the construction of an addition to the plant of the Baltic Mills Co., Baltic, Conn., manufacturer of lawns.

The contract has been awarded for the construction of a 4-story, 64x72-ft. plant for the Beacon Falls Rubber Shoe Co. at Beacon Falls, Conn.

The contract has been awarded for the construction of a 2-story, 20x60-ft. addition to the plant of the Bridgeport Mattress Co. on East Washington Ave., Bridgeport, Conn.

The contract has been awarded for the construction of a factory at Chester, Conn., for C. J. Bates & Son, manufacturer of ivory, bone and steel noveltiees.

MIDDLE ATLANTIC STATES

A basket factory will be constructed at Jackson St. and Erie R.R. by Bacon & Co., Attica, N. Y.

The Standard Oil Co., Buffalo, N. Y., will build two additions to its plant at 1103 Elk St. Estimated cost, $6,300.

Plans are being prepared by Wright & Kremers, Arch., 31 Loan Association Bldg., Niagara Falls, N. Y., for a 3-story factory at 3d and Walnut St. for the Defiance Paper Co., Niagara Falls, N. Y. Estimated cost, $175,000.

The Buffalo Sled Co., North Tonawanda, N. Y., will construct a factory on Schenk St. Estimated cost, $250,000.

Louis Quien, Jr., 229 Broad St., Elizabeth, N. J., has prepared plans for a 1-story factory at Spa Springs, N. J. (Woodbridge post office), for the New Jersey Glue Co. Estimated cost, $30,000.

An addition will be built to the plant of the Star Porcelain Co., Trenton, N. J.

The contract has been awarded for the construction of a 1-story, 60x125-ft. silk mill for the Allentown Spinning Co., Allentown, Penn. Estimated cost, $15,000.

The contract has been awarded for the construction of a 5-story addition to the plant of the De Ford Co., manufacturer of leather, 40-42 South Calvert St., Baltimore, Md. Estimated cost, $15,000.

Bids are being received by Otto Kubitz, Arch., 11 East Lexington St., Baltimore, Md., for a cold-storage plant for Andrew Schmidt, 2136 Harford Rd. Estimated cost, $7,500.

SOUTHERN STATES

The C. L. Robinson Ice and Cold Storage Corporation, Winchester, Va., will construct a 2-story cold-storage plant. Estimated cost, $50,000.

The Libbey Glass Co. and the Owens Bottle Machine Co. has purchased the holdings of the Union Gas Co. at Cedargrove, W. Va., and plan to construct a glass plant. Estimated cost, $500,000.

The Halltown Paper Board Co., Halltown, W. Va., will construct several additions to its plant.

The Harris Tannery, Sylva, N. C., has been purchased by the Armour Leather Co., Chicago, Ill., who will improve same. Estimated cost, $100,000.

The American Textile Co. has leased the plant of the former Sweetwater Milling Co., Chattanooga, Tenn., and will improve and enlarge same.

The Milne Chair Co., Chattanooga, Tenn., will soon be in the market for wood-working machinery.

Fire recently damaged the plant of the Richmond Hosiery Mills, Chattanooga, Tenn. Loss, $10,000.

former Sweetwater Milling Co., Chattanooga, Tenn., and will build a 150x500-ft. plant.

Press reports state that plans are being considered by the United Gas and Fuel Co., Ashland, Ky., for a plant for the manufacture of gasoline and byproducts and the purifications of oils. Estimated cost, $100,000.

MIDDLE WEST

An addition is being built to the plant of the Faultless Rubber Co., Ashland, Ohio. Estimated cost, $10,000.

George H. Mead, Pres. of Mead Pulp and Paper Co., Chillicothe, Ohio, has announced that a new coating mill will be constructed in the spring. Estimated cost, $150,000.

The contract has been awarded for the construction of a plant on Cleneay Ave., Cincinnati, Ohio, for the Ault & Wiborg Co., manufacturer of dyes. Noted Dec. 30.

The Cincinnati Rubber Co. will construct two additions to its plant at Cincinnati, Ohio. Special machinery will be installed.

An addition will be built to the plant of the Queen City Bottling Works, Cincinnati, Ohio.

Plans are being prepared for the construction of a 2-story, 200x300-ft. factory at Cleveland, Ohio, for the A. P. W. Paper Co.

The Cleveland Window Glass and Door Co. will establish a factory at Spruce, Center, Hemlock and Elm St., Cleveland, Ohio.

The Link-Belt Co. will construct an addition to its plant on Addison St., Indianapolis, Ind. Estimated cost, $12,000.

The contract has been awarded for the construction of an addition to the factory of the C. M. Hall Lamp Co., Hancock Ave. and Rivard St., Detroit, Mich.

A 2-story addition is being built to the plant of the Kiefer Tanning Co., Grand Rapids, Mich.

The Cappon-Bertsch Leather Co., Holland, Mich., has had plans prepared for a 3-story brick addition to its plant.

The Hawthorn Paper Co., Kalamazoo, Mich., will install a paper machine in its proposed new addition. Noted Dec. 30.

Fire recently destroyed the plant of the American Linseed Co., South Chicago, Chicago, Ill. Loss, $2,000,000.

Fire recently destroyed the nitro-glycerine plant of the Aetna Powder Co., Fayville, Ill. Loss unknown.

We have been informed that the yarn mill of the La Crosse Knitting Works, La Crosse, Wis., recently damaged by fire, will be rebuilt. Noted Dec. 30.

WEST OF THE MISSISSIPPI

Curtis Bros. & Co., Clinton, Iowa, will build a four-story woodworking plant on Second St., south of 12th Ave. Estimated cost, $150,000. R. S. Whitley is Supt. Noted Dec. 30.

The Dubuque Tanning and Rope Co., Dubuque, Iowa, will build a factory at Sixth and White St. Estimated cost, $65,000. Frank M. Rhomberg is Pres.

Plans have been submitted for the construction of a packing plant for the Independent Packing Co., Sioux City, Iowa. Estimated cost, $4,000.

The Faribault Packing and Provision Co., Faribault, Minn., will soon award the contract for constructing a plant. Estimated cost, $125,000. M. E. Brooks is Supt.

The Bardwell-Robinson Co., Minneapolis, Minn., has awarded the contract for constructing a four-story addition to its plant, at Second and 24th St., for the manufacture of sashes and doors. Estimated cost, $50,000. L. J. Bardwell is Secy. Noted Jan. 6.

The Midcontinent Tire Manufacturing Co., Wichita, Kan., plans to establish a factory for the manufacturing of tires.

The Manhattan Oil Co., Omaha, Neb., will build a garage at 4613 South 24th St., Omaha.

The John Nooter Boiler Co., St. Louis, Mo., will build an addition to its factory at 1400 South Second St., St. Louis, Mo.

WESTERN STATES

The Commercial Club, Nampa, Idaho, is interested in a project to construct a canning plant at Nampa.

The Gadstein Canning Co., Yuma, Ariz., will construct a fruit-canning plant.

The Oregon-Utah Sugar Co. will build a factory at Grants Pass, Ore. Estimated cost, $600,000.

The American Fish and Oyster Co. will construct a 1-story reinforced-concrete packing plant at Pittsburg, Calif. A. W. Cornelius, Merchants National Bank Bldg., San Francisco, Arch.

The Atlas Powder Co. will construct a plant at Richmond, Calif. Estimated cost, $1,000,000.

CANADA

The Canadian Cottons, Ltd., Marysville, N. B., is constructing a factory at Marysville and will be in the market for electrical equipment.

Gordon & Ironsides contemplates the construction of a packing plant at Ft. Francis, Ont.

The Goodyear Tire and Rubber Co., Akron, Ohio, contemplates the construction of a plant at New Toronto, Ont. Estimated cost, $1,000,000.

The National Hardware Co., 95 Barrie Rd. W., Orillia, Ont., will build an addition to its factory at Orillia. Estimated cost, $20,000.

We have been advised that the Chemical Refinery, Ltd., St. Catharines, Ont., is in the market for boilers, tanks, centrifugal and boiler pumps, valves, etc. Noted Dec. 23.

The McLaughlin Carriage Co. will construct a 3-story, 84x225-ft. addition to its plant at Winnipeg, Man.

Murphy, Stedman & Co., Ltd., 180 Gray's Inn Rd., Holborn, London, W. C., England, has an inquiry for machine tools both for British use and for export to countries outside as follows: 526 lathes, all sizes and types; 51 grinders, all sizes and types; 20 millers, all sizes and types; 4 sawing and cutting-off machines; 11 screw machines; 9 boring machines; 92 power hammers; 16 bar cutters; 19 punching and shearing machines; 10 gear-cutting machines; 66 drilling machines; 4 forging machines; 12 planing machines; 3 boring mills; 6 presses; 4 rifling machines; 24 shaping machines; 40 slotting machines; foundry equipment, machinery, etc.; eight 6½-in. by 6-ft. surfacing, sliding and crew-cutting lathes; ten 7½-in. by 8-ft. surfacing, sliding and screw-cutting lathes for chasing threads in 3'3, H. E. shells, at least 7-in. centers; 3 screw-cutting lathes; 45 lathes, No. 4 Warner & Swasey, or similar, chuck and bar feed, cutoff ovehhead chasing attachment, geared friotion head; 13 No. 2 Warner & Swasey, or similar, chuck and bar feed, cutoff overhead chasing attachment, lathes, plain head; No. 1 Warner & Swasey, or similar, chuck and bar feed, cutoff overhead chasing attachment lathes, plain head; 20 capstan lathes, ¼- or ¾-in. capacity; 6 lathes, 1½-in. through wire feed, chasing arm and cross-slide; ten 2-spindle sensitive drilling machines to drill up to about ⅝-in., cheap simple type; ten 3-spindle sensitive drilling machines, to drill up to about ⅝-in., cheap simple type; 60 plain horizontal milling machines for power, table about 34x10 in., cheap and simple; 3 sensitive drilling machines to drill up to 20 mm., cheap, simple type; 3 multiple drilling machines, 3 spindles, to drill up to 20 mm., cheap, simple type; 64 milling machines, vertical, Brown & Sharpe No. 1, or alternative; 40 milling machines, vertical, Brown & Sharpe No. 2 Y or alternative; 1 planing machine, 2 tools, admit 3M 500x1M250; 1 slotting machine, 450 mm. stroke; 1 slotting machine, 450-mm. stroke, largest size available; 2 planing machines, single tool, circularm otion, admit 2 m. 400 long by 1 m. 250 wide by 1 m. to 1 m. 500 high; 1 horizontal boring machine, 100 mm. through spindle, length of table capable of being used 3 m. 500; 1 radial drilling machine, drilling capacity 80 mm.; 1 vertical drilling machine, drilling capacity 25 mm.; 2 electric drilling machines, drilling capaciy 15 mm., continuous current 110 volts; 30 gold-sawing machines capable of sawing up to 170 mm.; 2 center machines for 60 mm. shafts; 1 slotting machine, preferably with inclined top, 300 mm. stroke; 1 slotting machine, preferably with inclined top, 300 mm. stroke; 1 slotting machine, preferably with inclined top, with 200 mm. stroke; 2 shaping machines, 16-in. stroke; 2 purifying or filtering machines, for filtering oils after use with automatic lathes; 4 twist drill grinding machines, take drills 5 mm. to 50 mm.; 2 twist drill grinding machines, take drills 5 mm. to 80 mm.; 5 universal grinders, capacity 5 to 200 mm.; 1 grinding machine to sharpen saw teeth; 4 multiple-spindle drilling machines to drill up to 7 mm.; 4 multiple-spindle drilling machines, reversible, to drill up to 7 mm.; 9 drilling machines up to 15 mm.; 7 drilling machines, reversible, to drill up to 15 to drill up to 15 mm.; 7 drilling machines, reversible, to drill mm. in steel; 2 drilling machines to drill up to 30 mm. in steel; 2 drilling machines to drill up to 30 mm. in steel; 1 shaping machine, 10-in. to 20-in. stroke; 1 shaping machine, 20-in. to 24-in. stroke; 1,000 plumbago crucibles of an equivalent size to Morgan's D. 60; crucibles in following sizes: 150 lb., 440 lb. and 1,120 lb. capacity.

American Machinist

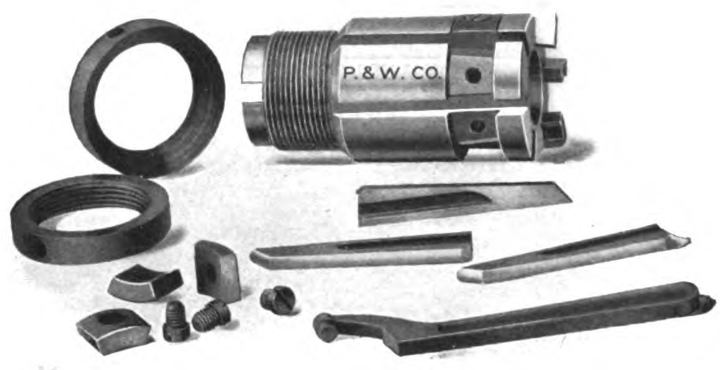
'olume 44, No. 3
ssued Every Thursday
ill Publishing Company

NEW YORK, JANUARY 20, 1916

Price, 15 Cents
Contents, First Page
Advertising Index, Last Page

Reamers
Always Up to Size

Make sure that all your reamed holes are smooth and accurate



Parts of P. & W. Solid Adjustable Blade Reamer.

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Unexcelled for Design, Simplicity and Ease of Adjustment

1. The eccentrically relieved blades are stronger than others, do not chatter and produce a smoother hole.

2. The hand, shell and fluted chucking reamers have interchangeable nuts, screws and wrenches.

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4. By a simple adjustment of the blades the reamer can easily be set to size without regrinding.

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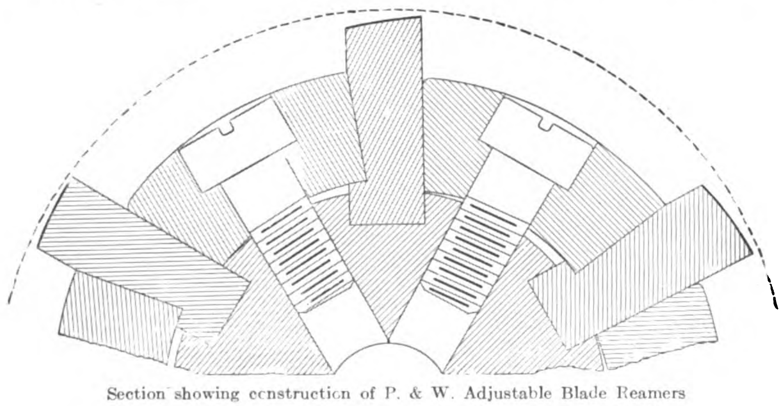
Write for catalog No. 8, "Small Tools" showing our complete line.



Section showing construction of P. & W. Adjustable Blade Reamers

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American Machinist

L. P. ALFORD, *Editor*

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WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormay processes, protected by United States patent issued June 22, 1915, and another pending

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The Future of the Automobile Industry

BY JOHN N. WILLYS, *President*, WILLYS-OVERLAND COMPANY

Reprinted from an article in Advertising & Selling.

THE selling and advertising of automobiles is now a tremendous industry in itself. Upwards of ten or twelve million dollars are spent annually in automobile advertising, and a great deal more is closely related to it. Multi-page advertisements are now common, and automobile advertising plays the most prominent part of most advertising mediums. Equally the development, training, stimulation and organization of a sales force and co-operation with dealers and agents is now a great industry in itself. Both are without lines of precedent to follow —and yet they face a great future. The noise of war detracts popular attention from the fact that, whereas, before the war, foreign cars were holding on to considerable of their prestige and had a good grip on at least their own market in their own country, now the American automobile is practically universally supreme.

The European war has opened entirely new fields all over the world for American-built cars, and created a big boom for them. And now that these new buyers have discovered the great advantages offered by American cars at any price, they will never abandon this country's trade to go back to foreign makers at the close of the war.

What policies have prepared American makers for this amazing opportunity, which has been met in a thoroughbred way, in all its suddenness and immensity?

First, the quantity production methods now in vogue in this country have enabled manufacturers to put the maximum of quality into their product at a minimum cost. The motor cars that are being manufactured in the big American plants today are better made, give better service, and sell at approximately half the price they did a few years ago. This is an achievement which is quite stupendous, when you really take time to think of it.

The foreign makers, and some few American makers, had limited their productions to a comparatively small number of cars each year. Therein lay their weakness. I believe it has now been proved that it makes no difference whether the product be motor cars or lead pencils, the factory that has the facilities for manufacturing in large quantities invariably turns out the best and lowest priced article and is equipped to seize the world-market in the natural evolution of events. I recommend this line of thought to every manufacturer of whatever line of goods.

Second, this automobile selling success is due principally to the fact that the article was backed up *by tremendous pressure of substantial advertising*. Without advertising, quantity production is almost an impossibility. The new product that is not advertised will not sell no matter how attractive the quality or price. Advertising is the very air which a new article must breathe if it desires to enjoy any real degree of prosperity or breadth of sale. Any retail merchant who carries on his shelves goods that are not advertised will bear witness to the truth of this statement. Any live salesman in the world, who really knows his business, will tell you that advertised goods are sold at a smaller selling expense than those unknown except to a comparative few. Yet it is amazing how the contrary idea does stick with large numbers of people who should know better.

In my own experience I have found that intelligent, aggressive advertising has paid dividends in *three* different directions:

(1) In increasing volume of sales

(2) In shaping a good will state of mind in the public, and

(3) In establishing self-conscious standards of service, policy and expectations in the manufacturer himself.

No man will ever be able to estimate the full effects of automobile advertising *on the industry itself*, to say nothing of the selling effect on prospects. It has established an esprit de corps of general educational co-operation which is somewhat like the co-operation practiced by the engineering committees from the various plants earlier in automobile history, when screws, tires, wheels, etc., were standardized. It inspired the confidence of bankers and investors, executives, salesmen and dealers alike, for somehow it had the ring of prophesy in it—it made you feel the future of the industry. It made writers and editors and reporters feel that way, too, for certainly no line of industry has from its very start been so blessed with gratuitous publicity as the automobile business.

Now this is all retrospective, but I speak of automobile advertising in this appreciative way because it has a great deal to do with my conception of the automobile future. There are many who, rather naturally, incline to the view that automobile advertising is at its maximum.

But if I know anything about automobile advertising it would be fatal to take such a view as that automobile advertising is at its peak and will now gradually recede. In my opinion automobile advertising is certain to grow, rather than to diminish, for if it is necessary (or advisable) in such quantity, at a time when factories are nearly all oversold and cramped with war orders, will it not be *doubly* necessary and advisable when the enlarged facilities called into existence by the war will need sales to keep them going *after* the war?

From all possible angles therefore, the value and attractiveness of automobiles for different types of people and for various uses must be kept before the people by educational advertising. I see rather more than less advertising during the next five years.

I am especially strongly convinced as to the need for judgment and foresight in regard to future auto selling. Innumerable failures have occurred in the past through overconfidence on the part of auto manufacturers. Possibly early success led them to believe that their product would sell itself. For a season or two they may have been unable to supply the demand for their goods. Then when the advertising appropriation was cut down and a false conception of selling applied, the inevitable occurred. As a result of such short-sightedness came a slack period. Business dropped off rapidly and eventually they started in to exploit their product again. But in the meantime competition had sprung up. Other concerns were in the field and they found themselves practically starting in from scratch, two years behind their competitors. The competitors had been consistent advertisers through the period of prosperity, while they had entirely overlooked the truth of the old saying—"Out of sight, out of mind."

The seller of automobiles, tires or accessories who now entertains any idea that his goods are exempt from the general rules of hard sales effort or careful study, just because of the industry's rapid and spectacular growth, will be the man who will fail in the years ahead of him. Automobiles are just emerging from the class of specialties into the class of staples, and it is literally true that automobiles will be sold like soap, and must be advertised like soap. We must sell a repeat order to our present customers, just as soap makers must; and we must educate present and prospective users about the various uses of the automobile, just as soap advertises itself for use on oil paintings, laces, and other uses. Like soap, we must induce people to use our goods more constantly and widely, once they've bought; so that their repeat orders will come faster. And like soap we must give so much value for the price through quantity manufacturing economy that competition will have a hard time giving equal value.

I believe the automobile selling and advertising record is full of lessons for the manufacturer of any article.

Three-Inch Russian Shrapnel--I

By John H. Van Deventer

SYNOPSIS—The accuracy and finish requirements of Russian field-artillery ammunition are more exacting than those of any other nation engaged in the present war. This article shows how American ingenuity has successfully solved the problem of combining extreme accuracy with remarkably low production cost.

In the American plant which has done more than any other to make a success of Russian shrapnel manufacture there is an indicating gage fearfully and wonderfully made. It is of Russian design with two indicating needles the scales of which read to the ten-thousandth part of an inch. Stand with me a moment in front of the inspector's bench while the official in charge of this instrument tests a shell. Selecting one at random, he places it upon the two sets of rollers mounted in the base of the gage and then adjusts the indicating contacts upon the inner and outer shell surfaces. Watch the fluctuations of the indicating needles as he rotates the shrapnel slowly upon the rollers. Neither of the two needles swings quite one full division during the revolution. And one full division is one ten-thousandth part of an inch!

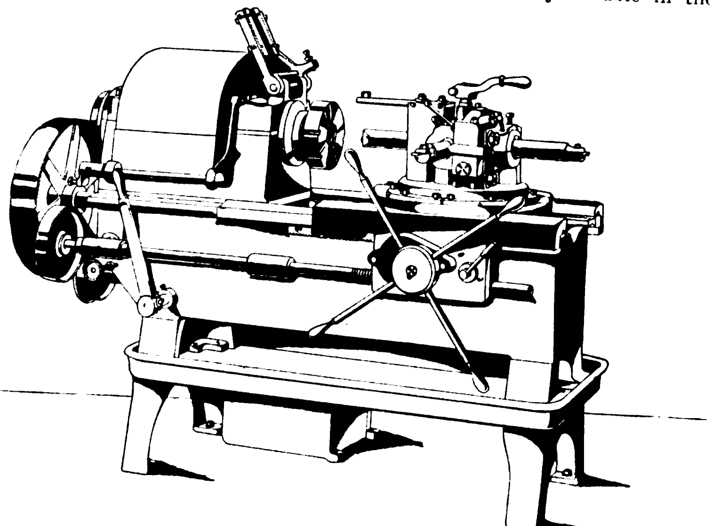


FIG. 1. SPECIAL-PURPOSE CHUCKING LATHE USED FOR SHELL OPERATIONS

Those of you who are familiar with the process of making the British 3-in. field shrapnel must forget the impressions you have gathered concerning this shell if you are to get an adequate conception of what it means to make an acceptable Russian shell of similar size. For while it is true that there is much similarity between the two in design and general construction, the details and the inspection requirements differ so widely that if Russian standards were to be applied to British shells now being made on this continent, fully nine-tenths of those which are passed as satisfactory would be decisively rejected.

This is not to be taken as a statement that the British requirements are too lax, or that on the other hand the Russian requirements are more strict than necessary. The final judgment in such matters, as is proper, rests with the ordnance officials of the nations involved, who must weigh the life of their field guns against the facilities for obtaining a plentiful ammunition supply. Also it must be remembered that the explosive charge and consequently the muzzle velocity of the Russian shell are considerably greater than the British, and that both of these factors have considerable bearing on the accuracy required in the shell.

The manufacturer who undertakes a shell contract faces a problem quite different from that which he encounters in his ordinary lines of work. He has a limited amount of business under control, with more or less likelihood of the initial order proving the final one also. The expenses of new machines, overhead items and all such charges must come out of the total amount received for the entire contract and leave something over for profit. It is a case involving very delicate judgment as to the cost of cutting corners. Investments which would be justifiable in the everyday work of an ordinary plant are out of the question on a limited contract. Keep this in mind as you follow the methods of manufacture outlined in this article, for it emphasizes the ingenuity displayed in keeping down the overhead investment without sacrificing the efficiency of the process as a whole.

A minor problem, but one which requires care in the handling, is that of keeping the "heat lots" separate. Shell forgings are secured from a number of different manufacturers in lots which vary from 100 to 5,000 pieces. Each lot is quite likely to have carbon and other chemical contents slightly different from the others, although these are held between definite outside limits. In order that any defect in a finished shell may be traced to its source, the various shipments of rough shells as received in the plant are distinguished by lot numbers, which must be kept associated with these pieces during their progress through the plant. In addition to the heat-lot numbers, each shell has its own consecutive individual number, so that a check upon the total production is obtainable; this number, however, is not stamped upon the shell itself but appears only on the book accounts. This total count is mechanical and is obtained as the rough shells are conveyed into the plant.

Neglecting fine subdivisions, the various steps in producing a finished Russian shell at this plant are as follows: The forgings on receipt are given the continuous total count, heat lots are separated and counted and the shells are then cut off at both ends. This preliminary work is followed by rough-turning and inside finishing, after which come the heat-treating operations. After these come the outside base finishing and band grooving.

followed by either the base grinding or nosing, which, although consecutive operations, are often reversed in order to accommodate shop conditions. Next, the heat-lot number, which has been removed by machining, is stamped upon the finished base of the shell, which then goes to the chucking lathes to have its nose end threaded and formed. The body profile is next turned, followed by a filing and polishing operation, after which the shells are washed inside and out and delivered to the Government inspectors for the first inspection. This test is succeeded by inside painting, the diaphragm is next inserted and the copper bands are pressed on. The shells are loaded with bullets and smoke powder, the fuse cap is screwed in, the brass plug inserted and the spaces

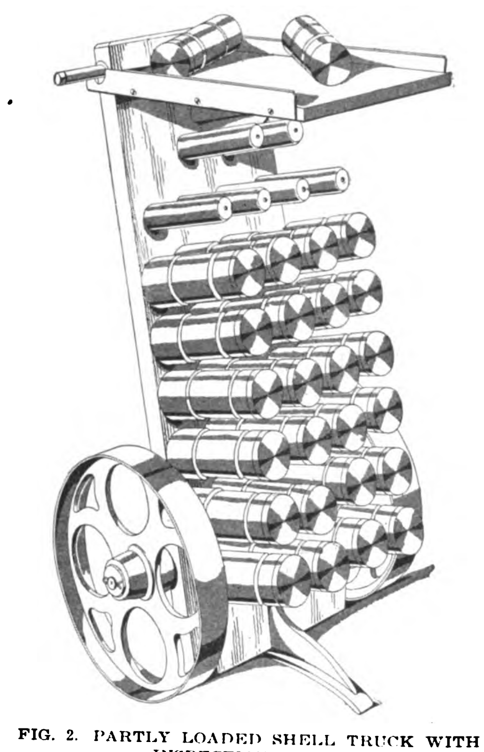
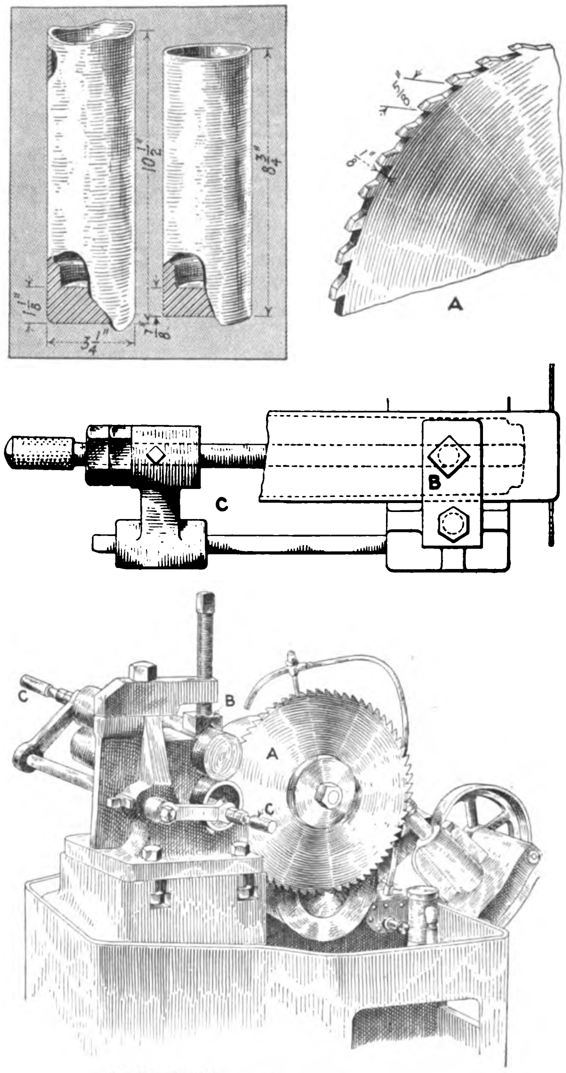


FIG. 2. PARTLY LOADED SHELL TRUCK WITH INSPECTION SHELF

between the lead balls filled with rosin, after which the standard weight is established. Next, the rosin filling-holes are plugged and riveted, and the shells go to a series of high-speed sensitive drill spindles which drill and tap for the cap-holding screws, which are then inserted and riveted over. The operation which follows is that of turning the copper band to its finished size and forming the nose end of the cap. This step is followed by nose filing and polishing, which is succeeded in turn by a final cleaning and the last Government inspection. The accepted shells are lacquered, the zinc plugs inserted and the shells boxed for shipment. Many of these operations, as will be noticed by following the operation sheets, are still further subdivided.

Specialized machinery has, since the outbreak of the war, done much to smash existing notions of what it is possible for metal-cutting machines to do. In this matter it is well to distinguish between two kinds of specialization—that which combines operations and results in more or less mechanical complexity, and that which isolates elementary operations and tends toward simplicity in both the machine and the operation performed. With either type of specialized machine it is quite possible to obtain the degree of accuracy required in a product such as the Russian shrapnel, but the gruelling punishment that is incident to obtaining day after day without interruption the production rates recorded in



OPERATION 1. CUT OFF BASE END

Machines Used—Cochrane-Bly No. 2-B saws.

Special Fixtures and Tools—15-in. saw blades A, ⅛ in. thick, ¾ in. pitch; regular-type holding-down block B; adaptation of regular length stop C.

Gages—None necessary after length stop is correctly set.

Production—20 to 25 per hr. per machine (on double-shell operation). One man can run 4 to 6 saws. Cut requires 3½ min.

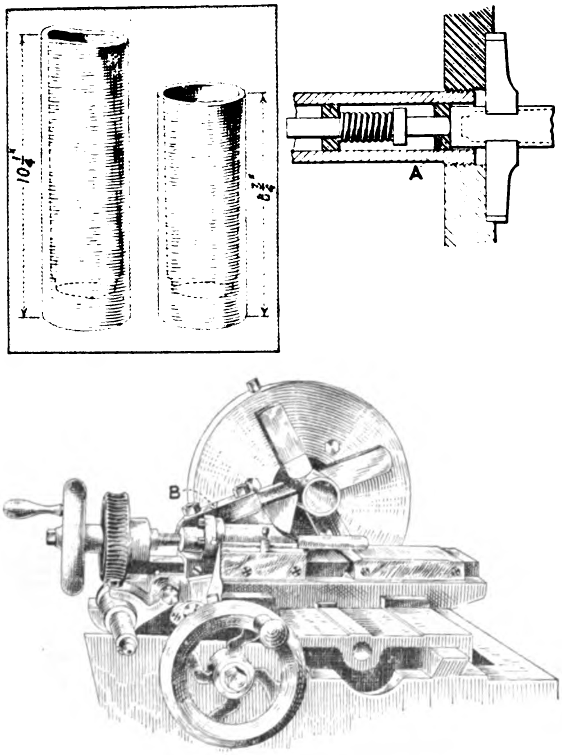
Note—Saws cut at 40 ft. per min. Blades require changing, on an average, every 7 hr. Cincinnati Bickford No. 10 automatic saw sharpener used for regrinding. Soap-water lubrication used. When run double, as shown, the succeeding operation is eliminated.

this article demands a specialization marked by simplicity, which is well typified in the special-purpose chucking lathe, shown in Fig. 1.

These machines, aside from what they have been and are accomplishing in the way of sustained high production, are notable in several respects. Some striking features are the method of driving these machines from a

floor shaft and the use of spring- and lever-actuated idler pulleys, which, by tightening or loosening the driving belt as desired, start and stop the machines without the need of clutches. These features, by eliminating stoppages for belt adjustment, are operating conveniences which also insures plenty of driving power at the spindle, while the unusually large spindle bearings and the low turret mounting provide rigidity for fast and heavy cutting.

Since one who is interested in following the making of the Russian shrapnel step by step may do so by referring to the operation sheets accompanying this article, it will not be necessary for me to duplicate these sheets



OPERATION 2. CUT OFF FUSE END

Machines Used—Hurlbut-Rogers 4-in. cutting-off machines.
Special Fixtures and Tools—Stop collar A in spindle for positioning shell, front cutting head B.
Gages—None.
Production—40 per hr. per machine. One operator to each machine. Cut requires 1 min.
Note—Cutting speed, 90 ft. per min. Front tool only is used. Feed (through belt and worm) approximates 0.003 in. per revolution.

with a full description of each operation in words. Therefore I will reserve the space available for text for pointing out and emphasizing the most interesting features of the process, somewhat as does a guide who accompanies a party through one of the Government department buildings in Washington. And just as many of the visitors there wander away from the guide to investigate things for themselves, so the reader may feel at liberty to leave the beaten path of text and wander about among the illustrations to his heart's content.

Previous to the war, finished Russian shrapnel were nickel plated. The need of an enormous number of shells in a short period of time suspended this requirement as far as American shops are concerned, although it still remains in the specifications. One not familiar with the reason might think it a high compliment to the possible enemies of a country to contemplate bombarding them with nickel-plated missiles, but finishing in this manner was intended as a protection against rust and not as an ornamentation.

American manufacturers have been able to persuade the Russian ordnance officials to permit the switching about of heat-treating operations so that these do not lead the sequence but follow the inside finishing and outside roughing operations, much to the benefit of the cutting tools. A curious thing was observed in one plant which had started with heat-treatment as the first operation on the rough shells and which later, as the result

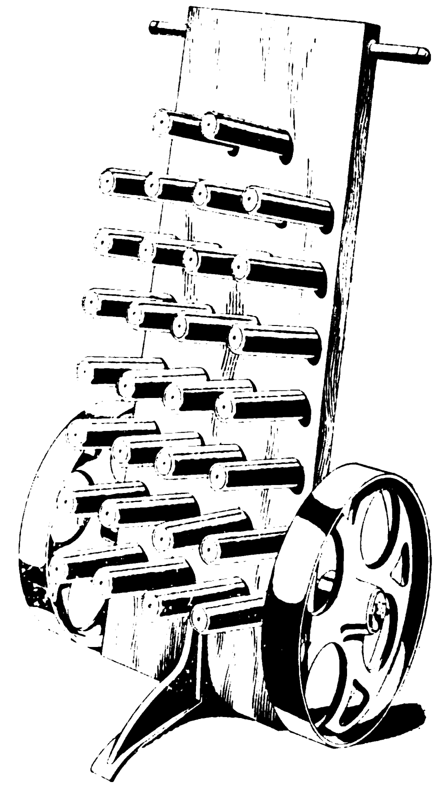
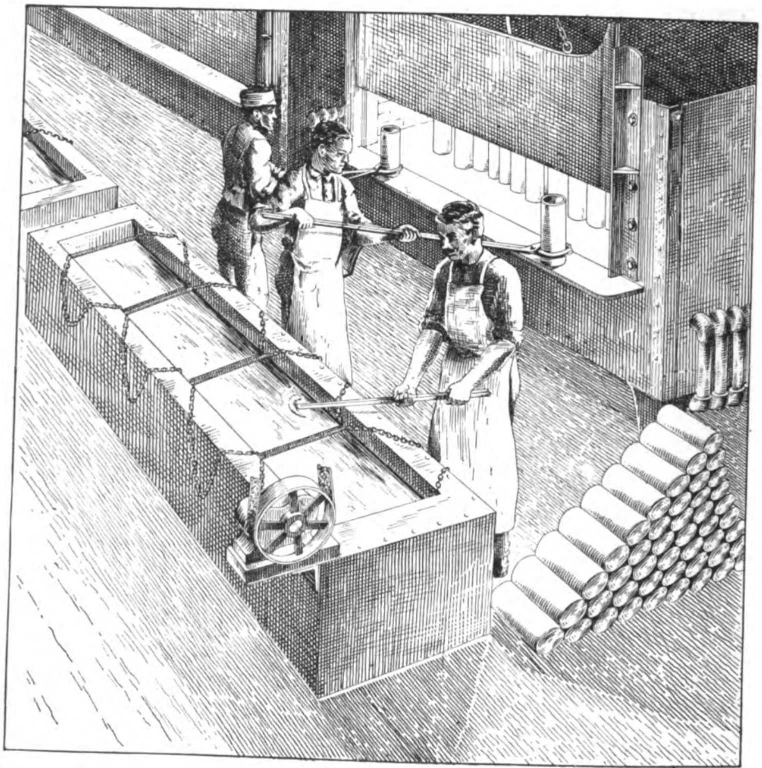


FIG. 3. EMPTY TRUCK, SHOWING SHELL PINS

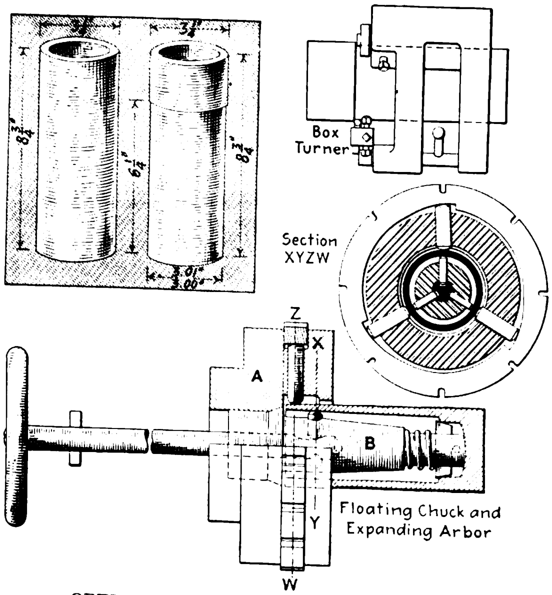
of excessive tool punishment, rearranged the sequence so that heat-treating follows the fourth machining operation. Formerly the capacity of heating furnaces and quenching tanks was taxed to keep up with the scheduled output. The removal of the forging skin by machining, although amounting in weight to not more than 15 per cent. of that of the rough shell itself, increased the capacity of the same number of furnaces and tanks over 30 per cent. In other words the outer skin of a steel forging has double the resistance to the conduction of heat than has the inner metal of the same piece.

The handling of several thousand shells as a daily output requires much study to prevent congestion, or more properly expressed, to balance successive operations. It is true that "dispatching" becomes a simple matter; in fact the necessity for it disappears altogether after the proper balance is once obtained. A shell shop is like a wood-planing mill in this respect, for an operator must keep up with the preceding machine or be buried under



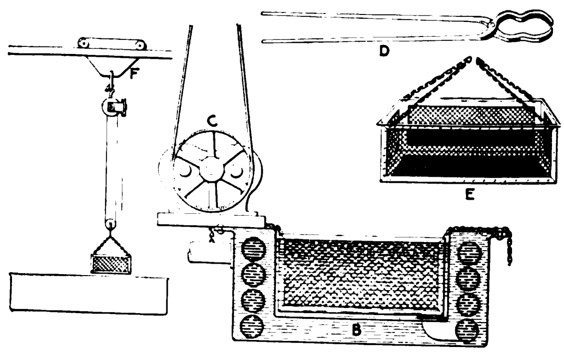
the product. Floor space is too valuable to permit using it for storage space between machines. The transportation and inter-operation storage problems have both been solved by the use of special trucks, shown in Figs. 2 and 3, which with the addition of detachable top shelves, also serve as inter-machine inspection tables. The wooden pins of these trucks are so spaced that shells which are "bottled" may be laid between them, while shells in a condition previous to this operation are placed over the pins.

The problem of balance is naturally more difficult to solve for the hand operations than for machine operations. The first heat-treatment is a good example of careful planning to avoid lost motions. One furnaceman pulls the hot shells from the furnace interior with a pair of long shell-tongs, a man on either side of him taking the shell which he draws out and plunging it endwise into the oil-quenching tank. After one or two endwise motions to insure proper cooling, the shell is dropped into the tank, falling into a wire-mesh basket. The location of the quenching tanks with reference to the furnaces is so well chosen that the two quenchers need not move their positions, simply swinging their bodies as they transfer the hot shells from furnace to tank. After the entire batch has been pulled and while waiting for the next batch of shells in the adjoining furnace, the three men lift out the baskets and remove the hardened shells.



OPERATION 3. ROUGH-TURN BASE END

Machines Used—Special-purpose chucking lathes.
Special Fixtures and Tools—Floating shell chuck A, internal expanding arbor B, roller back-rest box turning-tool C.
Gages—Go and not go snap gage; limits, 3 to 3.01 in.
Production—From 25 to 30 per hr. from one machine and one operator.
Note—Cutting speed, 75 to 90 per min.; feed, 1/8 in. Cut requires 3/4 min. Soap-water lubrication used. The forging is located in chucking position by the interior mandrel and then gripped by the floating chuck pins as an additional drive.
Reference—Chucking lathe, shown in Fig. 1.

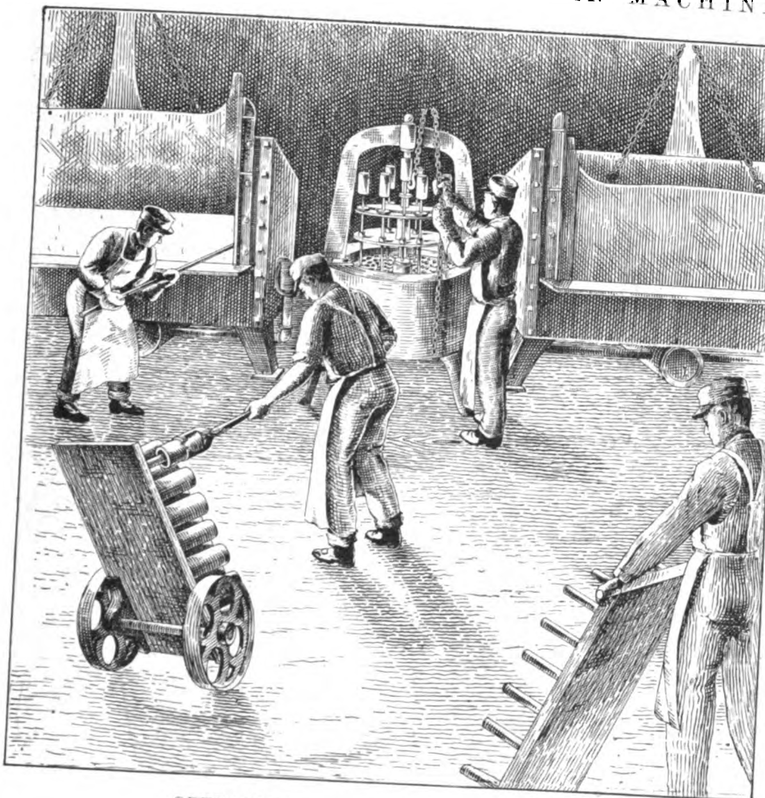


OPERATION 5. HARDEN

Machines Used—Equipment of Strong, Carlisle & Hammond No. 118 crude-oil fired muffle furnaces, blast from Root's positive blower; water-cooled oil-quenching tanks B; oil circulation supplied by rotary pump C.
Special Fixtures and Tools—6- and 8-ft. shell tongs D, wire-mesh tank basket E, overhead trolley and hoist F.
Gages—None. Pyrometers to control furnace temperature.
Production—From each furnace, one batch of 50 shells every 35 to 45 min. Three men required to handle each heat. One man pulls out the heated shells with the long tongs while the other two dip them.
Note—Furnace temperature maintained at 1,420 deg. F.
Reference—Heating furnace, illustrated in Fig. 4.

The shells after coming from their heat-treatment are neither sand-blasted nor pickled, it having been found that these processes are unnecessary. The inside surfaces of the shells do not scale appreciably, due to the fact that the air within them is not in circulation, and in fact the exterior of the shells is remarkably free from scale also, due to quick handling between furnace and oil bath.

Remarkably fast forming of tough heat-treated material is being done in the seventh operation. The cut,



OPERATION 6. DRAW

Machines Used—Equipment of two Strong, Carlisle & Hammond No. 118 oil-fired muffle preheating furnaces and one Frankfort No. 2 crude-oil fired lead pot.

Special Fixtures and Tools—Eight-spindle shell crib attached to melting pot.

Gages—Scleroscope hardness tester. Hardness ranges from 40 to 46.

Production—From one pot, using alternate preheating furnaces, three men draw 2,500 shells per day of 10 hr. One man takes shells from preheating furnaces, placing them in the pot. The second man operates the hoist and turns the crib. The third man takes shells from the pot and places them on the truck. An additional man is required to operate the scleroscope, and one man (the foreman) regulates temperatures and sees that trucks keep moving.

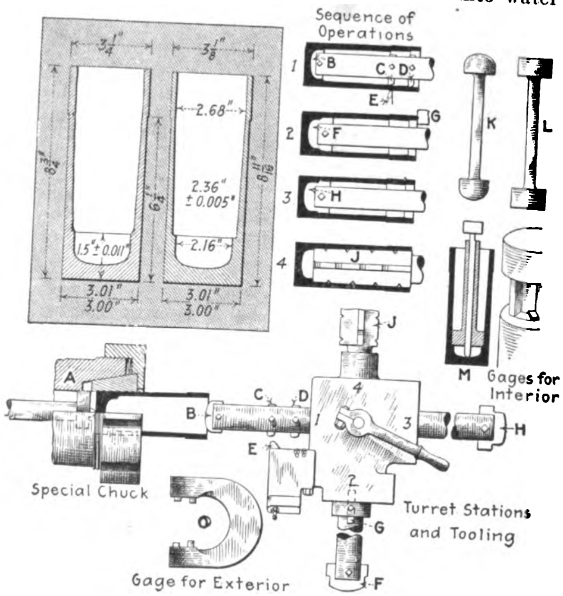
Note—The preheating furnaces heat the shells to 940 deg. F. The lead pot raises this to the drawing point, 1,040 deg. F.

which is over 2 in. wide, is taken at a cutting speed of 75 ft. per min.; and under this hard usage the tool, by careful handling, will stand a day's run without regrinding. Another interesting example of forming will be shown in the fifth suboperation of operation sheet 10, in which the nose-forming tool *H* roughs off the nose profile. This, however, is not altogether a forming operation, the tool being fed parallel with the axis of the shell until the full reduction in size is reached.

This operation was formerly divided into two parts with the purpose of putting less strain on the forming tools and thus securing longer service from them. Under this procedure, the base end was first rough formed to within 10 thousandths in. of finished size leaving the removal of this amount of metal together with the knurling and undercutting for the second half of the operation. Experience has shown, however, that the additional chucking and handling time offset the wear on the forming cutter and as a result, the two operations were combined into one, and are now performed as here described. This is an illustration of the fact that the best way to do a certain thing can be determined only by trying it out, and letting experience dictate the answer.

If there is or ever has been a more industrious lead pot than the one shown in Fig. 4, it has not as yet been recorded in history. This one easily takes care of drawing the temper of 2,500 shells in 10 hr. It is true that the shells are preheated to within 100 deg. of the drawing temperature in an oil-fired muffle furnace, but even with this assistance this lead pot is a very busy appliance. It also illustrates another example of nicely timed handwork. The perspective illustration of operation 6 shows one man at the pot, whose duty it is to rotate the shell-holding fixture and to raise and lower the weighted spindles by means of a hook attached to a tackle block. It is rather strange to see the shell rise to follow the lifted spindle and makes one look for some magnetic device until he remembers that steel will float on melted lead. The man standing in front of the furnace at the left takes the preheated shells from it and places them one at a time under the spindle which has been made vacant by the man in the center who removes the shells from the pot and places them upon the pins of the special trucks upon which they are allowed to cool.

The same difficulty that is encountered with entrapped air in thrusting an inverted glass tumbler into water is



OPERATION 4. BORE AND REAM

Machines Used—Special-purpose chucking lathes.

Special Fixtures and Tools—Special shell chuck A. Cutting tools: 1—Powder-pocket roughing cutter B, roughing cutters C and D for reamer, outside turning tool E. 2—Rough step cutter F for powder pocket and diaphragm seat, facing tool G. 3—Finishing step cutter H for powder pocket and diaphragm seat. 4—Reamer J.

Gages—Double-end limit plug gage K for diameter of powder pocket, double-end limit plug gage L for diameter of diaphragm seat, special limit gage M for depth of powder pocket, snap gage O for diameter of open end.

Production—12 per hr. from one machine and one operator.

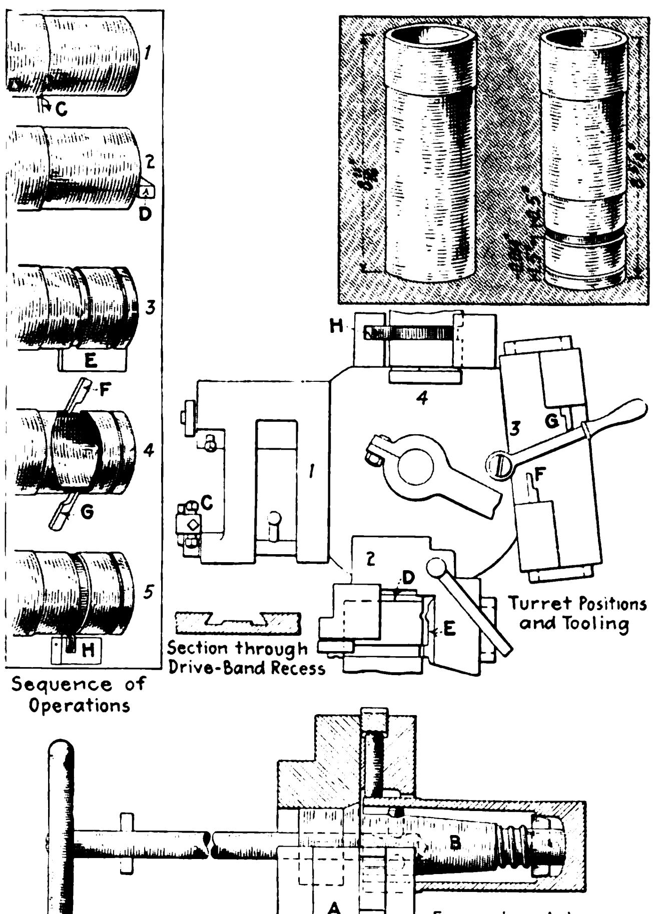
Note—Cutting speed, 70 ft. per min. Hand feed used on all suboperations except No. 1. Reaming speed, 45 ft. per min.

Reference—Chucking lathe, shown in Fig. 1.

encountered when an inverted shell is thrust into a lead pot. This trouble has been very cleverly overcome by the siphon device shown on the operation sheet, which acts not only as a support for the inverted shell but also as a means of venting the entrapped air.

From the manufacturer's standpoint, aside from its close limits, the Russian shell presents many difficulties which are avoided in the British shrapnel, as will be evident when we arrive at the description of the loading operations. It has one feature, however, which goes a long way toward offsetting these, in that the diameter of the hole in the finished shell nose is large enough to admit a bar with a cutter that is the full size of the finished powder pocket. This means that it is possible not only to finish bore the shell before heat-treatment, but also to correct that portion of the product that shrinks in heat-treatment and in which the powder-pocket diameter and disk seat come under the minimum limit.

You will notice that in the process outlined the shell is finished all over, inside and out, unlike the British shell, in which considerable of the rough-forging skin is left in the interior. This difference is not because of the insistence of the Russian specifications on this point, but because it is difficult to maintain the close limits required unless the finishing is done. However, this seeming drawback has been in a way made to serve as an advantage, for the inside finishing has been so carefully planned in connection with the nose bottling that it is unnecessary to finish the inside contour of the nose after the shell is closed in, as is required in the British shell.



OPERATION 7. FINISH FORM BASE END

Machines Used—Special-purpose chucking lathes.

Special Fixtures and Tools—Special floating chuck A, hand-wheel-operated expanding arbor B for gripping internally.

Cutting Tools—1—Roller-back-rest turner C. 2—End-facing tool D, groove-forming tool E. 3—Recess undercutting tools F and G. 4—Knurling tool H.

Gages—Limit snap gages for diameters of base and groove, limit templet gage for undercut and location of groove from base.

Production—From one machine and one operator, 12 per hr. Cutting speed, 75 ft. per min. Hand-lever longitudinal and cross-slide feeds.

Note—Soap-water lubrication used. This operation brings the base end of shell to a finish. The forming tool E by careful handling will stand a day's run. The end-facing tool D is operated in connection with the crossfeed on tool E for cutting to the center of the shell.

Reference—Special-purpose lathe, shown in Fig. 1.

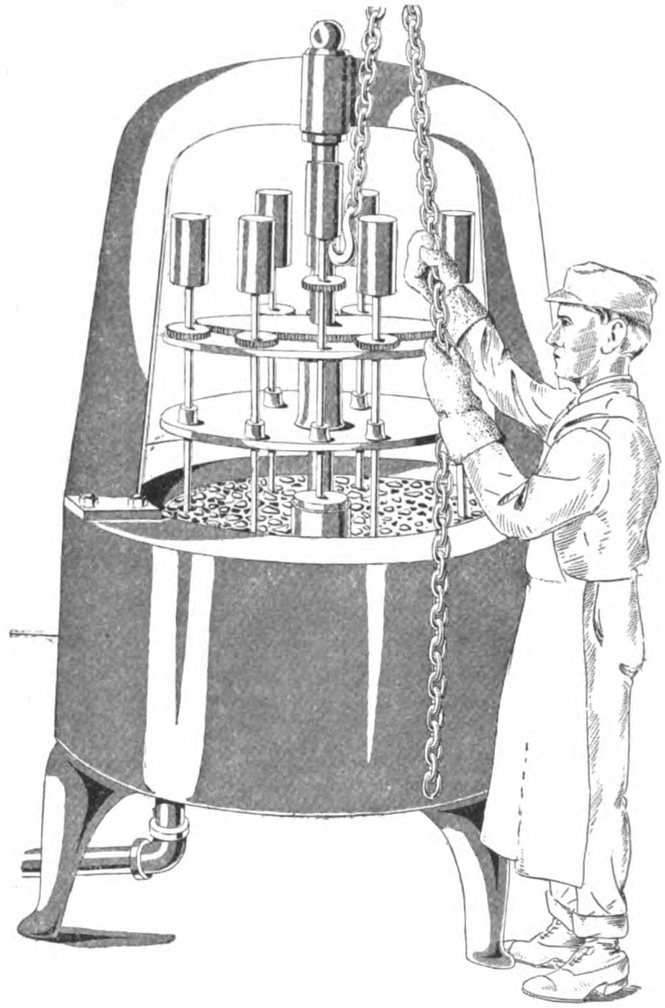


FIG. 4. THIS LEAD POT IS A BUSY APPLIANCE

Prompt Replies to Inquiries

By H. R. Gilliam

A feature of good service which, if appreciated, is not practiced as generally as it might be, is the prompt reply which should be made to unsolicited inquiries.

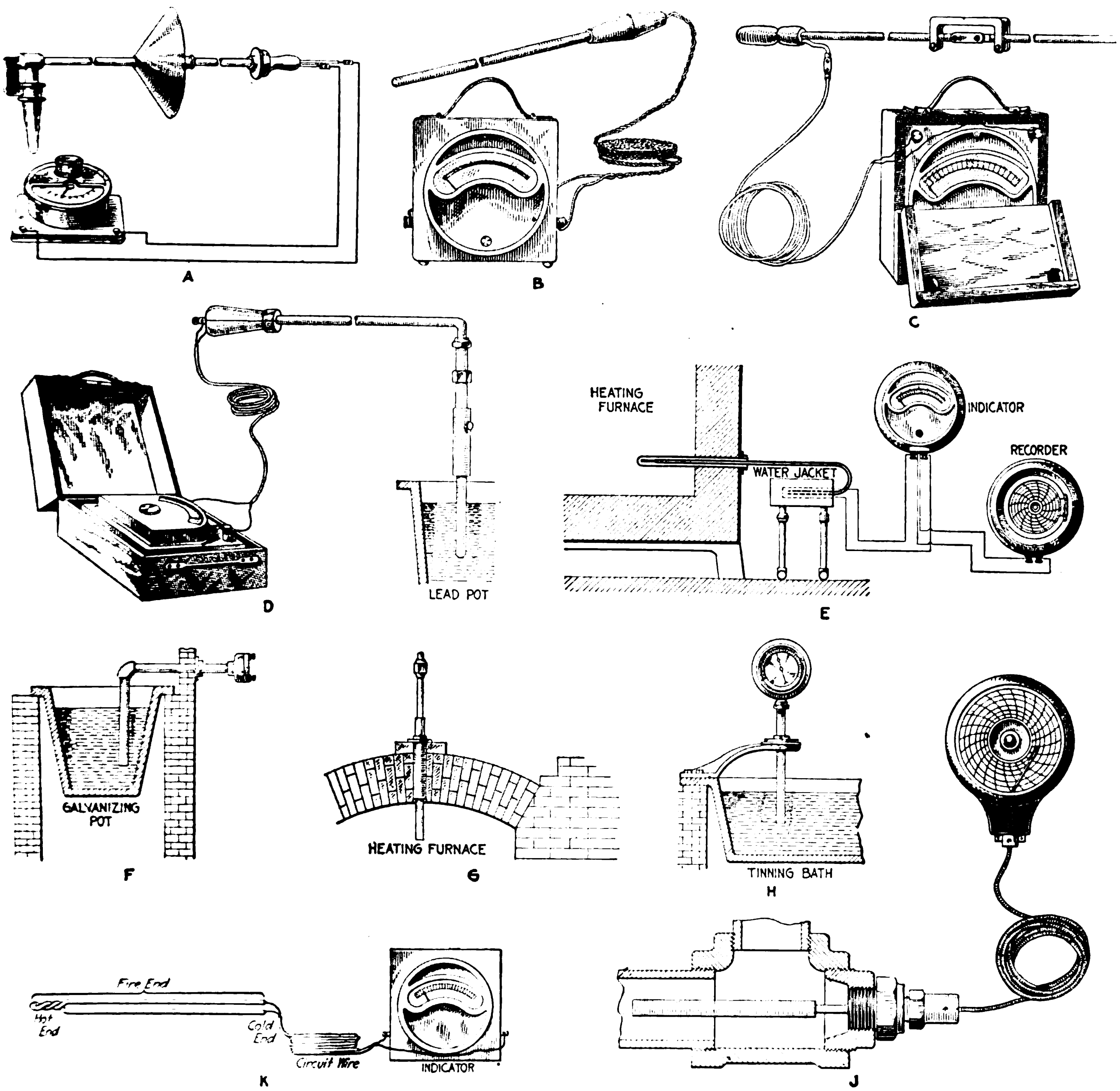
A certain concern suddenly found itself in need of a machine, and inquiry was made of two manufacturers for circulars and description. One of the manufacturers came back promptly with literature, prices and all necessary information. The need being urgent and the machine seeming to meet the requirements, the order was placed after short consideration. But much to the buyer's chagrin, when the reply eventually came from the other manufacturer it was found that the second machine came nearer the requirements than the first and would undoubtedly have been purchased had it been possible to have both machines under consideration.

Taking Small-Shop Temperatures

By John H. Van Deventer

SYNOPSIS—The small-shop man is not interested in abstract theories. But if an appliance, tool or instrument will help him make more money or produce a better product, he wants it. This article deals with pyrometers from the small-shop users' viewpoint.

Why does an Indian decorate himself with feathers and **war** paint, a doctor write prescriptions in hog Latin, and **a** scientist cover up a new grain of knowledge with a name that has been dead and buried for ten thousand years? Not because any one of these individuals has a grudge against the small-shop owner, but because each is instinctively following one of the three inherited principles of the preservation of prestige. The Indian is putting up a physical bluff—decorating his body so that he will appear imposing. The scientist is putting up a mental bluff—decorating his discovery with a name that will be hard for common people to pronounce and understand. The doctor is not bluffing at all—he is just keeping business in the family, and the worst part of it is that all three of these fellows get away with it!



VARIOUS TYPES OF PYROMETERS SUITABLE FOR USE IN THE SMALL SHOP

A—Le Chatelier portable thermocouple pyrometer. B—Hoskins portable pyrometer. C—Bristol portable thermocouple pyrometer. D—Englehard portable bent mounting for lead pots, etc. E—Hoskins base-metal thermocouple with indicator and recorder and water-cooled cold end. F—Brown base-metal thermocouple with bent mounting. G—Le Chatelier rare-metal fire end mounted in arch of heating furnace. H—Brown expansion pyrometer mounted in tinning bath. J—Bristol gas-expansion recording thermometer mounted for temperatures of fluid under pressure.

I believe that a man who invents a new machine or appliance and then goes back to the Dark Ages to find a name for it is unconsciously handicapping its sale and use. The name conveys the impression that the thing itself is highly scientific and thus erects a barrier of exclusiveness. Of course if it is something that people need, the demand for it will in time overcome the handicap of the name, which will become familiar; but nevertheless the handicap exists at first and is an unnecessary one. Take, for example, tachymeters, scleroscopes and pyrometers—one of a bashful and retiring disposition might hesitate to make the acquaintance of such high brows, whereas he would be glad to shake hands with a "speed gage," "hardness tester" and "heat gage."

This may be one reason why the measurement of temperatures in small shops is not as thoroughly understood as it should be. It takes time for instruments which originate in the laboratory to filter down to the level of small-shop practicability. But I venture to predict that 20 years from now the pyrometer will be as familiar and well understood a small-shop tool as is the micrometer at the present day.

Twenty years ago a micrometer was seldom found in a small shop. Nowadays you seldom find a small shop without one. Progress has made it necessary to work to close limits of size, and the use of proper size-measuring instruments followed this as a natural result. With later progress has come the refinement of materials which calls for some means to measure temperature as the micrometer measures diameter.

Old Man Jones, of Lancaster—an Optimist

Old Man Jones, of Lancaster, took a contract for some machines, among the parts of which were a number of nickel-steel heat-treated gears. He never had handled any alloy-steel work in the past, but had a blacksmith who was a crackerjack at hardening springs and cutting tools. Jones, being a progressive chap, determined to meet and get acquainted with the alloy-steel proposition, as he could see considerable business for one able to handle it. After careful machining, the gears were handed over to the blacksmith for heat-treatment. This gentleman was not as optimistic on the subject as Old Man Jones but said that he would do the best he could. The heat-treatment specified was to heat these gears to 1,550 deg., quench, reheat to 1,350, quench, and reheat to 800 deg., after which they were to be slowly cooled.

The first act of the worthy smith was to look up a color chart and translate the heat-treatment temperatures into colors instead of degrees. He found that 1,550 deg. F. represented a medium cherry red, 1,350 a dark red, and 800 deg. the lowest visible red. It was really as easy as matching shades of silk in a dry-goods store without the samples!

The furnace was a small one, and as a result the job had to be divided into several batches which were separately heated. When they were finished, the gears all looked much alike except that some had a little more scale than others. They rang the same when tapped with a hammer and seemed to give the same amount of pull upon a smooth file.

Old Man Jones and his blacksmith tried almost everything they could think of to test those gears, except biting a piece out of each of them. They were sure that they had a good job, but the customer's inspector did not seem willing to take their view of the matter. He put the gears under a strange-looking instrument that was a cross between a thermometer and an atomizer and declared that twenty-three out of thirty-five would not pass the required hardness test.

"Why don't you fellows get a pyrometer and know what you are about?" he asked Old Man Jones. Then being a decent sort of chap and seeing that he might as well have asked Jones why he did not keep an ichthyosaurus in his backyard, he explained what a simple instrument a pyrometer really is.

"What you need in your shop is a thermocouple pyrometer," said the inspector, "which is nothing more than a couple of wires running from an indicator and joined together within the furnace. When the joined end of the wires is heated, you look at the indicator and read off the temperature. The thing is really as simple as a thermometer and a good deal easier to read."

Various Pyrometers and an Irishman

There are a number of kinds of pyrometers besides those made on the thermocouple principle. Some depend on the pressure exerted by a gas inclosed in a tube. There is an accurate type known as the "resistance pyrometer," which is a bit too complex for the average small shop. There are radiation and optical pyrometers which look like telescopes and are simply pointed at the hot objects. They are most suitable for work above 3,000 deg. F., for no part of the apparatus itself is heated.

The instrument shown at *H* in the illustration is an "expansion pyrometer." It works on the difference of expansion of graphite and iron rods in its stem, and its upper working limit is 1,500 deg. F. I recall an experience with one of these instruments and with an Irishman named Pat, who was engaged to run the galvanizing department of a large upstate machine shop. The management of this plant had decided to have everything up to date and so got a pyrometer for Pat, without knowing that his education had not gone as far as reading either words or numbers. Pat, however, was too foxy an individual to give this fact away. Suspecting it and wishing to have a little fun with him, I asked him one day what temperature he was carrying on the galvanizing pot. Quick as a flash the answer came back, "Sure you have got spectakils on; you can see it twice as aisy as me!"

The thermocouple pyrometer, which is the one for the small shop, is made in a great variety of styles and in two general classes, portable and permanent. The first kind, as the name indicates, can be carried about from place to place and used to take the temperature of almost anything in the shop except a feverish haste. The second kind is installed in a lead pot, heating or annealing furnace or other place where it is desired to keep a continual check on temperatures.

What Constitutes a Thermocouple Pyrometer

The parts comprising a base-metal thermocouple pyrometer are shown in the illustration at *K*. The arrangement does not look formidable, and indeed it is about as simple an instrument as could be devised. It consists of a couple of wires of unlike material which are twisted and welded together at one end. At the other end they are connected through an electric-wire circuit with a simple indicating instrument exactly similar to a voltmeter, except that it registers degrees

of temperatures instead of volts. When the welded end of the couple is heated, an electric current is set up by which the degree of heat may be measured. Fire ends are of two general kinds. One kind is known as the "rare metal" thermocouple and is used for the high temperatures between 1,800 and 3,000 deg. F. The other kind is known as the "base metal" thermocouple and is made of more common and less expensive material, which, however, will not do for continuous service over 2,000 deg. F.

The fire ends of thermocouple pyrometers are protected by sheaths of various materials, according to the service and the degree of heat. Porcelain tubes are used for the highest temperatures. In a lead bath an iron sheath or seamless-steel tube is used with a nickel-plated envelope above the surface of the metal to protect against vapors. Firebrick tubes are sometimes used for annealing furnaces, and graphite or clay tubes are used for measuring melted-metal temperatures. The protecting tubes should project into the furnace or the melted metal at least six inches.

At the Other End of the Wires

Two kinds of instruments are connected to the fire ends of either of the foregoing types—indicators, which indicate temperature, and recorders, which make a continuous graphical record similar to that made by a recording pressure gage or recording wattmeter. An instrument of each kind may be attached to the same fire end and will register its temperature simultaneously, one indicating and the other recording. Again a number of fire ends in various furnaces may be attached to the same indicator and recorder by means of suitable switches, so that one fire end at a time can be switched on the instrument, thus letting it take care of several furnaces, but of course only one at a time. Usually the indicator is placed so as to be easily seen by the furnace tender; while the recorder, which is a more delicate and expensive instrument, is mounted in the office or in a protecting cabinet.

The average small-shop man can get along without the recorder. A good base-metal indicating outfit can be bought for from $25 to $50. Additional base-metal fire ends will cost from $3 to $8 each. Rare-metal fire ends are four or five times as expensive. Fortunately, for most shop use the base-metal fire end will serve, leaving the more expensive kind for the foundry, which can quickly make up its cost by rapping the patterns a little harder!

Making the Shop Pyrometer Behave

Even the ordinary mercury thermometer, on which we base our opinions of the climate, is likely to err. So it must not be supposed that a pyrometer, which is subject to such a high limit of temperature, will do its work day after day without attention. Portable pyrometers which are used occasionally do not change very quickly, but those which are subject to constant heat must be looked after at regular intervals.

Nine times out of ten when there is anything the matter with a pyrometer, it is in the fire end. It may be due to a faulty connection at the end of the couple where the instrument leads are attached, or to too hot a "cold end," but it is much more apt to be because heat and gases have affected the "hot end."

The prices of base-metal fire ends are so reasonable that the small-shop man can afford to have a half-dozen of them in stock, keeping one as a reference with which to check up the accuracy of those which are in daily use. Checking consists simply in connecting the two fire ends to the same source of heat and to the same indicator with a double-throw switch on the circuit so that alternate readings may be taken on each fire end with the same indicator. Of course the readings should be the same; but if there is any difference, the correction can be made. Fire ends which are in constant use at a temperature of 1,500 deg. F. should be tested once a week, and those which are subject to a constant temperature of over 1,500 deg. should be tested daily if accurate readings are desired. If out over 20 deg., the fire end should be annealed from one to five hours at a temperature of 1,472 deg. and then retested.

Another way of checking up thermocouple pyrometers is by the use of what are called "sentinel pyrometers." These are small cylinders approximately ½ by ¾ in. which melt at different temperatures ranging from 400 to 2,400 deg. F. Below 932 deg. they are inclosed in glass tubes so that they may be used over and over again. The higher-temperature sentinels are set in porcelain saucers and are also used repeatedly, being caught in the saucer when melted. Placing a number of these in the furnace with the pyrometer, watching when they melt and noting the indicator reading at the same time will give a very good check on the accuracy of the pyrometer.

There are other methods of checking thermocouple pyrometers, one of them being by the melting or freezing points of metals such as tin, lead, zinc, aluminum, salt and copper; however, for the small shop the sentinel pyrometers are more convenient and likely to give more accurate results.

Taking Care of the Cold End

The amount of current flowing is determined by the difference in the temperature between the hot end and the cold end, which latter is kept at a certain average temperature, or else corrections are made for any differences in temperature above or below that for which the cold end is set. There are various ways of taking care of the cold end of a thermocouple pyrometer. One of these, practiced by the Bristol Co., is to make the thermocouple element long enough so that the cold end is extended outside of the furnace down near the floor level, where the temperature does not vary a great deal. The Hoskins Co. in some cases recommends the use of a water-cooled cold end, and instruments of other concerns provide a compensator for adjusting for differences of temperature at the indicator. A fairly good way is to bury the cold end under ground. Don't have it where a draft of cold air is likely to blow on it. Don't locate it so that heat from the furnace or melting pot will be able to affect its temperature. A little care about these things will save "cuss" words later on.

The small-shop man who uses the same amount of intelligence with his pyrometer that he does with his micrometer will find it the means of getting uniform heat results which will better his product. He will not have much trouble keeping the appliance in good workng shape. He will find it accurate, reliable and long-lived—unless he does as they tell of one pyrometer purchaser, who stuck the indicator in the furnace and tried to get the fire-end sheath off so he could read the "dommed thaymometer" inside!

Machining Parts of Eight V-Motor

By Robert Mawson

SYNOPSIS—The operations include milling, drilling, reaming and boring. The parts are the cam-gear housing, cylinder cover and cylinder head. The milling fixture for the head holds two castings, one for machining the upper, and the other the lower surface.

On page 14 were shown some of the tools used in machining the cylinder of the eight V-motor built by the Ferro Machine and Foundry Co., Cleveland, Ohio. The motor itself was shown and described on page 19. This article takes up three other parts of this same motor including the cam-gear housing, cylinder cover and cylinder head. The tools shown for the first mentioned piece are for the operations of milling, drilling and boring, for the second, milling, drilling and boring; and for the third, milling, drilling and reaming. A feature of the milling fixture for the cylinder head is the arrangement by which two castings are held at the same time. One of the castings has its upper surface in position for machining and the other its lower.

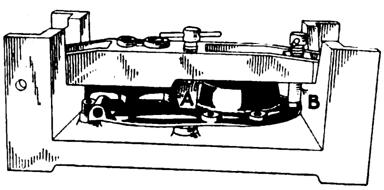


FIG.2

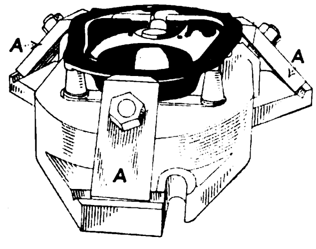


FIG.3

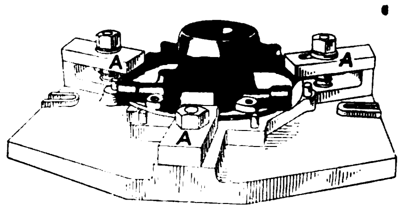


FIG.4

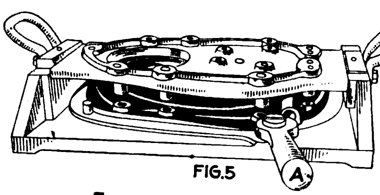


FIG.5

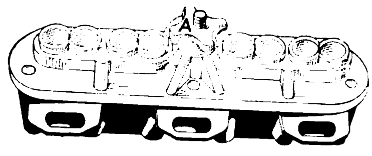


FIG.8

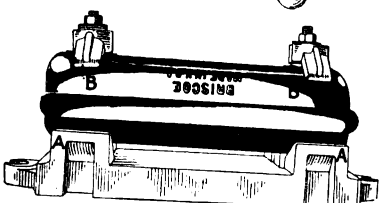


FIG.9

FIG.7

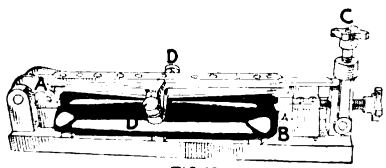


FIG.10

JIGS AND FIXTURES FOR MACHINING EIGHT V-MOTOR CAM-GEAR HOUSINGS; CYLINDER HEADS AND COVERS WITH WORK SHOWN IN POSITION

FIGS. 2 AND 2-A

Operation—Boring and counterboring cam-gear housing. This rests on steel pads and is located by two pins which fit into previously machined holes. The cover is then fastened down, equalizing clamp A and screw B holding it securely.

Holes Machined—One ½-in. drilled and reamed and one ⅞-in. drilled and reamed.

FIGS. 3 AND 3-A

Operation—Milling parting line surface on cam-gear housing, Fig. 1. This rests on three fixed pins and two equalizing pins. Clamps A hold it in position.

Surface Machined—Parting line, using 12-in. inserted-tooth cutter. Speed, 16 r.p.m.; feed, 0.125 in. per revolution.

FIGS. 4 AND 4-A

Operation—Milling pad on cam-gear housing. The part rests on hardened-steel pads and is set between locating pins, straps A holding it in position.

Operation—Milling pad B, using 5-in. end mill. Speed, 50 r.p.m.; feed, 0.083 in. per revolution.

FIGS. 5 AND 5-A

Operation—Drilling all small holes in cam-gear housing. The part rests on machined surface, forced back against pins with the cam lever A. The cover is dropped down and the jig base is located by dowels.

Holes Machined—Nine $\frac{11}{32}$-in. and six ¼-in., drilled. The latter are then tapped with $\frac{5}{16}$-in. U. S. F. threads.

FIGS. 7 AND 7-A

Operation—Milling both sides of cylinder head, Fig. 6. Casting rests on hardened-steel blocks as A and is held securely with open-type straps B. The faces are milled, using 6-in. gang cutters. Speed, 40 r.p.m.; feed, 0.083 in.

FIGS. 8 AND 8-A

Operation—Drilling and reaming valve bushing holes in cylinder head. They are located by pins which fit into holes previously machined and held with a hook bolt operated by the knob nut A.

Holes Machined—Eight, bored and reamed to 1.3125 in.

FIGS. 9 AND 9-A

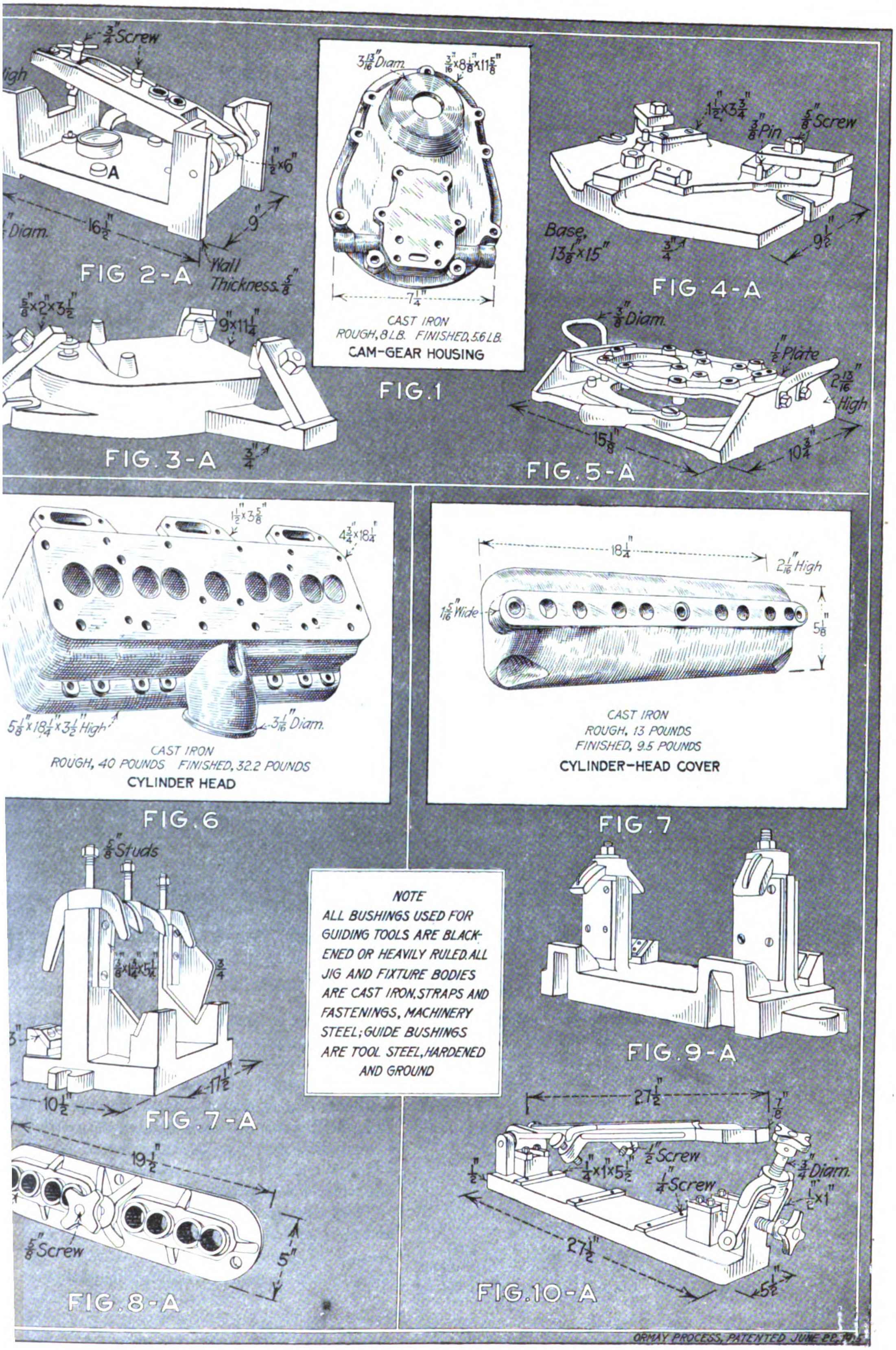
Operation—Milling outside surface of cylinder-head cover, Fig. 7, parting line surface being disk-ground. The casting is placed against a hardened-steel plate resting in two V-surfaces A. Clamps B, tightened down with nuts, hold two parts at one setting.

Surface Machined—Outside pad, using gang cutters 2½ in. in diameter, operating at 107 r.p.m.; feed, 0.083 in.

FIGS. 10 AND 10-A

Operation—Drilling and reaming, holding down bolt holes and spark-plug holes. The casting is located by V-block A, being forced back with the screw-actuated block B. The part rests on hardened-steel pads. The cover is then dropped down and held with the knob screw C. Knurled-head screws D hold the casting down.

Holes Machined—Eight $\frac{11}{16}$-in. and three $\frac{11}{32}$-in. both drilled.



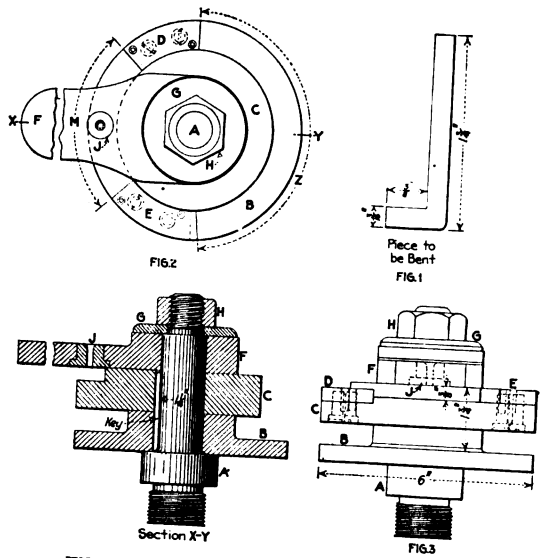
DETAILS OF JIGS USED IN MACHINING CYLINDER HEADS AND COVERS FOR 8 V-MOTORS

A Single Wire Bending and Cutting Fixture

By William Schneider

The fixture shown in the accompanying sketch was designed to bend and cut off brass wire. An engine lathe was used for this job because production was a very important part of our contract, which called for a specified amount to be shipped weekly.

The cost of making a punch and die for the punch press was found to be too great. At the same time it would not give the needed production, so a simpler and less expensive device had to be made that would give the desired production with a boy as the operator. The pieces (one being shown in Fig. 1) for which this device was



WIRE BENDING AND CUTTING FIXTURE

designed were bent and cut off at the rate of 40 per minute. The operator received the wire wound on hollow wooden disks, which were then placed on a reel at the end of lathe, this method making it easy for the operator to feed by hand through the guide, or die, *J*.

The fixture was made with a threaded shank *A* that screwed into the lathe spindle. The arm *F* was made long enough to rest on the outer edge of the lathe bed, in order to hold it steady while bending and cutting off the wire, which was done in one revolution of the spindle. Length plate *B* and cutter plate *C* were keyed to shaft *A*, while arm *F* was made a free running fit and held close to *C* by the nut and washer at the end.

The device operates as follows: The wire is run through the die *J* and held against the face of the plate *C* while revolving distance *M*, Fig. 2. Then the bending block *D*, which is held to the face of plate *C* and the thickness of the wire from the face of die *J*, bends the end. After the bending block passes the die, the wire is again run through and held against the face of plate *B* while revolving distance *N*, Fig. 2. The cutting block *E* now passes the die *J* and cuts off the wire, completing the operations.

The few general dimensions are shown to give an idea as to the size of this device. Fig. 3 shows another view of the fixture.

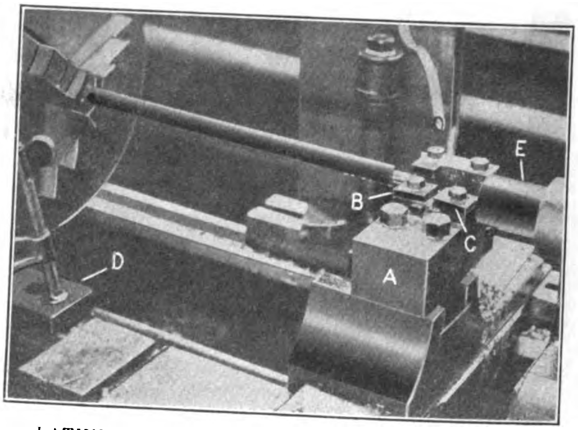
It was found by trying different speeds that 35 to 45 r.p.m. gave the best results, both for ease of feeding and for bending the wire. This fixture can also be used for cutting off straight wire to any length within the distance from the face of the die to the machine head, by removing the bending block *D* and the plate *B*, then fastening the stop the desired distance from the face of the die *J*.

Doing a Screw-Machine Job on a Plain Lathe

By E. A. Thanton

Not long ago a certain company wanted 5,000 pieces of cold-rolled steel 5/8 in. in diameter by 14 in. in length, with one end turned down to two different diameters and lengths; that is, the extreme end had to be turned to 3/16-in. diameter and 1/4 in. back, and from this shoulder it had to be turned 3/8 in. in diameter 9/16 in. farther back to a shoulder.

The contract was given to the Verdin, Kappes & Verdin Co., Cincinnati, Ohio. There was no screw machine available in the shop, so a plain lathe was rigged up to do the work, as shown in the accompanying view. A box tool *A* was made and clamped to the tool block. The two cutters needed were held by means of the clamps *B* and *C*. The guide for the end of the rod is not a round bushing, as usual, but is square and serves to take off the slight burr made by the first cutter on the outside



LATHE RIGGED UP FOR A SCREW-MACHINE JOB

diameter of the shoulder. The tailstock and spindle *C* are locked solid and serve as a back stop against which the box tool is run when inserting the work. The rod is then inserted in the jaws of the universal chuck, and the outer end is butted against the side of the box tool. The chuck jaws are then tightened, giving the rod the correct setting. The carriage is fed to the left until it butts against stop *D*, which is set to give the correct shoulder length for the cutters to turn.

The work can be handled very rapidly in this manner, and on a trial run 80 pieces were turned in an hour. An average of about 60 per hour is made by the boy on the job, which gives a comfortable margin.

Grinding on the Side of a Wheel Is Objectionable, and to overcome this practice the side of the wheel should be painted and the pores filled in, which will eliminate the possibility of grinding on the side.

Personal Reminiscences of James Mapes Dodge--I

By Charles Piez*

SYNOPSIS—In these personal reminiscences Mr. Piez tells of the struggles, early failures and final great successes of one of the most commanding figures in American invention and engineering, and shows us the genial, charming personality of one who did much to shape our present-day industrial ideals. This first part deals with the development of the conveying and coal-storage business and covers a period of Mr. Dodge's life down to about 1900.

Twenty-five years of business association, 25 years of intimate personal relationship, were brought to a close by the untimely death of James Mapes Dodge on Dec. 4, 1915, and these notes are penned while grief is still poignant, while the sense of loss sustained is still acute. Memory has been active in recasting the story of our association, in reviewing the development of a great art, in paying tribute to the genius to whom that development was largely due. For he was a genius, one to whom the accomplishment of today was but an augury of the possibility of tomorrow; a ceaselessly active, dynamic man eternally in quest of progress, yet an easily approachable and thoroughly human man, with deep affections, tender considerateness and an inexhaustible and never failing sense of humor.

Mechanical accomplishment, even though its influence reaches into every home, rarely receives wide public mention. The fact that it has been a source of pecuniary profit seems all sufficient in the way of reward. And yet the lessons to be learned from mechanical progress and the examples set by our notable inventors may have wider public application and deeper public influence than the much heralded attainments of statesmen or the widely recorded works of our men of letters.

It is in the hope that these reminiscences of a man who will occupy an important place in the mechanical inventors' Hall of Fame will prove of profit to the workers in the mechanical arts that they are offered in these columns.

In the spring of 1889 an advertisement appeared on the bulletin board of the School of Mines, Columbia College, for two engineering draftsmen, signed by the Link-Belt Engineering Co., of Philadelphia. My application in response to this advertisement was accepted, and I became a member of the Link-Belt organization immediately thereafter. The vice-president and chief engineer of that organization was James Mapes Dodge. He had been connected with William Dana Ewart, the inventor of link belting, for some years, had assisted him in the design of the detachable chains and their attachments, and more than any other man had begun the application of chain to purposes of conveying and elevating material.

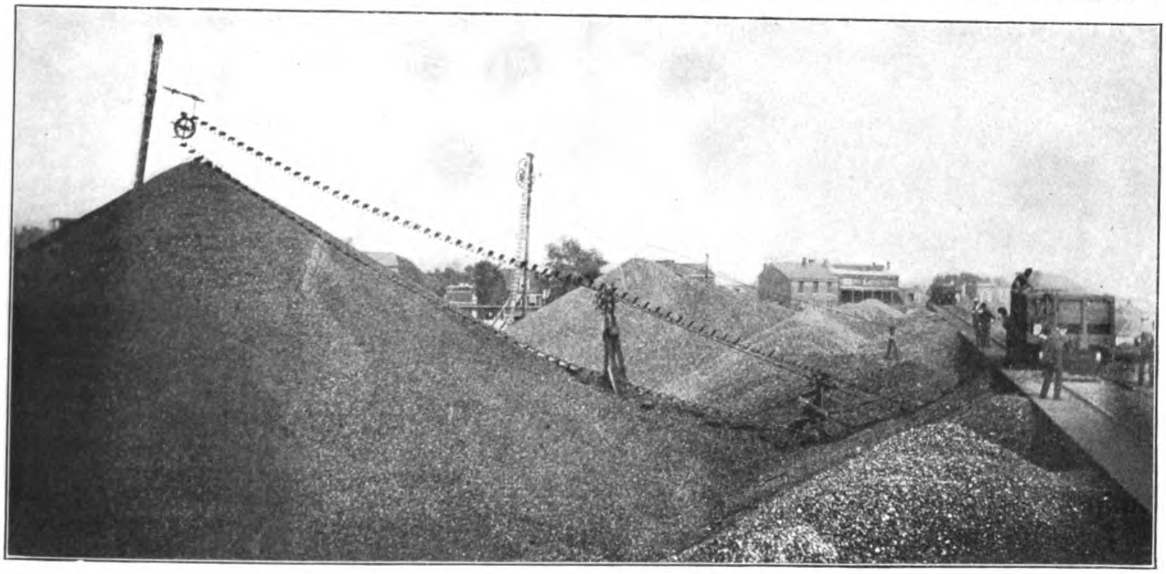


FIG. 1. ORIGINAL DODGE COAL-STORAGE PLANT OF THE READING RY. AT PORT RICHMOND, PHILADELPHIA, PENN.—THE BEGINNING OF A BIG BUSINESS

This period was followed by several years spent as superintendent of the malleable-iron foundry at which the chains were made, from which position he resigned to conduct some experiments on steel castings in Philadelphia. Upon the conclusion of these experiments, he became associated with Edward H. Burr, who then had the Pennsylvania agency for the Ewart Manufacturing Co. Under the firm name of Burr & Dodge, the application of chain to conveyors and elevators was pushed with such zeal that but for the kindly financial aid of Mr. Burr's father, a receiver would have ended the partners' efforts in the new field. The losses sustained grew out of inexperience, out

*President, Link-Belt Co.

of the optimism of the enthusiast. Mr. Dodge had invented a new chain known as the Dodge chain, a unique and distinct improvement on the old cable chain, and he felt he had practically found in it a solution of all conveyor problems. Joseph Cavanagh was in those days the only salesman of the firm, and when Joe came back from the anthracite region with his first order for a Dodge chain conveyor, the firm members came near meeting him with a brass band. If they had so met him and had known what the future held in store for them, they would have had the band play a dirge, for that order was but the first of the series that almost put the firm out of business. The experience was an expensive but nevertheless a very profitable one, for it was a much chastened enthusiasm that met the future problems; and experiments were thereafter conducted at home instead of in the plants of customers.

By 1888 Burr, Dodge and the New York office of the Link-Belt Machinery Co. had prospered to such an extent that a consolidation of the two interests was proposed by Mr. Dodge, and finally effected. The Link-Belt Engineering Co., of Philadelphia, grew out of this consolidation, and this company became the exclusive agent of the Ewart Manufacturing Co. for the Atlantic Coast States, the Link-Belt Machinery Co., organized in Chicago in 1880, retaining the agency for the rest of the country. While Mr. Ewart was president of both the Link-Belt companies, Mr. Dodge was the executive as well as the engineering head of the eastern company. Under his leadership there began an era of invention and development that in the retrospect appears little short of marvelous. Over 120 patents were taken out for him by the firm of Howson & Howson alone, and these patents cover only his later period of inventive activity. His inventions during this later period, beginning in 1884, pertained largely to conveying problems and to transmission chains.

Several years before I joined the organization he had conceived the idea of storing and reloading anthracite coal by mechanical means. In the preparation of anthracite for the market all sizes, from the largest domestic size to the smallest steam size, are produced. The demand for these sizes varies very materially, the steam sizes being in fairly uniform demand the year through, the domestic demand being active in the fall and winter but very light the rest of the year. To equalize production and to take care of the wide market fluctuations, a considerable portion of the anthracite output must be stored between the mine and the market. Storage of anthracite, when Mr. Dodge entered the field, consisted largely of dumping the cars on trestles and reloading with wheelbarrows. The cost averaged fully 10c. for the round trip, without taking into account the loss through degradation, which in this method of handling averaged fully 20c. more.

Mr. Dodge conceived the idea of piling the coal in conical piles and performing both the operation of stocking out and reloading mechanically. His ideas on this subject struck his associates as so bold and radical that they were unwilling to jeopardize the financial integrity of the conveyor business by this bold flight into fields untrodden. But nothing daunted, he proposed that they put up some money for an independent company and permit this company to install the storage systems. In those days, like most inventors, Mr. Dodge was considerably longer on ideas than he was on cash, and he was therefore under the constant necessity of inducing his moneyed associates to furnish the funds. Fortunately for both his associates and himself he was a magnetic and convincing talker and finally won a rather reluctant consent to his proposition. Ten thousand dollars was put up in cash, and a company known as the Dodge Conveyor Co. was organized. It contracted to store and handle a certain yearly tonnage for the Philadelphia & Reading Ry. at Port Richmond. In spite of limited means, inexperience and the crudest of crude machinery, his ideas proved sound and the contract financially remunerative. A second contract was thereupon secured from the Pennsylvania R.R. at South Amboy, in which an actual sale of the machinery was made to the railroad company. The soundness of the idea met with such prompt acceptance that further contracts for two plants were secured from the Delaware & Hudson company.

One of these covered a storage plant of 150,000 tons' capacity, to be located on a narrow island in the Hudson River at Rondout, N. Y. The system of storing as it had been developed at that time is illustrated in Figs. 1 and 2, and consisted of a mast and boom which carried the stock-

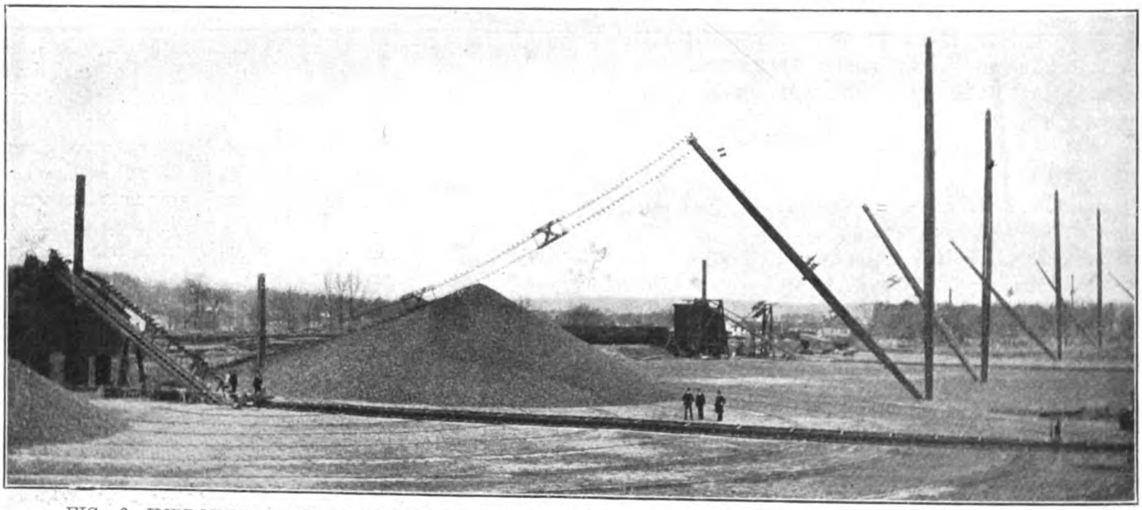


FIG. 2. IMPROVED MAST-AND-BOOM PLANT OF THE PENNSYLVANIA R.R. AT SOUTH AMBOY, N. J.

ing-out conveyor head machinery. The mast had to be securely anchored to guy ropes, which of necessity had to lead away from the coal pile. At Rondout Mr. Dodge almost met his Waterloo, for after the company had been awarded the contract he found the island just wide enough to hold the coal piles, and to use his own expressive phrase, "There wasn't a darn thing to anchor the guy ropes to except the swift current of the Hudson River."

But the difficulty was met in a very ingenious fashion, for right on the spot he developed the idea of spanning the piles with light hinged trusses and securing them against side wind pressure by anchor and guy ropes. This put the guy ropes lengthwise of the island, where there was plenty of terra firma for anchorage. The change, while adding considerably to the cost, added materially to the effectiveness of the storage system, for it afforded him the opportunity for the invention of the ribbon-bottom conveyor, which aided so materially in reducing the breakage of coal.

Compare the two cuts, and the tremendous step ahead attained by the invention of the shear-truss construction will be apparent at a glance.

The unsuitability of Hudson River water to serve as an anchorage for the mast and boom construction had developed the idea that was needed to round out and perfect the system. It became the recognized method of storing anthracite coal in large quantities and has remained so. See Fig. 3.

Mr. Dodge's invention was absolutely generic, and he was entitled to the broadest kind of patent protection; but a poorly drawn set of claims opened the doors to a competitor, who sold one plant. The patent office, recognizing the merits of Mr. Dodge's invention, granted his application for a re-issue, and the amended process claim was so carefully and yet so simply drawn that we were never again subjected to infringement.

Those days in the late eighties and the early nineties were active, interesting days. The conveying art was so young that few standards had been developed and a broad field for invention lay open before us. The shops worked in a happy though leisurely fashion, but the margins of profits were large and there was no immediate incentive for systematized intensification of production. In 1889 when the plant at Nicetown, Philadelphia, was built, Louis Wright was appointed superintendent. He was a capable man who had served several years of apprenticeship under Frederick W. Taylor, who was then at the Midvale Steel Works. Mr. Wright gradually brought about some semblance of orderly procedure in the manufacturing departments, though it was done only after a lot of argument and after the exercise of some pressure. For Mr. Dodge worked on impulse and looked upon any systematic procedure that harnessed or directed impulse as an unnecessary and unwise restriction of initiative. When Louis Wright argued that the execution of a customer's order should take precedence over the carrying on of an experiment, Mr. Dodge very reluctantly assented; but when Louis Wright argued for a further extension of system and records, Mr. Dodge said: "Louie, in the several years that you have been here, the only decision of any importance that you unearthed out of this mass of records was that when you wanted to paint a fence it was cheaper to use dressed lumber than rough lumber. I could have guessed that if you had asked me." His contempt for records in those days is particularly interesting because 15 years later he became recognized as the most ardent advocate of the Taylor system.

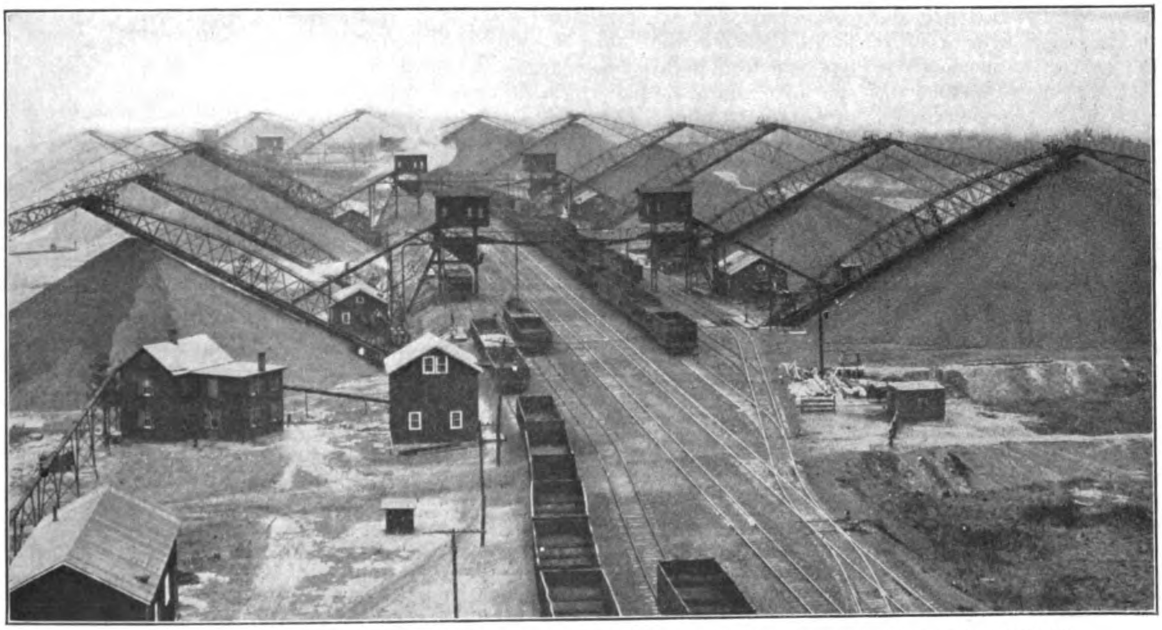


FIG. 3. SHEAR-TRUSS CONSTRUCTION INVENTED AS A RESULT OF THE RONDOUT EXPERIENCE; SUSQUEHANNA COAL CO.'S PLANT AT OLD BRIDGE, N. J.

His attitude toward college men underwent a similar change. Though a college man himself, his quick mind grasped mechanical and mathematical facts without the necessity of demonstration. He looked upon many of the mathematical propositions as self-evident and rebelled at the idea of being compelled to prove axioms. The whole college curriculum struck him as a perhaps necessary program for dullards but as unnecessarily restrictive to the student of wide mental grasp and quick perception.

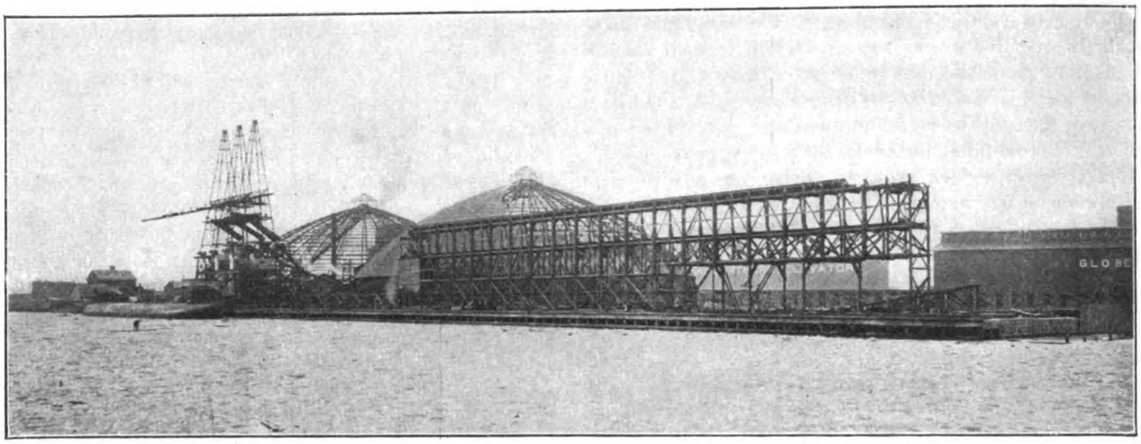


FIG. 4. CIRCULAR STORAGE BUILDINGS OF THE LEHIGH VALLEY PLANT

In his own experience he felt that his work in the shop had been of tremendously greater help to him than his work at college, and he was apt to minimize in those early days the practical value of technical training.

Yet in his annual address on the "Money Value of Technical Training," delivered in 1903, while president of the Society of Mechanical Engineers, he states, "The progress of the world, however, calls for a better and more speedy means of producing trained men than can ever be developed by the methods of self-instruction," and the chart accompanying the address—developed as the result of exhaustive analysis—shows the high esteem to which the graduates of technical schools had risen.

Our work had gradually taken on an engineering as well as a mechanical aspect, and the rapidly expanding engineering department gave him an excellent opportunity to compare the technically trained with the self-trained men. He realized upon investigation that while some technically trained men were absolutely lacking in mechanical instincts, and while more perhaps were wholly lacking in commercial sense, yet on the whole the percentage of capable and successful men developed out of our collegiate employees largely exceeded those developed out of the self-trained class.

A Unique But Very Simple Engineering Invention

During 1893 and the succeeding years our business gradually declined in volume as a result of the general depression following the Baring failure, and we were compelled in order to keep the plant going to take on several large contracts that were more hazardous than they were remunerative. The most conspicuous of these contracts was that taken from the Lehigh Valley Coal Co. for its coal dock at West Superior. We were called in at the very last minute and given an opportunity to bid. The problem submitted consisted in storing 50,000 tons of stove and 50,000 tons of nut anthracite coal under cover and 40,000 tons of bituminous coal in the open, the coal to be taken from vessels and delivered from storage into cars. The Lehigh Valley had practically decided to adopt a plan

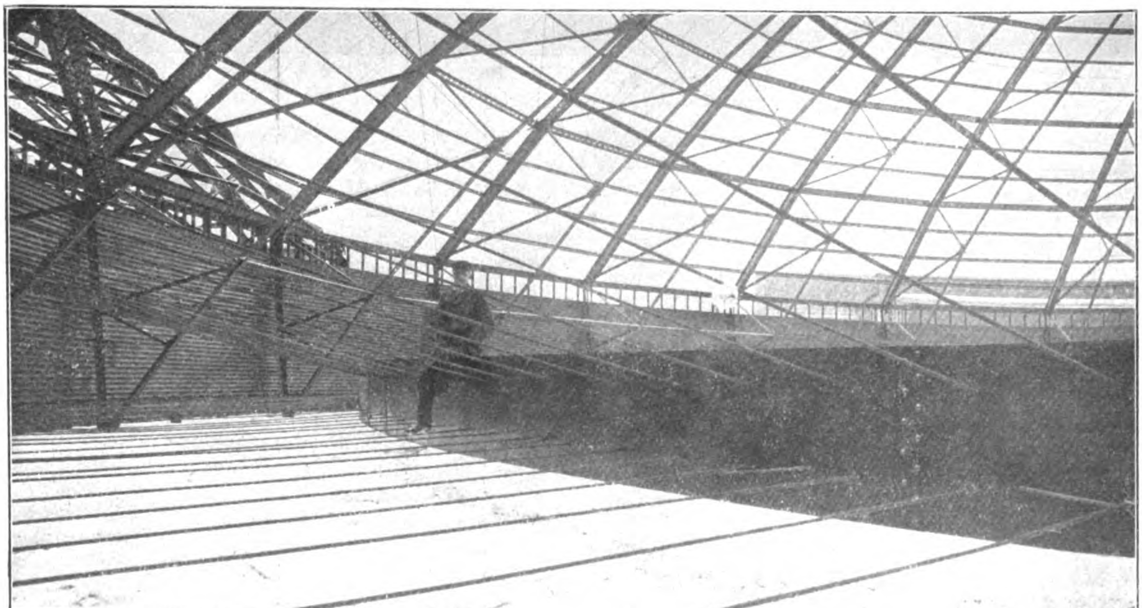


FIG. 5. CIRCULAR ANCHOR BAND TO WHICH THE OUTER WALL IS SECURED

consisting of wooden sheds into which the coal was to be distributed by means of a cable railway. Mr. Dodge, under the stress of this seemingly insurmountable competition, developed his covered storage system, convinced the Lehigh Valley of its value and secured the contract for upward of $260,000, in spite of the fact that the plan was wholly untried. The plant brought with it a train of engineering and mechanical problems, all of which were successfully met, but the particular idea which made it possible to secure the contract was a unique but very simple engineering invention.

The plan submitted by Mr. Dodge included the use of two circular buildings, 246 ft. in diameter, 90 ft. high, with vertical retaining walls 17 ft. high (see Fig. 4). Now the pressure exerted by anthracite coal is about one-third of water pressure when the coal is level with the top of the wall, and fully one-half of water pressure when the wall is surcharged, and the structure necessary to take care of this pressure loomed up as one involving prohibitive expense. Imagine a boiler 246 ft. in diameter with a pressure of 510 lb. per sq.ft., and you will get some idea of the structural problem involved. But Mr. Dodge decided to make the coal sustain the wall, and while it seems paradoxical to say that the material that causes the pressure can be made to sustain that pressure, yet that is exactly what his scheme contemplated. The illustration, Fig. 5, shows a section of the building and illustrates the use of the anchor band which solved the problem in very simple and economic fashion. The band is circular and is suspended about 30 ft. inside of the retaining walls. In the operation of stocking out coal a section of the band is covered before any pressure is exerted by the coal against the corresponding section of the wall, and the necessary anchorage to the band is readily secured by light rods.

The retaining walls were constructed of 8-in. I-beams and No. 10 corrugated metal, the anchor band of $\frac{5}{16}$-in. steel 3 ft. wide, but this simple and cheap construction has stood up without flinching for 20 years.

(To be continued)

Lubrication and Wearing of Tooth Wheels

By Hugo Friedmann

The question was recently raised whether it would be feasible to use an oil-film lubrication such as proves to be the best expedient for journal bearings to protect tooth wheels against wearing. In order to ascertain the value of this suggestion, we start with the consideration of a few physical properties.

It is a well-known fact that two pieces of perfectly straight plate glass, one laid upon the other, can hardly be separated in the direction *A*, Fig. 1. There exists between such polished surfaces a special mechanical attraction called adhesion. In the direction *B*, however, Fig. 2, the pieces may be easily separated. This difference of conditions is very remarkable and important.

Problem of Adhesion Applied to Gears

It is useful in considering the problem of tooth-wheel lubrication to remember how the physicists explain the phenomena of adhesion. They suppose that every substance has the property of attracting other substances. The influence of big masses reaches far (for instance, the attraction of the earth controls the motion of the moon), whereas the influence of those smallest particles that build up every material is effective only within the range of ten-thousandths of an inch. Between two separate bodies it cannot be observed therefore unless a high polish and perfect straightness of their surfaces permit bringing them very close together. This fact explains the strong attraction in direction *A*, Fig. 1.

Now as to conditions in Fig. 2. The influence of every particle is radiated in all directions of the space; but not all these forces may cause a visible effect. Looking at the simplified section, Fig. 3, we understand that the particle 1 in the body *A* is chiefly attracted by the particle 2 situated just opposite the body *B*. Particles 3 and 4 will likewise attract particle *A* and try to move it to their side, but these forces will annul each other. If then an exterior influence acts in the direction *C*, it is added to the influence of 4. The equilibrium is disturbed, and the body *A* will move to the right hand. Adhesion has no practical influence in this case, and the frictionless condition of the bases makes sliding very easy.

Practically the same results are obtained if a thin film of liquid is between the two bodies. This film has the additional effect of equalizing the solid surfaces to a certain extent, even if they are not perfectly smooth. For the liquid is able to fill minute irregularities, and the adhesion may act from one solid to the liquid and through this to the second solid. Adhesion becomes therefore more effective and sliding easier. This is the common influence of lubrication.

Capillary Action of Oil Discussed

Still another phenomenon has to be considered in the case of a liquid film—the capillarity. Capillarity may be observed best when a plain tube of narrow gage is inserted with one end in colored water. The liquid will be seen ascending in the tube far above the outer coil against the influence of gravity, Fig. 1. This phenomenon is another result of adhesion between solids and liquids. The same sucking form as in the glass tube is effective between two straight plates that are approached very closely without touching each other. This force hinders the lubricant from running out of the gap; more than that, this force acts so that the oil can hardly be squeezed out from its location by outside pressure. As a consequence the upper plate, Fig. 5, does practically float on the liquid film.

If we imagine these plates and the film rolled up to a cylindrical shape, we get exactly the conditions of a journal bearing with oil-film lubrication, Fig. 6. The rotating journal is actually sliding on the bearing surface, and the oil film is constantly maintained by the capillarity of the minute gap between bearing and journal. Experience proves that it is not destroyed even at the bottom of the bearing.

After having made clear these conditions we may proceed to study whether they can be imitated with tooth gears. The teeth always press each other along one line of contact only, Fig. 7, and in moving, this line is continuously shifted from one place to another. If we assume, just for the purpose of making the matter clear with a stationary drawing, that tooth 2 is resting, the relative position of tooth *I* will move from the full-

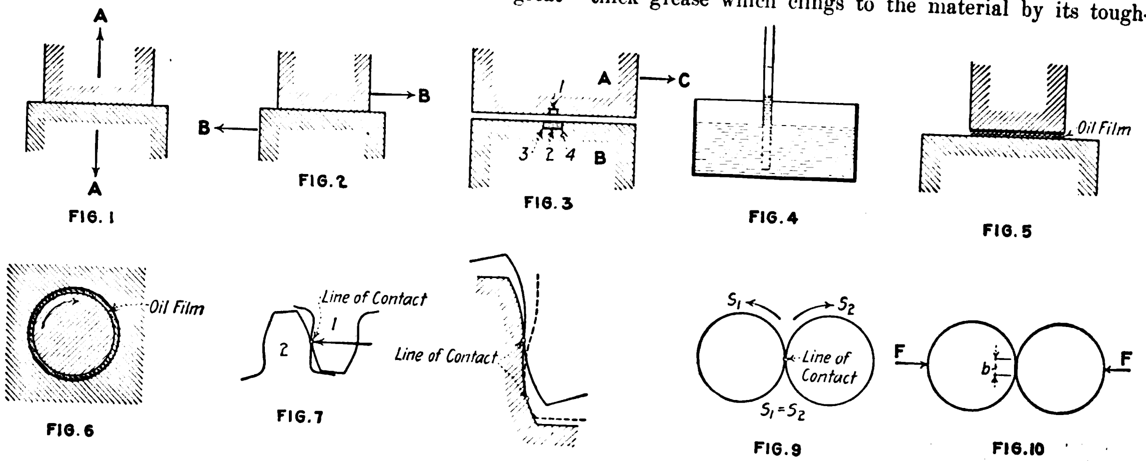
to the dotted-line position, Fig. 8. There is no sliding, theoretically, but a kind of rotating around a movable center. By this motion the gap is opened at one place and closed at another. The lines that were just touching each other are separated by force in the next moment, an action perfectly comparable to the one shown in Fig. 1. This motion acts against adhesion; it does not offer a continuous gap, and it destroys the oil film. In the action of tooth gears, as this motion cannot be changed, it becomes evident that their principle is strictly contrary to the conditions for oil-film lubrication. There is no chance therefore to reduce the recessing of spur gears by this form of lubrication. For worm gears the case is quite different. The motion of the worm is to a great extent a sliding along the teeth. Worm gears may therefore be efficiently protected by an oil film.

In order to keep the wearing of tooth gears within safe limits, other expedients have therefore to be chosen. They are generally known but not always fully appreciated, and it may be instructive to discuss connection with the preceding considerations.

As stated above, the motion of the teeth relative to each other is essentially a rolling. We consider therefore first the process of plain, ideal rolling. As shown in Fig. 9, two rolls moving in opposite direction with the same speed do not slide at all upon each other. Consequently there is no friction and no wearing. When, however, the rolls are exposed to considerable pressure from both sides, the material will be flattened by elastic deformation; and instead of the original line of contact, there will be a temporary face of contact of the width b, Fig. 10. The destruction of the true circular shape changes the original frictionless rolling into a more complicated motion, and a partial sliding of the fibers, in addition to the high local stress by pressure, causes wearing.

The same consideration may be immediately applied to tooth gears. It teaches us first that the load must be kept within certain limits, proportionate to the size of the teeth; secondly that these limits depend also upon the kind and quality of the material. In most cases where tooth wheels are worn out, it is caused by a load that exceeds the capacity of the size of the wheels and the elastic properties of the material. Moreover it has to be considered that the motion of the teeth is of a complicated character, if compared with the plain rollers, Fig. 9. As a matter of fact there must always be some sliding. In order to reduce this influence as far as possible, the outline of the teeth should always approach the theoretical shape as exactly as possible. The importance of clean, exact cutting and of the maintenance of the correct distance becomes therefore evident.

In the last place, lubrication may be of value. It reduces the friction of that amount of sliding which cannot be entirely avoided. As the action of capillarity and the establishing of an oil film cannot be depended upon, and in addition to that the centrifugal force tries to throw off the lubricant, it is necessary to use rather a thick grease which clings to the material by its toughness and envelops it everywhere. Under unfavorable conditions it is advisable to inclose the whole gearing in a tight sheet-metal case and to fill this with grease.



MECHANICAL CONSIDERATIONS IN THE LUBRICATION AND WEARING OF TOOTH WHEELS

Effect of Lubricant on Taps

C. T. Brunson, of the Wabash R.R., reported to the American Railway Tool Foremen's Association that he found a great deal of trouble in stripping threads in boiler shops to be due to the character of the lubricant used on the tap. The majority of machines on the floor have one oil can, and the oil in that can is used to oil the motor, to wash the men's hands, on a tap, or reamer, or on whatever comes along. Whenever instructions are given the men on the floor to use the proper lubricant for tapping, there will be eliminated a great deal of trouble in stripping threads. Mr. Brunson further stated:

"I have had men on turret lathes tell me that the only thing with which they can tap on their machines is white lead and a composition of soapy water. I have had to show them that they are wrong, that there are lubricants that beat that all hollow. In fact there was one man who was very positive. He had been running a turret lathe for a number of years and was sure that he knew all there was to know about the matter. He knew so much about it that he would not try the oil until I took the drill press and did a better job of tapping on the drill press than be could do on the turret lathe. Then he began to pay attention. But that is where a good deal of our trouble comes in the way of stripping threads in tapping, because of the use of the wrong lubricant."

Making 22-Caliber Sheet-Steel Rifle Barrels

By Ethan Viall

SYNOPSIS—Ordinarily a rifle barrel is made from a solid bar, drilled out, and then rifled in a special machine. The rifle barrels described in this article are made from sheet metal, and the rifling is produced in a punch press by a unique method. Besides the making of the rifle barrel, several other interesting shop processes are shown and described.

The making of a rifle barrel from sheet metal sounds unusual enough to attract attention, yet the process is not so complicated as one might imagine, though it shows considerable ingenuity. The type of rifle on which these barrels are used is shown in Fig. 1, where views of two of the models are given. The upper one is of the Boy Scout model, with bayonet, long fore-end and shoulder strap. The lower one is the regular target or light sporting model. With the exception of the stocks, fore-ends and a few rivets, these rifles are made entirely of sheet metal. They are made to use the regular 22-caliber cartridges, and are manufactured by the C. J. Hamilton & Son Manufacturing Co., Plymouth, Mich.

As it is the most interesting process, the making of the barrels will be described first. These barrels consist of three tubes telescoped into each other, soldered solidly together and pressed into another tube which forms the outer part of the barrel. As previously stated, these parts are all made of sheet metal. In making the inner tube, or lining, through which the bullet passes, the sheet metal is cut into strips of the correct length and width, which are then bent lengthwise into U-shape in an ordinary die. The next step is to form these pieces into tubes, which is done in a kneading machine, as shown in Fig. 2. In starting, the work is placed as shown at *A*, with a mandrel in the channel. The work is of course pushed in far enough so that the metal is entirely between the jaws. The machine is then started, and the jaws rock up and down, kneading the piece into a tube with the edges butted closely together in a way that could not be obtained in a punch press with an ordinary closing die. This process is followed for the other sizes of tubes used. A strip bent into U-shape and a finished tube are shown at *B* and *C*.

The outer tubes are left straight, but the inner one is twisted so that the edges conform to the spiral of the rifling. This work is done in the machine shown in Fig. 3. The tube to be twisted is placed between centers, with one steadyrest to support it at *A*. The centers used are merely sockets to receive the ends of the tube and have a projection in them that engages the slit. With the tube resting in the socket centers, the operator pulls on lever *B*. The lever not only presses the driving projections of the sockets into the slits, but forces the headstock center inward. This action causes a clutch to engage, and the spindle automatically turns backward just the right amount to give the required twist to the tube, as a stop throws out the clutch at the right point. As soon as the clutch is thrown out and the twisted tube removed, the weighted strap *C* pulls the spindle forward to starting position ready for the insertion of another tube. The spiral lines on the tube *D* show how it has been twisted. The gears at *E* are for the purpose of obtaining the needed twist with the amount of pulley travel available.

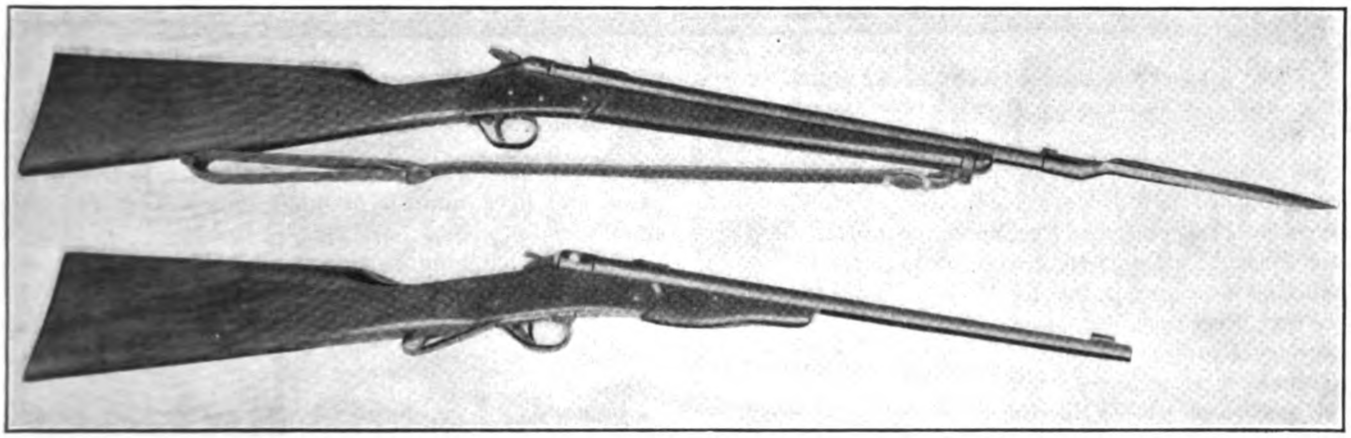


FIG. 1. TWO MODELS OF 22-CALIBER RIFLES WITH SHEET-STEEL BARRELS

The rifling is put into the inner tube not by cutting out grooves in it as usual, but by pressing or kneading the brass tube down over a spiral mandrel, after which the mandrel is forced out, leaving the interior of the tube of the same shape as the mandrel. Fig. 4 shows a twisted tube at *A*, a finished rifled tube at *B* and a mandrel at *C*. This mandrel is 17$\frac{31}{32}$ in. overall, without the handle. The spiral flat sides, 12 in number, are 15$\frac{9}{32}$ in. in length, measured parallel to the center line and not on the spiral. The amount of spiral twist is one turn in 13.71 in. The short round part on the end is 0.208 in. in diameter. Measured with a micrometer at the outer end, the opposing flats are 0.217 in. apart; that is, the mandrel is that much in diameter there. At the end next the handle it measures 0.215 in. This shows the amount of taper from one end to the other. The making of the mandrel was a difficult job, and was

described in *American Machinist,* page 429, Vol. 31, though the actual manner of working with it is here described for the first time.

In using the mandrel, a twisted tube is run on over it, and it is then laid in the special kneading jaws in a punch press, at *A,* Fig. 5. It will be seen that there are four jaws in this device, and the tendency of them all is to work or knead the metal inward as the press ram descends. About 20 strokes are required to flow the metal closely around the mandrel to form the rifling.

After the tube has been thoroughly pressed around the mandrel, it is removed from the jaws and placed in the device shown in Fig. 6. Here the tube rests on a fork at *A,* with handle below. A rod *B* is run through a guide at *C* with the lower end resting on the end of the mandrel. As the foot treadle *D* is pressed down the rod forces the mandrel out of the tube. This sequence of operations shows the necessity for the taper for the mandrel, which without the taper would be extremely difficult to remove. With the rifled tube as a basis, the outer tubes are pressed on, the ends of the inner tube are plugged and all are dip soldered. After this, one end is chambered for the cartridge and the muzzle end machined off smooth. The other operations on the barrels are of minor importance and will not be described.

The hammers used in these rifles are blanked out in a punch press and the pin hole pierced. The thumb-hold is then profiled off, as shown in Fig. 7. Here the master form is shown at *A* and the hammer to be milled, at *B.* The hammer is located in the special vise jaws by means of the pin hole, which fits over a pin set into one of the jaws, and by a number of other pins among which it fits.

The cross-hatching on the thumb-hold of the hammer is knurled on in a special machine, shown in Fig. 8. The

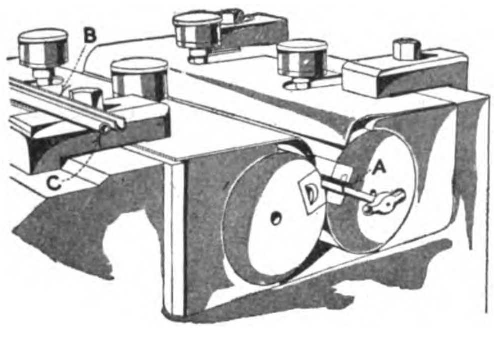


FIG. 2

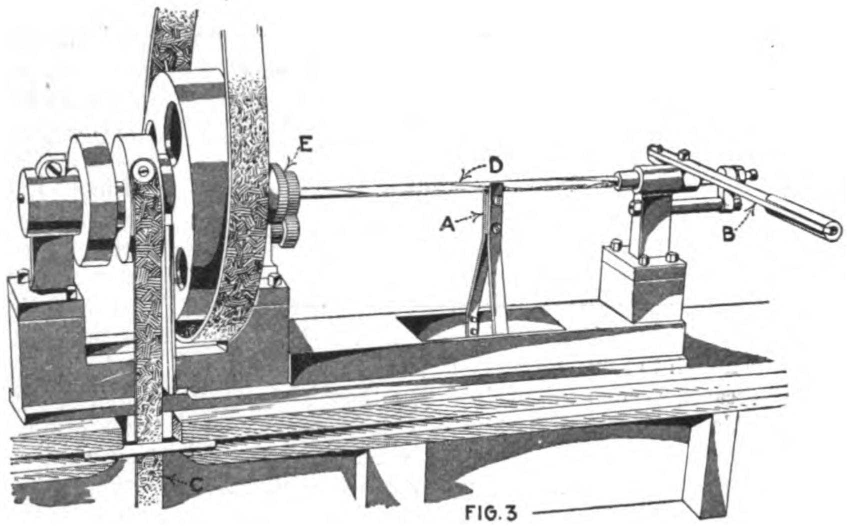


FIG. 3

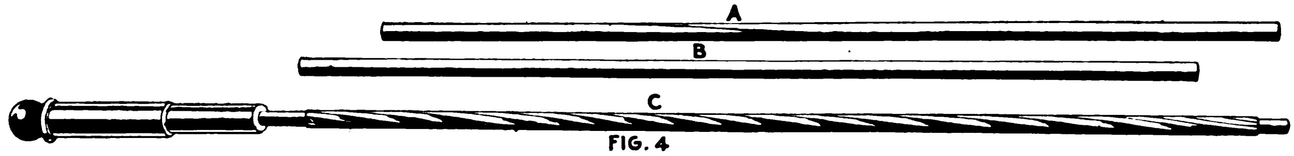


FIG. 4

FIGS. 2 TO 4. BARREL-HANDLING MACHINES AND MANDREL USED FOR TWISTING

Fig. 2—Kneading machine used as tube closer. Fig. 3—Twisting the inner tubes for the barrels. Fig. 4—A twisted and a rifled tube, with the mandrel used

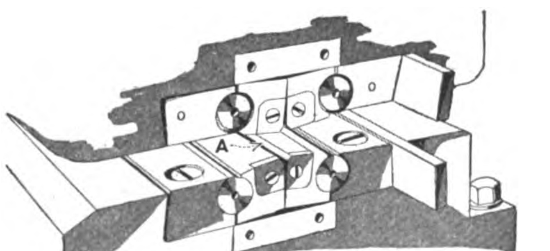


FIG. 5

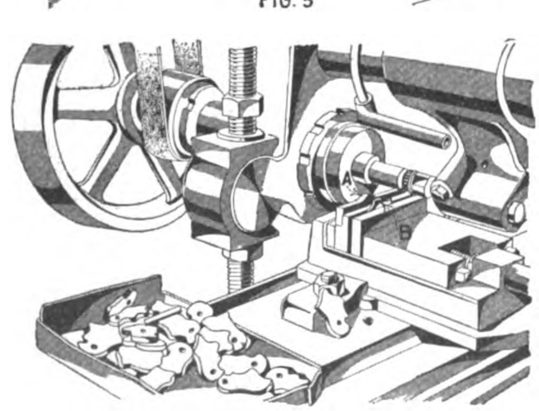


FIG. 7

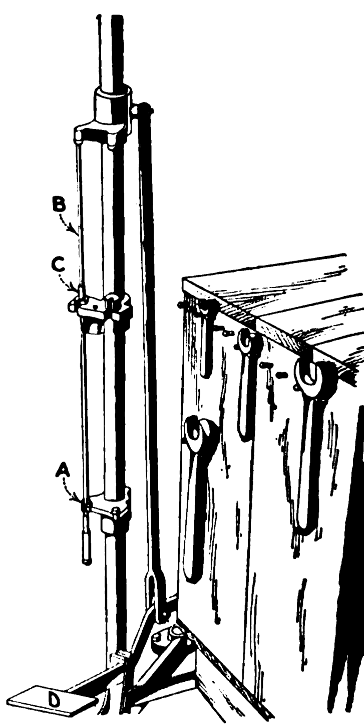


FIG. 6

FIGS. 5 TO 7. TWO BARREL KINKS AND A PROFILING JOB

Fig. 5—Press jaws used to knead the tube to the mandrel. Fig. 6—Special press for forcing out the mandrel. Fig. 7—Profiling the thumb-hold on a hammer

hammers are placed one at a time in a sort of revolving turret, as shown at *A, B* and *C*. As the turret slowly revolves, the hammers are carried past the two knurls at *D*, and the cross-hatching is automatically done. As a hammer is carried on around, the operator removes it and places another in its place, so that the work is continuous. A turret for another size of hammer is shown at *E*. It can easily be put on in place of the other.

The trigger guards used on some of the rifle models are first cut to length with the ends rounded and the sight notch and the hole are first cut by punches *E* and *F*, the punchings being shown at *G* and *H*. Punchings like those shown at *I* are then made by punch *J*. This leaves the part of the sight that is to be bent cut out on three sides. The punch *K* partly completes the bend, and the last punch, in which *L* is the pilot and *M* a knockoff pin, finishes it and blanks out the remaining part of the sight.

Another die, shown in Fig. 12, is used for making the parts at *A*. The piercing, blanking and forming are all

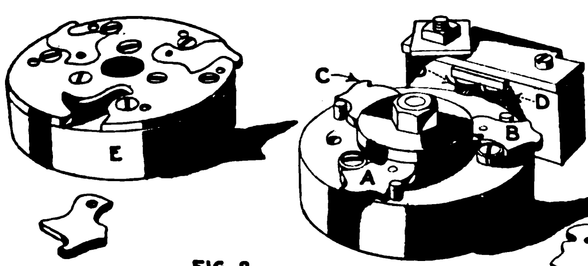


FIG. 8

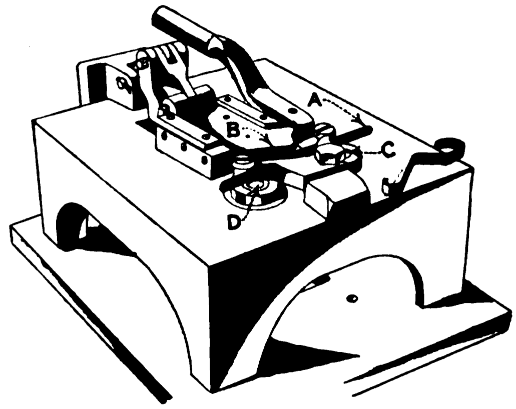


FIG. 9

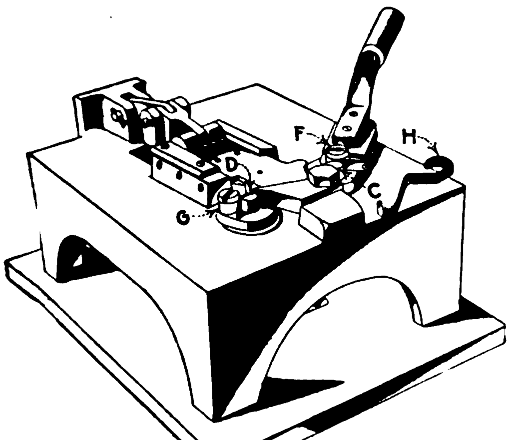


FIG 10

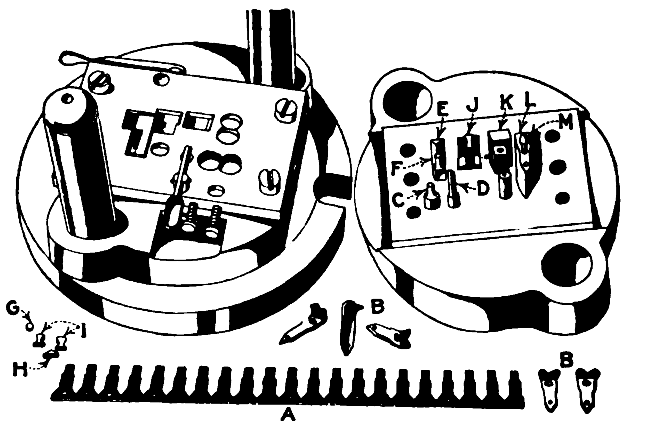


FIG. 11

FIGS. 8 TO 11. HANDY TOOLS FOR SMALL PARTS OF RIFLES

Fig. 8—Thumb-hold cross-hatching machine. Fig. 9—Trigger guard forming fixture. Fig. 10—Bending the end loops. Fig. 11—Die for making a rear sight complete

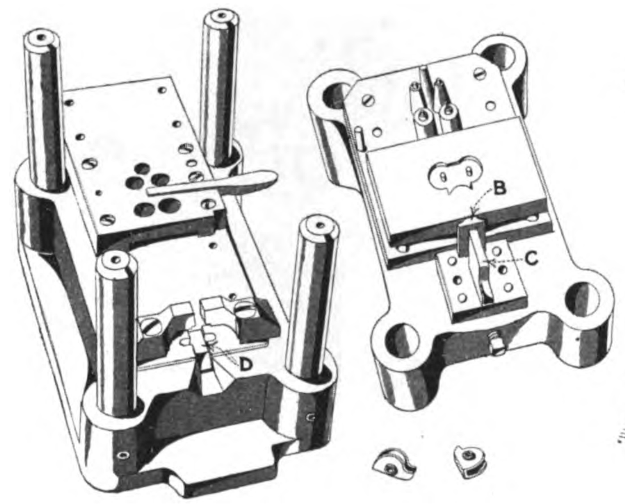
screw holes pierced. They are then bent to shape in the device shown in Figs. 9 and 10. In Fig. 9 the piece to be bent is shown at *A*. By pressing down on a foot treadle the slide *B* moves forward and the first bend is made. This movement also brings up two plugs *C* and *D* from below. These two plugs are shown elevated in Fig. 10, and it is around them that the two end loops are bent. To bend the ends, the operator pulls on the lever *E*, which causes the two rollers *F* and *G* to rotate around the plugs, bending the ends of the guard as they travel. As the hand lever is returned to starting position and the foot treadle released, the two plugs drop down into the table, and the bent guard is easily removed. One of the guards is shown at *H*.

Rear sights are made from strip stock in the die shown in Fig. 11. A strip of the scrap is shown at *A*, and one of the sights at *B*. Other similar ones are shown in the foreground. A row of pierced holes will be noted in the strip of scrap. These holes are for stopping and piloting purposes, and are made by the punch *C*, the pilot being indicated at *D*. In feeding the strip through the die the done in this die. It will be seen from the pieces that the holes are not only pierced, but also shouldered. The final cutting off and forming are done by the two punches *B* and *C* as the stock feeds out through the guides of the die at *D*.

A Novel Use for a Drilling Machine

A drilling machine laid on its side for doing some special work is shown in Fig. 13. While this is practically a screw-machine job, a screw machine was not used because the work could not be conveniently handled through the spindle from the back. The job done is the facing and chambering of the ends of rifle barrels. The barrel is thrust in with the left hand through the hole at *A*. The chuck jaws *B* are tightened down on the barrel by means of the handle *C*. The tool *D* is fed to the work by means of the handle *E*. The spindle runs in the same way as usual, except in a horizontal position. It will be seen that the shortness of the large hole in the bracket holding the chuck is a great convenience in this case.

The handle loops on cleaning rods are formed in the fixture shown in Fig. 14. It differs somewhat from the usual type used for this purpose. The rod to be bent is thrust in between the center pin and the block *A* until it butts against a stop. This action brings the end close to the edge of the hinged member *B*. As the operator pulls on the lever *C*, this member forces the end of the wire around the center pin until it butts against the side of the block *A*. This movement brings the long part of the rod around parallel with the side of the block and



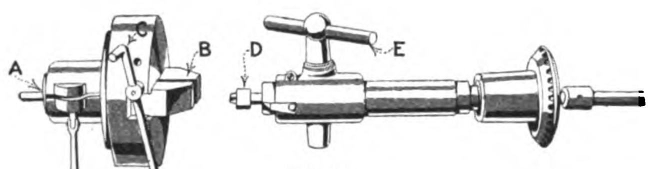


FIG. 13

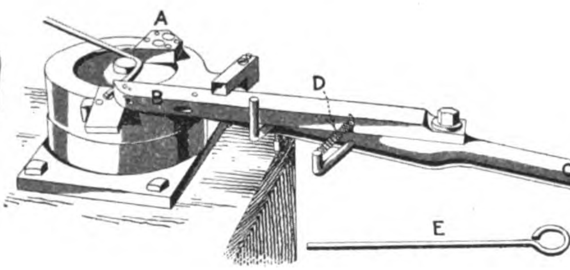


FIG. 12

FIG. 14

FIGS. 12 TO 14. SPECIAL TOOLS FOUND EFFECTIVE IN MANUFACTURING RIFLE PARTS
Fig. 12—Die for making a special lever part. Fig. 13—Drilling machine used horizontally. Fig. 14—Wire loop-forming fixture

finishes the work. The swinging in of the end of part *B* allows it to keep its grip on the wire, which gradually shortens as it encircles the center pin. As soon as the lever is pulled back, the spring *D* pulls the member *B* back to the starting position ready for the next piece. A finished cleaning rod is shown at *E*.

Tungsten and Molybdenum

One of the most spectacular advances in commodity prices occasioned by the war has been in tungsten, both metal and ore. This has been due to the extraordinary demand for tungsten steel—an essential constituent in making high-speed tool steel. The manufacture of immense quantities of military material has required greatly increased quantities of tool steel, and consequently corresponding quantities of tungsten; hence the advance in price for it.

Before the war high-speed tool steel was worth about 70c. per lb., tungsten about 60c. per lb. and tungsten ore about $6 per unit. At present high-speed tool steel fetches about $3 per lb., tungsten about $5 per lb. and tungsten ore about $50 per unit. Even at the enhanced prices supplies are scarce.

The fabulous price for tungsten ore has stimulated prospecting for it throughout North America and South America. This ore is not known to occur in large deposits. The annual production of concentrated ore in the United States previous to the war was only about 1,400 tons. However, this ore has now become so valuable that the discovery of a deposit that affords a single carload is the finding of a fortune. A ton of ore assaying 60% tungsten trioxide—the standard commercial grade—at $50 per unit is worth $3,000; a carload of 40 tons would be $120,000.

A contributory factor in the production of this situation was the utter stupidity of the British authorities. They fought the advance from the beginning. When they were offered some tungsten ore, they came back with a lower bid—trying to dicker in what was not a dickering market—and naturally failed to get what they wanted. Then they practically commandeered the supply of tungsten ore in the British Empire, appointing official brokers and fixing a price of 55s. per unit, or about $800 per 2,000 lb. of 60% ore if exchange be figured at 4.86. Previous to the war that would have been regarded as a fine price, but the producer in Australia, Burma, Malaya and elsewhere does not think very much of it when the same grade of ore is fetching $3,000 or so per ton in America. Patriotism does not go quite so far as that.

In the meanwhile there is relief immediately at hand if the manufacturers of tool steel would only avail themselves of it. We mean the substitution of molybdenum steel for tungsten steel. It is well known that molybdenum steel has excellent qualities of more or less the same character as tungsten steel. There is an extensive literature on this subject to which the tool-steel maker may refer. It is indeed claimed by some authorities that molybdenum steel is superior in certain respects to tungsten steel. The chronic reluctance of manufacturers to get out of the beaten tracks is offered as an explanation of their blindness to the merits of molybdenum steel. But even if it were not preferable with tungsten at 60c. per lb., it might be when that metal is more than eight times as high.

The point is that molybdenum ore and the products thereof are now a drug in the market. While the tungsten mines are being worked at the limit of their capacity, the molybdenum mines have had to be closed, and the smelters of molybdenum ore are carrying large unsold stocks of the products that probably they would be glad to sell at cost. The manufacturers of tool steel and the British authorities are recommended to give some attention to this situation.—*Engineering and Mining Journal.*

Empirical Design of Gas-Engine Piston Pins

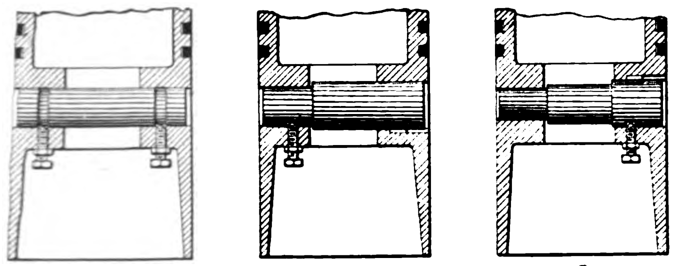
BY G. W. LEWIS* AND A. G. KESSLER†

SYNOPSIS—Empirical formulas are given to obtain the diameter and length of piston pins, also the diameter of pin bosses used on the pistons. These are for both horizontal and vertical types of engines. The formulas have been derived from data received from manufacturers of various American engines and represent the best average practice.

In Vol. 39, pp. 775 and 891, of *American Machinist*, we gave empirical formulas for obtaining the dimensions of gas-engine pistons of the open-trunk type. The following empirical formulas on the piston pin and piston-pin bosses were obtained from data received from manufacturers of American engines and represent average practice.

The function of the piston pin is to transmit to the connecting rod the pressure produced on the piston face by the combustion or explosion of the gas charge.

Two kinds of steel are used in making piston pins—for small engines, a machinery steel case-hardened and ground; for larger engines, a high-carbon, 85-point steel, tempered and ground. Some of the taper pins for large engines are made of a nickel steel of the following composition: Ni, 3.5 per cent.; C, 0.2 per cent.; Mn, 0.65 per cent. The core of a case-hardened pin of the above-mentioned steel has an elastic limit of 150,000 lb. per sq.in. and a maximum strength of 175,000 lb. per sq.in. with a ductility of 10 per cent.



A B C

FIG. 1. TYPES OF PISTON PINS IN USE

The types of piston pins used are shown in Fig. 1. *A*, a straight pin, is used in small engines up to a cylinder diameter of 8 in. The piston pin in all cases must be carefully secured in the piston bosses, and with straight pins two setscrews, locked with check nuts, are used. Type *B* shows a piston pin designed with two diameters or sizes, which provide for one end always being smaller than the central wearing portion. It is free from the defect common to straight pins which burr and wear a shoulder on the middle, making it difficult to remove the piston-pin bearing. This pin can be reground without leaving a shoulder and can always be put in or removed from the piston without readjusting the piston-pin bearing in the connecting rod. The most common method of fastening piston pins of this type is by means of a key and setscrew, as shown. At *C* is shown a similar type of pin fastened into the piston at one end by a setscrew with a locknut and a key. The advantage claimed for this method is that the other end of the pin is free to allow for changes in length due to large temperature differences. It will be noticed that this pin has three diameters and is considered a better design than either type *A* or *B*, but costs more to make. The diameter of the setscrews used for these types of pin equals 0.32, the diameter of piston-pin bearing.

For engines of 40 hp. and over per cylinder tapered pins as in Fig. 2 are used. The average taper of the pins is 1 in. per ft. The pin is provided with a key to prevent it from turning and is clamped into the piston by a nut with a ratchet, which is secured to the pin by a special pawl. Piston pins of this type are case-hardened and ground into the piston with emery and oil, making an almost perfect fit between the pins and bosses.

Piston pins are designed with two objects in view—for strength and for allowable bearing pressure, the latter being carefully considered so as to make lubrication as easy as possible.

To determine the piston-pin bearing diameter empirically the values of the cylinder diameter and the piston-pin diameter are plotted against each other in Fig. 3. The average relation for horizontal engines is expressed by the equation

$$D_{pp} = 0.0143\,D^2 + 0.7\ in. \qquad (1)$$

where

D_{pp} = Diameter of piston pin;
D = Cylinder diameter.

The average German practice from Haeder is given by the dashed curve and shows that for a given cylinder diameter a much larger pin is used, which means a much higher factor of safety, assuming that the same material is employed for each pin.

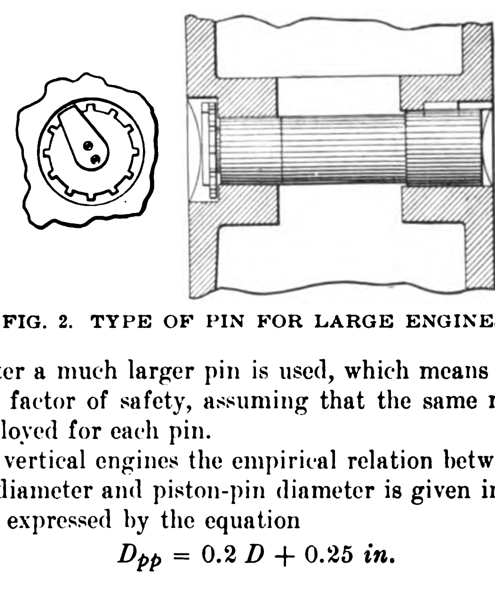


FIG. 2. TYPE OF PIN FOR LARGE ENGINES

For vertical engines the empirical relation between cylinder diameter and piston-pin diameter is given in Fig. 4 and is expressed by the equation

$$D_{pp} = 0.2\,D + 0.25\ in. \qquad (2)$$

where

D_{pp} = Diameter of piston pin;
D = Cylinder diameter.

The bearing length of the piston pin for horizontal engines is determined empirically from Fig. 5. From the

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position of the points two average curves have been drawn. Curve (a), representing the average of most of the data, gives the following relation:

$$L_{pp} = 1.4\, D_{pp} + 0.5 \textit{ in.} \qquad (3)$$

and curve (b)

$$L_{pp} = 2.8\, D_{pp} - 0.7 \textit{ in.};$$

where

L_{pp} = Bearing length of piston pin;
D_{pp} = Bearing diameter of piston pin.

The average relation given in text-books on gas-engine design is that the bearing length equals 1.5 times the bearing diameter. The dashed curve in Fig. 5 gives average German practice from Haeder.

For vertical engines the average relation between piston-pin diameter and piston-pin bearing length is given in Fig. 6 and is expressed by the following equation:

$$L_{pp} = 1.82\, D_{pp} \qquad (4)$$

where

L_{pp} = Bearing length of piston pin;
D_{pp} = Bearing diameter of piston pin.

The overall length of the piston pin for horizontal and vertical engines is given in terms of the cylinder diameter in Fig. 7 and the relation is given in the equation

$$L'_{pp} = 0.95\, D \qquad (5)$$

where

L'_{pp} = Over-all length of piston pin;
D = Cylinder diameter.

The allowable maximum bearing pressure in pounds per square inch on the projected area of the piston-pin

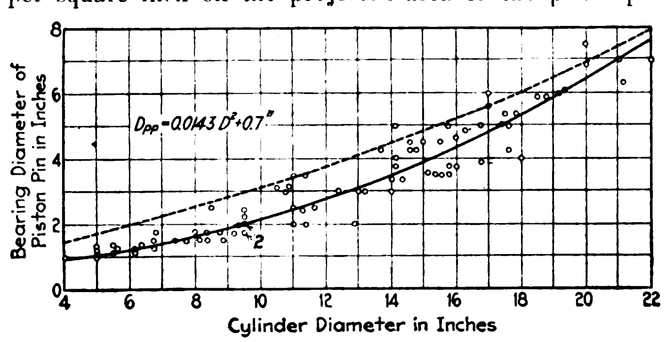


FIG. 3. PIN DIAMETERS FOR HORIZONTAL ENGINES

bearing is very high, due, first, to the great pressure on the piston face at the instant of explosion, and, second, to the short duration of this maximum pressure; and also that it occurs only for a fraction of a second every two revolutions in a four-cycle gas engine.

The wide variation of some of the points on the curves is due to the fact that engines using different fuels use a corresponding compression pressure, which means a variation in the maximum explosion pressure used in designing the machine parts subjected to the cylinder pressure. For instance, an engine using gasoline or illuminating gas has a compression pressure of from 60 to 80 lb. per sq.in., with a corresponding maximum explosion pressure of from 300 to 350 lb. per sq.in. An engine of the same size using producer gas has a compression pressure of from 120 to 160 lb. per sq.in. and a corresponding maximum pressure in the cylinder of from 350 to 400 lb. per sq.in. Therefore in Table 1 the maximum bearing pressure in pounds per square inch on the projected area of the piston pin K_{pp} has been computed from the average data on the assumption of explo-

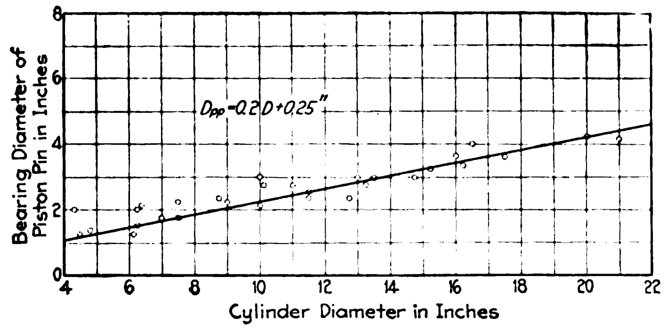


FIG. 4. PIN DIAMETERS FOR VERTICAL ENGINES

sion or maximum pressure in the cylinder of 300, 350 and 400 lb. per sq.in.

The value of K_{pp} is computed for Table 1 from the following equation:

$$K_{pp} = \frac{P_m \times \pi \frac{D^2}{4}}{D_{pp} \times L_{pp}} \qquad (6)$$

where

P_m = Maximum explosion pressure lb. per sq.in.;
D = Cylinder diameter in in.;
D_{pp} = Bearing diameter of piston pin in in.;
L_{pp} = Bearing length of piston pin in in.

The bearing pressures in Table 1 are actually not as high as computed, due to the inertia of the reciprocating parts, which is a maximum at the head end dead center

TABLE 1. PISTON PIN, HORIZONTAL ENGINES

D, in....	4	6	8	10	12	14	16	18	20	assumed
Lpp, in..	3.8	5.7	7.6	9.5	11.4	13.3	15.2	17.1	19.0	eq. (5)
Dpp, in..	11/16	1 1/4	1 5/8	2 1/8	2 3/4	3 1/2	4 1/4	5 1/8	6 1/16	eq. (1)
Lpp, in..	1 7/16	2 1/4	2 13/16	3 1/2	4 3/8	5 3/8	6 7/16	7 11/16	9 1/4	eq. (3)
App, in..	1.76	2.66	4.57	7.43	12.04	18.85	28.7	42.7	61.2	Dpp×Lpp
Pm......	....	....	....	....	300	....	....	....	....	assumed
Kpp.....	2,150	3,010	3,310	3,170	2,815	2,450	2,100	1,790	1,540	eq. (6)
Sb......	7,300	8,315	8,410	7,300	6,060	4,920	4,000	3,320	2,960	eq. (7)
Pm......	....	....	....	....	350	....	....	....	....	assumed
Kpp.....	2,500	3,520	3,850	3,710	3,285	2,860	2,450	2,085	1,800	eq. (6)
Sb......	8,520	9,700	9,800	8,530	7,070	5,750	4,670	3,870	3,450	eq. (7)
Pm......	....	....	....	....	400	....	....	....	....	assumed
Kpp.....	2,865	4,020	4,410	4,230	3,760	3,270	2,810	2,385	2,050	eq. (6)
Sb......	9,750	11,100	11,210	9,750	8,080	6,575	5,330	4,425	3,950	eq. (7)

when the explosion takes place in the cylinder. The inertia of the reciprocating parts, when the engine is running at normal speed, measured in pounds per square inch of piston face is about one-fifth the total explosion pressure at head end center and of course acts in the opposite direction. Therefore all the unit bearing pressures given in Tables 1 and 2 can be reduced a fifth.

In Table 2 the values of the maximum unit bearing pressures for vertical engines of various sizes are com-

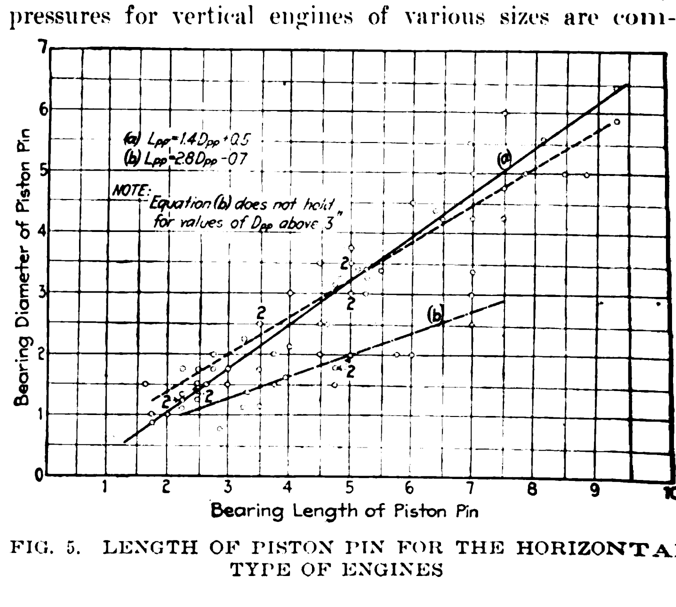


FIG. 5. LENGTH OF PISTON PIN FOR THE HORIZONTAL TYPE OF ENGINES

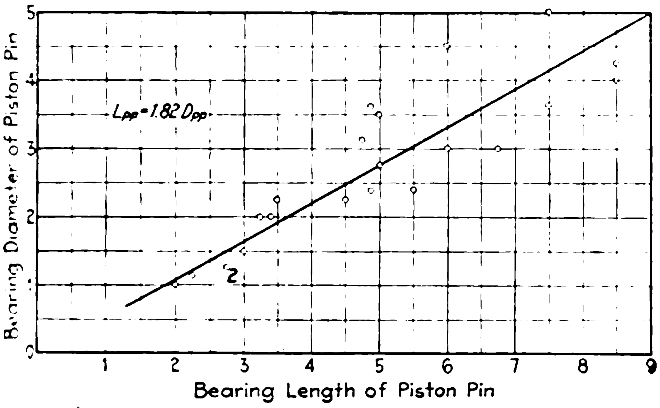


FIG. 6. LENGTH OF PINS FOR VERTICAL ENGINES

puted from the average data. German practice gives a maximum allowable bearing pressure of from 1,700 to 2,000 lb. per sq.in., and computing K_{pp} for a 12-in. and an 8-in. cylinder from the German curves in Figs. 3 and 4 for an explosion pressure of 350 lb. per sq.in., the values are 1,795 and 1,845 lb. per sq.in. respectively.

Fiber Stress in Pin

In considering the maximum unit fiber stress (S_b) in the pin, the piston pin is considered as a uniformly loaded beam fixed in the piston-pin bosses. The values for S_b

TABLE 2. PISTON PIN, VERTICAL ENGINES

D, in	4	6	8	10	12	14	16	18	assumed
Lpp, in.	3.8	5.7	7.6	9.5	11.4	13.3	15.2	17.1	equation (5)
Dpp, in	1 1/16	1 7/16	1 13/16	2 1/4	2 5/8	3 1/16	3 7/16	3 13/16	equation (2)
Lpp, in	1 15/16	2 5/8	3 5/16	4 1/16	4 3/4	5 1/2	6 1/4	6 15/16	equation (4)
App., in..	2.06	3.78	6.00	9.16	12.48	16.86	21.50	26.45	Dpp × Lpp
Pm...	....	....	....	....	300	....	....	....	assumed
Kpp	1,835	3,245	2,510	2,570	2,720	2,740	2,810	2,890	equation (6)
Sb.....	5,180	6,380	7,110	7,120	7,560	7,520	7,890	8,120	equation (7)
Pm...	....	....	....	....	350	....	..	....	assumed
Kpp	2,135	2,620	2,930	3,000	3,170	3,200	3,270	3,370	equation (6)
Sb.....	6,030	7,450	8,300	8,315	8,800	8,780	9,200	9,460	equation (7)
Pm....	....	....	....	....	400	....	....	..	assumed
Kpp	2,445	2,995	3,350	3,430	3,620	3,650	3,740	3,850	equation (6)
Sb	6,900	8,520	9,490	9,500	10,800	10,300	10,520	10,820	equation (7)

for the various cylinder sizes and for explosion pressures of 300, 350 and 400 lb. per sq.in. for both horizontal and vertical engines are given in Tables 1 and 2 respectively. The following sample computation is made for a 35-hp.

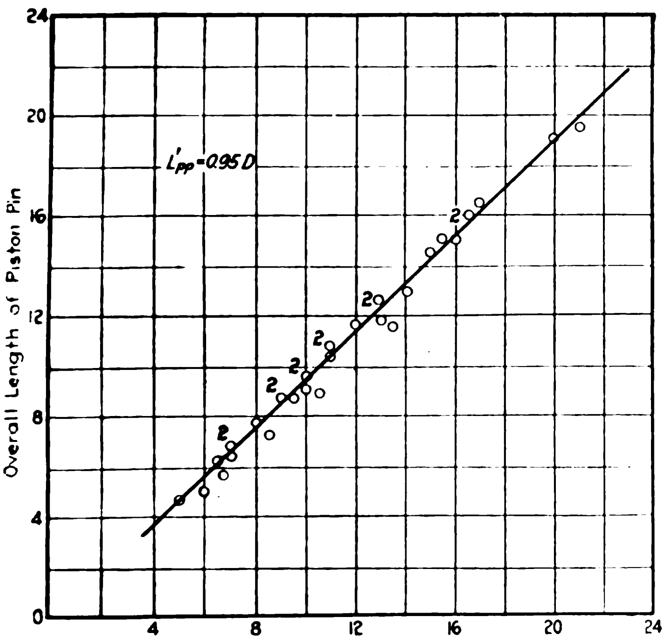


FIG. 7. LENGTH OF PIN FOR HORIZONTAL AND VERTICAL ENGINES

TABLE 3. EQUATIONS FOR PISTONS, PISTON PINS AND RINGS

	Horizontal Engines	Vertical Engines
D = Cylinder diameter		
Lp	1.55 D − 3/8 in.	1.72 D — 2 5/16 in.
Dist. a	0.56 Lp	1/2 Lp + 1 3/4 in.
Tpf	0.075 D—1/8 in. (unwebbed)	0.13 D—1/4 in. (webbed)
Tpb	0.035 D	
Tw	0.027 D + 0.1 in.	
b	1.4 Tpb	
c	0.085 D	
No. of rings	4 to 6	
Dbl = Diameter of ring blank	1.03 D	
Wr	$0.24\sqrt{D - 3\text{ in.}}$	
Dr-r	Wr + 1/4 in.	
Tr max.	0.021 D + 0.1 in. (concentric rings)	
Tr max.	0.026 D + 0.1 in. (eccentric rings)	
Tr min.	0.637 Tr. max.	
Dg	Tr max. + 1/32 in. to 1/16 in.	
Dpp	0.0143 D² + 0.7 in.	0.2 D + 1/4 in.
Lpp	1.4 Dpp + 0.5 in.	1.82 Dpp
L'pp	0.95 D	
Dppb	1.65 Dpp	
Taper of pin	1 inch per foot	

gas engine of a horizontal type with a cylinder diameter of 12 in. From Fig. 8 the maximum moment for a beam with both ends fixed and the load uniformly distributed equals $\frac{1}{12}\,W \times L_{pp}$, where

W = Total load; and

L_{pp} = Bearing length of pin.

Example:

$P_m = 350$ lb. per sq.in. assumed;

$D = 12$ in. cylinder diameter;

$D_{pp} = 2.75$, Equation (1);

$L_{pp} = 4.375$, Equation (3);

$$W = P_m \frac{\pi D^2}{4}$$

$$\therefore \textit{Maximum bending moment} = M_b = \frac{1}{12} \times 350 \times \frac{\pi \times 12^2}{4} \times 4.375$$

$$M_b = 14{,}470 \textit{ in.-lb.}$$

but

$$M_b = \frac{S_b I}{c}$$

where

$$\frac{I}{c} = \frac{\pi D_{pp}^4}{64} \times \frac{2}{D_{pp}} = \frac{\pi D_{pp}^3}{32}$$

$$\therefore S_b = \frac{M_b \times c}{I} = \frac{14{,}470 \times 32}{\pi \times 2.75^3} = 7070 \textit{ lb. per sq.in.} \quad (7)$$

In German practice the piston pin is considered as a uniformly loaded beam supported at the center of each boss. This of course gives a longer beam and a correspondingly higher fiber stress, so that the allowable maximum unit stress given by Haeder and Güldner is from 11,000 to 13,000 lb. per sq.in.

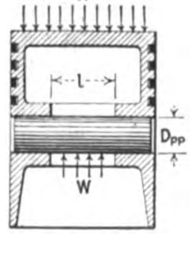


FIG. 8. MOMENTS ON A PISTON

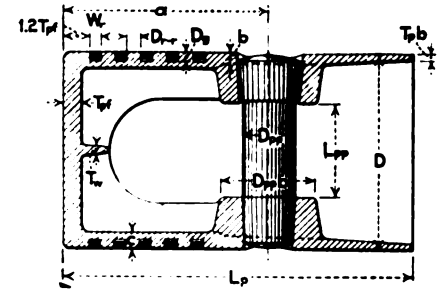


FIG. 9. DIMENSIONS OF PISTON PIN

The diameter of the piston-pin boss expressed in terms of piston-pin diameter is given in the following equation:

$$D_{ppb} = 1.65\, D_{pp} \qquad (8)$$

where

D_{ppb} = Diameter of piston-pin boss;
D_{pp} = Diameter of piston pin.

German average practice from Haeder gives

$$D_{ppb} = 1.79\, D_{pp} \qquad (9)$$

Table 3 gives the empirical equations for determining the dimensions of pistons, piston pins and piston rings for horizontal and vertical engines using gasoline, illuminating gas, natural gas and producer gas as fuel. The dimensions corresponding to equations in Table 3 are given in Fig. 9.

Care of Pneumatic Tools*

By August Meitz†

In handling pneumatic tools several points are to be taken into consideration. First of all, it is a good policy to adopt a standard of such tools on any one railroad system. This plan would reduce the cost of repairs and maintenance about 50 per cent. as well as reduce the expense for repair parts to be carried in stock in order to expedite repairs and to prevent holding tools out.

In selecting pneumatic tools for service a great many mistakes are made by the workmen as regards to speed and power. For instance, an air motor of high speed will be used by a boiler maker to drill out stay-bolts; and as soon as he has completed this drilling, he will use the same motor for running in a stay-bolt tap, say $1\frac{1}{16}$ in., thereby using the same speed as he had just used on a $\frac{3}{16}$-in. high-speed drill. In such cases damage is done to the motor as well as to the tap—the motor is overloaded and the tap is overspeeded, with the result that the motor will break in some place and the tap is spoiled. The same result is had by drilling and reaming at too high speed on the motor—the reamer is spoiled. Taking the standard rule, "What is gained in speed is lost in power," we come to the conclusion that it is unwise to have all high-speed motors in any one shop, as the little time gained by drilling is a double loss on spoiled drills and taps which, if handled in a more reasonable manner, would pay for the lost time.

All motors should be kept clean and well oiled at all times. Good engine oil should be used, and it will also be found to pay to use some light grease to fill the case or crank chambers.

Air hammers should always be well oiled before using. A light mineral oil, we have found, gives best results. Any oil which will gum or thicken in cold weather should be avoided. After a hammer has been in service and returns to the toolroom, it should be placed in a solution of gasoline and signal oil, equal parts, as small particles of rubber from the hose lining frequently lodge in the chamber between the handle and the throttle-valve sleeve. The gasoline mixture will cut this rubber, and by blowing out the hammer with compressed air, all refuse and foreign substances are removed. After the hammer has lain in the oil about five minutes, it should be taken out and hung up to drip. Before the hammer is used again, all parts should be properly oiled.

Others find that if air hammers are kept in a coal-oil bath when not in use, there is very little repair work to be done on these tools until some part becomes worn so that it must be replaced by a new one.

The throttle handle of the motor is filled with coal or signal oil every evening, which prevents throttle valves from sticking and also keeps the valves of the machine clean; both give more or less trouble when neglected.

*From American Railway Tool Foremen's Association Proceedings.

†Tool foreman, Missouri, Kansas & Texas Ry., Parsons, Kan.

Making Steel Filing Cabinets with Oxyacetylene Torch

Editorial Correspondence

The oxyacetylene welding torch is now entering quite extensively into the manufacturing of steel furniture. In this article methods used by the Shaw-Walker Co., Muskegon, Mich., when making steel filing cabinets will be illustrated.

FIG. 1. WELDED FILING CABINET

One of the finished vertical filing cabinets is shown in Fig. 1. It is composed of four drawer sections each of which measures $10\frac{1}{2}$ in. high by 12 in. wide by $25\frac{1}{2}$ in. deep. The dimensions of the cabinet as assembled are $13\frac{7}{8}$ in. wide by 27 in. deep and 52 in. high. The

drawers and casing are made from No. 18 gage steel. In making this cabinet eight corner welds are made, and the time occupied is approximately 30 min.

Using a No. 2 tip, the amount of gases consumed is 2¾ cu.ft. of oxygen and 2½ cu.ft. of acetylene. It has been found advisable, to facilitate the welding, to electric spot weld many of the elements. In Fig. 2 is shown an electric machine spot welding one of the cabinet elements prior to flame welding.

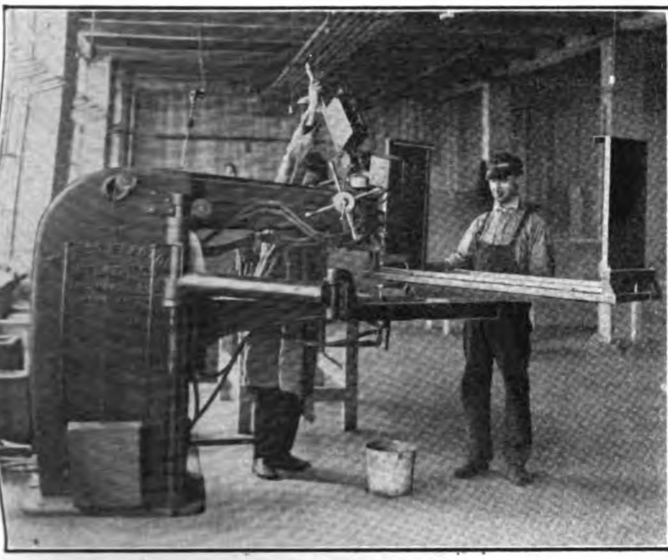


FIG. 2. SPOT WELDING THE SECTIONS

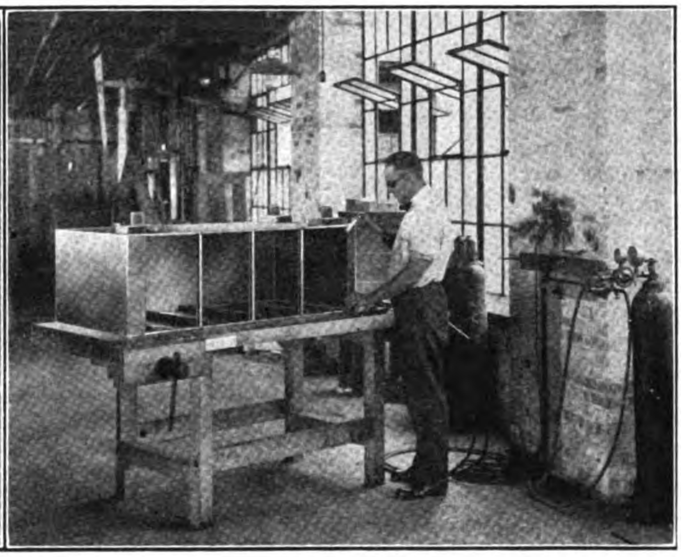


FIG. 3. FLAME WELDING A CASING

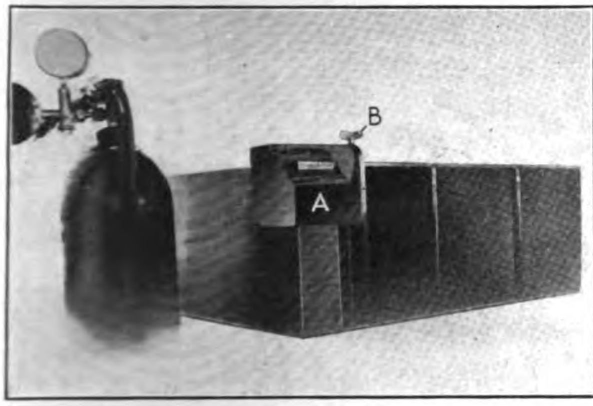


FIG. 4 FIXTURE FOR WELDING CORNERS

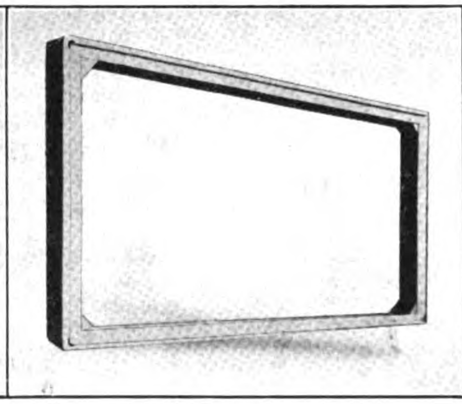


FIG. 5. A WELDED CABINET BASE

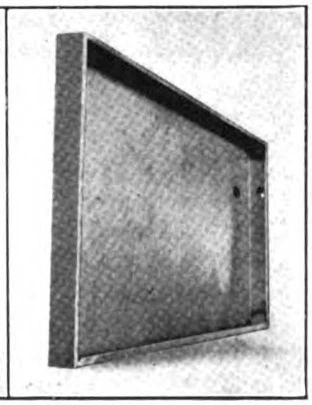


FIG 6. A WELDED CABINET TOP

Welding Corners of a Cabinet Casing

The operation of flame welding the corners of a cabinet casing is shown in Fig. 3. After the elements have been spot welded, the corners are flame welded. The advantage of the previous spot welding is that the elements are held securely, and the joint may be finish welded quicker and with a smoother appearance.

Sometimes it is found an advantage to hold the plates when making the corner welds. For this purpose a fixture, shown in Fig. 4, was devised. The cast-iron block *A* is fastened on the corner of the cabinet with the clamp *B*. The block is made with a slot, as shown, so that the flame may be fed as near to the metal as desired and a neat weld made. This cabinet section is made from No. 20 gage steel and is 12 in. wide by 10½ in. deep by 25 in. long. When welding the four corners the time required is 1 min.; and using a No. 1 tip, 0.058 cu.ft. of oxygen and 0.054 cu.ft. of acetylene gas are consumed.

In Fig. 5 is shown a base used on a horizontal section which has been welded. This part is made from No. 16 gage steel, and miter welds are made at each corner. The time occupied is 20 min., and the amount of gases consumed is 1.81 cu.ft. of oxygen and 1.76 cu.ft. of acetylene.

One of the tops used on the horizontal sections is shown in Fig. 6. It is made from No. 20 gage steel, and the four corners are welded, taking approximately 2 min. For this work a No. 1 tip is used, and the gases consumed are 0.116 cu.ft. of oxygen and 0.108 cu.ft. of acetylene. The apparatus was made by the Davis-Bournonville Co.

A Brazilian Railroad Shop

Special Correspondence

Railroad men in this country will be interested in the illustrations from the shops of the Central Railroad of Brazil, at Eughenio De Dentro. It is indeed difficult to realize that the building in Fig. 1 is the entrance to a railway repair shop, but such is the case. Only the truck wheels in front link it up in any way with railway-shop work.

Inside, however, it has a very shoppy appearance. Fig. 2 shows a section of the foundry, and Figs. 3 and 4 are two views in the erecting shop. This, as will be seen, is well equipped with traveling cranes made by the Niles Co. These views give a good idea of the size of

A BRAZILIAN RAILWAY SHOP EQUIPPED WITH MODERN MACHINE TOOLS OF AMERICAN MANUFACTURE

Fig. 1—The front of the building. Fig. 2—In the foundry. Fig. 3—Transferring a locomotive by overhead crane. Fig. 4—Another view in the erecting shop. Fig. 5—The machine shop used for small work. Fig. 6—In the wheel shop

the locomotive used, as well as of some of the shop appliances.

In Fig. 3 will be seen the substantial laying-out tables in the foreground. They are mounted on brick piers. The sanitary drinking fountain is also very much in evidence, beneath the cab of the suspended locomotive. Fig. 4 shows a type of small, square work-bench that seems to be distributed between the erecting tracks for the benefit of the workmen. Both these views give a good idea of the type of shop construction used in Brazil, the side windows and skylight apparently affording an adundance of light and air.

A view in the machine shop is shown in Fig. 5, this shop being supplied with a traveling crane on the track in the aisle at the left. The manner of suspending the line shaft down the aisles and the method of belting from it to the various countershafts are shown. Fig. 6 gives a view of the wheel shop, which is supplied with a 10-ton Whiting crane.

It is interesting to note that nearly all the machinery in these shops comes from the United States, a large percentage of it being supplied by the Niles-Bement-Pond Co. Those who are interested in extending their trade in this direction can secure a good deal of the kind of machines needed and to some extent, of the conditions to be found in the average shop in this part of the world. As will be seen, most of it is general rather than special machinery. These photographs are from our own correspondent, Duncan C. Hood.

Letters from Practical Men

High-Speed Steel Taps for Iron Fittings

The use of high-speed steel taps in the manufacture of gray and malleable-iron fittings has enabled manufacturers to reduce their machining cost considerably.

In a series of tests at a large fitting plant it was found that high-speed steel tap blades should be hardened and drawn in a different manner from most high-speed

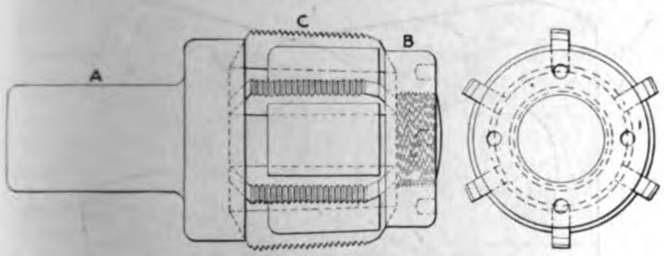


FIG. 1. SOLID ADJUSTABLE INSERTED-BLADE TAP

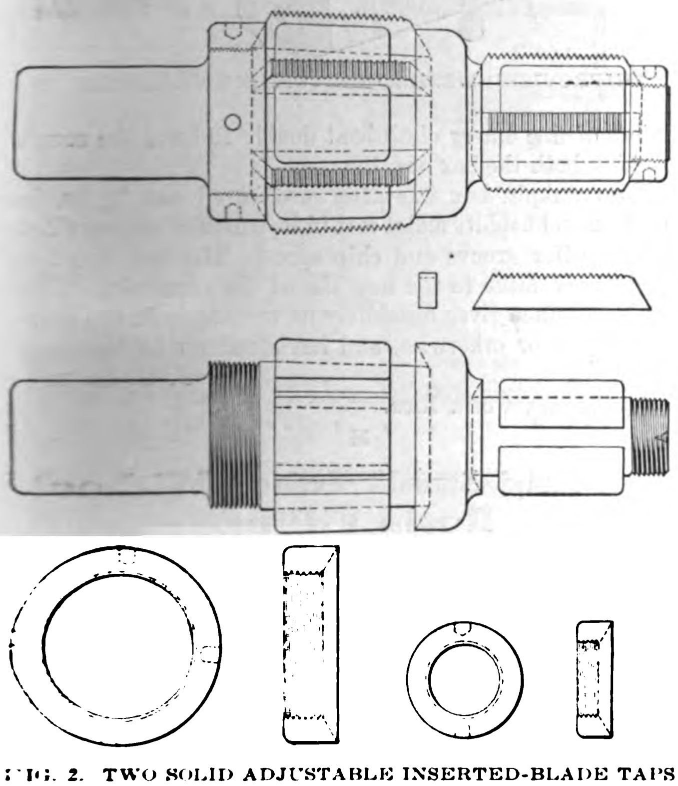


FIG. 2. TWO SOLID ADJUSTABLE INSERTED-BLADE TAPS

cutting tools. Several brands of steel were used in these tests, some showing greater life than others, and all of them, when properly treated, tapping from 28 to 40 per cent. more holes at one sharpening than did carbon-steel taps of the same construction. This work consisted of tapping rough-cored holes only in gray and malleable castings at surface speeds ranging from 50 to 55 ft. per min. The best results were obtained with a high-speed steel hardened in a good grade of lard oil at approximately 1,900 deg. F. and the temper drawn to as high as 750 deg. F. On some of the smaller sizes in which the blades had to be made quite small, measuring approximately $\frac{7}{32}$x½ in. in cross-section, the best results were obtained by drawing the temper to a heat that would quite thoroughly anneal a carbon blade.

Thin blades have to be drawn to a very dark-red heat before the crumbling up of the threads can be eliminated. Another curious thing that was discovered on automatic tapping machines before they were speeded up for high-speed steel was that the new high-speed taps in some cases did not show any more production per sharpening than did the old carbon taps. It was only after having speeded up the machines to nearly twice the old speeds that the high-speed taps showed their superiority by tapping from 28 to 40 per cent. more holes per sharpening.

The cutting lubricant used in this plant is composed of three parts soft soap and one part lard oil boiled

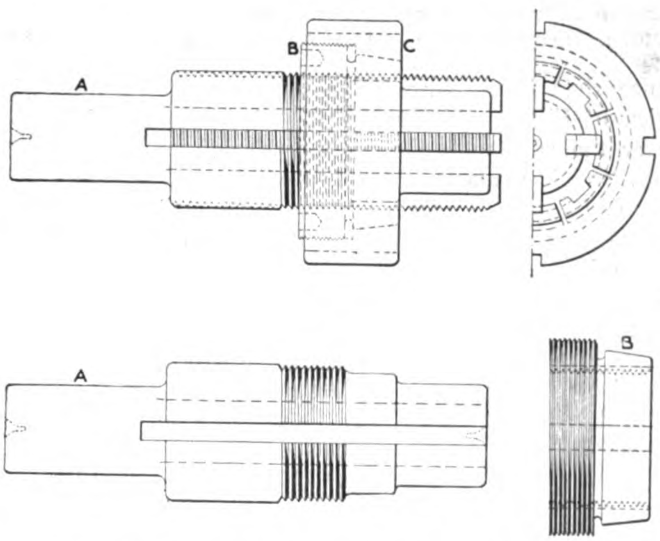


FIG. 3. INSERTED-BLADE HIGH-SPEED TAP

in water for ½ hr. and distributed throughout the plant by a centrally located pumping system. It is used freely on all metal cutting.

In Fig. 1 is shown a high-speed, solid, adjustable inserted-blade tap designed to be made in sizes from 1 in. up. It is not very expensive, is very rigid and accurate and can be adjusted easily by placing thin strips of metal under the blades. The beveled-face nut *B* forces the blades down upon their seats with equal pressure. This nut is made of hardened steel and the body *A* of a low-grade tool steel left soft, so that a slight cut can be taken in a lathe across the beveled shoulder *C* should it require truing up. This is an extremely rigid adjustable blade tap and gives good service. Fig. 2 shows the same construction of tap made in two sizes, designed for tapping electric-light pole couplings at one operation. These couplings are tapped for 2½-in. pipe at one end and 4-in. pipe at the other, from the rough casting. When tapped formerly in two operations at two different settings, it was difficult to tap the holes in line with each

other. The large tap was made tapering, but the small one, being run in from the back end of the hole, had to be made straight. The small hole, which is tapped straight, makes no difference in the joint in this case. This double tap lowered the machining cost 75 per cent. on these couplings and eliminated an expensive straightening operation on the poles that was necessary when the couplings were tapped from each end at two different settings of the work.

In Fig. 3 is shown an inserted-blade, high-speed tap designed for tapping standard pipe fittings in large quantities on special semiautomatic tapping machines. Its great advantage is the long life of the tap body, since it can be sharpened by grinding off the ends until fully half their length has been ground away. *A* is the body, which for hard usage should be made of low-grade hardened tool steel. It has radial cutter slots milled across the body and is threaded to the same diameter as the tap cutters, to fit the collet *B*. The collet *B* has clear-

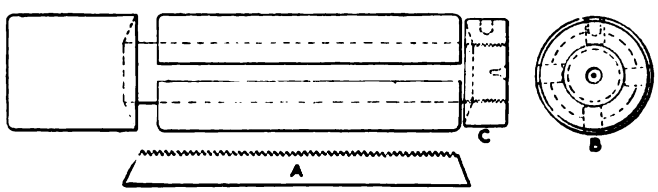


FIG. 4. MASTER HOLDER FOR THREADING TAP CUTTERS

ance slots in its threaded hole, as shown in the end view of Fig. 3, which allows it to be slipped on the tap over the cutters to the position shown. The collet *B* is then given about one-eighth of a turn, as shown in the end view at Fig. 3, and held in place with a spanner wrench while the threaded collet ring *C* is tightened upon it, thereby securely locking the jaws of collet *B* against the cutters. This collet and collet ring are made of hardened tool steel.

In Fig. 4 is shown a master holder used for threading the long tap cutters shown at *A*. The cutter slots are milled at a slight angle with the center line as shown at *B*, so that when these cutters are mounted in the radial slots of the working holder *A*, Fig. 3, the tap will have eccentric relief on its threads. The beveled-face nut *C* secures the long cutters in the slots for threading them. It is apparent that if this nut were made very tight, the cutters, owing to their great length, would spring up slightly in the center. These cutters, if properly fitted to the slots, are held securely by a very slight tightening of the nut. A. J. CHAMBERLAIN.

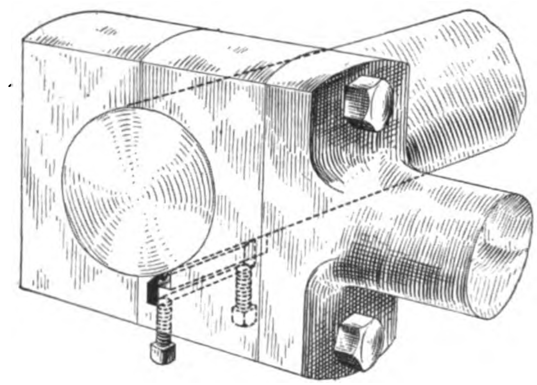
South Bend, Ind.

Improvised Method of Turning a Scored Crankpin

A few months ago the 65-hp. heavy-duty gas engine in the tug "Miraballes" belonging to a steamship company developed a badly scored crankpin. We found that it would mean taking the whole engine down to get the crankshaft out, and that our lathe was too small to take it.

As a hurry-up job was required, I decided to make a box tool out of the crankpin bearing box. As shown in the illustration I chipped a groove $\frac{1}{4}$ in. wide and $\frac{7}{8}$ in. deep in the upper half of the box. In this groove I inserted a cutter the length of the bearing and a snug fit in the groove. This cutter was made out of a file, the cutting edge being finished on an oil stone and raked about 20 deg. I took great care to get the cutting edge perfectly straight. Four holes were then drilled and tapped back of the cutter, and $\frac{3}{16}$-in. setscrews inserted in them, to feed the cutter toward the center of the box. A space $\frac{3}{8}$x$\frac{3}{8}$ in. was also chipped above the cutting edge to make room for chips.

The box was assembled on the crankpin, the setscrews set up evenly to take a very light scrape (rather than cut) and the engine barred over by hand two turns. The box was then taken apart, chips cleaned out and the operation repeated. This was done several times until the pin was smooth. The last chip taken out was in one piece and resembled a roll of tissue paper. The surface of the crankpin was then further smoothed up by removing the cutter from the box and assembling the box with



IMPROVISED METHOD OF TURNING CRANKPIN

a piece of fine emery cloth bent double to have the rough touching both the box and the pin.

The crankpin box was afterward bored out $\frac{1}{4}$ in. in the lathe and babbitt metal cast in it, which of course filled up the cutter groove and chip space. The box was finished in the lathe to the new size of the crankpin. This repair has since given absolutely no trouble from the bearing heating or otherwise, and has stood up to the work very well. J. G. SAXE.

Puntarenas, Costa Rica.

Bending Small Tubes Without Rosin Filling

Steel, brass and copper tubes from $\frac{3}{4}$ to $\frac{1}{2}$ in. in diameter, if bent without filling, do not hold their cylindrical form but flatten; and the thinner the wall of the tubes the more this flattening occurs. To overcome this change in shape, it is common to fill these tubes with melted rosin, which prevents collapse or distortion of the tube; but the rosin has to be melted out after the tube is bent. It is difficult to get it all out, and the job is a messy and expensive one.

A better way is to use a closely wound spiral spring, rolled up from a small-diameter wire. This spring must enter just nicely into the tube, but the whole trick after bending the tube is to withdraw the spiral spring. It can be done as follows:

A plug of three or four diameters in length must be fitted inside the spring, which should extend outside the bent tube about an inch or a little more. The spring with the plug in it should then be clamped in a lathe chuck. Revolving the lathe in a direction which will

wind up the spring, at the same time pulling on the tube, withdraws the spring easily, and a good job is readily made of the bending.

Some experiments have to be made to get the size of wire and its temper just right. Should the spring be too highly tempered, it is apt to break; if a too large diameter of wire is used, it will be difficult to withdraw, while if it is left too soft, it will stretch in pulling out and have a permanent set. Generally speaking, a small diameter of wire is preferable; and it is always well, in fact necessary, to lubricate the spring. Albany grease or vaseline will be found preferable to oil.

New London, Conn. A. R. NEMOUR.

Reaming Fixtures for Pistons

In Fig. 2 is shown a fixture used by the International Motor Co., Saurer Plant, Plainfield, N. J., for line-reaming pistons. The piston is placed on the inside of the fixture, which is bored to receive it. The reaming bar

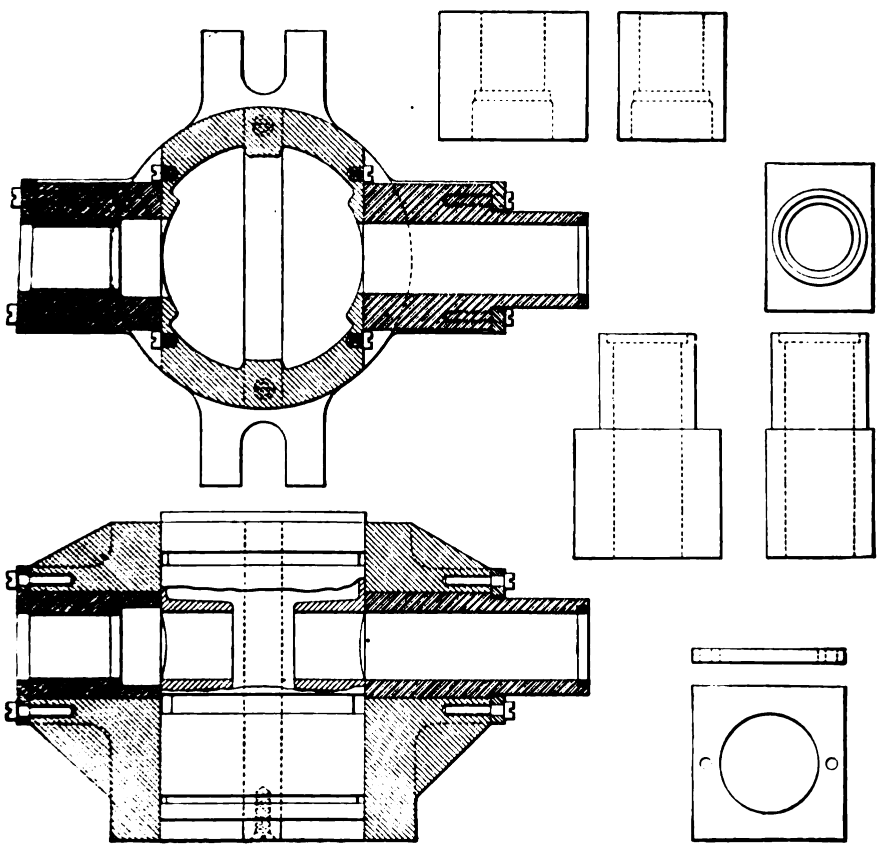


FIG. 1. DETAILS OF LINE-REAMING FIXTURE

is then placed in position, being guided in bushings on each side of the fixture. It will be observed that the bar is provided with oil grooves to prevent any seizing when

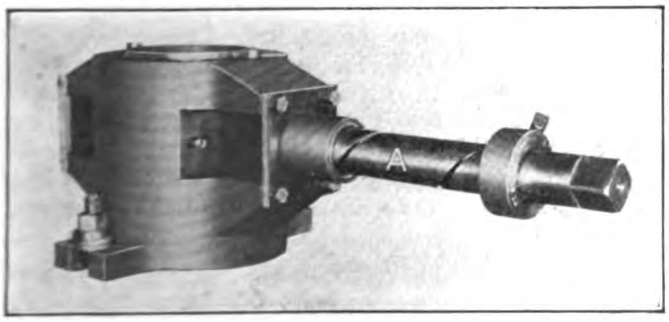


FIG. 2. LINE-REAMING FIXTURE

the hole is being reamed. Turning motion is obtained on the bar by means of a wrench on the squared end. The fixture is fastened on a table as shown to hold it during the operation.

Details of the fixture are shown in Fig. 1. It will be noticed that the bushings are carried in supports. These are made loose and attached to the fixture. By this method different sizes of bushing may be used.

New York, N. Y. A. TOWLER.

Use of Micrometer Collar on the Crossfeed Screw

Considerable attention has been given the lathe—its construction and the work that can be done with it—but it seems as though one little part has been forgotten and is not clearly understood by lathe hands, that is, the micrometer collar on the cross and compound-rest screw. To most operators this collar is there and marked just to remember easily where to start when cutting a thread. For an example to illustrate the use of the collar, take a $\frac{1}{5}$-pitch crossfeed screw with a micrometer collar of 100 lines to the circumference. Divide the pitch by the number of lines on the collar. The quotient is the value of each line; $\frac{1}{5}$ pitch $= 0.200$, $\frac{0.200}{100} = 0.002$, which equals 0.004 on the diameter. Now let us put a $\frac{1}{4}$-in. ball groove $3\frac{1}{4}$ in. in diameter in a 3-in. bore; $3\frac{1}{4} - 3 = \frac{1}{4} = 0.250$. Dividing this difference by 0.004, or simply 4, gives the number of lines to feed in with the grooving tool; $\frac{0.250}{4} = 62\frac{1}{2}$ lines. Now touching the 3-in. diameter lightly with the tool, feed in $61\frac{1}{2}$ lines, and no inside caliper will be needed. To most lathe hands the job of cutting a thread in the lathe is a hard one. We find them taking the piece in and out of the lathe, trying to fit a standard nut sometimes at half the depth of the thread. Let us take for an example a $\frac{3}{4}$-in. U.S.S. nut to be fitted to a shaft. The shaft is turned 0.010 small; $\frac{3}{4}$ U.S.S. = 10 threads. Ten threads constant equal 0.12990; $0.12990 - 0.010 = 0.11990$, and $0.11990 \div 4 = \frac{0.11990}{4} = 29\frac{9}{10}$ lines. We then proceed to cut the thread in the same way as described. HARRY F. KIENKER.

Cincinnati, Ohio.

Jig and Fixture Standards

The standardization of jig and fixture design has been given more attention during the past few months than ever before and it is hoped that the question will be agitated further.

It is with this idea that this set of standards has been tabulated and shown in this article.

There are many styles of vises that can be purchased that will hold parts for milling operations by designing special jaws or by taking cuts on regular jaws. The bases for drill jigs are tabulated and illustrated in Fig. 1. These bases are castings. The figure *C* is ample to cover almost all cases and yet leave space for a tool-steel locating plate and for suitable clamping devices.

The standard leaf for each jig is shown in Fig. 2. This part is made of tool steel spring tempered and machine steel carbonized, reheated and hardened and then ground on top and bottom and both sides. The tempered half is used where clamping only is done by the leaf; but

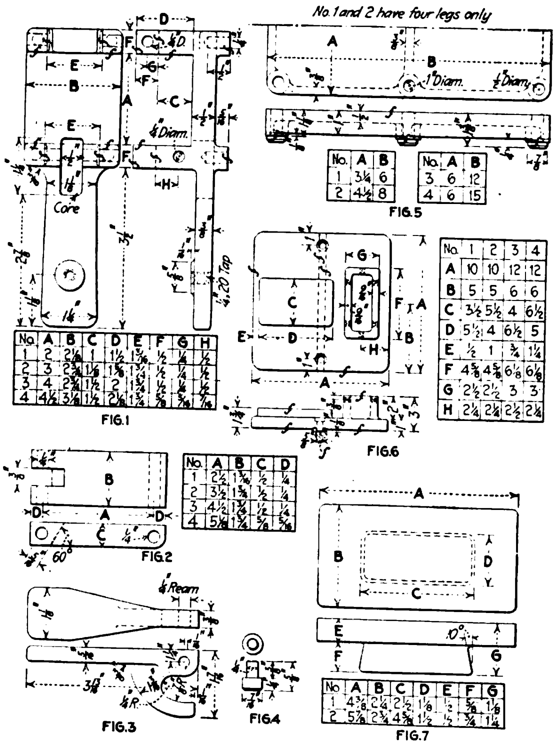


FIG. 1

No.	A	B	C	D	E	F	G	H
1	2	2 1/16	1	1 1/2	1 3/16	1/2	1/4	1/2
2	3	2 3/4	1 1/8	1 5/8	1 1/4	1/2	1/4	1/2
3	4	2 3/4	1 1/2	2	1 3/4	1/2	1/4	1/2
4	4 1/2	3 1/16	1 1/2	2 1/16	1 3/4	5/8	5/16	7/16

FIG. 2

No.	A	B	C	D
1	2 1/2	1 3/16	1/2	1/4
2	3 1/2	1 3/8	1/2	1/4
3	4 1/2	1 3/4	1/2	1/4
4	5 1/8	1 3/4	5/8	5/16

FIG. 5

No.	A	B
1	3 1/4	6
2	4 1/2	8
3	6	12
4	6	15

FIG. 6

No.	1	2	3	4
A	10	10	12	12
B	5	5	6	6
C	3 1/2	5 1/2	4	6 1/2
D	5 1/2	4	6 1/2	5
E	1/2	1	3/4	1 1/4
F	4 5/8	4 5/8	6 1/8	6 1/8
G	2 1/2	2 1/2	3	3
H	2 1/4	2 1/4	2 1/2	2 1/4

FIG. 7

No.	A	B	C	D	E	F	G
1	4 3/8	2 1/4	2 1/2	1 1/8	1/2	5/8	1 1/8
2	5 7/8	2 3/4	4 5/8	1 1/2	1/2	3/4	1 1/4

JIG AND FIXTURE STANDARDS

where the leaf is used to guide the drill or reamer, the machine-steel leaf is employed. The clamping handle, a tool-steel drop forging hardened, is shown in Fig. 3, while Fig. 4 shows standard tool-steel legs hardened, the ends of which bear on the drill table. They are ground after being forced in place true with the finished surface of the jig, upon which the locating block is placed.

A flat-plate jig is shown in Fig. 5, which is suitable for irregular-shaped pieces or parts too large to go in any of the other standard jigs. These jigs are ground on the top, turned over and ground on the big bosses and the holes for the legs drilled and reamed. The legs are forced in and ground on the ends, the same as the other jigs. These bosses are left in stock in this shape and when it is desired to make a jig from this base, any slots or holes may be machined to suit the conditions of the work. Where possible, standard leaf and handle parts are used from the other jig and flat handles are applied in convenient places to facilitate handling.

Profiling bases are shown in Fig. 6. These bases are cast iron. The work is clamped or held in special vises to the large finished pad indicated by dimensions *C* and *D*, while the adapter of Fig. 7 is fitted on the other pad with the cored portion. Six square-head machine screws are used to adjust the adapter, upon which is screwed and doweled the former plate in correct relationship with the piece to be profiled.

This same base may be used for several different jobs, and a new base may be used for each operation, depending on the time taken to produce the cuts.

Providence, R. I. M. S. WRIGHT.

Efficiency in Checking Tools Out of the Crib

In many shops in which I have worked, the tools were checked from the tool crib through a window. Generally this window is just about wide enough for one man to move his arms comfortably around while getting his checks out, looking at the tools offered, etc. It is close quarters for two and a tight squeeze for three to obtain a hearing.

The result is that while the one or two able to be at the window are explaining what they want, examining what they get, demanding something else, changing their minds, or discussing last night's experiences, quite a few are waiting back of them for a chance to get near enough to the window to do business. This operation is repeated over and over again every day.

Obviously there is time lost to the firm as well as a real annoyance to those who are truly interested in their work. The best remedy that I have ever seen is to substitute a counter for the window and have it long enough to accommodate at least six men. Then the crib attendant can go from one to another while each man is making up his mind or examining the tools. I do not claim originality for this plan, but I do fully appreciate its value under practical conditions.

Another idea to which I have given considerable thought and which is original so far as I know, is to issue tool checks of varying value, especially to the tool makers. In one of the finest shops I ever worked in, each tool maker received 25 checks. In the tool crib were kept all needed supplies, even to bolts, straps, counterweights, etc. A man with his 25 checks could at once secure all the tools required, even down to bolts in any length desired, varying by ½ in.

Of course this system makes it possible for each man to have out 25 tools of more or less value. Most shops could not and would not stand this expense. Therefore the usual allotment of checks is from 6 to 15. Such a regulation does not permit a man to have out many tools at a time. Even if auxiliary tools such as bolts, straps, etc., and parts as necessary as the height gage or indicator in boring a jig, for instance, were kept in the crib, he would have difficulty in securing them, because he would not have checks enough to go around under the arrangement mentioned.

To overcome this difficulty I would suggest issuing to each tool maker say 6 checks of a fixed shape—each one good for any tool in the crib. I would also issue perhaps 15 checks of a different shape and of a limited value—good only for such auxiliary equipment as I have mentioned. CHARLES F. ROGERS.

Springfield, Mass.

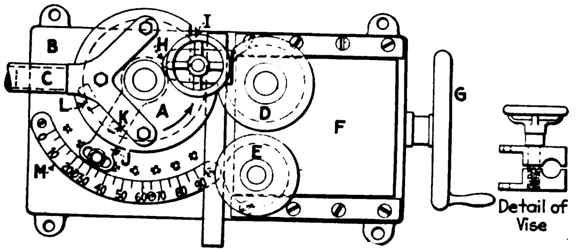
Discussion of Previous Question

Fixture for Bending Tubes

The tube-bending device described by F. C. Mason on page 1040, Vol. 43, reminds me of one which I designed recently. As it proved successful, a description of it may be of interest.

Referring to the illustration, *A* is the main forming roll. It is mounted on the base *B* and operated by means of the handle *C*. At *D* is shown a supporting roll the principal function of which is to prevent the tube from flattening, while *E* is the guide roll. Both are mounted on the slide *F*, which is attached to the base and operated by the handwheel *G*. The slide is for the purpose of adjusting the rolls and also to facilitate the removal of the work; but in most cases it was not found necessary to use it for the latter purpose.

The rolls *A* and *D* are cut away to make room for the vise *H*, which is mounted on *A* and operated by the small handwheel *I*. The jaws of the vise are bored to



FIXTURE FOR BENDING TUBES

the size of the tubing to be bent and are so located that they are a continuation of the groove in the forming roll and tangent to it. When the handwheel is released, the jaws are opened by means of springs (not shown).

The swinging arm *J*, which is pivoted on the boss supporting the roll *A*, is provided with a stop *K* that engages with a stop *L* on the roll. By means of this arm and the protractor *M* the machine can be set accurately to any desired angle within its range.

This fixture was used for bending 1¼-in. No. 14 gage seamless steel tubing with a radius of 4½ in. The bends ranged from a few degrees to 90 degrees.

Lansing, Mich. F. R. CONNER.

Suggestions from Employees

The editorial on this subject, on page 1001, Vol. 43, points out many of the defects of the suggestion-box scheme, tells why it works for a time and then just naturally peters out. I believe the editorial shows the case exactly as it is, but I still believe the scheme a good one and that it can be made to work if there is an attempt to follow out some of the first principles of fairness, as suggested.

The paying of a fixed and usually inadequate premium will attract for a time only, until the accumulation of ideas is exhausted. No firm pays a fixed price for patents it buys, from an outsider at least, but pays in accordance with their value to the firm. Some may be dear at $100 and others cheap at $100,000. In the same way, ideas from employees should be paid for according to their value to the company. And while the exact value may be hard to determine, a fair approximation can be had with a little care and a little more tendency to take men into the confidence of the firm and a little less of the old, autocratic, "this is solely my business" attitude.

If a suggestion saves a half-hour a week, no man would expect a very heavy reward, even though this counts up to about a month in five years. But if the suggestion cuts the labor in half on a piece that is made day after day, it is very evident that a $5 or a $10 reward is wholly inadequate. A small sum at adoption and a monthly bonus of a portion of the savings as these savings accumulate ought not to be difficult and would make a reward that would be well worth while.

As a matter of strict justice this monthly bonus should continue as long as the idea saves money for the firm, whether the man continues in its employ or not, especially as a pension to his widow or heirs. But aside from this, even the continuance of the bonus during employment would make for longer terms of service and help to promote good feeling.

I believe the suggestion box can be worked to mutual advantage, but it will not run itself. It requires a careful consideration of the rights of the suggester as well as those of the firm. The men themselves can be depended on to play fair if they are met with a similar attitude.

FRANK C. HUDSON.

New York, N. Y.

Ribbed Glass for Shop Windows

The statement on page 1086, Vol 43, by Professor Sweet, in favor of ribbed-glass windows for shops is not convincing, as it merely shows that the glass area in that particular shop was sufficient for pattern work, the windows being high enough to admit light into the interior of the room. But pattern work does not require as much light as machine work; hence a satisfactorily lighted pattern shop might make a very inadequately lighted toolroom, especially where die work has to be done.

Furthermore, Professor Sweet's contention carries less weight, because plain-glass windows had not been tried in that particular shop. Let him remove the ribbed glass from one window and note the improved illumination of the area served.

I have worked in three shops that had ribbed-glass windows and know from actual experience, and have the testimony of others, that the light in those shops was very unsatisfactory as regards volume and quality. Within the past year I have seen the ribbed wire glass of the lower sashes of the windows in one shop removed,

at great expense, and replaced with transparent wired glass. The shop is high above surrounding buildings, and the window area is immense, yet the light was unsatisfactory in the interior and at the benches close to the windows.

One of the head men in the concern told me he used to think the complaints of the men regarding light were uncalled for, that they were "kicking" on general principles. One day he tried to do a fine piece of work and found he could not see to do it until the ribbed glass was removed. This experience convinced him that the complaints against the glass had a good foundation. After the change had been made to plain glass for the lower sashes in this shop, many men noted with astonishment the great improvement in the volume and quality of the light.

I grant that there is greater uniformity in the illumination of different areas in shops that have ribbed-glass windows. There is no more light in any particular area than there would be with plain glass, but the benches near the windows have been robbed of the light which has been projected into the interior. The total volume of light in the shop is much less than with plain glass, especially when the ribbed glass gets a little dirty. The amount of light "stopped off" by the ribbed glass can be judged by taking a small pane of it to various parts of the shop and noting the shadow cast by it. The uniformity of the illumination deceives some people into believing that the light is good. The eye gets used to the gloom, the iris expands, and it is only when doing fine work that the brain becomes conscious that the eye is struggling in semidarkness.

Some men working behind ribbed glass object to the windows being cleaned. They say the light, especially when the sun shines square against the glass, hurts the eyes. We even find the windows painted white and tracing paper stuck on it to cut off the glare. Surely when men perform such stunts as these, which cut off still more light, the objection they have to ribbed glass is not all imaginative.

There is in Brooklyn a series of buildings devoted to various industries, some requiring much light and others very little. It is very noticeable that the old buildings have ribbed and the new ones plain glass. It looks very much as though the ribbed glass had been tried and found so unsatisfactory that it was finally decided to abandon it.

F. J. BADGE.

Brooklyn, N. Y.

Machinist Instruction in the Public-School System

Some valuable suggestions have been brought out under the above heading. I have had some of my seemingly difficult problems solved. I should like to reënter the discussion at this time to comment on what has been written and to seek further light on the subject.

It seems to me that Mr. Turbon hits the nail squarely on the head in his criticism of Mr. Kreider's methods of instruction. To my mind there is absolutely no room in the vocational-school course in this stage of development for scrap-heap exercises. The vocational movement is growing. More schools will be started, and they will need equipment, part of which might just as well be designed and built in the schools now in operation.

Some will protest that such work is beyond the boys' ability, but I believe, if the scheme suggested by Mr. Turbon on page 958 is followed, almost any of the ordinary machine tools within the capacity of the school's equipment can be built. We have carried out this idea for the past two years with good results. Very often it is necessary for the instructor to make the final adjustments for the finishing cut on an important part, if the machine is to be carried on to completion. This fact should not eliminate the machine as a school product, but should be a legitimate part of the instructor's work.

The time element in school work is one point on which I wish additional light. There are some here who think that time should not enter into the school work at all, believing that if a certain time is set on a job the boy is very apt to spoil his work in an effort to approach the estimated time; they also believe that it is better to turn out a first-class job in six weeks than to scrap it in ten minutes. I am not sure whether or not they considered future attempts.

Personally I believe that quality should be the foremost consideration, but the time element should always be present. The more a boy does, under adequate instruction, during the course the more efficient he will be when he graduates.

I shall be glad to see this time element discussed.

Buffalo, N. Y. GEORGE HEALD.

What's the Matter with Our Methods of Threading?

There may be something wrong, but I am certain it is not wholly in the threading. I feel that our chief trouble lies in the gaging. We can go on producing as perfect a thread as is possible; but if we have to depend upon such gages as are being turned out at present by gage makers, we never will find a remedy.

The editorial in question happens along at an opportune time. The words "accuracy" and "precision" have been supplemented by "good enough" and "let is go at that." The Whitworth thread gages for the nose of 18-lb. high-explosive shells are a standing joke in our community. No two correspond. I considered it a joke due to ignorance when a tool maker (?) told the inspector he would make his gage small enough to fit the test gage; after swelling his chest and shining his "mikes," he elaborately ground off the top of the threads. But when I received a certified gage from a maker claiming to make accurate gages and found the top ground off to make the outside diameter right, my feelings were not fit to print.

It is admitted that a Whitworth thread gage is one requiring skill in its manufacture, but that does not excuse manufacturers for trying to palm off poor work on the anxious purchaser who pays the present high price for what is received. The way to be safe is to order a dozen thread gages and pick out an accurate one if you can find it, returning the others.

Some thread gages received from tool firms lately have threads so rough that a common wrought-iron pipe thread would blush if laid alongside of it. I am not naturally a pessimist, but I am affected with the same ailment as hundreds of others in the business and am hoping for a remedy.

JOHN HOMEWOOD.

Alberta, Canada.

Methods for Making High-Speed Steel Go Farther

SYNOPSIS—Details of four methods for attaching high-speed steel points to carbon-steel shanks in making single-pointed cutting tools. These methods include brazing with a brazing compound, brazing with a piece of sheet copper, welding with a flux composed of borax and mild-steel filings, and welding with the oxyacetylene flame.

The increase in the price of tungsten steel, its scarcity and the scarcity of tungsten metal bring into importance all the means of successfully using high-speed steel points or bits for machine-shop tools. Several methods of brazing or welding high-speed steel points to mild-steel shanks have been shown in the *American Machinist* during the past five years, and such processes are by no means unknown in American machine shops.

With the purpose, however, of aiding in the economical use of the present available supply of high-speed steel for single-pointed tools, four methods of attaching high-speed steel tool points to carbon-steel shanks are described in detail. Three of these are from the practice of British shops and one from an American shop. The source of the first three is a circular issued by the British Ministry of Munitions to British workshops, some copies of which have reached American shops. Commenting on the importance of conserving the supply of tungsten steel, the opening paragraph of this circular reads:

"Owing to the present scarcity of tungsten, it is of the highest national importance that every practicable economy should be exercised in the use of high-speed steel, and in order that this may be done, the use of high-speed steel points brazed to carbon-steel shanks is strongly recommended. Tools made in this way are very widely used and are undoubtedly successful, and are much cheaper than tools made of high-speed steel throughout, so that, even from the economical point of view, apart from considerations of national economy, the process is most desirable. In order to enable you to put the process into practical operation in your works, the following information is afforded."

These three British methods are, first, brazing, using a commercial brazing compound; second, fire welding, using a flux composed of a mixture of borax and mild-steel filings; and third, brazing, using a thin sheet of copper and powdered borax between the point and the shank. The fourth method, taken from an American shop, shows and describes in detail a process of preparing both point and shank for flame welding, using the oxyacetylene torch. This method is also used in British shops, and the circular lists the names of several that are in a position to demonstrate the particular processes used.

The method of preparing shank and point for the British methods is illustrated in Fig. 1, reproduced from the circular of the Ministry of Munitions previously referred to. The accompanying explanation reads:

"The illustration shows the appearance of a tool ready for the brazing process. The shanks are pieces cut off from rectangular black bar and can be made of ordinary mild steel, although in practice it is found that steel having 0.5 per cent. of carbon gives better results. The end of the shank which is to receive the high-speed steel point is ground down about 1/8 in. so as to present a clean surface for brazing and location for the high-speed steel point which is ground upon the two faces which are in contact with the shank. . . ."

First British Method—Brazing With a Commercial Compound

"According to one method, the brazing is accomplished by means of a brazing compound which is known as Laffitte's brazing compound and which does away with the use of borax or any other flux. This compound is supplied in small compressed plates or sheets, and in practice a sheet of the compound is placed between the high-speed steel point and the shank, the whole being wired together as indicated by the illustration. The brazing is usually accomplished in a high-speed steel furnace, of the type which contains two chambers, one for preheating and the other for the final high temperature required for hardening the high-speed steel. In cases where this type of furnace does not exist, the preheating can be done in any furnace, the object of preheating being to enable the brazing compound to run effectively and to avoid cooling down the high-speed steel furnace by placing cold steel in it. The three parts, bound together as described, are placed in the first furnace and brought up to red heat, after which they are removed and the high-speed steel point is tapped lightly with a hammer to distribute the brazing compound between the two faces, after which the tool is put into the high-speed steel furnace and brought up to the proper heat for hardening. While this is being done, the tool should be carefully balanced so that the point does not slip away, as it is liable to float on the brazing compound, which is fluid.

FIG. 1. POINT WIRED TO SHANK FOR WELDING OR BRAZING

"After removing from the high-speed steel furnace, a jet of air should be directed on the nose of the tool in the usual way, after which the tool can be dressed to shape on a grindstone."

This method is used by Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd.; Mather & Platt, Ltd.; Vickers, Ltd.; Ruston, Proctor & Co., Ltd.; Alfred Herbert, Ltd.

Second British Method—Fire Welding With Borax and Fine Steel Filings

"This method is in use by a number of engineering firms. The compound used as a flux is a mixture of borax and mild-steel filings, or cuttings obtained from a hacksaw.

"The borax is purchased in crystals, but before mixing with the steel filings is melted slowly until it becomes liquid and is then allowed to cool, when it is pounded down to a powder. The proportions are one part of borax to two parts of steel filings or cuttings.

"The shank of the tool is shaped at the point in the same way as for the first method, see Fig. 1, and the same applies to the high-speed steel point.

"Before putting on the point, the shank is put into the fire and heated for 2 in. up or more, according to the size of the tool, to a red heat. It is then cooled for ½ in. long at the point before putting on the flux.

"The flux is then put on about ⅛ in. thick, for a 1-in. square tool, and the high-speed steel point is laid on the top. The tool is then put into the fire and brought to a good red heat, after which it is taken out and examined to see whether the point is in correct position. If found to be so, it is given a few blows by the round of a hammer so as to fix it and to keep it from moving in the further process. It is again put into the fire and brought up to a welding heat, after which it is brought again to the anvil and welded, the blacksmith holding a fuller or rounding tool on to the high-speed steel point, and the striker using a small hammer striking blows quickly and lightly.

"The fuller is kept in the first instance toward the back end of the point, as, if used at the front, the tool would collapse owing to the soft nature of the shank. After the point has been fairly fixed at the back, it is gradually worked up toward the end, using very light blows, and, by this time has cooled down considerably and can bear the light hammering without giving way.

"The hardening is then performed as before described; and after hardening, it is well to strike the shank of the tool on the anvil so that the sudden jerk will cause the point to tumble off if it has not been properly welded."

This method is used by John Lang & Sons, Johnstone, Scotland.

"The mild-steel shank and high-speed steel point are prepared as shown in Fig. 1.

Third British Method—Brazing with Sheet Copper and Powdered Borax

"For brazing, a piece of sheet copper about $1/25$ in. [0.040 in.] is placed between the shank and the point and powdered with borax (prepared as in the second method) sprinkled thickly both underneath and on top of the copper. The tool is then carefully put into a smith's fire, the most important thing being to see that the tool is perfectly level so as to prevent the point from slipping off when the copper melts. Wiring the point on, as shown in Fig. 1, will assist in preventing this. The front of the tool is then raised to a dazzling white heat, the copper melts and adheres to both shank and point. The tool is then carefully withdrawn from the fire and cooled down in an air blast until it is at a black heat, when it can be put in water. For this process the shank is preferably milled; the milled part should be perfectly flat and the point ground to fit."

This method is used by Messrs. Siemens Bros. Dynamo Works, Ltd., Stafford, England.

Fourth Method—Welding with the Oxyacetylene Flame

The circular of the British Ministry of Munitions also mentions the fact that the oxyacetylene process of flame welding is successfully employed by several firms who are willing to demonstrate their processes to interested parties. The list of firms comprises: Messrs. Werner, Pfleiderer & Perkins, Ltd., Peterboro; James Bennie & Sons, Clyde Engine Works, Govan: Burmeister and Wain Oil Engine Co., Ltd., Glasgow; Fairbairn MacPherson, Wellington Foundry, Leeds; John McDowall & Sons, Walkinshaw Foundry, Johnstone; Willans & Robins, Ltd., Victoria Works, Rugby.

This flame-welding process is also used in the United States, and Fig. 2 and the following description are from the practice of the Root & Vandervoort Engineering Co., East Moline, Ill.

The mild-steel shank and high-speed steel point or bit are shaped as shown at *A* and *B*, Fig. 2. The details give the proportions of one kind of round-nose turning tool for roughing cuts, and for both right-hand and left-hand setting. The shanks and points may be forged or machined to the shapes given, but in the case of forgings the angular surfaces must be ground to free them from scale.

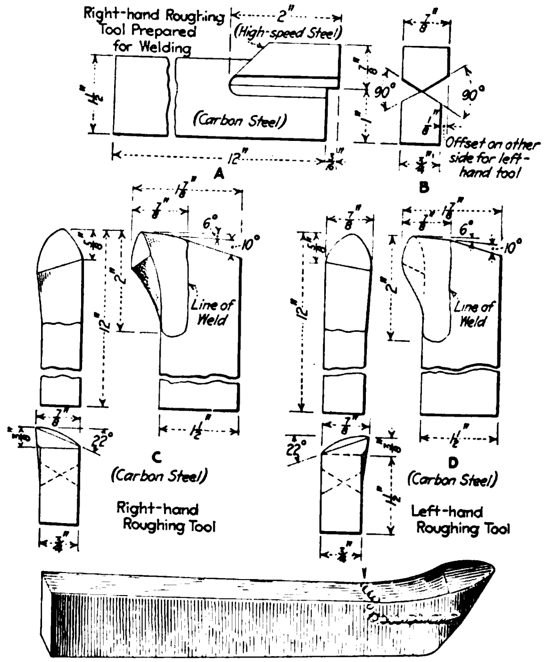


FIG. 2. DETAILS OF TOOL WITH OXYACETYLENE-WELDED POINT

When welding, the tool is laid on its side and the parts blocked up so that they are in proper relation to each other. They are then welded, using an oxygen-acetylene welding outfit, with a torch having a tit, giving a flame about ⅝ in. long. Round Norway iron $\frac{3}{16}$ in. in diameter is used for filling, and care is taken to prevent the flame from touching the high-speed steel point. The operator keeps the welding rod between the flame and the piece of high-speed steel. The angular grooves on the sides of the tool, as shown at *B*, are filled up a little more than flush, and most careful attention is given to see that a first-class weld is made.

After the tool is welded, no hammering of any kind is done on it, and all shaping is done by grinding. After rough grinding, the tool is hardened in the usual manner, and then after finish grinding, it is ready for use.

The finished shape and dimensions of a right-hand roughing tool made by this method are shown at *C*. and a similar lelft-hand tool at *D*. Fig. 2.

Editorials

The Need for a Uniform and Safe Boiler Code

Securing the safety of employees has become a very important function of shop management, but in too many cases it is confined to the shop and does not extend to the boiler room. This in too many small plants is so situated as to cause widespread damage in case of explosions. There are on the other hand many small shops which rent power and have no control over the power plant that may possibly blow up the whole shop.

The way toward safety lies in the direction of adopting stringent but rational laws concerning boilers, and all shop managers, whether supplying their own power or renting it, should be interested in the matter of safe boiler rooms.

A step in this direction is to secure the adoption of the Boiler Code of the American Society of Mechanical Engineers, which is the result of careful study and investigation by some of the best engineers of the country. That such action is necessary can be judged by the record of one insurance company last year, which shows that its inspectors found nearly 25,000 serious defects and had to condemn almost 800 boilers which they found in use.

Every safety engineer should be interested in the movement to secure safety in the boiler room as well as the shop, and particularly because it is a constant menace to the safety of such a large number of employees. The rules governing boilers on locomotives in interstate commerce, as well as the rules for marine service, show that the Government engineers have for years recognized the danger of boilers. And as they are so closely connected with manufacturing industries, it behooves us all to work for the adoption of adequate boiler codes by all the states. To this end the American Uniform Boiler Law Society has been formed to secure the legal adoption of the A. S. M. E. Boiler Code. This consists of twelve members, representing about all branches of the boiler-making industry, who are all devoting time and effort to secure its adoption. Everything seems to favor the movement, and the machine industry should aid so far as lies in its power.

Reclaiming and Handling Oils

Somewhere on the outskirts of every machine shop—often out-of-doors—is a greasy, evil-smelling place where steel chips are stored. If any quantity of these is allowed to accumulate, one will probably find pools of oil that have drained away and settled in near-by holes in the floor or depressions in the ground. That oil cost money. Along with the oil that drained from those chips has gone the loss of good dollars. These puddles of dirty, stinking oil are a text from which many a shop manager should preach a sermon on economy.

His "firstly" might be an attack on the inefficiency of the design and operation of the centrifugal chip and oil separating machines. On the design side, many of these are intended to be run at too slow a speed to bring about proper separation of the oil from the chips. Recent experiments seem to show that the smaller-sized machines are more efficient than the larger; that is, they turn out drier chips. On the operation side, the length of time that the chips are allowed to stay in the separator has a marked influence upon the degree of dryness. It is wise to make an occasional test to determine just how long it is economical to whirl the chips. Another handicap to the efficient operation of such centrifugal separators is the need of stopping the machine to empty and refill the pan. There seems to be no good reason why such machines should not be arranged to be filled and emptied while in motion.

"Secondly" in this sermon on shop economy the manager might well deal with the methods of transporting the chips from the screw and other machines to the centrifugal separator. The usual devices—a leaky wheelbarrow, sieve-like metal cans and slopping oil buckets—teach their own lessons. Oil-tight receptacles should be used throughout, and these should be loaded, filled and transported in such a fashion that there will be a minimum of dripping down the sides and slopping on the floor. If every gallon of oil should be thought of as a quarter of a dollar, it might emphasize the lesson.

The "thirdly" should emphasize the importance, after the oil has been reclaimed from the chips, of the cleaning and purifying processes to fit it to be returned to the machine tools. The really effective oil-filtering plant in a machine shop seems to be a species of rare bird. Yet the reasons that make careful filtration a necessity are many.

Oil that has been run through a metal-cutting machine is dirty; it is filled with fine metal particles, grit and iron oxide, or rust. The latter impurity comes from the action of the acid in the oil, which readily attacks the steel chips, particularly when they are hot. It may be pointed out that mineral oils are not supposed to contain free acid, but a great deal of screw-machine work is done today with an oil blended from mineral lard oil and hog lard oil. Hog lard oil always contains a certain percentage of fatty acid. The older the oil, the more it has been used, the more it has been exposed to the air, the greater this amount.

The result of proper cleaning by filtration is to supply a reclaimed cutting lubricant that does not dull and grind out the cutting tools, that has a minimum of free acid and helps to produce accurate, uniform work. It is recognized that impure or improper cutting lubricants have an influence upon the sizes cut by the tool, although this action has never been satisfactorily explained. The experiment has been tried of tooling up a screw machine and beginning cuts with lard oil. After the sizes were properly established all of the lard oil was pumped out and its place taken by another oil or cutting compound. There followed an actual difference in the sizes cut when the change in lubricant was made. To check the apparent results, the experiment was carried farther, and with

unchanged tool setting the machine was pumped out again and the original lard oil replaced. At once the normal sizes were cut by the tools. Thus all other conditions being the same, the condition of the lubricant affects the sizes of the work.

In addition to these items of economy the sermonizing general manager as his "fourthly" and "lastly" should insist upon the sterilization of the cutting oil each time it is filtered. It is well known that blood poisoning often follows the entrance of impure oil into scratches and minor hurts.

Influence of Electric Motors on Machine Tools

"Better knowledge of the data governing the design of machine tools.

"Greater possibilities in regard to power.

"Closer control of a machine tool in regard to speed, stopping, starting, etc.

"Flexibility of the use of machine tools, by making them portable, and by making a better shop construction possible."

In these four items A. L. De Leeuw sums up the beneficial influence of the electric motor on machine tools, in a paper presented at the International Engineering Congress, held in San Francisco. The changes that have come because of these influences are often difficult to trace, because high-speed steels were introduced, practically speaking, simultaneously with the application of the electric motor. The effect of each has been pretty much the same.

From the first the electric motor provided means for ascertaining the amount of power required to drive machine tools. With a better understanding of what these power requirements were, came a knowledge of the strains and stresses developed in machine-tool members. It is probably true that all of the existing knowledge in regard to the power and pressures exerted in machine-tool operation is due to the adoption of the electric motor as a driving means. And what is true of our knowledge of power and pressures is also true of our information in regard to speeds. With an increase in our appreciation of the stresses of machine-tool members have come improvements in frame construction, particularly in designs to insure rigidity. With an increased knowledge of what speed means in production has come a deliberate attempt to gain greater convenience in machine-tool handling. And with the adoption of chains and gears, which could not be run in the open because the device must be properly lubricated, has come an increase in the safety of machine-tool mechanism.

All of these changes sum up under the first influence listed by Mr. De Leeuw. In fact he believes this to be the greatest of the four, and says:

"The writer believes that the most marked and most beneficial influence of the electric motor on machine tools has been the bringing into view of the lack of the fundamental knowledge of machine tools, and that it has opened up a new era for the machine tool, which may be called the scientific era."

In contrast to the scientific era that we are just entering, he pictures the past as follows:

"Machine tools have been the product of the requirements of mechanics. They were simply contrivances to help the mechanic in his work. They were more or less highly developed implements. Their various features were products of development and evolution, rather than of invention. The scant knowledge of their principles was the result of observation, rather than of experimentation. Mathematics had never been applied to machine tools. The stresses and strains to which machine-tool members were subject were not known. The forces required in the machine tools and the amount of power for certain work to be done in a machine tool were absolutely unknown, and what is more, this lack of knowledge was not recognized as such. It is due to the electric motor that this condition of affairs in regard to machine tools has become recognized, and that efforts have been made to put their design and application on a more scientific basis. It must also be stated here that very little has been done, so far, along this line. Nevertheless, we must thank the electric motor for the fact that we are now aware of our ignorance and are at last put in a position to seek for knowledge and data, on which a theory of machine tools may ultimately be built."

The influence in regard to the application of power in machine tools is perhaps as apparent as any. With the opportunity to apply more power, more was used, until now motors are connected to ordinary-sized machines of a rating that was unthought of a few years ago. To be sure, the requirements of high-speed steel go hand in hand with the ability to apply more power. And when we observe the final effect we must not forget that both factors have contributed to the increase.

The closer control of machine tools has become a reality and has led to such expressions as "centralized control," "localized control" and others. These are now almost everyday expressions in describing the features of machine tools.

The item of flexibility needs no amplification. It is customary so to drive all machines in isolated locations—those set up under craneways, those intended for special overtime work, those that are portable and those intended to be used on floor-plates. Flexible shafts and other connections of the days before are now almost forgotten.

To turn the tables, it must be remembered that machine tools have also influenced the design and application of motors. The requirements of machine-tool operations have brought into being the adjustable-speed motor in its various forms. The same requirements have brought in the reversing motors for planers and a number of systems of machine-tool motor control. In spite of this it is probably true that the fundamental design of motors has not been materially affected.

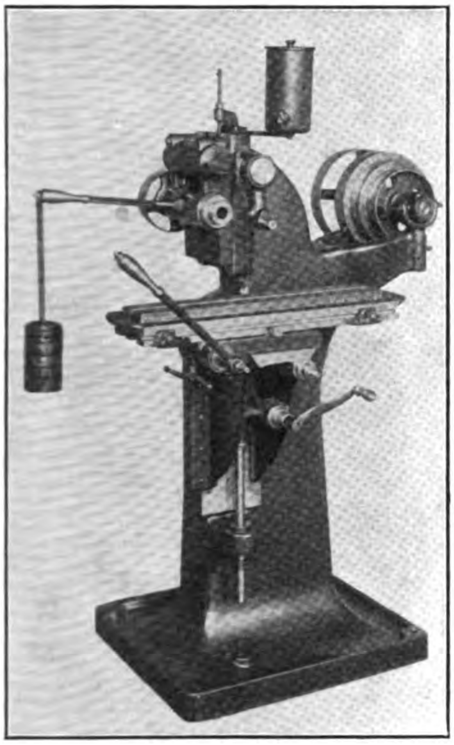
One of the most desired things at the present moment is a standardization of machine-tool motor proportions and sizes in such a fashion that we may have the much desired elements of interchangeability and uniformity. With the influence and inter-reaction of the electric-motor industry and the machine-tool building industry, such standardization ought to be possible at a not far distant date. It would be a further influence of machine-tool design upon electric-motor design.

On page 110 is reprinted editorial comment from the *Engineering and Mining Journal,* pointing out that relief from the present scarcity of tool steel may be found in the substitution of molybdenum for tungsten as the principal alloying element.

Shop Equipment News

Hand Miller with Weight Feed

The illustration shows a hand miller recently developed by the U. S. Machine Tool Co., Cincinnati, Ohio.



HAND MILLER WITH WEIGHT FEED

In general the design and construction will be apparent from the illustration. It will be observed that a weight feed is provided for use on both the cross and the vertical feed.

Milling Multiple Keyseats

The tool shown is an adaptation of the regular type of keyseat-miller tool made by the National Machine Tool Co., Cincinnati, Ohio. The difference between this and the regular type is the addition of a demountable guide which is used in conjunction with the regular guide to obtain the correct spacing of the multiple keyways, or splines. While these tools are made specially to mill double, triple or quadruple keyseats, the one shown was made to mill the keyways in a six-spline automobile gear, shown at the right. In this case the additional guide is spaced one-sixth around the circumference of the body from the regular guide.

When using this tool, the first keyway is milled without the use of the additional guide. Then the additional guide is screwed into its locating slot and inserted into the milled keyway. As the end of this guide extends down below the cutter, it enters the cut keyway far enough ahead of the cutter accurately to space and steady it for the second cut. When this is milled, the tool is again set with the spacing guide in the keyway last milled, and so on around the hole. These tools can be used in any good-sized drilling machine.

Torpedo-Flask Boring Machine

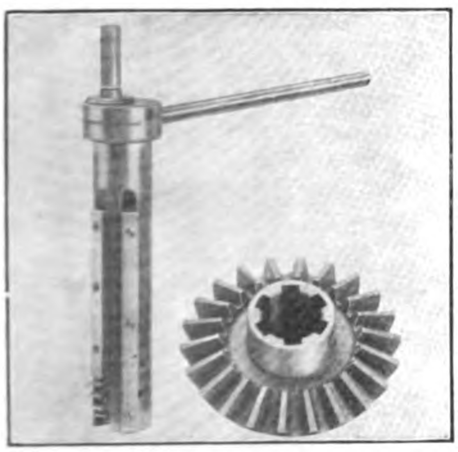
The illustration shows a machine recently developed by the Newton Machine Tool Works, Inc., Philadelphia, Penn., for rapidly finish-boring torpedo flasks.

The outside of the flask is gripped in two revolving chucks which are rotated in unison by a common shaft through wormwheels. The boring bar is stationary and is equipped on each side with tool heads which pass each other without interference.

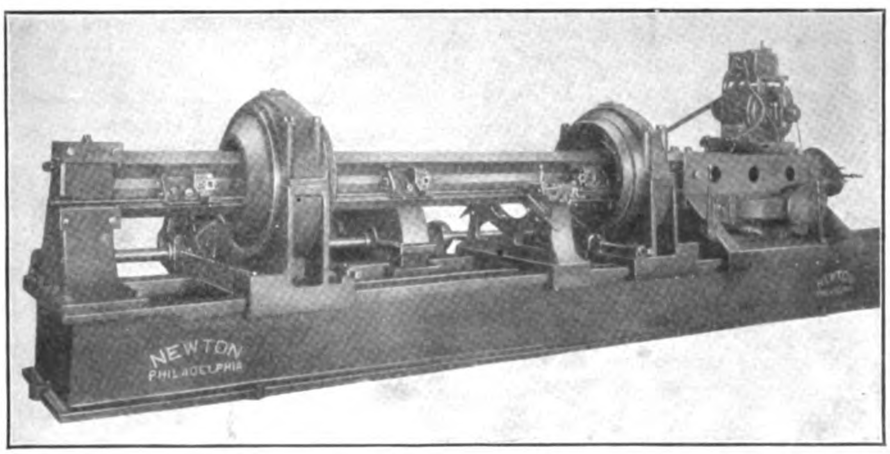
Each tool head has power feed along the bar, with automatic release, and has adjustment at right angles to the axis of the bar in a movement controlled with formers conforming to the contour of the flask.

The main head, on which the drive motor is mounted and to which the boring bar is attached, has reversing fast-power traverse on the base to permit the insertion and withdrawal of the boring bar after the flasks are located in the revolving chucks.

When inserting the flasks, the idea is to adjust one head away from the stationary or end head, to give a



MULTIPLE KEYSEAT TOOL

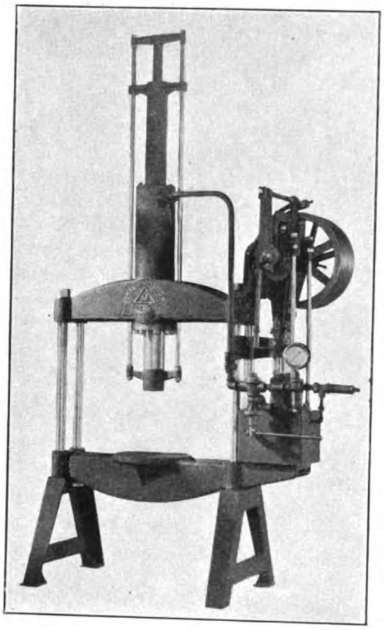


TORPEDO FLASK BORING MACHINE

distance greater than the length of the flask, which is then moved horizontally through the chuck on the stationary head; the movable head is adjusted back over the flask until it reaches the desired position. The chuck jaws are of special design.

Vertical Hydraulic Press

There is little explanation needed as to the construction or scope of the press shown. The design of the machine is such as to make it adaptable to a wide variety



VERTICAL HYDRAULIC PRESS
Stroke, 18 in.; distance between columns, 42 in.; distance from platen to ram, 24 in.; capacity, 20 tons

of straightening, forcing and broaching work. The ram pullback is by air or counterweight.

The constructional details in general follow the lines of the previous machines made by the builders—the Metalwood Manufacturing Co., Detroit, Mich.

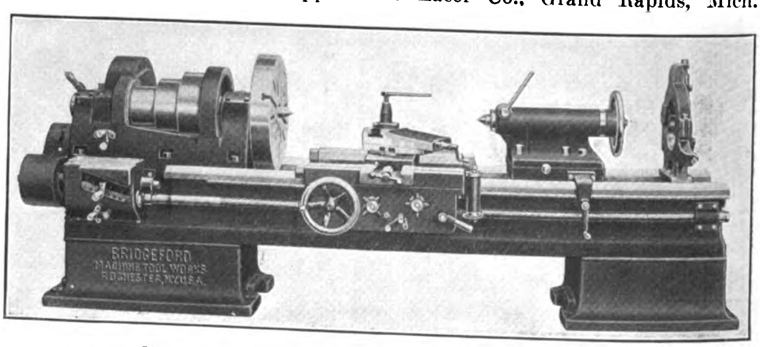
Heavy Cone-Driven Lathe

The Bridgeford Machine Tool Works, Rochester, N. Y., has strengthened and otherwise improved the 26-in. lathe, as illustrated herewith.

The improvements include a further reinforcement of the bed by using a center rib, and the addition of a rack and pawl at the rear of the tailstock for use on heavy work. Both headstock and tailstock have been improved as to strength, rigidity and lubrication. The lathe is now built with either a 3-step cone for 5-in. belt or with 4 steps for a 4-in. belt, as may be desired. The apron is of the double-wall type. Spindle speeds of 6 to 260 r.p.m. are available. The machine weighs 8,000 lb. The spindle, which has a $2\frac{1}{8}$-in. hole through it, has bearings of bronze; the driving gears are cut from the solid, having coarse pitch and wide face for heavy duty. The back gear sleeve and pinion are a steel forging.

The carriage is of heavy construction and has a $38\frac{1}{2}$-in. bearing on the V's. There are independent frictions for both cross and lateral feeds, these being controlled from the apron. This provides the usual interlocking mechanisms to prevent the engagement of both feeds at once. The apron is of the double-wall type and this, together with the compound rest and cross slide, is of extra heavy construction.

The regular equipment includes large and small faceplates, compound and center rests, the standard set of change gears, countershaft of self-oiling type and either American or English tool post.



HEAVY-DUTY 26-IN. MANUFACTURING LATHE

"Clipper" Belt Lacer

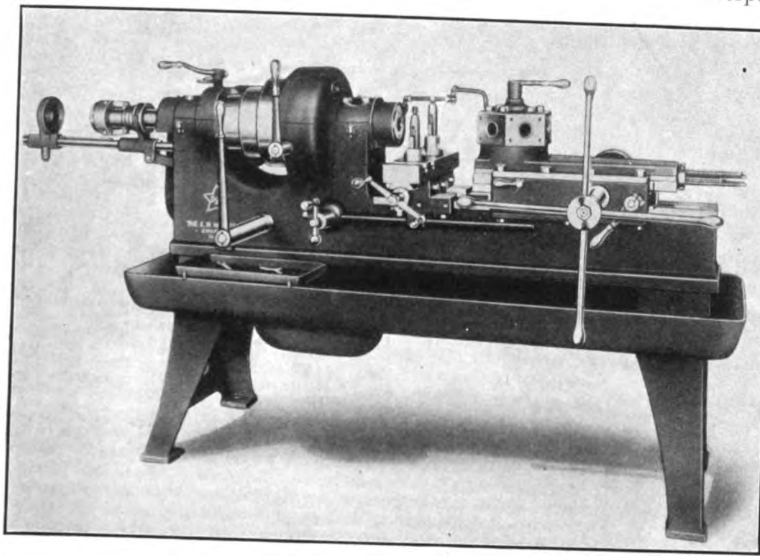
In the illustration is shown a new model of the Clipper belt lacer, known as the No. 3. It is designed to lace belts more easily, from the added strength and the power which can be applied. This increased power is estimated

CLIPPER BELT LACER

at 50 per cent., enabling an average man to push 6 in. of hooks into a belt. The lacer shown is the latest model of the Clipper Belt Lacer Co., Grand Rapids, Mich.

Hand Screw Machine

The hand screw machine shown is a 1½-in. machine, having a friction geared head, positive power feed to the turret slide, independent stops, automatic chucks, wire feed, oil pump and piping. All operating levers are within easy reach, with reverse obtained through countershaft.



FRICTION-HEAD HAND SCREW MACHINE
Collet opening, 1½ in.; power feed, 9 in.; 6 turret holes

The maker, the E. H. Wachs Co., Chicago, Ill. is not a newcomer, but is merely reëntering a field of former endeavor, with a lathe of new design.

Present Government Attitude Toward Business

Since the enactment by Congress of the Federal trade-commission law and the Clayton law, the Federal Trade Committee of the Chamber of Commerce of the United States has been constantly presented with inquiries not only relative to the relationship which it might be expected would be established between the Department of Justice and the Federal Trade Commission at points where jurisdiction seems to overlap, but also as to the probable attitude of the Department of Justice with respect to future proceedings.

It was explained to the Attorney General by the representatives of the national chamber that if he would express himself it might be regarded as reassuring to the public mind and at the same time dispel some of the uncertainty which has heretofore existed. Several interviews have resulted between the Attorney General and members of the Federal Trade Committee, and the latter body now offers the following summary:

"Persons entering into transactions in good faith, having good cause to believe. them lawful, will not be criminally prosecuted, but if their business be found violative of the law, they will be given opportunity to readjust in conformity with the law without legal proceedings, unless consent decree in a civil suit is desired.

"The Department of Justice intends to give substantial recognition to the provisions of paragraph E of section 6 of the Federal trade commission law, which authorizes the commission 'upon the application of the Attorney General to investigate and to make recommendations for the readjustment of the business of any corporation alleged to be violating the anti-trust acts in order that the corporation may thereafter maintain its organization, management and conduct of business in accordance with law.'

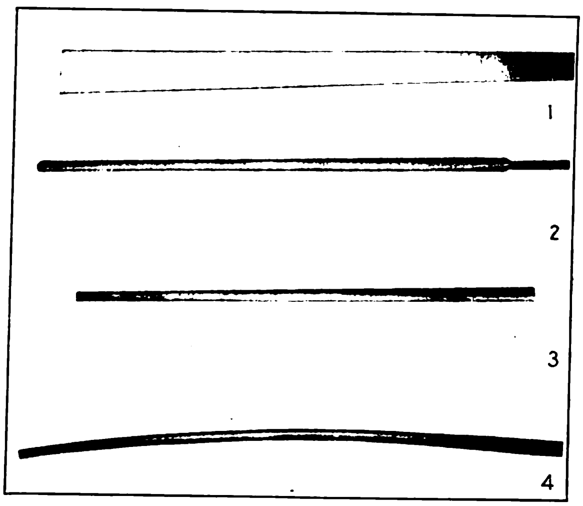
"In cases as to which both the Department of Justice and the Federal Trade Commission have jurisdiction, such for example as those arising under the Clayton act, the department will await the conclusion of the commission's proceedings as to any matters in which the commission's jurisdiction is first invoked.

"It is not improbable that the working arrangement between the Department of Justice and the Federal Trade Commission is to follow along the same lines as have been established by custom as between the department and the Interstate Commerce Commission with relation to violations of the act to regulate commerce, as a result of which arrangement the department rarely, if ever, institutes proceedings without the recommendation or sanction of the Interstate Commerce Commission."

This explanation of the official attitude toward the trade laws involved will no doubt clarify the situation.

Making Sword Scabbards

The making of scabbards has been done in the past by a number of concerns, usually in small quantities, as the demand is limited in the United States. Since the beginning of the European War, however, other firms have become interested in their manufacture. With this fact in mind and thinking that the description will prove of interest to the reader, the operations followed in making scabbards are here set forth.



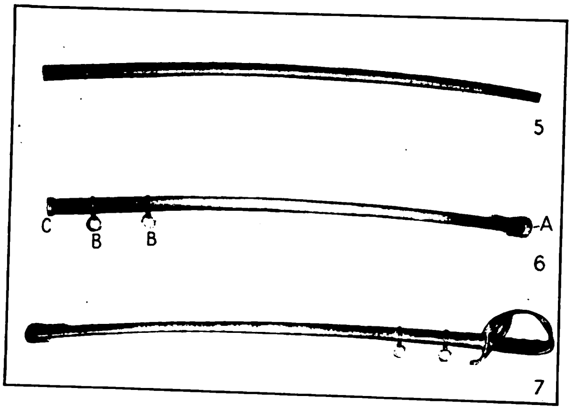
FIGS. 1 TO 4. THE CUTTING AND FIRST ROLLING OPERATIONS ON THE SCABBARD

The firm of Charles Schilling, Philadelphia, Penn., is one of the oldest in the industry, having been in existence with the present owner and his father for over half a century, and the illustrations and methods here outlined were obtained at this shop.

The first operation in making the scabbard is cutting to shape. For this work a templet is laid on the steel sheet and the shape marked off. This shape is then cut out with power shears. The steel used for making scabbards is No. 21 gage (0.034 in.) thick. One of the scabbard blanks is shown in Fig. 1.

Rolling the Blank Straight

The blank is bent over by hand and the steel former, Fig. 2, placed on the inside. The former and the blank are then gripped between jaws in a machine, and a hardened-steel roller made with a concave face is fed over. This action forces down the blank against the former. The roller is fed down and made to travel across the blank until it has been forced to the shape of the former. The



FIGS. 5 TO 7. THE FINAL OPERATIONS

scabbard is then slid off and the longitudinal seam brazed, a coke fire being used to obtain the necessary heat.

The scabbard, after it has been rolled straight and brazed on the seam, is shown in Fig. 3. The part is slightly bent over in a vise until it can be slid on the curved former, Fig. 4.

It is then placed in a set of vise jaws, which are made with a contour similar to the former, and dropped into position in the same machine used for the straight rolling operation. The roller is operated in a like manner until the scabbard has been forced to the same shape as the former. The part is then removed and the lower end peened over and brazed. One of the scabbards at the conclusion of these operations is shown in Fig. 5.

Final Operations on the Scabbard

The scabbard is ground all over on the outer surface until the desired smoothness is obtained. The shoe *A*, Fig. 6, strap rings *B* and top guard *C* are then slot soldered into position, as shown. The scabbard is finally nickel-plated and polished until the proper finish is secured.

One of the scabbards with a sword in position, ready for delivery, is shown in Fig. 7, and the finish produced and final appearance of the scabbard are apparent.

NEW PUBLICATIONS

HOW TO RUN AND INSTALL GASOLINE ENGINES. By C. von Culin. 96 pages; 3⅜x6 in.; paper covered. Published by the Norman W. Henley Publishing Co., New York. Price, 25c.

This is a handy little pocketbook for those installing or using gasoline motors. It is written particularly for users of motor launches, and in addition to information concerning the motor itself, it deals with navigation and hull construction of small boats.

FORD ENGINE CHART. By Victor W. Page. 25x38 in. Published by the Norman W. Henley Publishing Co., New York. Price, 25c.

This chart shows sectional and assembled views of the Ford engine and transmission units, the thermo-siphon cooling system, the Ford ignition system and the carburetion group, from the gasoline tank to the motor manifold. It names all the different parts and shows their relation to one another. In addition it gives considerable condensed information as to the various troubles which can occur in an internal-combustion motor, the symptoms shown by the different troubles and, by inference, the proper remedy. It should be useful to both the user and repairman.

PRACTICAL APPLIED MATHEMATICS—By Joseph W. L. Hale. Two hundred and six pages, 4½x7 in.; 185 illustrations. Published by the Norman W. Henley Publishing Co., New York.

Reviewed by Dexter S. Kimball*

This book and its companion volume, entitled "Practical Mechanics," by the same author, are intended for use in trade apprentice schools, the two taken together constituting a fairly comprehensive, though simple, presentation of elementary mathematics and mechanics. An effort has been made therefore to obtain a logical sequence throughout the two volumes. These books are based on instruction sheets developed by the author in five years' experience organizing apprenticeship schools for the Pennsylvania R.R.

The contents of this volume are presented in 20 short chapters under the following headings:

Simple Processes (in arithmetic), Common Fractions, Decimals, Percentage, Ratio and Proportion, Measurements of Angles (elementary geometry), Mensuration of Rectangles and other Four-Side Figures, Mensuration of Triangles, The Circle (its properties and its mensuration), Mensuration of Simple Solids, Use of Rules and Formulas, Simple Equations, The Binomial, Use of Tables and Curves, Cube Root, Mensuration of Prisms, Pyramids and Cones, Mensuration of Miscellaneous Solids, Miscellaneous Rules for Polygons, Miscellaneous Rules for Length, Area and Volume, Metric System, and an Appendix containing tables of square roots, cube roots, etc.

The volume is therefore an elementary treatise on arithmetic with comprehensive applications. As might be expected, many of the illustrations and problems are drawn from the field of railway practice; in fact that is so much so, that the book may not be so interesting to students in other lines of work as its scope and purpose warrant. While the treatment is simple and concise, the contents of the book are by no means watery, and the student who has mastered it will have a sound mathematical basis for the trades. It would probably prove a little difficult for independent study, but it should be found useful in technical high schools and in trade and vocational schools generally.

PRACTICAL MECHANICS AND ALLIED SUBJECTS—By Joseph W. L. Hale. Two hundred and twenty-eight pages, 4½x7 in.; 201 illustrations; indexed. Price, $1. McGraw-Hill Book Co., New York.

Reviewed by Dexter S. Kimball*

This book and its companion volume, entitled "Practical Applied Mathematics," by the same author, are intended for use in trade apprenticeship schools, the two taken together constituting a fairly comprehensive, though simple, presentation of elementary mathematics and mechanics. An effort has been made, therefore, to obtain a logical sequence throughout the two volumes, and hence this volume presupposes a knowledge of elementary arithmetic and simple arithmetical applications. Both books are based on instruction sheets developed by the author in five years' experience in organizing and operating apprenticeship schools for the Pennsylvania R.R.

*Professor of machine design and construction. Sibley College, Cornell University.

The contents of the book are presented in 20 short chapters under the following chapter headings:

Forces (general conceptions), Gravitation, Density and Specific Gravity, Screw Threads, Calculation of Levers, Pulleys (Block and Tackle), Inclined Plane and Wedge, Gears and Lathe Gearing, Belts and Pulleys (considered as mechanism only), Efficiency of Machines, Motion, Cutting Speeds, Volume and Pressure of Gases, Work and Power, Calculation of Belting (for power), Energy, Heat, Logarithms (with simple applications), Measurement of Right Triangles (elements of trigonometry), Measurement of Oblique Triangles (further trigonometry), Electricity, Strength of Materials.

Unlike its companion volume, the illustrations and problems included in this book are not drawn to any considerable extent from the railway field but are quite general in their scope. The treatment is concise and practical and the book contains a large amount of information for its size. Like its companion, it will probably be rather difficult for independent study, but when a student has mastered it he will have accomplished something worth while.

There are a few consistencies in its make-up however. One wonders why in a book of this character, where space is so valuable, three pages should be devoted to a drawing of a lathe and a tabulation of its 300 parts, or why another page should be devoted to pictures showing ten tools used by machinists, or why it is more important to there illustrate the hacksaw than a monkey wrench. But these, after all, are small defects in a book that has many valuable features.

PURCHASING—By H. B. Twyford. Two hundred and thirty-six 6x9-in. pages; 112 illustrations; indexed. Price, $3. D. Van Nostrand Co., New York.

The appearance of books on purchasing is another indication of the growth of the science of management. A few years ago purchasing ability was synonymous with personal shrewdness; and while, no doubt, some elements of this character will always remain it appears that even in this work there are basic principles that can be written into books.

This volume is a businesslike treatment of the problems and methods of purchasing as they appear to one who has had a long and varied experience in this field. It contains little on the psychology of buying, and such philosophy as it does contain is not of the speculative kind, but practical and direct.

The subject matter is presented under four main subdivisions and 15 chapters as follows: (a) Purchasing—(1) Principles of Purchasing, General Considerations; (2) Functional Position of Purchasing Considered; (3) Ethics of Buying. (b) The Purchasing Organization—(4) The Purchasing Agent; (5) The Purchasing Department; (6) Organization of Department; (7) System of Procedure. (c) Operation of Purchasing Department—(8) Obtaining and Tabulating Proper Records; (9) Work Connected with Requisition and Order; (10) Invoices and Method of Handling; (11) Operation of Stores. (d) Purchasing as Practiced—(12) Purchasing for Railroad Construction Work and for Operation of Electric Railroads; (13) Purchasing for a Manufacturing and Construction Co.; (14) Purchasing for Construction and Operation in Widely Separated Localities; (15) Purchasing for a Small Manufacturing Establishment.

The first section deals with the principles and ethics that underlie successful purchasing. The reasoning is sound, and the ethical standards are high.

The second section treats of the work of the purchasing agent, the relations that he and his department should hold to other departments and the general organization of the purchasing department. These chapters constitute a clear and intelligent solution of these problems; and while the plan is developed for a large organization, the principles laid down apply equally well to a small business. Mr. Twyford's idea that a purchasing department should intelligently serve the other departments instead of handicapping them, as is often the case, is worthy of attention.

The third section treats of the actual operations of a large purchasing department. Typical forms and blanks are inserted in sufficient number only to illustrate the important points.

Each chapter in the fourth section describes in some detail the purchasing department of some enterprise with which the author has had actual experience. The businesses referred to range from large and complex ones to a small and simple one. Each chapter is well illustrated with forms and blanks, the general idea being to present a range of practical illustrations.

The work is well written, the reasoning is clear, and the book on the whole is excellent. It should be helpful, not only to purchasing agents, but also to managers who have not given this important feature of management much attention.

One of the best features of the book is the care the author has taken to point out the limitations that should be observed in laying out systems of any kind and the danger from borrowing methods instead of developing such office machinery as the particular case demands. In other words, the book deals largely with principles and is not a mere collection of forms taken from the author's experience.

The reviewer takes exception to the author's inference in Chapter 11, that the method of drawing material from the stores by foremen's requisitions is better than the method by production orders made out in advance. If the saving of material costs is as important as the author says it is elsewhere in the text, no foreman should write requisitions, since this is one of the most wasteful of methods. A foreman who is doing his full duty has no time to do such work as accurately as it should be done, and as accurately as good cost-finding methods demand. Modern methods tend toward planning all operations in advance, the procedure including the purchasing of the material and the drawing of it from the storeroom in just the right quantities. Any progressive shop large enough to have a purchasing department anything like what Mr. Twyford advocates will also have some form of production department that will not only give the purchasing department accurate information regarding the material required, but will also advise the storekeeper just how much material a job requires and when it will be wanted.

PERSONALS

D. E. Jones has been promoted to foreman in charge of the night force at the factory of the Peters Cartridge Co., Kings Mills, Ohio.

Charles Piez, president of the Link-Belt Co., has been elected president of the recently organized Electric Steel Co., Chicago, Ill.

H. W. Kruesberg, president of the Champion Tool Works Co., Cincinnati, Ohio, was presented with a loving cup by his employees as a New Year's testimonial.

E. C. Waldvogel, for the past 11 years associated with the Yale & Towne Manufacturing Co., has been appointed general manager, with headquarters at the home office.

William H. Carpenter has been appointed manager of the Mayo Radiator Co., New Haven, Conn. Mr. Carpenter was formerly superintendent of the Bristol Brass Co., Bristol, Conn.

S. Shirley French, recently appointed assistant general manager of the William Tod Co., Youngstown, Ohio, has assumed the general management of the plant operations, succeeding L. A. Woodward, who has retired.

A. S. Baldwin has resigned as works manager of the R. D. Nuttall Co., Pittsburgh, Penn., to become manager of ordnance for the Poole Engineering and Machine Co., Baltimore, Md. Mr. Baldwin was previously held similar positions with the Driggs-Seabury Ordnance Corp. and the American British Mfg. Co., and was for four years general manager of the Alberger Pump and Condenser Co.

OBITUARY

George R. Ray, founder and president of the Manistee Iron Works, Manistee, Mich., died at his home in that city on Jan. 3.

George H. Cushing, plant superintendent of the H. B. Smith Co., Westfield, Mass., died on Jan. 6. Mr. Cushing was a native of Worcester, Mass., and was 55 years old.

William A. Comstock, president of the Cleveland Wire Spring Co., Cleveland, Ohio, died on Jan. 9 as the result of injuries sustained when he was struck by an automobile.

BUSINESS ITEM

The organization of the Electric Steel Co., of Chicago, Ill., represents a new development for that section in that the plant will confine itself to small castings of the alloy variety. The plant will be located at 31st and Wood St., in the former works of the Wildman Boiler Co., and the organization has progressed sufficiently to insure delivery of product by Mar. 1. The officers of the new company are: Charles Piez, president, and P. L. Coonley, secretary and treasurer, who are respectively president and vice-president of the Link-Belt Co. The active management of the company will be in the hands of John M. Olmsted as vice-president, who has been a member of the sales force of the Link-Belt Co. These three with W. C. Frye and C. R. Messinger, of Milwaukee, constitute the board of directors.

Prices--Materials and Supplies

PIG IRON—Quotations were current as follows at the points and dates indicated:

	Jan. 14 1916	Dec. 17 1915	Jan. 15 1915
No. 2 Southern Foundry, Birmingham	$15.00	$14.00	$ 9.50
No. 2 X Northern Foundry, New York	19.75	19.00	14.25
No. 2 Northern Foundry, Chicago	18.50	18.00	13.00
Bessemer, Pittsburgh	21.45	19.45	14.70
Basic Pittsburgh	18.70	18.45	13.45
No. 2X, Philadelphia	20.00	19.50	14.25
No. 2, Valley furnace	18.50	18.00	13.00
No. 2 Southern, Cincinnati	17.90	16.90	12.40
Basic Eastern Penn	19.50	18.00	13.50
Gray forge, Pittsburgh	18.45	17.95	13.45

MISCELLANEOUS METALS—NEW YORK

	Jan. 14, 1916	Dec. 17, 1915	Jan. 15, 1914
	Cents per pound		
Copper, electrolytic (carload lots)	24.00	20.00	13.75
Tin	41.00	40.00	33.50
Lead	5.90	5.40	3.90
Spelter	17.62½	18.00	6.05
Copper sheets, base	30.00	25.00	18.50
Copper wire (carload lots)	30.00	28.25	14.25
Brass rods, base	35.00	27.25	13.00
Brass pipe, base	38.00	32.00	16.50
Brass sheets	35.00	27.25	13.25
Solder ½ and ½ (case lots)	25.75	24.25	22.00

ST. LOUIS

Lead .... 5.77½ Spelter 18.50

In New York, Lake copper is quoted nominal at 24c. cash and deliveries are not promised until June.

MONEL METAL—The following prices hold:

Mill Lengths 8 Ft. and Over

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less than 500 Lb. of a Size and Over
Rounds—Squares	Cents per Pound				
3/16 — 7/32	31.50	32.00	32.50	33.00	36.00
1/4 — 5/16	31.25	31.75	32.25	32.75	35.75
3/8 to 1 7/8	31.00	31.50	32.00	32.50	35.50
1 15/16 to 2 7/8	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3 7/16	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3½ to 3 15/16	32.25	32.75	33.25	35.75	36.75
Squares					
3 1/16 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4 15/16	33.00	33.50	36.00	36.50	37.50
5 tc 6 15/16	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.
Hexagon Bars two cents (2c) per pound over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

STANDARD PIPE—

	Discount			
	Black		Galvanized	
	Jan. 14, 1916	Jan. 15, 1915	Jan. 14, 1916	Jan. 15, 1915
¾- to 2-in. steel butt welded	77%	81%	62½%	72½%
2½- to 6-in. steel lap welded	76%	80%	61½%	72½%

At the above discounts, the net prices follow:

	Cents			
	Black		Galvanized	
Diameter, In.	Jan. 14, 1916	Jan. 15, 1915	Jan. 14, 1916	Jan. 15, 1915
¾	2.65	2.20	4.31	3.15
1	3.91	3.24	6.37	4.67
1¼	5.29	4.38	8.62	6.30
1½	6.33	5.25	10.31	7.55
2	8.51	7.05	13.88	10.15
2½	14.04	11.70	22.52	16.70
3	18.36	15.25	29.45	21.80
4	26.16	21.80	41.97	31.00
5	35.52	29.60	56.88	42.20
6	46.08	38.40	73.92	54.60

SAL SODA—The quotations below are per 100 lb. at the places designated:

New York	$1.00
Philadelphia	.75

ANTIMONY—For spot delivery on Chinese and Japanese brands, duty paid 43c. per lb. is asked.

STEEL SHEETS—

	Cents per Pound		
	Sheets from Warehouse, New York		
Black	Jan. 14, 1916	Dec. 17, 1915	Jan. 15, 1915
No. 12	3.00	2.70	2.20
No. 14	3.05	2.80	2.25
No. 16	3.15	2.90	2.35
Nos. 18 and 20	3.15	2.95	2.40
Nos. 22 and 24	3.20	3.00	2.45
No. 26	3.25	3.05	2.50
No. 28	3.35	3.15	2.60
Galvanized			
No. 24	5.05	4.80	3.05
No. 26	5.20	4.95	3.20
No. 28	5.50	5.25	3.50

ZINC SHEETS—The following prices prevail:

Quantity	Cents per Lb.
Carload lots, f.o.b. mill	23.00
In casks, New York	24.00
Broken lots, New York	25.00

SEAMLESS DRAWN TUBING—As we go to press, the base price is 35c. for brass and 35c. for copper. For immediate stock shipment 3c. is added, which gives the following quotations:

	Cents per Pound			
	Copper		Brass	
Diameter, In.	Jan. 15, 1916	Jan. 15, 1915	Jan. 15, 1916	Jan. 15, 1915
¾ to 2½	38.00	20.00	38.00	16.00
3	38.00	21.00	38.00	17.00
3½	39.00	21.50	39.50	17.50
4	40.00	22.00	40.50	18.00
4½	42.00	23.00	42.50	19.00
5	44.00	24.00	44.50	20.00
6	45.00	27.00	45.50	23.00
7	47.00	29.00	47.50	25.00
8	49.10	31.00	49.60	27.00

OLD METALS—The following are the dealers' purchasing prices in New York:

	Cents per Pound	
Copper	Jan. 15, 1916	Dec. 17, 1915
Heavy and crucible	18.50	16.50
Heavy and wire	18.00	16.00
Light and bottoms	16.00	14.00
Lead		
Heavy	12.50	4.25
Light	10.00	4.00
Brass		
Heavy	12.50	11.25
Light	10.00	9.00
No. 1 yellow rod turnings	12.50	11.50
No. 1 red turnings	12.00	11.00
Zinc	12.00	10.00

COKE—Below are the prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Dec. 25 1915	Jan. 1 1916	Jan. 8 1916	Jan. 15 1916
Prompt furnace	$3.00@3.50	$3.00@3.50	$3.25@3.50	$2.50
Prompt foundry	3.50@4.00	3.50@4.00	3.50	3.75@4.00

STEEL SHAPES FROM JOBBERS' WAREHOUSE, NEW YORK

	Jan. 14, 1916	Dec. 17, 1915	Jan. 15, 1915
	Cents per pound		
Steel angles base	2.50	2.40	1.85
Steel T's base	2.55	2.45	1.90
Machinery steel (bessemer)	2.50	2.40	1.80

The above prices are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger.

TURNBUCKLES—On sizes smaller than 1¼ in. diameter, 50% off list is charged, and on 1¼ up to 2 in. diameter 40%. At this rate prices follow:

Size	In.	Size	In.	Size	In.
⅜	$0.20	⅞	$0.375	1½	$0.90
7/16	.21	1	.44	1⅝	1.05
½	.225	1⅛	.50	1¾	1.20
⅝	.25	1¼	.75	1⅞	1.35
¾	.315	1⅜	.828	2	1.59

The above prices are for buckles having right and left stub ends and with openings between the heads measuring 5½ in.

ROLL SULPHUR in 360-lb. bbl, sells in New York at $2.15 per 100 lb.

COTTON WASTE—In New York, the prices below hold:

	Cents per Pound
White	8.50@9.50
Colored mixed	6.50@8.00

COPPER RIVETS sell at 35 and 5% off list and burs at 78½%.

WELDING MATERIAL (SWEDISH)—Prices are as follows:

Welding Wire

	Cents per Lb.
⅜, 11/32, 5/16, ¼, 7/32, 3/16	8.50
No. 8, 5/32 and No. 10	9.25
⅛	10.00
No. 12	11.00
3/32, No. 14 and 1/16	12.00
No. 18	14.00
No. 20	16.00

Special Welding Steel

⅛	33.00
3/32	30.00
1/16	28.00

Cast-Iron Welding Rods

	Cents per Lb.
¼ by 19 in. long	22.00
5/16 by 12 in. long	26.00
⅜ by 19 in. long	20.00
½ by 21 in. long	20.00

Vanadium Wire in Coils or Sticks

1/16	15.50
3/32	15.00
⅛	14.00
5/32	12.00
3/16 and larger	11.00

The above prices are subject to change according to quantity and shipment desired.

WROUGHT WASHERS—From New York warehouse the present quotations for round plate washers is $5 from list price. At this rate the following prices hold:

Diameter, In.	Price per 100 Lb.	Diameter, In.	Price per 100 Lb.
5/16	$9.00	1½	$4.30
⅜	7.20	1¾	4.20
½	6.40	2	4.10
1	5.50	2¼, 2½, 2¾	4.00
1¼	4.40	3¾, 4, 4¼, 4½	4.50
1⅛	4.80	3, 3¼, 3½	4.20

Cast-iron washers are $2.25 per 100 lb.

CARRIAGE BOLTS—On ⅝ by 6 in. and smaller 65 and 10% off list is allowed; for larger and longer sizes 60% off list is charged . At this rate the price per 100 is as follows:

Length	Diameter ¼	5/16	⅜	7/16	½	⅝	¾
1½ in.	$0.32	$0.44	$0.60	$0.88	....	....	....
2 in.	.35	.48	.65	.96	....	....	....
2½ in.	.38	.52	.70	1.04	$1.30	$2.30	$3.40
3 in.	.41	.55	.75	1.12	1.41	2.45	3.60
3½ in.	.44	.59	.80	1.20	1.52	2.60	3.80

MACHINE BOLTS—From New York warehouse, on sizes from ⅝ in. by 4 in. and smaller 70% off list is discounted; for larger and longer sizes 60% is allowed. These quotations are for bolts having square heads and square nuts. At this rate prices per 100 are as follows:

Length	Diameter ¼	⅜	⅝	¾	⅞	1 In.
1½ in.	$0.51	$0.72	$2.08	$3.08	$4.20	$6.04
2 in.	.53	.77	2.23	3.30	4.48	6.40
2½ in.	.56	.82	2.38	3.52	4.76	6.76
3 in.	.58	.86	2.53	3.74	5.04	7.12
3½ in.	.61	.91	2.69	3.96	5.32	7.48

Bolts, 1⅛ and 1¼ in. by 3 in. and up to 12 in. take 50% off list. On longer lengths a special pound price is quoted.

With cold-punched square nuts 50% is discounted from list, with hot-pressed hexagon nuts up to 1 in. by 30 in. 50 and 10%; up to 1 in. diameter, cold-punched hexagon nets 50%.

Buttonhead with hexagon nuts sell at 50% off list, as do hexagon head with hexagon nuts.

TAP BOLTS—The following are for delivery from New York warehouse, the present discount being 30% from list. These are for tap bolts with hexagon heads:

Length of Screw	Price per 100 Diameter ¼	5/16	⅜	7/16	½	⅝	¾	⅝	1
1½	$0.77	$0.88	$1.04	$1.23	$1.54	$2.31	$3.23	$4.62	$6.16
1¾	.81	.93	1.09	1.30	1.62	2.40	3.35	4.77	6.35
2	.85	.97	1.08	1.37	1.69	2.49	3.47	4.93	6.55
2¼	.89	1.02	1.20	1.44	1.77	2.58	3.58	5.08	6.73
2½	.93	1.07	1.26	1.52	1.85	2.68	3.70	5.24	6.93
2¾	.96	1.11	1.31	1.58	1.93	2.77	3.81	5.39	7.12
3	1.00	1.16	1.36	1.65	2.00	2.86	3.92	5.54	7.32
3¼	...	1.21	1.41	1.72	2.08	2.96	4.04	5.70	7.51
3½	...	...	1.47	1.79	2.16	3.05	4.16	5.85	7.70
3¾	...	...	...	1.86	2.23	3.13	4.27	6.00	7.89
4	...	...	...	...	2.31	3.23	4.39	6.16	8.09

ALUMINUM—Quotations are as follows in ton lots:

	Cents per Pound
No. 1 virgin 98-99%	53.00@55.00
Pure 98-99% remelt	51.00@53.00
No. 12 alloy remelt	43.00@45.00

Jobbers usually charge 2c. per lb. over the above figures.

WIRE ROPE—On this material the following discounts are for warehouse delivery, New York:

Galvanized	35 and 2½%
Bright	50 and 2½%
Special brands, bright	40%

BABBIT METAL—In New York, quotations are as follows:

Grade	Cents per Pound
Best	55@60
Commercial	25@30

COPPER SHEETS—Hot rolled 16 oz. (large lots) base per lb. is 30c.; cold rolled, 14 oz. and heavier, add 1c. extra per lb. to the above; polished takes 1c. per sq.ft. extra for 20 in. widths and under; add 2c. per sq.ft. for over 20 in.

OILS—Prime winter lard oil sells at 92@96c. per gal. in 5-bbl. lots; cottonseed crude, f.o.b. mill, 67c.; and linseed, raw, in carload lots, at 68c.

COLD DRAWN STEEL SHAFTING—To consumers requiring fair-sized lots the price is 25% off list.

TIN PLATES—The following prices are in effect from warehouse, New York:

Coke tin plate, 14x20:	Price per 100 lb.
100-lb.	4.45
I. C. 107-lb.	4.60

Terne plate, 20x28:

Base Weight	Net Weight	Coating	Price	Base Weight	Net Weight	Coating	Price
100-lb.	200	8	8.30	I. C.	226	20	13.50
I. C.	214	8	8.60	I. C.	231	25	14.25
I. X.	270	8	10.60	I. C.	236	30	15.50
I. C.	218	12	12.00	I. C.	241	35	17.00
I. C.	221	15	13.00	I. C.	246	40	19.00

COACH OR LAG SCREWS sell at 70 and 10% off list. At this rate the following prices hold:

Length	Price per 100—Conical or Gimlet Point ¼ and 5/16	⅜	7/16	½	9/16 and ⅝	¾	⅞	1
1½	.61	.73	.85	1.01	...	...	...	...
2	.66	.80	.94	1.11	1.62	...	...	...
2½	.715	.87	1.02	1.21	1.755	2.48	...	...
3	.67	.94	1.11	1.30	1.89	2.67	4.05	...
3½	.82	1.01	1.20	1.40	2.025	2.86	4.32	5.94
4	.88	1.08	1.28	1.50	2.16	3.05	4.59	6.29
4½	.93	1.15	1.37	1.595	2.295	3.24	4.86	6.64
5	.985	1.22	1.455	1.69	2.43	3.43	5.13	6.99
5½	1.04	1.29	1.54	1.79	2.565	3.62	5.40	7.34
6	1.09	1.36	1.63	1.89	2.70	3.81	5.67	7.695

RIVETS—On this product the following discounts from list and prices are in effect:

	Discount
Steel tank 7/16 and smaller	70%
Tinned	70%

	Price per 100 Lb.
Button heads, ¾, ⅞, 1 in. diam. by 2 in. to 5 in.	$4.00
Cone heads, above sizes	4.10

	Extra per 100 Lb.
1⅛ to 1¾ in. long, all diameters	0.25
⅝ in. diameter	0.15
½ in. diameter	0.50
1 in. long and shorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

NUTS—On hot pressed square nuts $4 off list is allowed and on hexagon $4.20. At this rate, the following prices hold:

Hot Pressed Square

Short Diam.	Per 100 Lb. Blank	Tapped
½	....	$11.00
⅝	$7.00	8.50
11/16	5.00	5.90
⅞	4.00	4.70
1¼	3.50	3.90
1 7/16, 1⅝, 1 13/16, 2	3.40	3.80
2 3/16	3.50	4.00
2⅜	3.80	4.40

Hot Pressed Hexagon

Short Diam.	Per 100 Lb. Blank	Tapped
½	....	$16.70
11/16	....	10.30
⅞	$5.40	6.40
1¼	4.20	4.80
1 7/16, 1⅝, 1 13/16, 2	4.10	4.70
2 3/16	4.20	4.90
2⅜	4.50	6.30

Semifinished nuts sell at 75% off list.

On cold-punched square nuts, $3.50 from list is deducted, and on hexagon, $4.50. At this rate the following prices hold:

Bolt	Cents per Pound — Square Blank	Square Tapped	Hexagon Blank	Hexagon Tapped
¼	16.50	18.50	22.50	25.00
5/16	14.50	16.00	19.50	21.50
⅜	11.00	12.10	14.00	15.60
7/16	10.50	11.40	13.50	14.80
½	7.80	8.50	9.50	10.50
9/16	7.80	8.40	9.50	10.40
⅝	6.50	7.00	8.00	8.70
¾	6.20	6.60	6.90	7.50
⅞	6.10	6.50	6.60	7.20
1	6.10	6.50	6.60	7.20

BOILER TUBES—From Pittsburgh the following are the less-carload basing discounts for lap-welded boiler tubes:

Size	Discount	Size	Discount
1¾ and 2 in.	57%	3½ to 4½ in.	66%
2¼ in.	54%	5 and 6 in.	59%
2½ and 2¾ in.	60%	7 to 13 in.	56%
3 and 3¼ in.	65%		

Above discounts apply to standard gages and to even gages not more than 4 gages heavier than standard. For long tubes charge 10% net extra as follows: 1¾ in. size over 18 ft. and not exceeding 22 ft.; 2 to 3 in. sizes over 22 ft. and not exceeding 24 ft.; 3¼ to 13 in. sizes over 22 ft. and not exceeding 25 ft.

NICKEL—Manufacturers quote the following prices:

	Cents per Pound
Ordinary grade	45.00
Electrolytic	50.00

BAR IRON—Prices are as follows at the places named:

	Cents per Lb.
Pittsburgh, mill	2.10
New York	2.20@2.25
From storehouse, New York	2.50@2.60

NAILS—Wire nails f.o.b. Pittsburgh sell at $2.10; galvanized 1 in. and longer, $4.10, and shorter, $4.60. These prices are to regular customers and delivery is made at the mill's convenience.

SWEDISH (NORWAY) IRON—This material sells at $4.25 base per 100 lb. f.o.b. New York. In coils an advance of 50c. is charged.

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

The Seavey Garage and Auto Supply Co. will build a 1-story, 50x70-ft. addition to its garage at Derry, N. H.

The contract has been awarded for the construction of a 2-story, 53x170-ft. garage for R. B. Grysmith, 1817 Commonwealth Ave., Boston, Mass.

The contract has been awarded for the construction of a 2-story garage at Boston, Mass., for the Mitten Estate. Estimated cost, $50,000.

Plans are being prepared for the reconstruction of the 2-story garage of the Thomas, Chauncey & Co., Inc., 101 Chestnut St., Boston, Mass. Estimated cost, $35,000. Noted Nov. 11.

George H. Walker has awarded the contract for the construction of a 3-story, 82x92-ft. garage at Boston, Mass. Estimated cost, $50,000.

Bids are being received by John C. Spofford, Arch., 15 Beacon St., Boston, Mass., for the construction of a 2-story garage at Brighton, Mass. (Boston post office), for the John D. Long Estate. Estimated cost, $30,000.

The contract has been awarded for the construction of a 4-story, 72x107-ft. reinforced-concrete factory at Cambridge, Mass., for the Simplex Wire and Cable Co. Estimated cost, $25,000. Noted Jan. 13.

Plans are being prepared by Morton & West, Arch., 16 State St., Boston, Mass., for 20 garages at Newton, Mass. Estimated cost, $40,000.

William E. Gove is constructing a 1-story, 62x73-ft. machine shop at 25 New Derby St., Salem, Mass. Noted Jan. 13.

The Quigley Furnace and Foundry Co. has awarded the contract for the construction of a 91x108-ft. foundry at Springfield, Mass. Noted Dec. 23.

The Chase Metal Works will construct an addition to its plant on Thomaston Ave., Waterville, Mass.

Plans are being prepared for the construction of a 1-story, 40x90-ft. garage at Worcester, Mass., for Ellen M. Clark. Estimated cost, $10,000. John P. Kingston & Son is Arch.

The contract has been awarded for the construction of a 1-story machine-shop addition to the plant of the Wyman & Gordon Co., at Worcester, Mass. Noted Dec. 30.

The United Wire and Supply Co. will construct a plant at Pawtucket, R. I.

The American Brass Co. is constructing a 1-story, 40x75-ft. factory at Ansonia, Conn. Estimated cost, $12,000.

The contract will soon be awarded for the construction of a 3-story, 100x150-ft. addition to the plant of the Rogers Silver Plate Co., at Danbury, Conn.

Fire recently damaged the plant of the Gong Bell Manufacturing Co., East Hampton, Conn.

The Billings & Spencers Co., manufacturer of forgings and tools, has awarded the contract for the construction of a 2-story, 50x97-ft. factory at Hartford, Conn.

The New York, New Haven & Hartford R.R. is constructing a 1-story, 33x80-ft. factory at Hartford, Conn., to be occupied by the Hartford Automobile Parts Co.

The contract has been awarded for the construction of a factory at New London, Conn., for the National Electric Bulletin Corporation, New York, N. Y., manufacturer of electric bulletin machines.

The Waterbury Manufacturing Co., manufacturer of brass goods, has awarded the contract for the construction of 2 additions, one, 1- and 2-story, 50x136- ft., other, 1-story, 39x90-ft., to its plant at Waterbury, Conn.

Fire, Jan. 6, damaged the plant of the Winsted Edge Tool Works, Winsted, Conn. The plant will be rebuilt.

MIDDLE ATLANTIC STATES

The Hopes Combustion Engineering Co., recently organized, will build a plant at Glens Falls, N. Y., for the manufacture of grates and boilers. Charles W. Hopes is Pres.

The Hancq Co., Jamestown, N. Y., recently incorporated with $50,000 capital stock, will construct a plant for the manufacture of textile machinery. S. Lawrence is interested.

The contract has been awarded for the construction of a 1-story, 50x100-ft. garage on Quincy St. near Stuyvesant Ave., New York, N. Y. (Borough of Brooklyn), for Simon Hock, 847 Gates Ave. Estimated cost, $10,000. Noted Dec. 16.

The contract has been awarded for the construction of a 2-story, 50x75-ft. garage for Albert H. Marquis, 311 Brandon Ave., New York, N. Y. (Borough of Brooklyn). Estimated cost, $15,000. Noted Dec. 9.

C. B. Meyers, Arch., 1 Union Sq., W., is preparing plans for a 6-story, 50x100.5-ft. garage on 57th St. near 3rd Ave., New York, N. Y. (Borough of Manhattan), for E. C. Burns, 201 West 71st St. Estimated cost, $20,000.

The Peerless Tube Co., manufacturer of collapsible tubes, has awarded the contract for the construction of an addition to its plant at Bloomfield, N. J. Noted Nov. 18.

The Universal Caster and Foundry Co., Newark, N. J., will improve and enlarge its plant at Ferry St.

The C. Pardee Works, Perth Amboy, N. J., manufacturer of steel billets and bars, will build a 1-story addition to its plant.

The Shelby Steel Tube Co. will improve and enlarge Mills A and B at its plant at Elwood City, Penn.

A new foundry will be constructed by the Franklin Foundry Co., Franklin, Penn.

The McKeesport Tin Plate Co., McKeesport, Penn., is building several additions to its plant. Noted Nov. 18.

The Pittsburgh Tool and Steel Wire Co., Monaca, Penn., is building several additions to its plant. Noted Oct. 28.

The Abrasive Metal Co., manufacturer of corundum and emery wheels, Philadelphia, Penn., has awarded the contract for the construction of a 2-story brick factory. Estimated cost, $50,000.

Bids will be received by Carl P. Berger, Arch., Penn. Square Bldg., Philadelphia, Penn., until Jan. 22, for a 10-story concrete garage on South Broad St. for the Pennsylvania Taximeter Cab Co. Estimated cost $300,000. Noted Jan. 6.

Plans are being prepared for a 3-story, 60x100-ft. service building at Scranton, Penn., for the Ford Motor Co. Estimated cost, $12,000.

The National Malleable Casting Co., Sharon, Penn., plans to increase the equipment in its plant.

The American Sheet and Tin Plate Co. will build an addition to its plant at Vandergrift, Penn., to be used as a sulphuric-acid plant.

George W. Eisenhauer, 1728 North Charles St., Baltimore, Md., has awarded the contract for the construction of a 2-story garage. Estimated cost, $20,000. Noted Dec. 30.

The contract has been awarded for the construction of a 2-story, 49x156-ft. garage at Baltimore, Md., for George W. Rife. Estimated cost, $25,000.

Plans are being prepared by Walter M. Gieske, Arch., Baltimore, Md., for the construction of a 100x150-ft. factory at Canton, Md., for the Baltimore Oil Engine Co., Dover, Del., recently incorporated with $1,050,000 capital stock. Leon Wygodsky is Vice-Pres. and Gen. Mgr.

SOUTHERN STATES

The Central Realty Co., Charlotte, N. C., will construct a 2-story, 94x170-ft. garage. Estimated cost, $37,000.

The Chevrolet Automobile Co., Flint, Mich., will construct an assembling plant at Atlanta, Ga.

The contract has been awarded for the construction of a 2-story garage at Chattanooga, Tenn., for E. M. Prigmore. Estimated cost, $20,000.

The John G. Duncan Co., 308 West Jackson Ave., Knoxville, Tenn., is in the market for a second-hand gasoline hoisting engine.

The North American Fluorspar and Lead Corporation, Smithland, Ky., desires prices on steam or oil-burning hoisting engines.

R. Ashurst, Somerset, Ky., is in the market for logging equipment, including cars, cables, locomotives, rails, drum hoisting engines, etc.

MIDDLE WEST

The General Ozone Co. of America will establish a plant at Akron, Ohio, for the manufacture of equipment for electrically purifying water.

The Buckeye Twist Drill Co. will build an addition to its plant at Alliance, Ohio.

The Carnegie Steel Co. is rebuilding blast furnace No. 1 at its Bellaire, Ohio, works.

The Dover By-Product Coke Co., Canal Dover, Ohio, is building a byproduct coke plant.

The contract has been awarded for the construction of a plant at Cincinnati, Ohio, for the American Tool Works. Estimated cost, $300,000. Noted Dec. 30.

Plans are being prepared by Elzner & Anderson, Arch., 135 Ingalls Bldg., for a garage and salesroom for the Graydon Estate, 152 East 4th St., Cincinnati, Ohio, to be leased by W. M. Moreland, 421 East 5th St. Estimated cost, $100,000. Noted Dec. 9.

Plans are being prepared by G. C. Burroughs, Arch., 1301 Union Trust Bldg., Cincinnati, for the construction of a 2-story, 60x160-ft. factory at Cincinnati, Ohio, for the Gruen Watch Manufacturing Co. Estimated cost, $40,000.

The Lunkenheimer Co. plans to construct a foundry at Cincinnati, Ohio.

Bids will soon be received for the construction of a 2-story, 125x400-ft. foundry and machine shop for the Oesterlein Machine Co. at Cincinnati, Ohio. Estimated cost, $750,00. William Oesterlein is Pres. Noted Jan. 6.

The Queen City Engineering and Machine Co., Cincinnati, Ohio, has purchased the plant of the Hickory Carriage Co., Cincinnati, and will improve it for the manufacture of lathes. New machinery will be installed.

A public garage and repair shop will be established on West Eighth St., Cincinnati, Ohio, by the Rudisell & Davis Motor Car Co.

Bids will soon be received by Anthony Kunz, Jr., Arch., 955 West Court St., Cincinnati, Ohio, for the construction of a 2-story, 65x85-ft. factory on Colerain Ave., Cincinnati, Ohio, for John Steptoe Shaper Co. Estimated cost, $20,000. Noted Jan. 13.

William L. Voight will construct a 2-story garage and salesroom at Cincinnati, Ohio. Estimated cost, $20,000. Zettle & Rapp, 607 Johnston Bldg., Cincinnati, is Arch.

We have been advised that the Cleveland Automatic Machine Co., 2269 East 65th St., Cleveland, Ohio, will build an addition to its plant for the manufacture of automatic machines and not shell-casting machinery as was noted in our issue of Dec. 23.

Preliminary plans have been prepared for the construction of a 2-story factory at Cleveland, Ohio, for the Cleveland Galvanizing Works. J. Carter, 1423 Illuminating Bldg., Cleveland, is Arch. Noted Dec. 23.

Bids are being received by Henry Hradilek, Arch., 1001 Illuminating Bldg., Cleveland, for the construction of a 2-story, 55x143-ft. garage at Cleveland, Ohio, for Vincent Geraci. Estimated cost, $11,000. Noted Jan. 13.

The contract has been awarded for the construction of a 1-story, 98x165-ft. factory at Cleveland, Ohio, for the Globe Machine and Stamping Co., 1240 West 79th St. Estimated cost, $12,000. Noted Jan. 13.

The Horseburgh Forging Co. has awarded the contract for the construction of 2 additions to its plant at East 51st St. and Hamilton St., Cleveland, Ohio. Noted Dec. 2.

The National Acme Manufacturing Co., manufacturer of screw machinery, will build a 1-story, 50x100-ft. addition to its plant at Cleveland, Ohio. F. G. Walker, Arch.

The contract has been awarded for the construction of a 40x150-ft. addition to the plant of the A. E. Russ Co., 5700 Walworth Ave., Cleveland, Ohio, manufacturer of beer pumps and fixtures.

The H. J. Walker Machine Shop and Foundry Co., recently incorporated, is establishing a plant on East 131st St., Cleveland, Ohio.

The West Steel Castings Co., 805 East 70th St., Cleveland, will build a 2-story, 60x100-ft. factory at Cleveland, Ohio, in the spring.

Preliminary plans have been prepared for the construction of a garage and service station at Cleveland, Ohio, for the Willys-Overland Co. Estimated cost, $50,000. J. N. Willys, Toledo, is Pres. Noted Nov. 25.

Carl R. Baker of the Windermere Garage Co., Cleveland, Ohio, will establish a sales garage and service station at 2344 Euclid Ave.

A. M. Wright has awarded the contract for the construction of a garage at Cleveland, Ohio.

We have been advised that the Ohio Metal Co. is constructing an addition to its smelting plant at Columbus, Ohio. Henry Loeb is Pres. Noted Jan. 6.

The contract has been awarded for the construction of a 1-story, 100x100-ft. factory with 50x50-ft. wing at Columbus, Ohio, for the Solar Metal Products Co. Estimated cost, $40,000. Noted Jan. 13.

The Miami Brass and Foundry Co. will build a 1-story, 40x105-ft. addition to its plant at Dayton, Ohio.

The Western Automatic Machine Screw Co. has awarded the contract for the construction of a 2-story, 50x200-ft. factory at Elyria, Ohio . Estimated cost, $25,000. Noted Dec. 30.

Plans have been prepared for the construction of additions to the plant of the Seneca Wire and Manufacturing Co., Fostoria, Ohio. Estimated cost, $100,000. Noted Jan. 13.

The Lumex Manufacturing Co., recently incorporated at New York, N. Y., with $100,000 capital stock, will construct a plant at Lima, Ohio, for the manufacture of a simplified motion-picture machine.

The Wright Manufacturing Co., manufacturer of chain hoists, will construct a 30x75-ft. addition to its plant at Lisbon, Ohio.

The Peerless Drawn Steel Co., Massillon, Ohio, is enlarging its plant. Noted Sept. 16.

The Mahoning Steel Products Co., Niles, Ohio, recently incorporated, will establish a plant in the old building of the Sykes Metal Lath and Roofing Co. on Walter St., for the manufacture of steel specialties. C. H. Lewis is Secy.

The contract will soon be awarded for the construction of the Bessemer furnace at Struthers, Ohio, for the Youngstown Sheet and Tube Co.

The contract has been awarded for the construction of a 1-story, 50x120-ft. garage for James Hildge, 1925 Parkwood Ave., Toledo, Ohio. Estimated cost, $12,000.

The West Carrollton Parchment Co., West Carrollton, Ohio, will be in the market for paper making machinery and transmission equipment. Noted Nov. 18.

Plans are being prepared by Walker & Weeks, Arch., Euclid Bldg., Cleveland, Ohio, for garage at Willoughby, Ohio, for F. E. Drury, Pres. of Cleveland Foundry Co., Cleveland.

The Brier Hill Steel Co., Youngstown, Ohio, has awarded the contract for the construction of 84 Koppers byproduct coke ovens.

A. M. Strauss, Arch., Bank Bldg., Ft. Wayne, Ind., preparing plans for garage at Hamilton, Ind., for Jnagy Bros. Estimated cost, $10,000.

The National Automatic Tool Co. has awarded the contract for the construction of a 1-story, 120x130-ft. factory at Richmond, Ind.

W. S. Butterfield will construct a 3-story garage on West Jackson St., Battle Creek, Mich. Estimated cost, $15,000.

The W. J. Burton Co., Detroit, Mich., will construct a factory at Detroit for the manufacture of metal ceilings and special iron work.

The Arthur Colton Co., manufacturer of pharmaceutical machinery, has awarded the contract for the construction of an addition to its plant at Detroit, Mich.

The Western Cartridge Co. has had plans prepared for the construction of a brass rolling mill and foundry at Alton, Ill.

An addition will be constructed to plant of the Aurora Foundry Co. at Aurora, Ill., which is operated by Love Bros.

Bids will soon be received for the construction of a 2- and 3-story, 120x176-ft. garage and machine shop at Milwaukee, Wis., for the Neacy & Read Investment Co. Estimated cost, $60,000.

Bids will soon be received by F. W. Andrae, Arch., Craeker Bldg., Milwaukee, for the construction of a 3-story, 50x150-ft. garage and repair shop at Milwaukee, Wis., for the Wallace Realty Co.

The Allis-Chalmers Co., West Allis, Wis., will construct a 1-story forge shop. Otto H. Falk, Pres.

WEST OF THE MISSISSIPPI

The contract has been awarded for the construction of a 1-story, 150x150-ft. garage at Minneapolis, Minn., for Clarkson Lindley, 301 Lindley Bldg. Estimated cost, $31,000.

The Serlis Motor Co., Kansas City, Mo., will equip a machine shop.

The Sportsman's Cartridge Co., Kansas City, Mo., will equip a plant for the manufacture of shrapnel and cartridges. L. A. Sherman is Vice-Pres.

The King Foundry Co., St. Joseph, Mo., will install additional equipment in its plant.

Bids will soon be received by William P. McMahon, Arch., Wainwright Bldg., St. Louis, Mo., for constructing a 2-story, 71x130-ft. garage at St. Louis, Mo.

The Chevrolet Motor Co., St. Louis, Mo., will enlarge its plant.

The Missouri, Kansas & Texas Lines, St. Louis, Mo., will expend about $90,000 for tools and equipment for its shops. G. E. Scott, St. Louis, Pur. Agt.

The contract has been awarded for the construction of an addition to the plant of the Quick Metal Stove Co., at 5025 Wilson Ave., St. Louis, Mo. Estimated cost, $6,500.

The St. Louis Brass Manufacturing Co., St. Louis, Mo., will build an addition to its plant.

WESTERN STATES

M. M. Wilkinson, 1027 Bellevue Ave., Seattle, Wash., will construct an automobile repair plant at 101 Broadway N., Seattle.

The contract has been awarded for the construction of a 50x150-ft. garage and machine shop at Lemoore, Calif., for B. Bauer.

Plans have been prepared for the construction of a 75x140-ft. garage and machine shop at 7th and Bonnie Brae St., Los Angeles, Calif., for the Wright-Callender-Andrews Co.

M. O. Ainsworth plans to construct a commercial garage and machine shop at West Chapman and Olive St., Orange, Calif.

The contract has been awarded for the construction of a 1-story reinforced-concrete garage on Pacific St., San Francisco, Calif., for E. and G. B. Podesta. Estimated cost, $15,000.

The Union Iron Works has awarded the contract for the construction of an addition to its plant and remodeling its foundry at San Francisco, Calif. Estimated cost, $100,000. John A. McGregor is Pres. Noted Nov. 25.

CANADA

The William Kennedy & Sons, Ltd., Owen Sound, Ont., has taken over the plant of the Northern Iron and Steel Co., Collingwood, Ont., and will improve the plant and install new machinery.

The Hammant Steel Car Co. contemplates the construction of an addition to its plant on Kenilworth Ave., Hamilton, Ont. J. Marsella is Mgr.

Bids are being received by John Coulter, Port Elgin, Ont., for the construction of a garage.

A. J. Bates, of the McConkey-Bates Co., Stratford, Ont., plans to construct a factory for the manufacture of corrugated iron.

The Canada Metal Co., Ltd., is constructing an addition to its plant on Fraser Ave., Toronto, Ont. Estimated cost, $25,000. Noted Jan. 13.

GENERAL MANUFACTURING

NEW ENGLAND STATES

It is reported that Daniel E. Cummings, Pres. of the McGilvery-Cummings Co., Pittsfield, Me., plans to establish a shoddy mill at Webster, Me.

The E. C. Bradley Co., manufacturer of brush handles, South Worthington, Mass., purchased the buildings of the Stowel Manufacturing Co., at Putney, Vt., and will move to new buildings and install new machinery.

The West Boylston Co., manufacturer of cotton goods, has awarded the contract for the construction of a 3-story, 120x600-ft. addition to its spinning mill at Easthampton, Mass. Noted Jan. 6.

Fire, Jan. 4, damaged the plant of the Twentieth Century Dye Co., at Lynn, Mass. Loss $5,000.

The Stoddard Rubber Co. is constructing an addition to its plant at Millbury, Mass.

Fire, Jan. 9, destroyed the tannery of the Thomas H. O'Shea Co., at Peabody, Mass. Loss, $250,000.

The contract has been awarded for the construction of a 3-story, 60x100-ft. addition to the plant of the Melburne Leather Co. at Salem, Mass.

The contract has been awarded for the construction of an addition to the Stevens Linen Works, Webster, Mass.

The American Paper Tube Co. has awarded the contract for the construction of a 4-story, 55x166-ft. factory at Woonsocket, R. I.

It is reported that a bleachery to be known as the Robertson Bleachery will be constructed at New Milford, Conn. Estimated cost, $800,000.

MIDDLE ATLANTIC STATES

We have been informed that the plant of A. V. Morris & Son, manufacturer of knit goods, Amsterdam, N. Y., recently destroyed by fire with a loss of $100,000, will not be rebuilt. Noted Jan. 6.

Bids will soon be received for a 10-story cold-storage plant at 10th Ave., Marginal, 16th and 17th St., New York, N. Y. (Borough of Manhattan), for the Merchants' Refrigerating Co., 7 Harrison St. Estimated cost, $1,000,000. J. B. Smooks sons, 261 Broadway, Arch.

The plant of the Fords Porcelain Works, Fords, N. J., recently destroyed by fire with a loss of about $60,000, will be rebuilt on a larger scale.

The R. H. Shreve Co. has acquired a site at the foot of St. Paul's Ave., Jersey City, N. J., and will construct a plant for the manufacture of aniline and kindred specialties.

The Stewart-Hartshorn Co., Harrison, N. J., manufacturer of shade rollers, will establish a machine shop at Millburn, N. J.

Fire, Jan. 5, destroyed the plant of the Lake Ruth Manufacturing Co., Outcault, N. J. (Helmetta post office), manufacturer of rubber specialties. Loss unknown.

The contract has been awarded for the construction of a 4-story, 100x300-ft. addition to the August Silk Mill, Madison Ave., Paterson, N. J. Estimated cost, $60,000.

The George W. Blabon Co., manufacturer of oilcloth, Nicetown, Philadelphia, Penn., has awarded the contract for the construction of 3 factory buildings, including a 2-story pump house.

SOUTHERN STATES

An addition will be built to the plant of the Stehli Silk Corporation, High Point, N. C. Estimated cost between $10,000 and $15,000.

The W. S. Gray Cotton Mills, Woodruff, S. C., will construct a 2-story, 65x100-ft. addition to its plant.

The Woodruff Cotton Mills, Woodruff, S. C., has awarded the contract for the construction of an addition to its plant. Noted Dec. 30.

An addition will be built to the plant of Hirsch & Spitz, Atlanta, Ga., manufacturer of mattresses.

A company will be formed by Laurens County Farmers' Union at Dublin, Ga., to build a meat-curing and cold-storage plant.

Press reports state that W. H. Smith contemplates the construction of a rope and twine mill at Jefferson, Ga.

MIDDLE WEST

The contract has been awarded for the construction of 2 factory buildings at Akron, Ohio, for the Goodyear Tire and Rubber Co., South Main St., Akron. Estimated cost, $50,000.

The contract has been awarded for the construction of an addition to the plant of Mersman Bros. & Brandt, manufacturer of furniture, Celina, Ohio. Estimated cost, $15,000. Noted Nov. 18 and Dec. 30.

The Queen City Bottling Works has awarded the contract for the construction of an addition to its plant on Corwine St., Cincinnati, Ohio. Noted Jan. 13.

J. H. Hahn Co., manufacturer of corrugated paper cases, has awarded the contract for the construction of a 1- and 2-story, 120x400-ft. plant at Cleveland, Ohio. Noted Dec. 23.

Henry A. Lindsley, manufacturer of paper fiber, 1366 West 70th St., Cleveland, Ohio, will construct a factory on West 116th St., Cleveland.

The Willard Storage Battery Co. will construct 11 factory buildings at Cleveland, Ohio. T. A. Willard, East 131st St., Cleveland, Gen. Mgr.

Bids will soon be received for the construction of a 5-story plant on North 5th St., Columbus, Ohio, for the Central Ohio Paper Co. Estimated cost, $35,000. Noted Dec. 9.

The contract has been awarded for the construction of an addition to the plant of the Columbus Oilcloth Co., North Grant Ave., Columbus, Ohio. Noted Jan. 6.

Plans have been prepared by W. C. Owen & Co., Arch., Leader-News Bldg., Cleveland, Ohio, for the construction of a 2-story factory at Kent, Ohio, for the Mason Tire and Rubber Co. Estimated cost, $60,000. Noted Dec. 16.

The New York-Cleveland Chemical Co. has purchased 50 acres of land along the Youngstown-Girard Rd., Youngstown, Ohio, for the construction of a chemical plant.

WEST OF THE MISSISSIPPI

Plans are being prepared for a plant on Roberts St., St. Paul, Minn., for Foot, Schulze & Co., manufacturer of boots and shoes. Estimated cost, $500,000.

The Kansas Chemical Manufacturing Co., Hutchinson, Kan., plans to enlarge its plant. Estimated cost, $50,000.

The Great Western Sugar Co., Denver, Colo., will build a sugar-refining plant at Burlington, Wyo.

The Major Stave Co., Ashdown, Ark., will equip a stave plant at Camden, Ark. R. E. Major is Gen. Mgr.

The Southland Cotton Oil Co., Decatur, Tex., will rebuild its mill which was recently destroyed by fire, at a loss of $80,000.

The Reed and Thornton Rotary Subsoil Plow and Tractor Co., Ft. Worth, Tex., will build a plant. Estimated cost, $500,000.

F. W. Hustmyer and A. H. Prince, of the Orange Grocery Co., Orange, Tex., are interested in the establishment of a cannery.

A. N. Deering, Waco, Tex., and associates plan construction of cotton-seed oil mill at Waco. Estimated cost, $75,000.

The Interstate Compress Co., Altus, Okla., will rebuild its plant, which was recently destroyed by fire. Work will be started about Apr. 1. Estimated cost, $100,000. R. A. Rooker is Supt. Noted Dec. 30.

Bids will be received about Feb. 1 by J. J. Brown, Jr., Gen. Mgr., for oil refinery for the Planet Oil Co., Blackwell, Okla. Estimated cost, $30,000. Noted Jan. 6.

The Boynton Refining Co., Boynton, Okla., will equip a refinery of 1,500 bbl. daily capacity.

The Pierce Oil Corporation, Sand Springs, Okla., will build a paraffin plant in connection with its refinery. Estimated cost, $800,000.

The Pierce Oil Corporation, St. Louis, Mo., plans to build a factory at Tulsa, Okla., for making paraffine, etc. Estimated cost, $800,000.

The Pueblo Saddle Tree Co., Pueblo, Colo., contemplates building a larger factory.

WESTERN STATES

The Parker Match Co., Steilacoom, Wash., contemplates building an addition to its plant at Steilacoom.

The Imperial Valley Hardware Co. has awarded the contract for the construction of a factory at 2nd St. and Rockwood Ave., Calexico, Calif. Estimated cost, $45,000.

The San Antonio Growers' Association will build a packing plant at Ontario, Calif. Estimated cost, $40,000. C. McWhitney is Secy.

The Union Ice Co. contemplates the construction of a pre-cooling plant on 7th St., Redlands, Calif. Estimated cost, $75,000. M. H. Robins is Vice-Pres.

The Pacific Box Co. will construct an addition to its plant at North Beach, San Francisco, Calif. S. L. Hyman is Mgr.

CANADA

The Weeden Chemical Co. will rebuild its plant at Weeden, Que., which was recently destroyed by fire with a loss of $10,000.

The William Gray Carriage Co., 78 William St., Chatham, Ont., will rebuild its factory, recently destroyed by fire. New machinery will be installed.

Fire recently destroyed the plant of the Jamestown Table Co., Jamestown, Ont. Loss, $12,000.

The Ontario People's Salt and Soda Co. will construct an addition to its plant at Kincardine, Ont. Estimated cost, $10,000. J. Tolmie is Mgr.

Plans are being prepared for enlarging the plant of the Parnell Steam Baking Co., London, Ont., and installing new machinery. Estimated cost, $50,000. E. Parnell, Bruce St., London, is Mgr.

The Cadwell Sand and Gravel Co., Ltd., will construct a factory at Sandwich, Ont. Estimated cost, $50,000.

The Whitby Silk Mills, Ltd., will construct a factory at Whitby, Ont. Estimated cost, $50,000.

Classified Advertising

The Classified Advertising section appears on pages 167, 168, 169, of this issue and will in future appear in the same relative position in the paper.

American Machinist

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VOLUME 44 JANUARY 27, 1916 NUMBER 4

CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormay processes, protected by United States patent issued June 22, 1915, and another pending

NUMBER OF COPIES PRINTED THIS ISSUE, 22,500
This includes the English Edition. None sent free regularly, no returns from news companies, no back numbers.

Talks With Our Readers

By the Publisher

Jan. 18, 1916.

WYLIE B. JONES ADVERTISING AGENCY, BINGHAMTON, N. Y.

Gentlemen:—

We have your letter of Jan. 14, containing your order for an advertisement of the Lestershire Spool Mfg. Co., for wooden shrapnel plugs. We thank you for this, but we are obliged to return it to you, together with the blueprint. The advertisement is not in our line and we cannot accept it.

It may seem strange to you that we should do this, but the American Machinist is an engineering paper devoted to one particular line—only to the design and construction side of the machinery business.

We appeal only to the men responsible for results in machine-making plants, and allow no advertising in the American Machinist except for machine-shop equipment.

We are sending to you, under separate cover, a copy of the American Machinist, and ask you to look through it. You will find there only concerns making machine-shop equipment; you will find nearly all of the best concerns making this kind of equipment; and you will also note that every one of them has a direct message to send to the machine-making industry, and practically every one sends this message in an interesting and informing way.

It is true that you will find machines for making shrapnel, cartridge cases, etc. These are machine shop *products* the same as locomotives or typewriters, and are made by machine tools which are advertised. But the products can not be advertised.

For the same reason that we do not want the advertising of shrapnel plugs, we do not want the advertising of office furniture, typewriters, watches, or any other of the thousand and one things that are the product of machine shops or are used in the distribution of machinery.

There has been so much waste of money in advertising that has not been properly placed that we do not want to be a party to it. We do not want a dollar from the pocket of any advertiser until he has made more than a dollar of profit from our paper.

No doubt you think this is very queer business on our part, but we do not do everything here just for business. We have some old-fashioned principles about our paper, and one of them is to give readers and advertisers both just what we say we will give them.

We want our readers, when they take up a copy of the American Machinist, to know and realize that there is nothing foreign to distract their attention—nothing but news and information about their work.

We thank you for sending us this order, and hope that whenever you have anything directly in our line we will hear from you.

Yours very truly,
MASON BRITTON,
Manager

Millholland Turret Lathe

SYNOPSIS—This machine is, as a whole, no radical departure from established lines, yet it embodies many original features developed during the experience of its designers. With these features are combined well-known devices. Safety, convenience and durability have apparently been the ideas kept uppermost in mind during its construction.

There are numerous features incorporated in a new machine, shown in Fig. 1, that will at once appeal to the practical user. This machine is the latest product of the W. K. Millholland Machine Co., Indianapolis, Ind., and is the combined result of two generations of engineering and mechanical experience—father and sons. While every dangerous moving part has been guarded, the guards have been hinged or made otherwise easily removable so as to cause the minimum of inconvenience to the operator.

Taking up the description of the various parts of interest, the headstock, shown in detail in Fig. 2, has a three-step cone pulley and double friction back gears in addition to the friction between the cone pulley and the drive gear. This combination gives nine spindle speeds, with three speeds available without shifting a belt. The steps of the cone pulley are of large diameter, wide face and so proportioned as to transmit the maximum power with the proper spindle speeds. Die-cast bearings are used throughout, as indicated in the illustration. The solid, high-web type of casting makes a rigid form of head.

The spindle is forged from high-carbon steel and ground to size. The bearings are die-castings of a special high-grade babbitt and are carefully scraped and fitted. They are of generous proportions. Sight-feed oilers are provided for lubricating. The spindle nose is of large diameter, threaded and provided with a pilot end. It is so constructed that the overhang for either bar chuck or casting chuck is reduced to a minimum. Adjusting collars with hardened and ground thrust washers are provided to take up the end thrust.

The automatic chuck and bar feed, operated by the long lever shown on the front of the bed just below the headstock, grips or releases the work instantly. One movement of the lever opens the chuck and feeds the bar without stopping the machine. A stepped wedge, shown in Fig. 3, operating the fingers automatically compensates for slightly varying sizes of stock. The ends of the fingers are fitted with rollers to reduce the friction. The bar chuck is provided with a master collet of the push-out type, adapted for taking bushings for different diameters of stock. The bushings can be changed without unscrewing the collet hood by inserting a socket wrench through the opening in the hood and loosening the screws that hold the bushings in place. The collet hood, master collet and bushings are hardened and ground to gage, so that they interchange and can be duplicated whenever required. Extra capacity chucks or fixtures can be readily attached to the spindle nose in place of the collet hood.

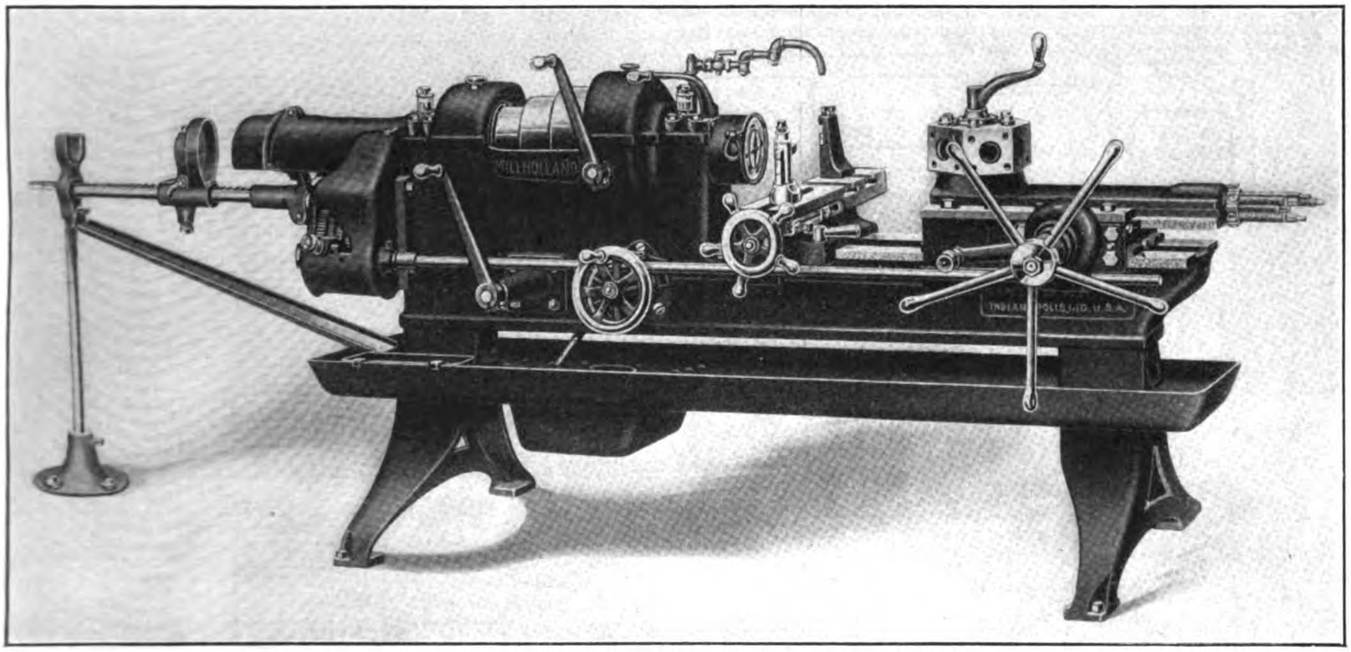


FIG. 1. THE MILLHOLLAND TURRET LATHE, INCORPORATING SEVERAL INTERESTING FEATURES

Feed Box, Cutoff Slide, Turret Slide and Saddle

The gears in the feed box are of heat-treated steel. Eight different feed changes are available. Four changes are obtained by means of the tumbler lever, and these are doubled by means of the pull pin at the end of the feed box, as shown in Fig. 4. This illustration is a detail view of the complete feed-box layout and connections.

The cutoff slide and the accompanying mechanism, shown in Fig. 5, have broad flat bearings well gibbed to insure rigidity under heavy forming and turning cuts. The hand longitudinal adjustment is provided with a large-diameter dial and with adjustable clips, so that different shoulder lengths can be accurately duplicated. This illustration also shows a cross-section of the bed.

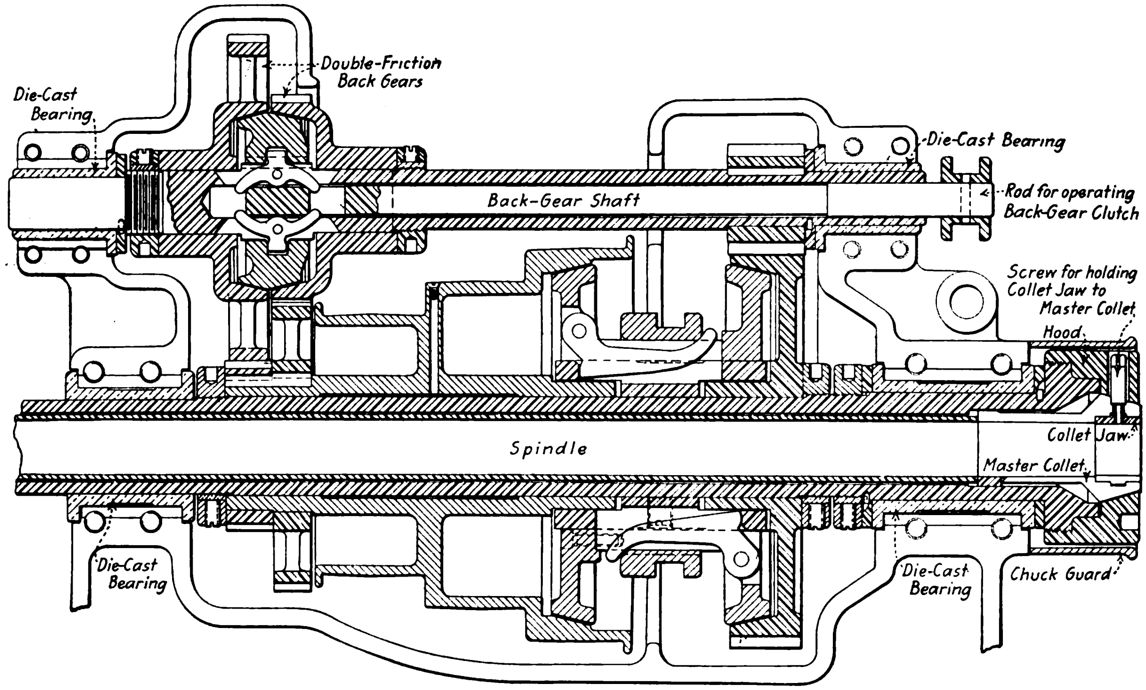


FIG. 2. PLAN VIEW OF HEADSTOCK OF MILLHOLLAND TURRET LATHE

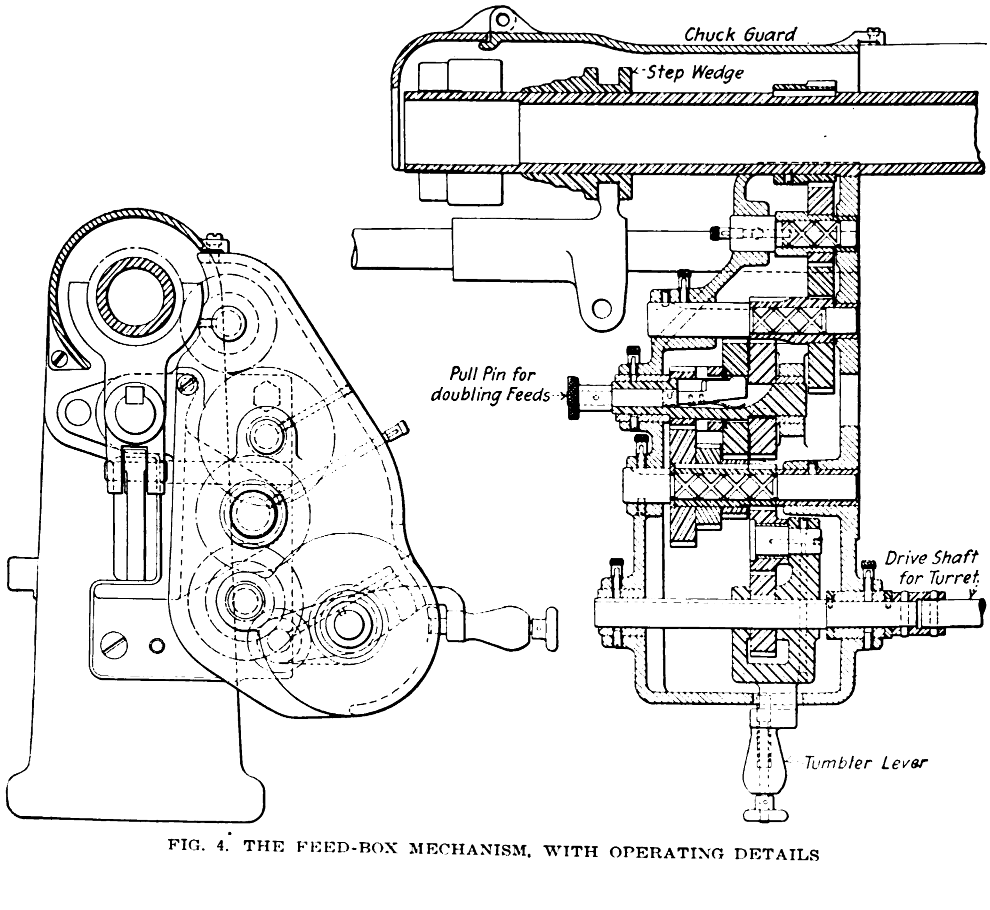


FIG. 4. THE FEED-BOX MECHANISM, WITH OPERATING DETAILS

The turret-slide and saddle unit, shown in Fig. 6, is provided with a supplementary taper base and taper gibs for vertical and horizontal adjustment. The turret is a solid hexagon, though a hollow hexagon will be furnished on order. The turret slide is operated by a turnstile rack and pinion. The turret is automatically indexed by the backward movement of the slide and is held firmly in its seat by the large steel stud upon which it revolves. This stud is tapered, is provided with adjustment for taking up wear and is bored so that long stock can pass through the turret, thus allowing long stiff tools to be used. The lock bolt is made of special steel, hardened, ground and lapped. It is operated vertically and locks into tapered holes in the hardened and ground steel bushings. The locking takes place at the front end of the slide almost directly under the working tool.

The tool holes in the solid-hexagon turret are regularly 1¾ in. in diameter, with binder bushings for holding round-shanked tools. Each face of the turret also has four tapped holes $\frac{9}{16}$ in. in diameter for tool-bolting purposes. The tool holes may be bored to any specified sizes. The turret feed is engaged by a friction clutch, and the lever for engaging the feed is located in the most convenient place for the operator. Eight feed changes, obtained through the feed box as previously mentioned, are automatically tripped by the independent adjustable stops. These stops operate automatically for each position of the turret. They are threaded their full length and are readily adjustable for the length of each cut to be taken. Each stop is provided with a binder for clamping it in position when set.

The oil pan is of pressed steel, to eliminate the possibility of breakage. The oil reservoir is of cast iron bolted to the pan and is fitted with a strainer to prevent chips from entering. A screw plug in the bottom provides means of cleaning. A partition in the reservoir prevents sediment from entering the pump. The oil pump is driven by a belt from a pulley on the countershaft and operates when running in either direction. It delivers through two pipe lines. An item of construction worth noting is that the lagscrew holes are so placed in the legs that the screws may be put in with a socket wrench.

The principal dimensions of this machine are as follows: Swing over bed, 18 in.; swing over cutoff, 9 in.;

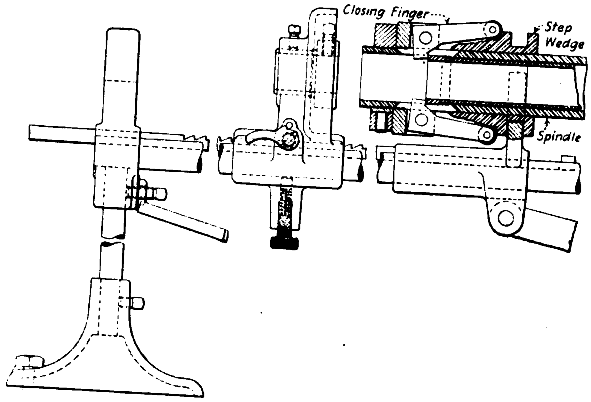


FIG. 3. REAR END OF SPINDLE AND BAR-FEED MECHANISM WITH AUTOMATIC CHUCK

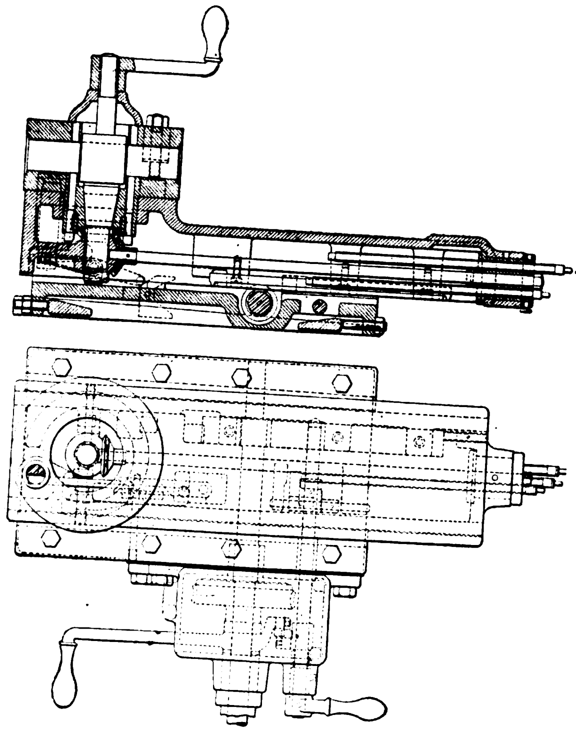


FIG. 6. DETAILS OF TURRET AND SLIDE

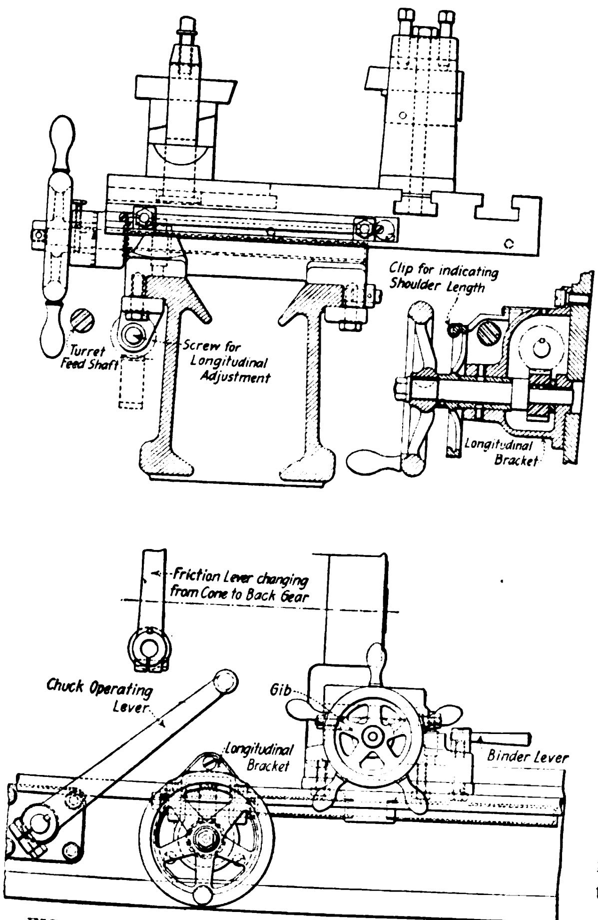


FIG. 5. OPERATING LEVERS AND CUTOFF SLIDE

capacity of automatic chuck, 1⅝-in. round stock; size of hole in automatic chuck plunger, $1\frac{1}{16}$ in.; threading capacity on soft machinery steel, with self-opening die-head, U. S. Standard or Whitworth thread, 1½ in.; hole through spindle, $2\frac{1}{32}$ in.; diameter of thread on spindle nose, 5¼ in.; pitch of thread on spindle nose, 6; diameters of three-step driving cones, 8, 10 and 12 in., using double belt 3 in. wide; double back-gear ratio, 2.86 to 1 and 8 to 1; speeds, nine in number, ranging from 54 to 345 r.p.m.; total travel of crossfeed, 9 in.; total longitudinal travel, 11 in.; diameter of solid-hexagon turret, 9 in.; tool-hole diameter, 1¾ in.; size of tapped holes in turret faces, $\frac{9}{16}$ in.; feeds, eight, ranging from 0.0038 to 0.048; from center of holes in turret to top of slide, 3⅜ in.; effective turning movement of turret at any one time, 10 in.; greatest distance from face of automatic chuck to turret face, 27 in.; width of bed, 9 in.; double friction countershaft speed, 230 r.p.m.; friction pulleys, 12-in. diameter and 4-in. face; net weight, 2,500 lb.

Welding Sheet-Metal Parts with the Oxyacetylene Torch

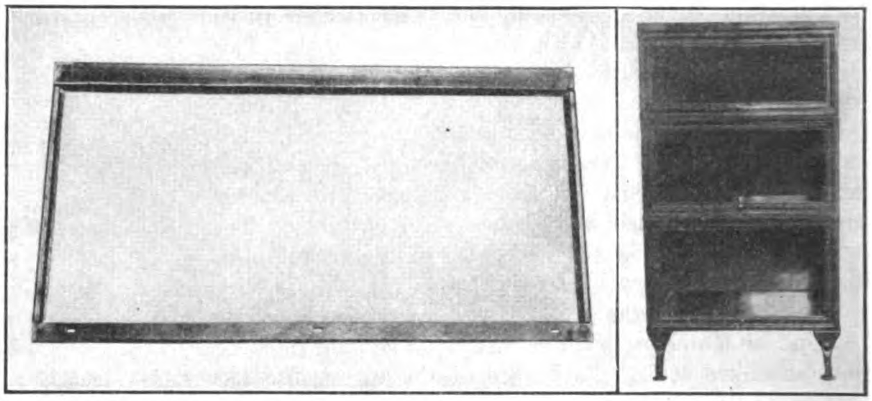
The Terrell Equipment Co., Grand Rapids, Mich., makes a specialty of manufacturing sheet-steel parts. During the process of manufacture the welding torch plays an important part.

In Fig. 1 is shown a 12-in. wide by 60-in. high locker frame. This part is made from 1-in. wide steel, No. 16 gage thick. After the elements have been cut to length they are held in a fixture and the corner miter joints welded.

Description of Welding Fixture

A view of the fixture used when welding a 36x72-in. front cupboard frame, is shown in Fig. 2. It is made with right-angle supports *A* which line up the elements squarely. The clamp *B* is then fastened over the frame to hold the parts securely. It will be observed that the end of the clamp is made with a slot so that the flame can be directed near the joint when welding.

A view of the fixture set up on the stand with a frame in position is shown in Fig. 3. It will be seen that the fixture is placed at a convenient height for the welding operation. Under the table is a ball joint *A*, so that the fixture may be easily swung around to suit the operator.



FIGS. 4 AND 5. WELDED BOOKCASE TOP AND COMPLETE CASE

The time required for making these four-corner welds is 1½ min., using a No. 3 tip, and the gas consumed is 0.23 cu.ft. of oxygen and 0.2 cu.ft. of acetylene.

A Welded Bookcase Top and Welded Lockers

A bookcase top which has been welded is shown in Fig. 4. After the steel has been formed to the correct contour, size welds are made in each corner. The time required is 3 min. Using a No. 1 tip, the gases consumed are 0.17 cu.ft. of oxygen and 0.16 cu.ft. of acetylene.

A view of a finished bookcase is shown in Fig. 5. The upper section measures 24x10 in., the middle section 24x12 in.; the lower section is 24x14 in., and the depth is 12 in.

It will be observed that all the corner joints have been welded and the finished article presents a neat appearance, which would not be possible if rivets had been used.

A set of three lockers on which the welding torch has been used to advantage is shown in Fig. 6. Each section measures 15x12 in. by 72 in. high, and all the corners have been welded, as shown in a previous illustration. The gases consumed when welding this part are 9 cu.ft. of oxygen and 8 cu.ft. of acetylene, using a No. 3 tip.

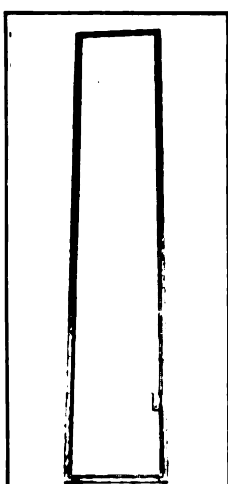


FIG. 1 WELDED LOCKER FRAME

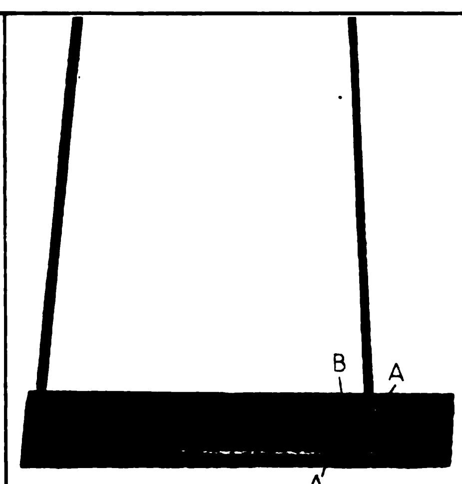


FIG. 2. THE WELDING FIXTURE IN USE

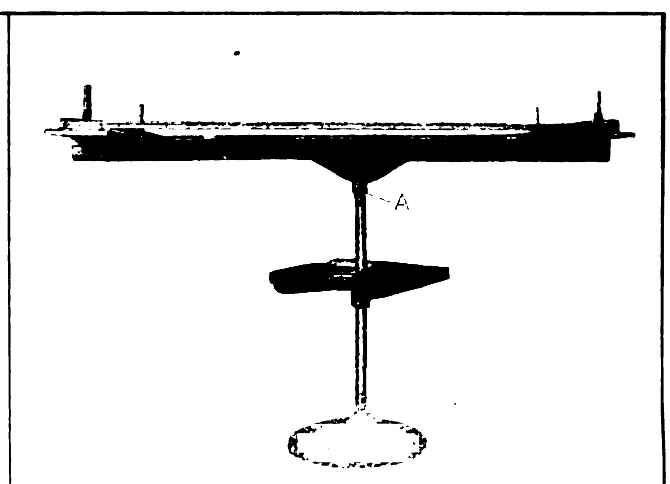


FIG. 3. THE FIXTURE SET UP IN POSITION ON THE WELDING STAND

It will be observed that the welded sheet-metal parts present a very neat appearance. It has also been found in practice that the joints made are amply strong for any strain put upon them and can also be made as quickly.

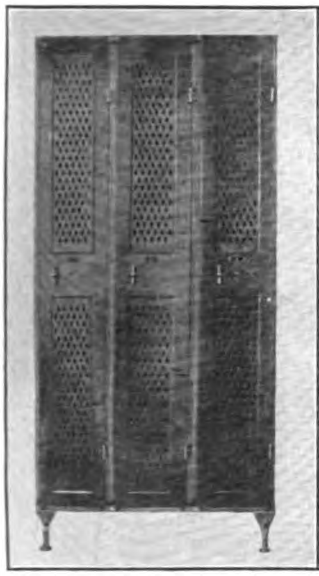


FIG. 6. SET OF WELDED LOCKERS

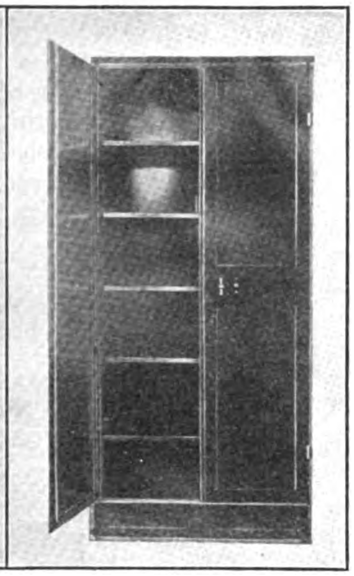


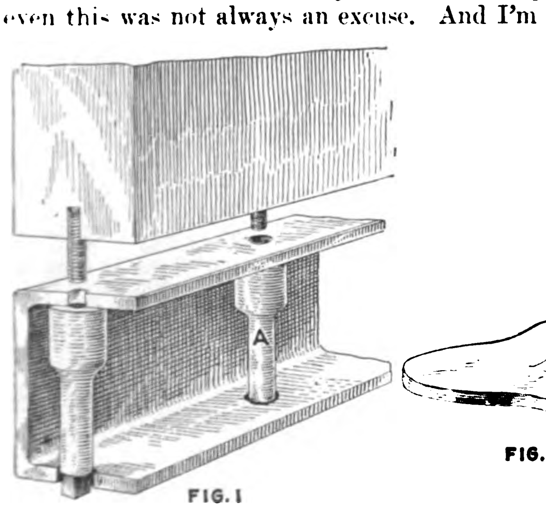
FIG. 7. A COMPLETELY WELDED WARDROBE

A welded wardrobe is illustrated in Fig. 7. It measures 36x15 in. by 72 in. high and has five shelves. All corner joints are welded. With a No. 1 tip the gases consumed are 3.5 cu.ft. of oxygen and 3.25 cu.ft. of acetylene. The apparatus is the Davis-Bournonville.

Designing Machinery Without Proper Shop Knowledge

By Frank C. Hudson

An old man I used to know in the shop always said that no man had any business in the drawing room until he had worked several years in the shop, and that even this was not always an excuse. And I'm inclined to



TWO EXAMPLES OF POOR DESIGN

agree with him. Not that shopwork makes an inventor, or even a designer, but it does show a man what sort of things can be made commercially in the shop. It teaches him to use a round hole that can be drilled instead of an oblong- or square-ended opening when the lathe is not absolutely necessary. A little study of some of the drawings for fuses which have been published shows very clearly that no shopman had a hand in designing them.

The automobile game has developed many examples of how not to do it, largely because the designers never worked in the shop and have no notion of how little things count in making repairs. In fact much of the designing seems to be done on the assumption that no repairs will be needed. Of course there is nothing like lofty ideals, but radiators will spring a leak, oil and water pumps clog and magnetos lose their "pep," once in a while. And when they do, it's mighty convenient to be able to fix them up without entirely dissecting the car, especially if it's a cold, stormy night and you are seven miles from nowhere.

I had a little cycle car come in for repairs the other day. It showed two examples of this kind. It is a good little bus and these defects in design do not interfere with its running. The radiator had an unhappy way of leaking pretty consistently, and while the soldering only took about 15 min. it took about 2 hr. to get the radiator off the car. Fig. 1 shows how it was fastened, but not how really difficult it was to take off. The channel is across the front of the car, with the opening at the rear, and here unfortunately are the motor and all its connections.

A man with a long, thin arm could just manage an open-end wrench and get about a sixth of a turn without hitting the pan or the side frame. It looked perfectly easy on the drawing board, but it's different in the garage. As the owner is a friend of mine and I'm likely to have this car come in again, I drilled holes in the bottom flange and made a couple of elongated nuts, as shown at *A*. These can be slipped through the lower flange before the radiator goes on and then screwed up from the front without any trouble. Of course the short studs could have been replaced by longer ones, but with my facilities the way shown looks the easiest for the job.

At the same time I found the front plate over the timing gears, Fig. 2, broken around the hub for the crank handle. This was a very thin plate of aluminum, while the hub was rather long and heavy. There was apparently no strain on it in starting the motor, but the hub broke off just the same. I welded it back in place very neatly, using the oxyacetylene torch, and it is stronger than ever, as I ran in quite a large fillet. The two sections were too unlike to be together, particularly in aluminum. It's a safe bet the designer never worked in the shop.

Influence of Oxidation on Steel—The extent to which steel is subjected to oxidation during its manufacture influences the tendency to unsoundness. In general, it was stated in a paper presented before the International Engineering Congress, the bessemer process oxidizes the steel to the greatest

Process	Nature	Remarks
Bessemer (generally baby vessels)	Acid	Very oxidizing
Openhearth	Basic	Generally thought to be less oxidizing than the bessemer
Openhearth	Acid	Less oxidizing than either of the above
Crucible	Acid	Hardly oxidizing at all
Electric	Acid Basic	Not oxidizing. Oxidation of steel made by other processes may be corrected by final treatment in the electric furnace

extent, the open-hearth process to a less degree, the crucible process to a still less degree and the electric-furnace process least of all. The processes by which the steel may be made and their more marked characteristics are shown in the accompanying tabulation.

Machining Details Used on a Two-Sheet Rotary Press

SYNOPSIS—When machining the vibrating-roll side frame the operations are performed on jigs designed to hold right- and left-hand parts.

The two-sheet rotary printing press described on page 58 is made by the United Printing Machinery Co., Woonsocket, R. I. On page 56 were shown some of the jigs and fixtures used in manufacturing the press. In this article are shown tools used for machining four other details used on the same printing press. It will be observed that these like those shown in the preceding article are examples of high-grade special small-tool jig and fixture design and construction used in a modern shop.

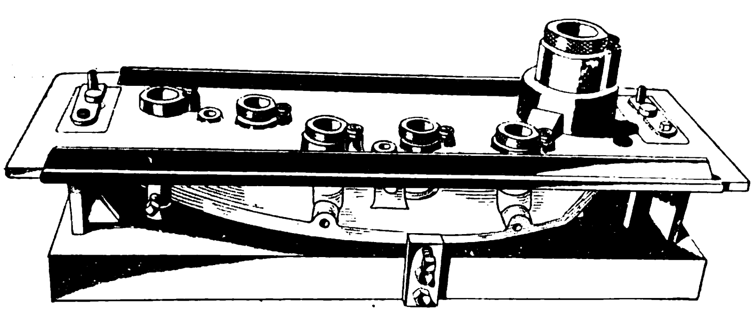


FIG. 2

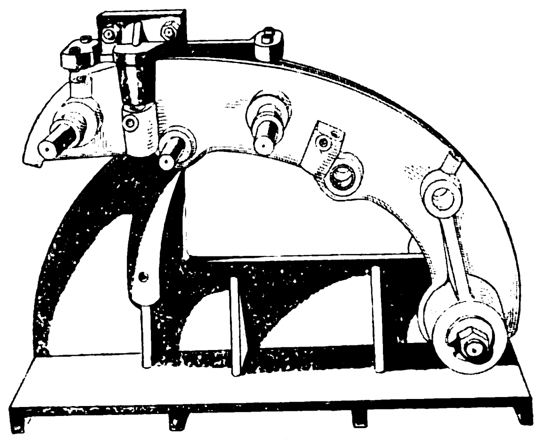


FIG. 3

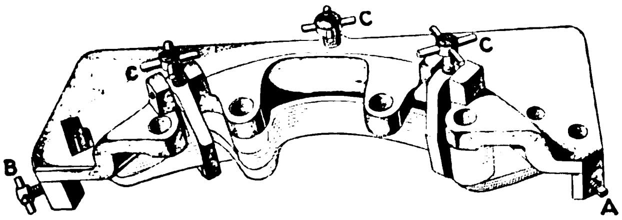


FIG. 5

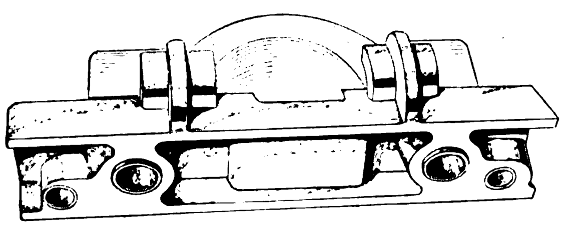


FIG. 7

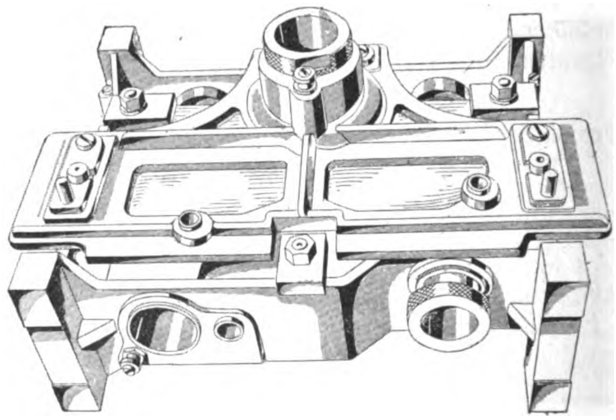


FIG. 9

DETAILS OF JIGS USED IN MACHINING PRINTING-PRESS ELEMENTS WITH THE WORK IN POSITION

FIGS. 2 AND 2-A

Operation—Drilling holes in face of vibrating-roll side frame, Fig. 1. The casting is forced against the locating screws with setscrews and held down with a clamp. The cover is then placed over the casting. The pin A and the jig plate are dropped into the second position B for the second setting.

Holes Machined—One $2\frac{1}{2}$-in. drilled and reamed $2\frac{5}{8}$ in., five $1\frac{11}{32}$-in. drilled and reamed $1\frac{3}{8}$ in., two $\frac{15}{32}$-in. drilled and reamed ½ in.

FIGS. 3 AND 3-A

Operation—Drilling holes in edge of vibrating-roll side frame. The castings, one right-hand, one left-hand, are located by plugs A fitting in holes reamed in previous operation.

Holes Machined—Three ½-in. drilled.

FIGS. 5 AND 5-A

Operation—Drilling all holes in form-roll socket-holder frame, feeder side, Fig. 4. The milled casting is forced against the adjustable screw A with the pin screw B and held in position with the hook bolts C.

Holes Machined—Eight $\frac{11}{16}$-in. drilled and two $\frac{13}{16}$-in. drilled. The former holes are then tapped with ¾-in. threads and the latter with ⅞-in. t

FIGS. 7 AND 7-A

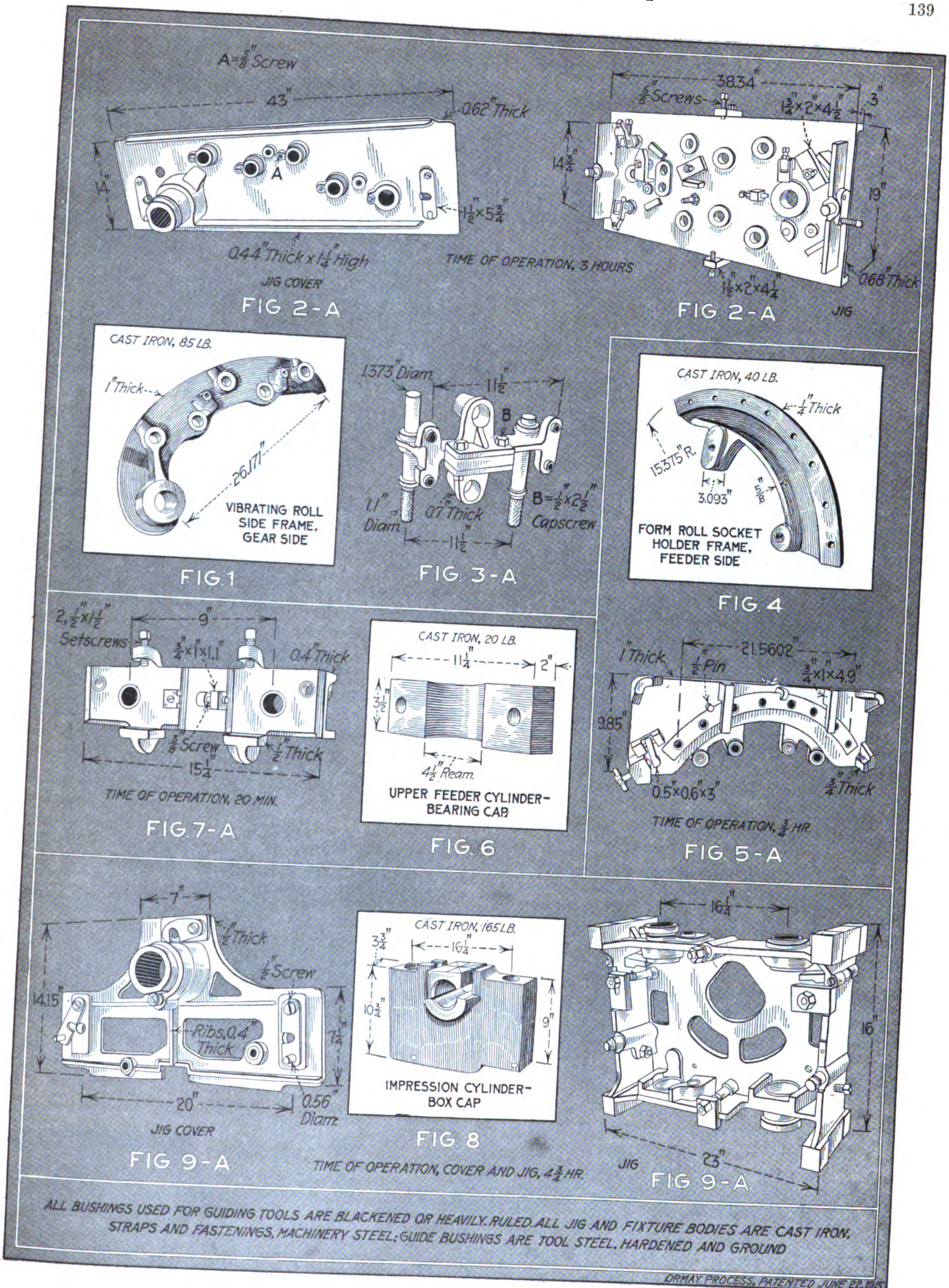
Operation—Drilling holes in upper feeder cylinder bearing cap, Fig. 6. The milled casting is located in the jig against a steel plate, being forced back with a knurled-head screw. It is held in position with two setscrews forcing it against the pads on the side.

Holes Machined—Two $1\frac{1}{32}$-in. drilled.

FIGS. 9 AND 9-A

Operation—Drilling all the holes in the impression-cylinder box cap Fig. 8. The casting has been milled in a previous operation. The piece is then located in the jig against adjustable screws, being forced back into position by setscrews placed on the opposite sides of the jig. The jig is fitted with three straps and after the casting is located these are tightened over it to hold it securely in position. The cover of the jig is then placed over the casting, being located by two dowels. Open side plates are then swung over shoulders on the locating dowels to hold the cover in position on the jig while machining.

Holes Machined—Two ⅝-in. drilled and reamed, afterward being spot faced 1⅜ in., two 2-in. drilled and reamed, two $2\frac{1}{16}$-in. drilled, one 1-in. drilled, reamed and 1¼-in. counterbored, one 2½-in. drilled and reamed



DETAILS OF JIGS USED IN MACHINING PRINTING-PRESS ELEMENTS

Molds for High-Grade Silverware

The H. O. Rogers Silver Co., Taunton, Mass., manufactures a variety of high-class silverware. In Fig. 1 is shown a candelabrum, and the molds used and the manner in which they are made are here described.

The first work is the designing, which is done on paper. After the design has been approved, the workman builds up with plaster of paris the different molds. These molds are smoothed off until they are of the correct contour to suit the designed part. In Fig. 2 are shown the plaster of paris molds for the base of the candelabrum. After being smoothed, they are sent to the foundry, where they serve as patterns for brass molds.

Preparing the Metal Molds

The metal molds are filed and smoothed until a part can be cast with the required thickness of wall. Those for the base are shown in Fig. 3. At *A* is shown the lower part, and at *B* may be seen the metal core, which is made in two parts so that it may be easily removed.

The upper part of the mold is shown at *C*. The air, or vent channels, may be seen in the parts *A* and *C*. Dowels are used so that the mold will line up in the correct position. One of the cast bases before the "fins" have been removed may be seen at *D*, and at *E* one after they have been taken off.

The Metal Molds Used for the Cups

The metal molds used for the candle cups and other pieces are shown in Fig. 4 When making hollow parts such as *A*, the metal is poured into the mold. After sufficient time has elapsed to allow the wall to solidify, the rest of the metal is poured out.

The time necessary can be estimated only by practice and experience. If the metal is not allowed to remain long enough, the walls will be too thin; on the other hand, if too long a time is allowed, the walls will be thicker than desired and the part produced will be heavier than planned and will contain too much metal.

In Fig. 5, at *A* is shown the fixture used when bending the scroll *B*. The bar is bent between the guide plates on the fixture, and the elements afterward soldered together in order to form the completed scroll as shown.

The mold for the lower part of the candle cup is shown at *C*, and one of the tubes which has been cut to length, at *D*. One of the candle cups and half of the metal mold are shown at *E*. The other cups are similarly molded.

FIG. 1. A SILVER CANDELABRUM

After the parts have been made, they are united by soldering and the piece polished until the desired finish is obtained. The polishing operations follow the usual practice of silverware manufacturers.

When making the molds the die maker uses quite a variety of tools. This is necessary, as the shapes made

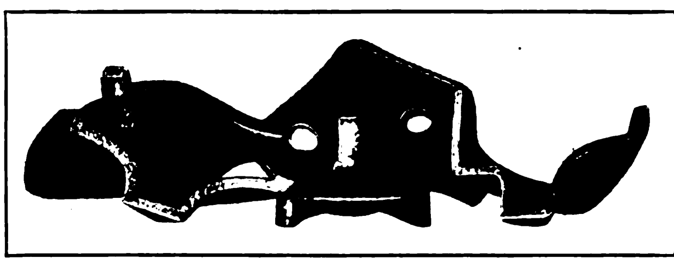


FIG. 2. PLASTER MOLD FOR BASE

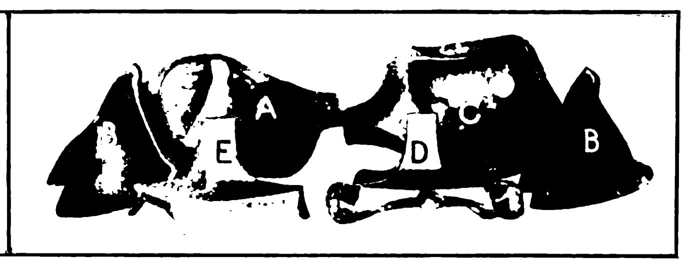


FIG. 3. METAL MOLDS FOR BASE

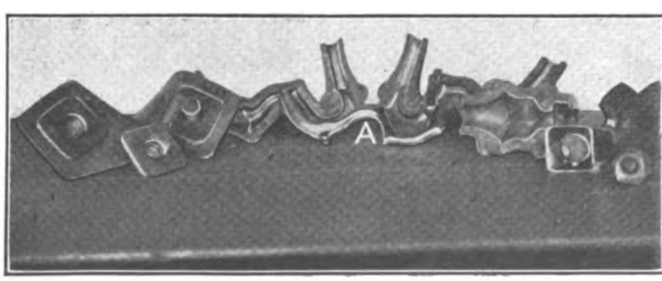


FIG. 4. MOLDS FOR THE CUPS

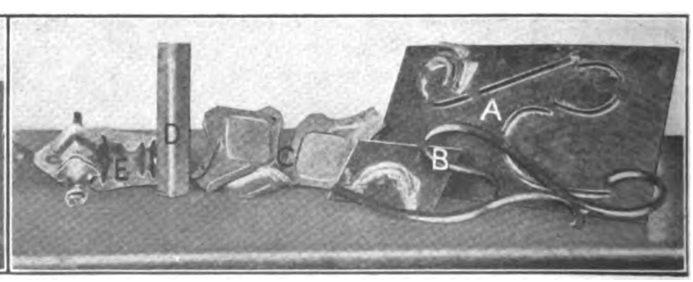


FIG. 5. THE SCROLL AND TUBE ELEMENTS

are often intricate in design. In Fig. 6 at the right is shown a box of tools used by the die maker at the factory. At the left of the illustration is shown one of

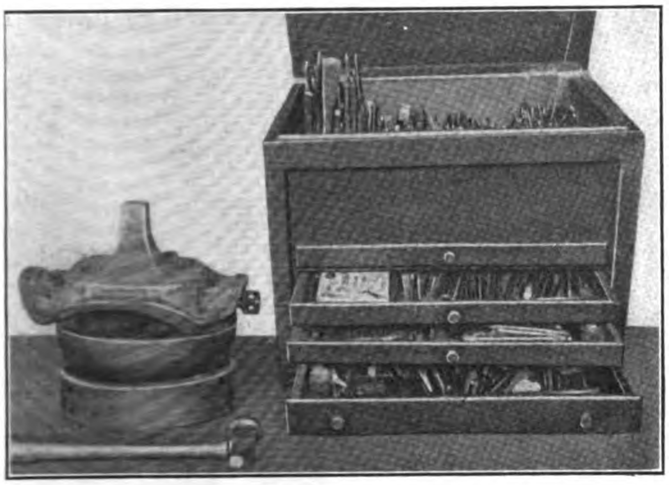


FIG. 6. BENCH AND TOOLS USED

the metal molds held in a special fixture which may be revolved, thus enabling the man to chip or file conveniently any surface as desired.

An Electrical Limit Gage

By George H. Cheney*

A short time ago it became necessary for me to design a gage to be used in gaging finished push rods, which it was necessary to test for size, taper and roundness with a tolerance of 0.0005 in. for each. The gage in use for this was the best type I knew of, being a built-

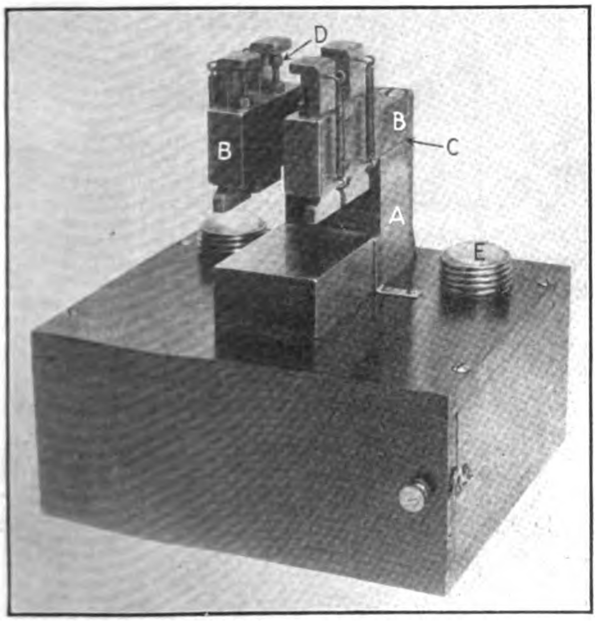


FIG. 1. ELECTRICAL TESTING GAGE FOR PUSH RODS

up snap gage composed of a central block which was lapped to an exact low limit with plates bolted on each side, one being flat and the other with a step the height of the limit allowed.

This gage was easily repaired as the central sizing block was not affected by wear, and it was a simple matter to lap the plates flat when they became worn. But as there were from 3,000 to 4,000 pieces to be gaged daily, the time consumed in testing the parts and repairing the gage was considerable.

Consequently I looked for a fast, accurate method of doing this work and decided to make a test of an electric contact gage. For this purpose I took a U-shaped forging with an insulated screw in one side to determine how much gap a low-voltage current would jump, and found that with three dry cells it was necessary to have actual contact to light a lamp.

In making this test I used very accurate testing blocks and found one which showed a taper; one end would light the lamp, and the other would not. I tried this repeatedly with the same result, but could find this taper in no other way, thus indicating the sensitiveness of the device. From these tests I designed the gage as shown.

It consists of the base A, as shown in Fig. 1, upon which are mounted the two arms BB, being insulated at

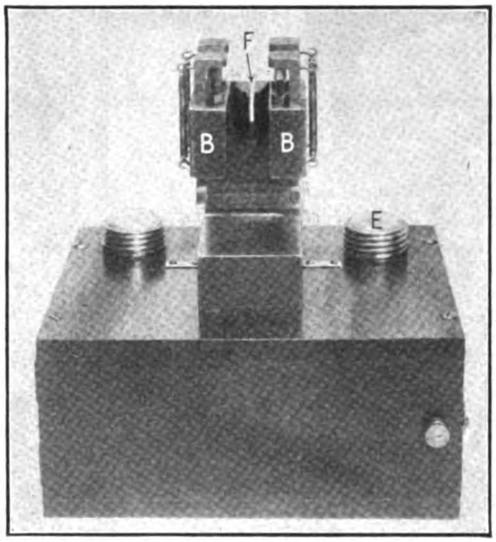


FIG. 2. FRONT VIEW TO SHOW SEPARATION OF POLES

C. The four contact arms, which have a vertical movement in the arms B, are held down by springs on the adjusting screws shown at D. Fig. 2 shows the space F between the two arms B.

The supporting box contains the dry cells, one pole being connected to the base A, Fig. 1. Two wires are run from the other pole to the two arms BB, with one of the lamps shown at E in series with each. The lamps are the heads of an ordinary flashlight.

The contact arms have a face equal in length to approximately one-third the circumference of the work. The two front contact arms are now set to the high limit and the two rear ones to the low limit allowed.

It will readily be seen that if a piece of work touches the base and any contact arm, it will close the circuit and light a lamp. Therefore if we roll a piece under the front arms and it lights either lamp, there is a spot on the piece over size; likewise if we roll a piece under the rear arms without lighting both arms, there is a spot under size, the right or left lamp indicating which end is incorrect.

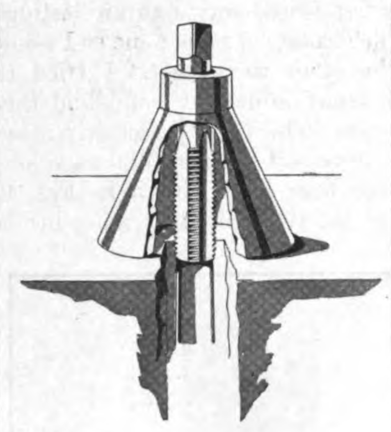
As the springs used are very light, just enough to insure the return of the arms should they be lifted by an oversize piece, there is very little wear. The faces of the arms and the base must of course be lapped perfectly parallel. This furnishes the most accurate sensitive gage I have ever found.

*Superintendent of tools, the Studebaker Corporation.

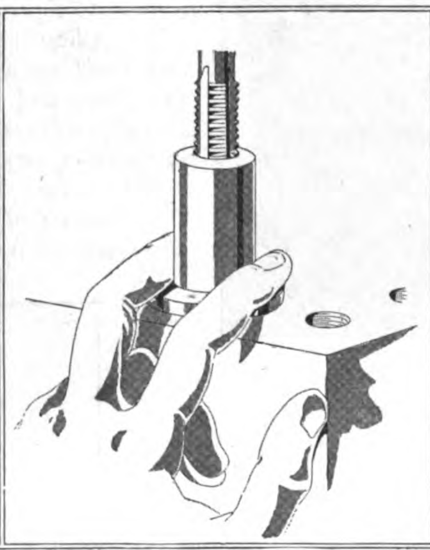
From A Small-Shop Notebook

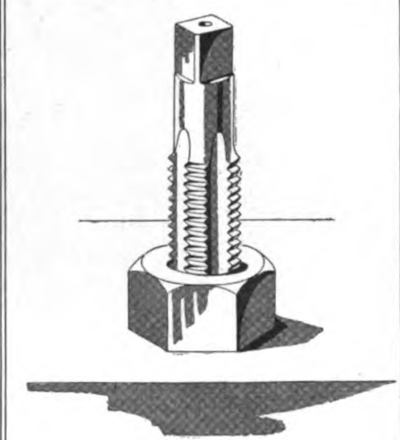
By John H. Van Deventer

Three Devices That Square Up a Hand Tap



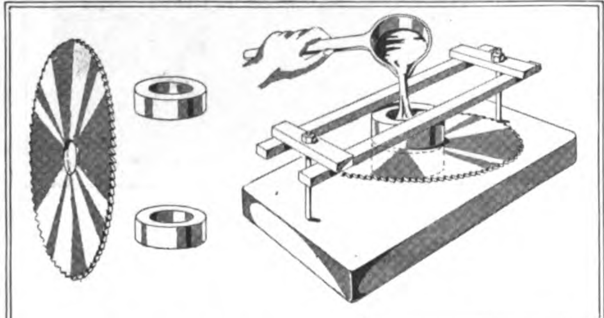
Makes it easy to start a tap square with the work.





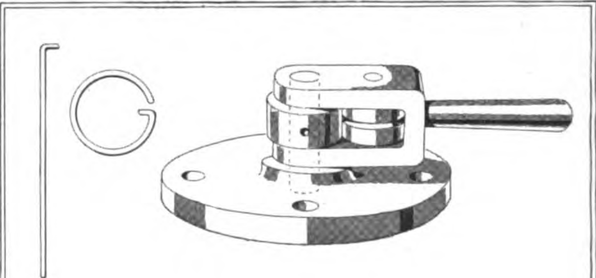
A faced nut will do when nothing else is at hand.

Easy Local Annealing of Saw Blades



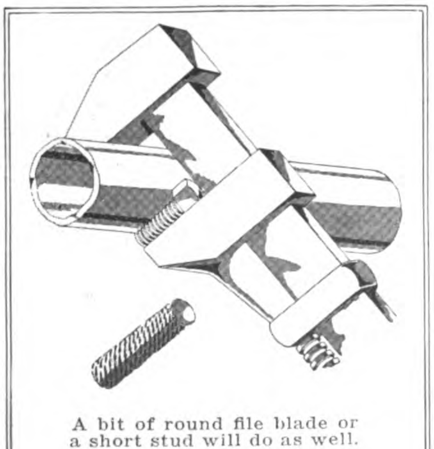
Melted lead does the job so one can file a keyway.

Simple Hand Fixture for Wire Rings



This device will take up little room and pays rent.

A Pipe Wrench for Emergencies

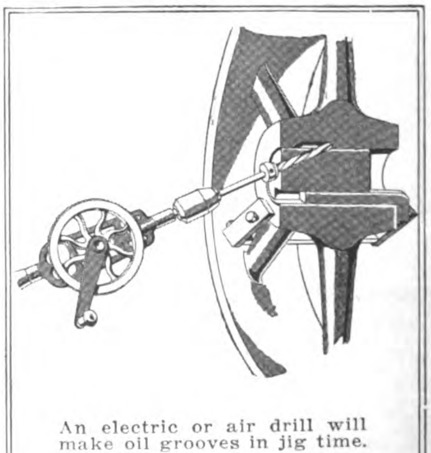


A bit of round file blade or a short stud will do as well.

Making an Accurate Templet

Small errors can be seen easily through the glass.

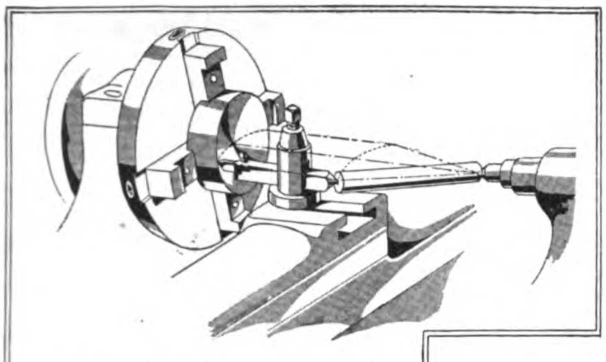
Oil Grooving with Twist Drill



An electric or air drill will make oil grooves in jig time.

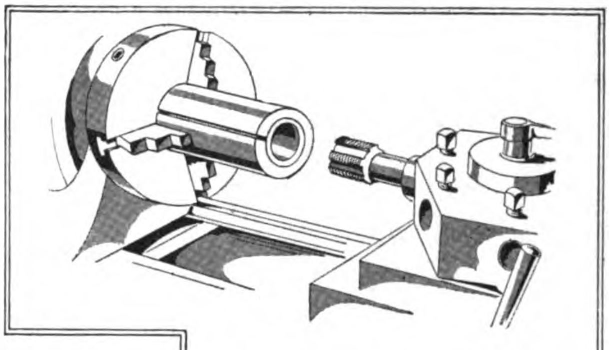
BENCH, VISE AND ASSEMBLING METHODS

Turning a Concave Surface



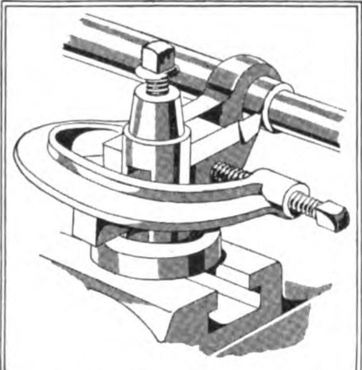
A mandrel with large centers is all of the rigging needed.

A Thin Tube Tapping Kink



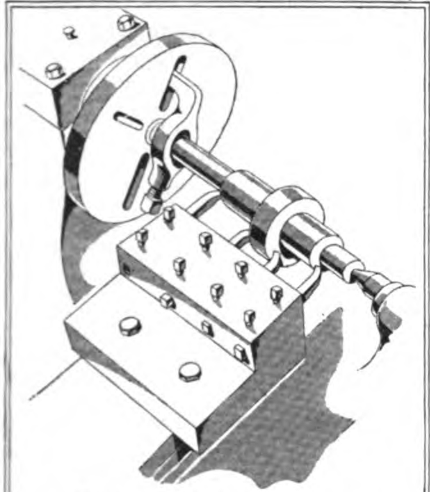
Thin tubes chucked like this will tap without distortion.

A Follow Rest for Smooth Stock



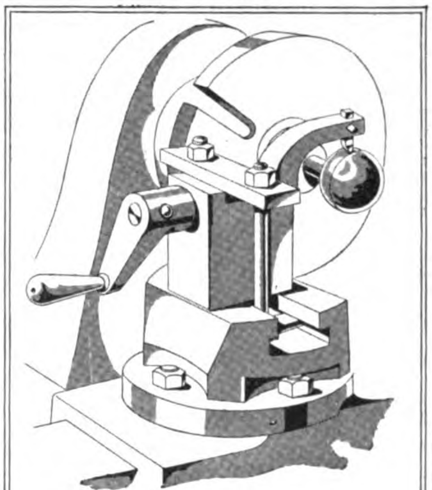
Good for springy shafts.

Multiple Facing Tools in Lathe



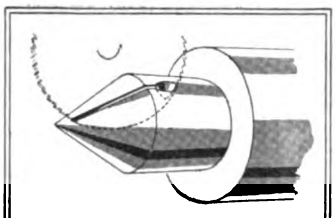
Facing shoulder lengths on a quantity of duplicate pieces.

Simple Ball-Turning Fixture



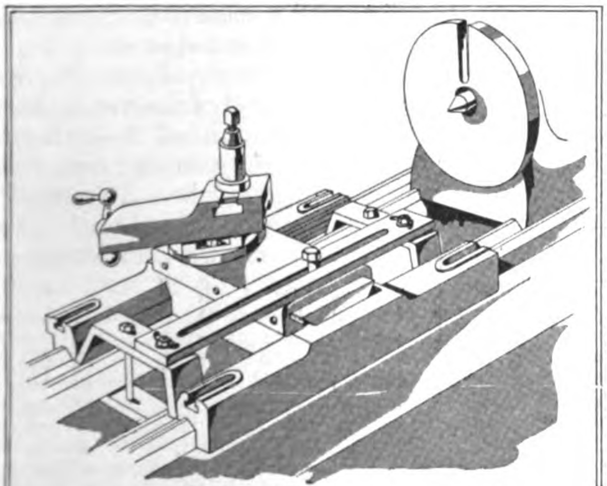
The bearing box is split and clamps the tool to its cut.

Self-Lubricating Tail Center



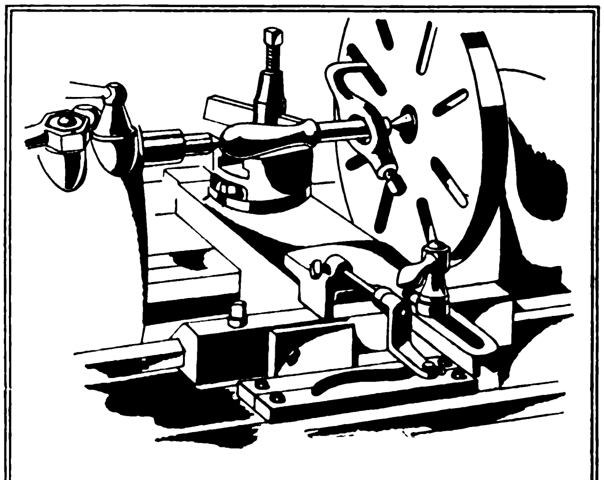
Will not heat or cut.

Rigging Up a Taper Attachment



Lathes without taper attachments can be made more flexible by using this rig.

Form Turning in the Engine Lathe



The screw machine need not have it all its own way in the form turning of steel.

DEVICES THAT MAKE LATHES PROFITABLE

Special Punch-Press Fixture

By E. V. Allen

The fixture shown in Figs. 1 and 2 is used in the shop of the Indiana Lamp Co., Connersville, Ind. The main part of the fixture is bolted solidly to the column of the press, but the central part may be removed and other die-holding blocks put in its place. The die block is held so that on certain parts of lamp shells or bodies, where a number of holes are to be pierced from different angles, the central part may be indexed around. In the particular case shown, only one hole is pierced, as shown in the second illustration. The work is of course comparatively light, most of it being thin sheet brass.

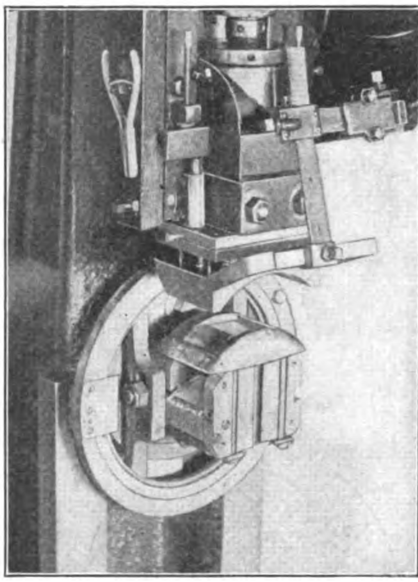


FIG. 1. SPECIAL PUNCH-PRESS FIXTURE

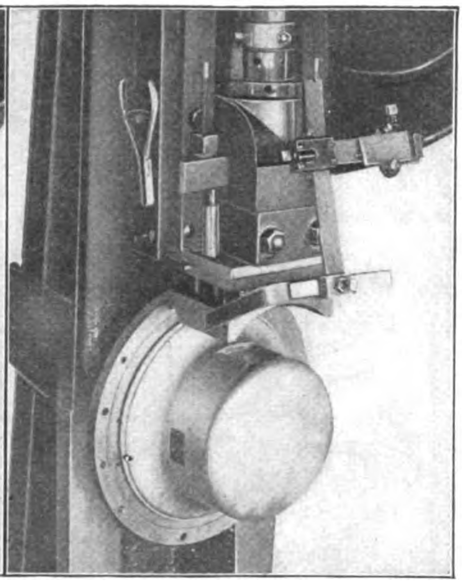


FIG. 2. FIXTURE WITH WORK IN PLACE

Training Men for Foreign Trade Service

A problem of commanding importance in the development of our international commerce is the education of men for foreign trade. It is absolutely necessary that we train men to carry on our foreign trade, for we find ourselves today without an adequate supply. This problem may be regarded as the very fundamental of success in this field. Our banks cannot establish branches because they have not the men with which to man them. Our manufacturers find it difficult to secure salesmen. Our investors cannot find competent advisers on foreign offerings.

Perhaps the most discouraging feature in this problem is that the leaders in our schools and colleges seem unable or unwilling to see the need, or having seen it are unable or unwilling to give the thorough instruction necessary. If ever the educator had a definite, concrete problem to solve, it is this. Up to the present time there are no appreciable results. Several of the commercial schools and colleges are giving excellent instruction to young men intending to engage in business in this country, and some are offering good courses in foreign trade. But these courses have not been grouped so as to give the all-round training necessary for success in export trade; the language w is inadequate, and no opportunity is provided to acquire the requisite practical experience.

At one institution a novel step has been taken and a promising plan is ready to be put into operation. New York University has announced the creation of a limited number of special business fellowships for the purpose of training men for foreign trade. These fellowships are awarded by business concerns to men selected from a large number of applicants throughout the country. The plan is to employ the men on a part-time arrangement in the New York offices of these concerns and let them spend the remainder of their time in study at New York University. During the summers, which would ordinarily be devoted to vacation, the men will be expected to devote their entire time to the work of the business concerns employing them. For this half-time work they are to receive from $60 to $75 per month, and the course of training will usually last three years, though each man must of course adapt his training to the need of his employers. It is also expected that the men will live in clubs located near the university, each club devoted to the study of one foreign language. During the coming year there probably will be 25 to 30 men studying and working on this basis, and a rapid increase in the number is expected in the future.

Other colleges and universities, even those having highly developed schools of business, are doing too little to train men for foreign trade. Perhaps this is to be expected, because the demand for such training is of recent origin. Nevertheless the mere offering of one or two courses on the subject of foreign trade, foreign tariffs or South America is absolutely inadequate. When compared with the thorough and careful training which Germany has given her foreign representatives, our work is lamentably inadequate.

It is also to be regretted that the actual work of instruction is not intrusted to men who have some practical or personal knowledge of the subject. A mere second-hand acquaintance, a mere book knowledge of foreign trade, is inadequate. I do not mean by this statement to advocate the employment of merely practical exporters as instructors. But I do advocate the employment of men who have gathered their facts and information by personal investigation and have thus acquired a first-hand knowledge and have a practical contact with the things which they propose to teach.—Report of Chief, Bureau of Foreign and Domestic Commerce.

The Consumption of Aluminum in the United States in 1914 was the largest on record and amounted to 79,129,000 lb., which is much greater than the output, and though some metal is exported, a much larger quantity is imported. The consumption of the metal is growing rapidly, and the facilities for turning out enough for home consumption are inadequate. When one considers the multiplicity of uses to which aluminum is now applied, and the part that it is destined to play, the question of the domestic supply of bauxite, the mineral from which aluminum is now made, assumes importance. So far as our present resources are concerned, we may consider the United States as practically independent, especially as new bauxite occurrences may be found, and American inventive genius may be trusted to solve the problem of extracting the metal from clay or some other aluminum compound.

Manufacturing British 18-Pounder High-Explosive Shells--III*

By E. A. Suverkrop

SYNOPSIS—The copper driving band near the base of the projectile performs a very important function. The lands of the rifling cut into it and cause it to rotate in the barrel of the gun. If it be rigidly fitted, it transmits its rotary motion to the projectile which it embraces. It also acts as packing and prevents the leakage of gas from the propulsive charge past the shell and the consequent loss of efficiency.

At the moment subsequent to the explosion of the propulsive charge the direction taken by the projectile is in a straight line without any rotary motion. Immediately the shell strikes the rifling, it is caused to

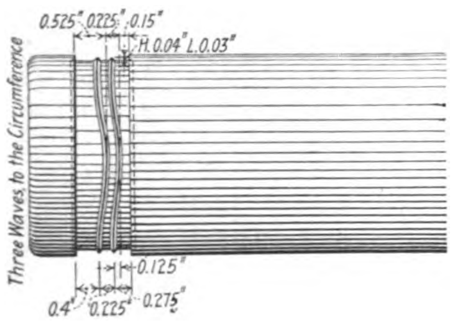


FIG. 25. WAVE RIBS FOR HIGH-EXPLOSIVE SHELL

rotate at a high rate of speed, and enormous stresses are instantly set up. To withstand these the metal used in the driving band and the mechanical means used for fastening it to the projectile must be adequate.

Copper seems to be the metal best suited for the purpose. It is soft, takes the rifling readily without eroding it excessively, yet is hard enough to resist undue wear itself during the short period of time that it is moving from the breach to the muzzle in contact with the rifling and bore of the gun. It is also tough enough to resist stripping either on the exterior where it is in contact with the barrel or on the interior where it is in contact with the projectile.

There are various ways of securing driving bands. In the Russian shell the bottom of the driving-band groove is knurled with a coarse knurl. In assembling, the band is compressed and the soft copper embeds itself in the knurling. In the French shell a series of serrations is turned in the bottom of the groove. When assembling the copper band in the French shell, the metal enters the serrations; but in this instance they are at right angles to the serrations made by the knurl in the groove in the Russian shell. The method of applying the driving band to British shells is much more elaborate. The groove is dovetailed on each side, and depending on the size of the projectile, two or more wave ribs, as shown in Fig. 25, are turned in the bottom. When the copper band is pressed on, the wave ribs embed themselves in the metal. The object sought by these various methods is to assure that, at the moment of firing, the friction between the band and the shell shall be sufficient to overcome the inertia of the shell and cause it to follow the rifling in a rotary as well as a forward motion.

Which, if any, of these methods of securing the driving band is the best is doubtful. There is, however, no doubt that the British method is by far the most difficult to manufacture.

The rough grooved shells from the fourteenth operation go to 20-in. by 8-ft. engine lathes, one of which is shown in Fig. 26. They are equipped with heavy combination chucks A to hold the shells and drive them. The base end of the shell is supported by the tail center. Mounted on the carriage of the lathe is a stop B which is so located that it brings up against the base of the shell between the edge and the riveting flange. This stop is fixed in the carriage and bears a positive position relatively to the undercutting attachment C on the front of the carriage, and also to the waving attachment on the back. The waving cam E is secured to the face of the chuck A in such manner that it does not interfere with the operation of the chuck.

Two types of undercutting attachments have been tried; that shown in Fig. 26 is a modification of the one designed by the Canadian Allis-Chalmers Co. and shown some time ago in the series of articles on the manufacture of the 4.5-in. high-explosive shell. The original undercutting attachment is shown in Fig. 27. It utilizes a

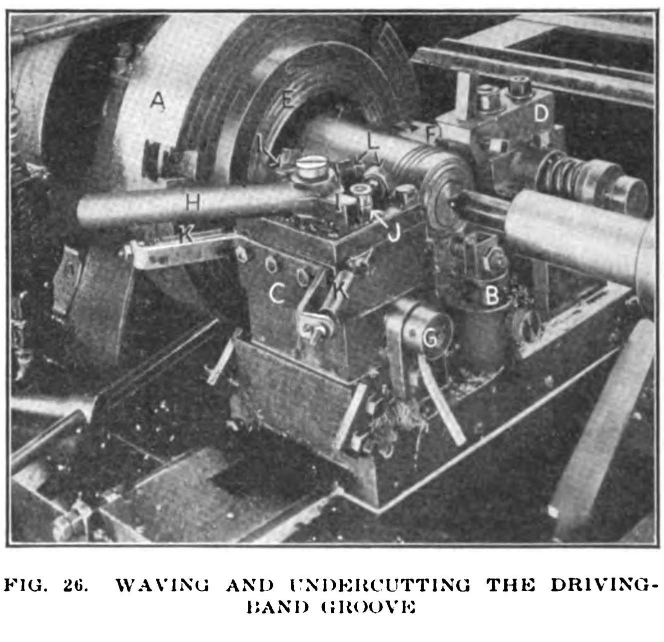


FIG. 26. WAVING AND UNDERCUTTING THE DRIVING-BAND GROOVE

formed cutter, as shown at C. By referring to Fig. 25 it will be noted that the space between the forward wave rib and the side of the driving-band groove at the narrow parts is only about one-tenth of an inch in width. As the undercutting tool must pass here, it means that it must be very delicate at this point. With skilled operators there would be little trouble; but as previously

*Previous installments appeared on pages 1 and 45.

stated, many of the machine hands are unskilled, and the tools for their use must of necessity be as strong as possible.

The other type of undercutting attachment utilizes a pair of simple tools made from square steel, and while one of these must enter the same space as the formed tool, they are, owing to their shape, not so subject to breakage as the formed tool and when broken, are more easily put in working order again by grinding. In Figs. 26 and 27 similar parts are indicated by similar reference letters.

The operations of undercutting and waving are performed as follows: The operator enters a shell in the chuck of the engine lathe. Inside the spindle and backed up by a stiff spring is a sliding plug. The nose of the shell fits over this. The rear end of the shell is located on the tail center, which is then run out, compressing the spring and holding the shell. The jaws of the chuck are now tightened on the body of the shell. The carriage is run forward till the stop *B* brings up against the base end of the shell, thus correctly locating the undercutting and waving attachments in relation to the rough-turned driving-band groove. The carriage is now clamped and the undercutting tool fed to the bottom of the groove, a stop controlling the motion of the cross-slide.

With the old style of undercutting attachment the tool was fed lengthwise of the lathe by means of the screw *G*, undercutting first one side of the groove and then the other. With the new style of attachment, shown in Fig. 26, the diagonally disposed tools are alternately advanced by operating the handle *H* first to the right and then to the left. The two lugs *I* contact with the pins *J* attached to the tool holders. The tool holders are returned by the springs *K*. Stops are provided at *L* to limit the forward movement of the undercutting tools. When both sides are undercut, the cross-slide is run back. This brings the waving attachment at the back of the cross-slide into operating position, with the roller *F* in contact with the wave cam *E*. While the waving tool is reciprocated by the cam and roller, it is fed to depth in the groove by the crossfeed screw, which in turn is controlled by the handwheel *L*. The scheduled output for undercutting and waving is 21 shells per hour.

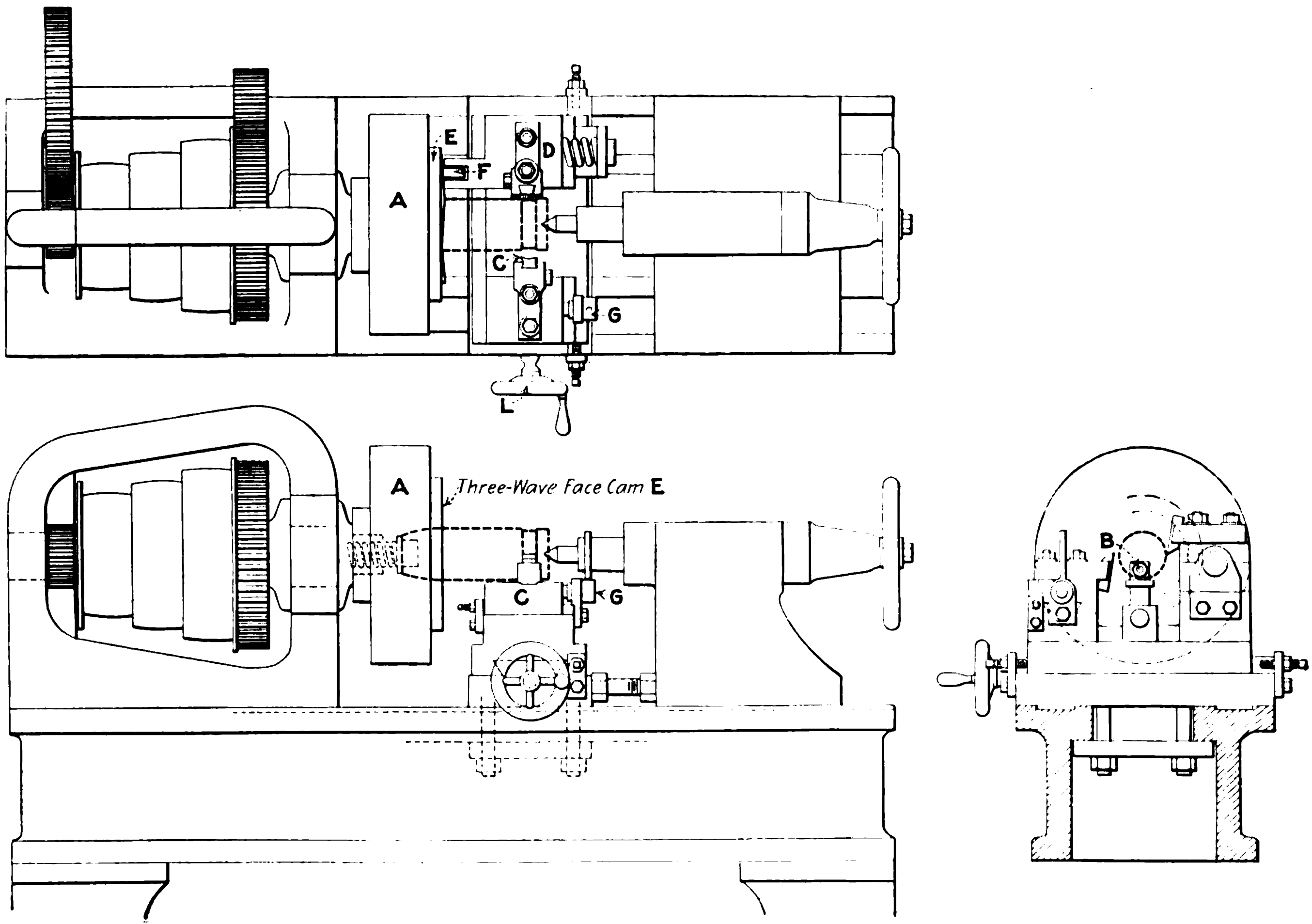


FIG. 27. ARRANGEMENT OF GARDNER 20-IN. BY 8-FT. ENGINE LATHES FOR WAVING AND UNDERCUTTING

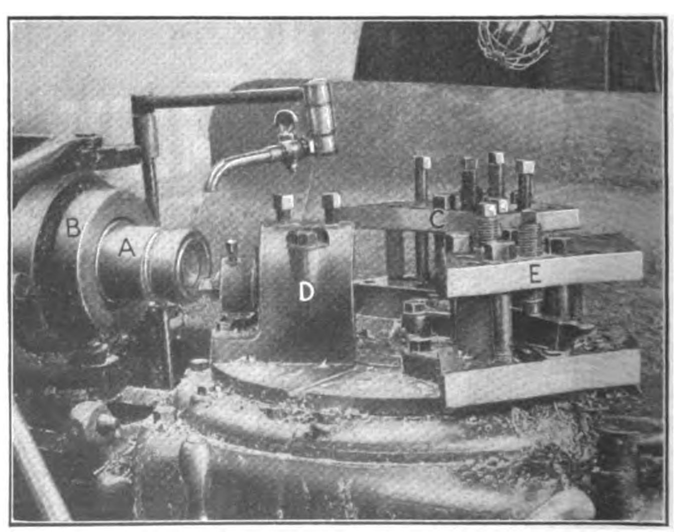


FIG. 28. RECESSING FOR BASE PLATE

After the wave is cut, a small thread-like ridge is left on one side of the driving-band groove. This is removed by a boy with a hammer and a chisel. This completes the fifteenth operation.

The inspection on this operation requires the same gages as the previous one. High- and low-limit snap gages

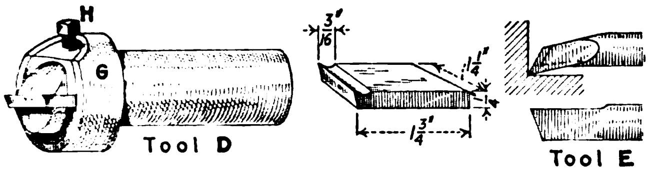


FIG. 29. ROUGHING AND FINISHING RECESSING TOOLS

for the diameter are 3.110 and 3.090 in. respectively; the distance from the base of the shell to the groove is 0.77 in. high and 0.73 in. low, and the width of the groove is 0.915 high and 0.885 low. Having passed inspection, the shells are credited to the operator, and the truck gang conveys the work to the next operation.

The sixteenth is another operation on which the Jones & Lamson flat turret lathes have been retained. It consists of forming the recess in the base of the shell for the reception of the base plate.

It is performed on 2x24-in. machines, as shown in Fig. 28. Three stations of the turret are used. The shell *A* is held in the regular Jones & Lamson collet chuck *B*. The first station *C* of the turret carries an ordinary stop. The second station *D* carries a flat recessing tool, and the third station *E* carries a single-pointed boring and facing tool.

The shell is entered in the chuck and lightly gripped. The stop in *C* is then brought forward, forcing the shell in the chuck to the correct depth; this is determined by the stop for the turret slide. The chuck is then fully closed. The turret is indexed and the tool in *D* brought to operating position. The turret is fed forward till the stop is reached. The tool used in *D* is shown in Fig. 29. Its body is made of machine steel and the inserted cutter of high-speed steel. The collar *G* prevents the holder from opening up when the setscrew *H* is tightened on the cutter. The tool is set so that it cuts from the center outward. It leaves the recess about $^1/_{64}$ in. smaller in diameter and the same amount shallower than final size.

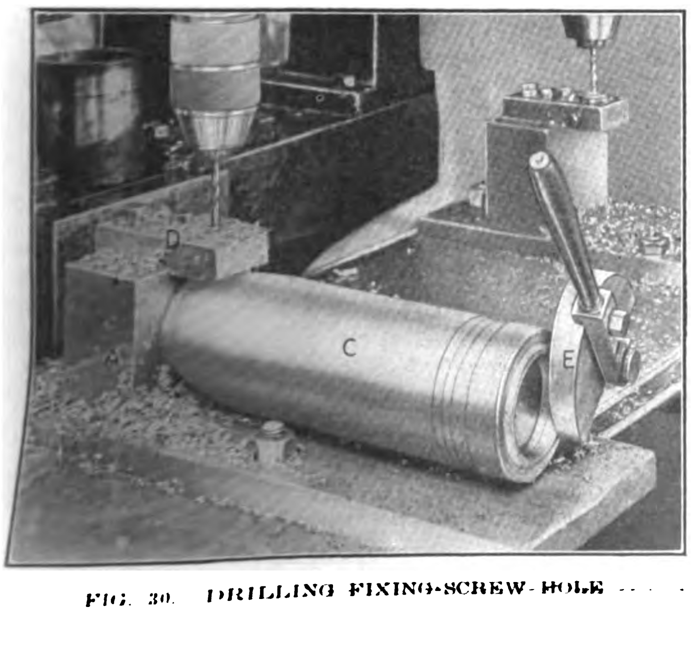
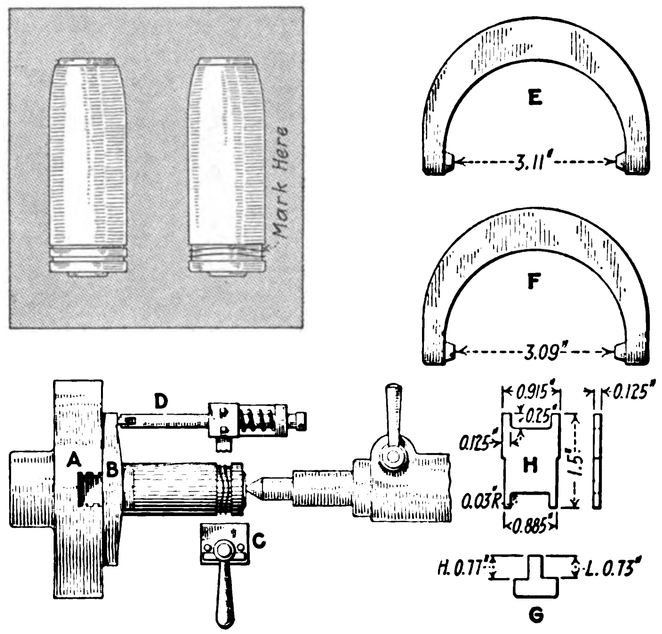


FIG. 30. DRILLING FIXING-SCREW HOLE

The third station of the turret carries a combination boring and facing tool, which is also shown in Fig. 29. The operator sets the head of the machine over to bore the correct diameter. The turret is fed by hand till the stop is reached. The turret is then clamped and the crossfeed on the head thrown in to face the bottom of the



OPERATION 15. UNDERCUTTING AND WAVING

Machines Used—20-in. by 8-ft. engine lathes.
Special Tools and Fixtures—Universal chuck A. Waving cam B. Undercuting attachment C. Waving attachment D.
Gages—High and low snap gages E and F. Gage G, distance from base to driving-band groove. Gage H, width of driving-band groove.
Production—One man and one machine, 21 per hr.
Note—Cutting compound used.
References—See Figs. 25, 26 and 27, also Fig. 10, for position of inspector's mark.

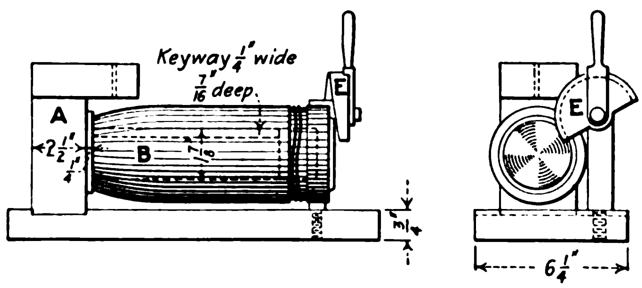


FIG. 31. DRILL JIG FOR FIXING-SCREW HOLE

recess. The scheduled output for the recessing operation is 25 pieces per hour.

Inspection covers the thickness of the base of the shell measured from the bottom of the hole in the shell to the bottom of the base-plate recess and the diameter and flatness of the bottom of the recess. Those shells which pass inspection are stamped in conformity with the standard marking chart, Fig. 10, the checker credits them to the operator, and the truck gang delivers them to the next operation.

Drilling and Tapping the Fixing-Screw Hole

The seventeenth operation is done on sensitive drilling machines handled by boys. It consists of drilling a hole, ¼-in. tapping size, for the fixing screw. The outfit used is shown in Figs. 30 and 31. The jig *A* is, like all the other tools used in this shop, very substantial in construction. In this respect it compares favorably with a jig used for the same purpose in another factory. This

latter jig is a simple V-block made of wood. As the nose of the shell is coned and the hole to be drilled is beyond the parallel part of the shell body, the work has to be held down by the operator. The distance from the nose of the shell to the fixing-screw hole must be within close limits, and a wooden jig is not sufficiently positive for

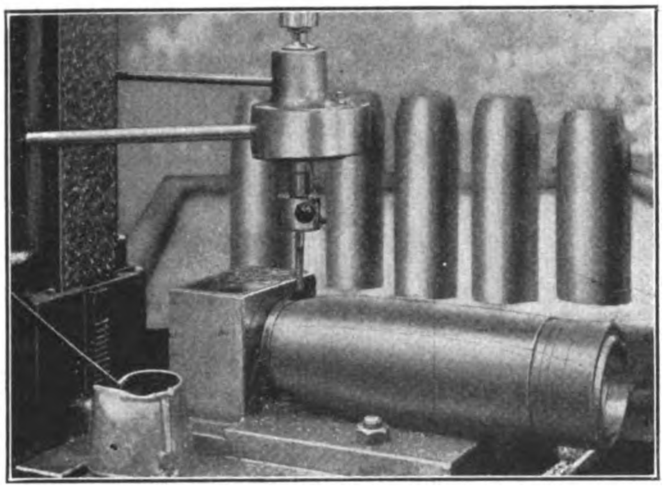
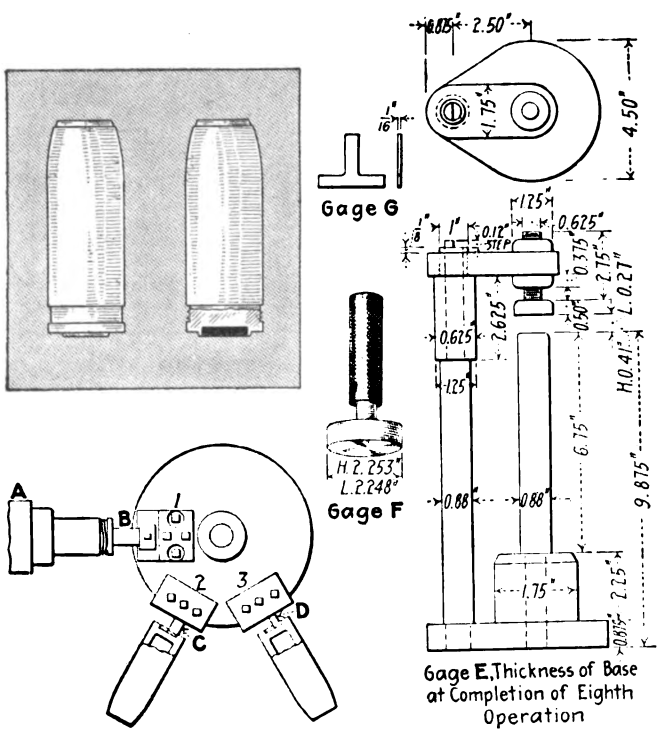


FIG. 32. TAPPING THE FIXING-SCREW HOLE

the work. The chips and the handling of the work into and out of the jig cause excessive wear, so that wood for even a simple jig like this is unsuitable. The foregoing is intended in the nature of a warning.

The base *A* is made of cast iron and carries a horizontal post *B* which is an easy fit for the hole in the shell. A keyway or slot runs along the top of *B* so that the burrs



OPERATION 16. RECESSING BOTTOM OF SHELL FOR THE BASE PLATE

Machines Used—Jones & Lamson 2x24 flat-turret lathes.
Special Tools and Fixtures—Jones & Lamson collet chuck A. Stop B. Recess roughing tool C. Finish-boring and facing tool D.
Gages—Gage E, thickness of base. Gage F, diameter of recess. Gage G, flatness of botom of recess.
Production—One man and one machine, 25 per hr.
Note—Cutting compound used.
References—See Figs. 28 and 29, also Fig. 10, for position of inspector's mark.

caused by drilling will not jam when the work is removed. It must be remembered that owing to wear on the boring tools and other conditions in the boring operation, the holes are not all of exactly the same size; for this reason the post *B* must be of such size that it will fit the smallest acceptable size of hole. Mounted on the base at the rear end of the shell is a vertical member which carries a circular wedge *E*. This is used to force the shell against the vertical member of *A* which acts as a stop and also prevents the shell from shifting during drilling. The

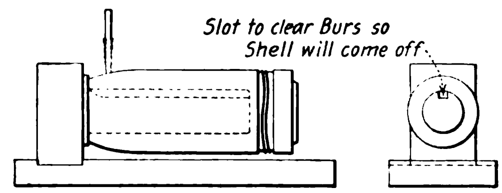


FIG. 33. THE TAPPING FIXTURE

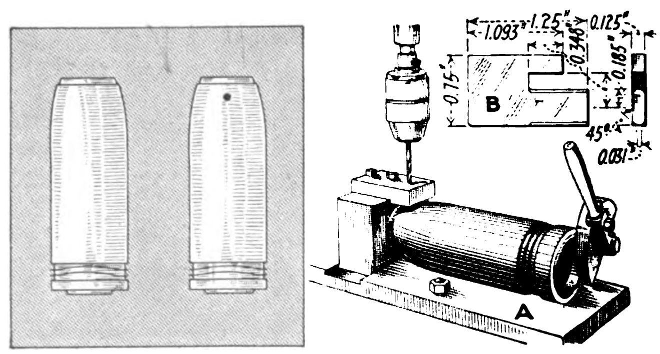
scheduled time for drilling the tapping-size hole for the fixing screw is 50 per hour, but as high as 80 per hour has been done.

The inspection covers the size of the hole and its distance from the nose of the shell. Drilling is day's work plus a bonus. The boys drill all the shells that pass the previous operation.

The eighteenth operation is tapping the ¼-in. fixing-screw hole. It is done on sensitive drilling machines, as shown in Fig. 32. These machines are situated within easy reach of the machines where the hole is drilled. As soon as a shell is drilled, the boy lays it on a table convenient for the boy who does the tapping. The jig, shown in Fig. 33, is similar to the one used for drilling, except that the wedge is dispensed with so that the work is free to float slightly and accommodate itself to the tap. This operation is also handled by boys, and the scheduled output is 80 holes per hour. As in the drilling operation, the tapping must keep pace with the speed of the shop.

The nineteenth operation is hand tapping the fuse hole. The result of hand tapping is twofold—the burr left by the tap in the fixing-screw hole is removed and the thread in the fuse hole is brought to standard size. It will be remembered that the thread in the fuse hole was milled 0.002 in. under size.

The shells are held in cast-iron hinged chucks, similar to the one shown in Figs. 4 and 5, and mounted on stout posts set in the floor of the shop. Adjustable taps are used and give fair satisfaction. In another works the



OPERATION 17. DRILLING FIXING-SCREW HOLE

Machines Used—Sensitive drilling machines.
Special Tools and Fixtures—Drill jig A.
Gages—Distance of fixing screw from top, gage B.
Production—One boy and one machine, 50 per hr.
Note—Drilling compound used.
References—See Figs. 30 and 31.

taps are of the shell type, double ended and solid, as shown in Fig. 34. These taps are threaded without any relief. The flutes are cut with a plain half-round cutter. Sanderson double special steel is used. The taps are held on a shank such as is used for shell reamers. When one end of the tap is worn, the tap is reversed on the holder and the other end used. Solid sizing taps give much more uniform results than are obtainable with the usual run of adjustable taps. Ordinary tap wrenches

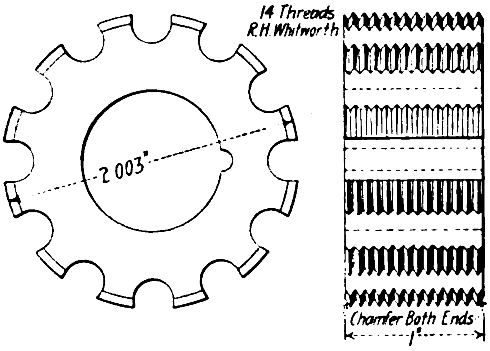


FIG. 34. SOLID DOUBLE-ENDED SHELL TAP FOR FUSE HOLE

are used with either type of taps, and a man can tap about 30 fuse holes per hour.

The inspection on this operation covers the size and condition of the thread and the angle of the fuse seat. The high diameter of the thread is 2.003 and the low diameter 1.997 in.

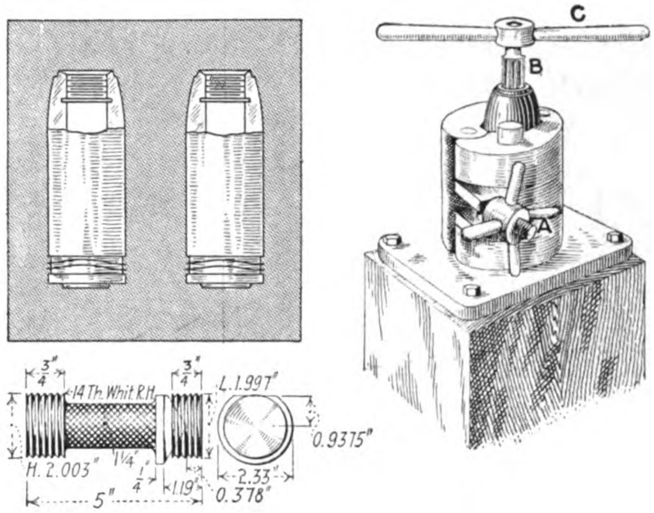
Having passed inspection, the shells are conveyed by the truck gang to the sorting floor to be arranged in series.

The twentieth operation is the selection of shells to make up a series. Formerly a series was made up of 120 shells, and when of this size seven heat numbers were allowed in its make-up. That is to say, a series of 120 shells may contain shells representing seven different heat numbers. The number of shells in a series now is 250, and 15 heat numbers are permitted in its make-up.

In Fig. 35 is shown the sorting floor, laid out in squares, each of which is marked with a *current* heat number. The shells are grouped according to their heat numbers in the squares bearing a similar mark, and the series is made up from these lots, care being exercised that the small series (120 shells) contains not more than seven heat numbers and the large series (250 shells) not more than fifteen heat numbers.

The record so far for sorting shells is: 14 series of 250 shells in 10 hr. by a squad of 8 men.

A series having been selected, the shells are put in tote boxes, as shown behind the marking machine in Fig. 36, and taken by the truck gang to the air-operated marking



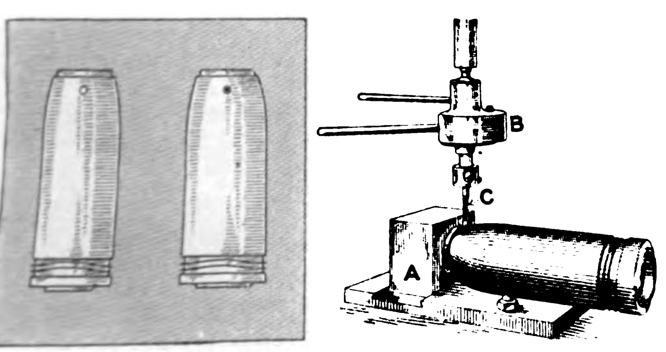
OPERATION 19. HAND TAPPING THE FUSE HOLE TO FINISHED SIZE

Machines Used—None.
Special Tools and Fixtures—Hinged vise A. Adjustable tap B. Tap wrench C.
Gages—High and low plug thread gage D with angular seat gage on one end.
Production—One man, 30 per hr.
References—Figs. 4 and 5 for details of vise. Fig. 34 for sizing tap.

machine to undergo the twenty-first operation, that of marking.

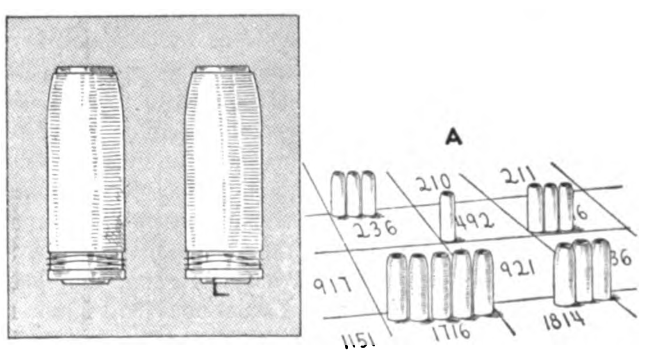
The projectiles for fixed ammunition are always marked on the side. This is somewhat easier to accomplish than marking on the base, which is required with separate ammunition. The shells are laid on their sides on tables and as they are rolled along toward the marking machine three chisel cuts are made across the wave ribs.

The air cylinder *A*, Fig. 36, is about 6 in. in diameter and is supplied with air at 80 lb. pressure per square inch. The forward end of the ram *B* is loosely connected by means of a yoke with the slide *C*. In the center of the slide *C* is a chase to hold the removable hardened-steel type. Certain parts of the imprint (such as the maker's name) on the shells are permanent. That is to say, they do not require to be changed from series to series. Other parts, such as the series letters and the date of manufacture, require to be changed from time to time. The



OPERATION 18. TAPPING THE FIXING-SCREW HOLE

Machines Used—Sensitive drilling machines.
Special Tools and Fixtures—Jig A. Tapping attachment B. ¼-in. tap C.
Gages—None.
Production—One boy and one machine, 80 holes per hr.
Note—Oil used as lubricant.
References—See Figs. 32 and 33.



OPERATION 20. SORTING SHELLS BY HEAT NUMBER

Machines Used—None.
Special Arrangements—Tote boxes and trucks. The floor A is divided into squares marked with current heat numbers as shown.
Gages—None.
Note—14 series of 250 shells in 10 hr. by 8 men.
Reference—See Fig. 35.

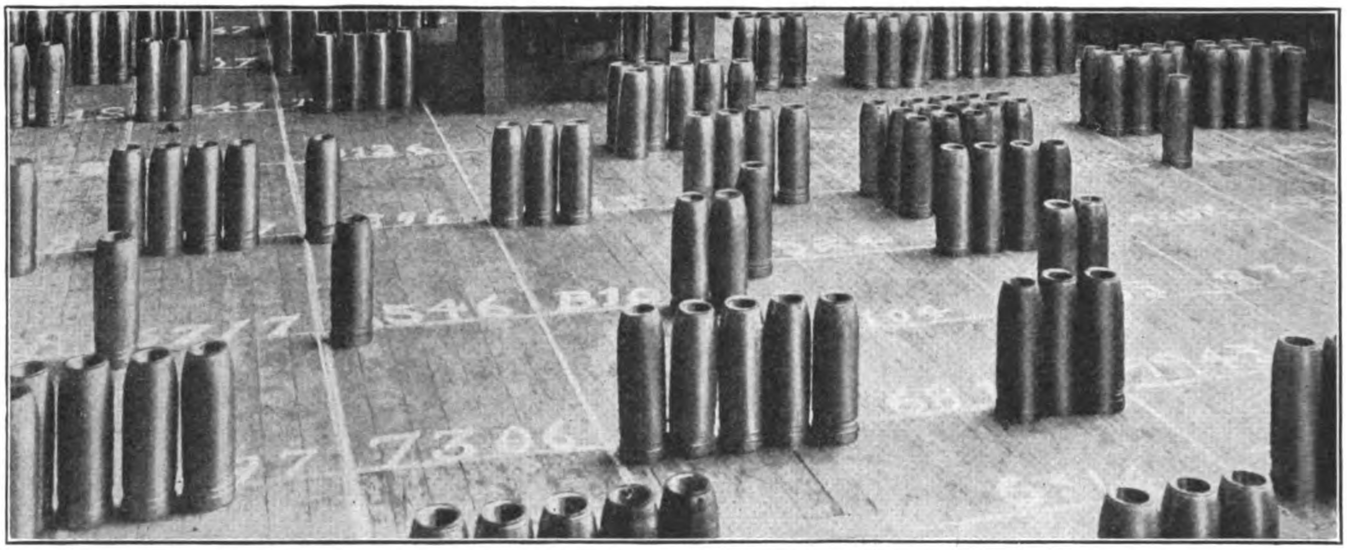


FIG. 35. THE SORTING FLOOR LAID OUT IN SQUARES, ONE FOR EACH HEAT NUMBER

shell to be marked is placed by one operator in the position occupied in the illustration by the shell *D*. When the shell is properly located, the operator signals his assistant, who opens the air valve. The plunger goes forward, and the shell is rolled between the type in the chase and the inner surface of the housing *E*. As there is only a line contact between the type and the shell, the imprint can be made very deep and distinct.

The scheduled output of the marking machine is 125 shells per hour. This represents the speed at which the operators can handle the shells, not the speed of the machine. With the shells arranged so that they are within easy reach of the operator he can mark them at the rate of 20 per minute.

First Complete Shop Inspection and Hospital Work

The twenty-second operation is the first complete shop inspection. It covers all the work done in the various operations up to this point of manufacture. It also includes the discovery and correction, if possible, of all injuries suffered by the shells in their passage through the shop. Having undergone so many operations and handlings, many of the shells are slightly bruised and dented. It is the duty of the shop inspectors to look for such defects and of the "hospital gang" to correct all which can be corrected. The hospital gang works under the direction of the shop inspectors, and among its duties is the removal, by filing in the lathe, of the burrs raised by the type in the marking operation. The removal of these burrs permits the high-diameter ring gage to pass over the shell. The edge of the fuse seat in the nose of the shell is quite sharp and for that reason is likely to be dented by coming in contact with the other shells and hard materials in its way through the shop. These dents are corrected with a rose reamer of the proper shape. After passing shop inspection and the necessary corrections having been made by the hospital gang, the shell bodies are thoroughly cleaned. Exceptional care is taken with this part of the work. All dirt and grease both inside and out, are removed by immersing the shells in hot caustic soda. While thus immersed, they and the soda are agitated. After draining, the work is put through two baths of clean boiling water to remove all traces of soda.

For the preliminary examination, shells with the machined parts finished are presented in lots and inspected for freedom from cracks, flaws, scale, rust and other material defects and for smoothness of surface. The operations enumerated in Table 2 are carried out. The recess in the base of the shell is examined. Shells which

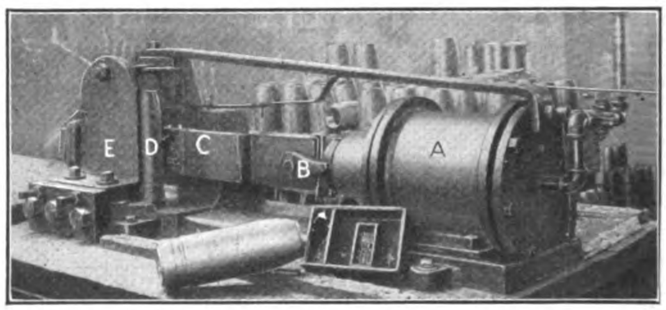
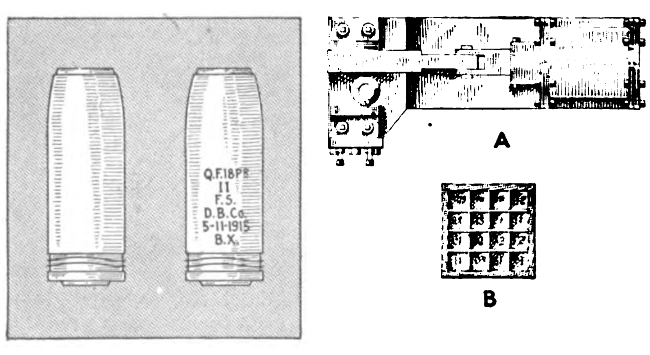


FIG. 36. PNEUMATIC MARKING MACHINE

are to be fitted with the new type of base plate have the recess inspected for both the diameter and flatness of the bottom.

No patching, stopping, plugging or electric welding is allowed. Shells found correct are marked by the inspector with this work mark in the following manner, as illustrated in Fig. 37.

1. A work mark is stamped on the body immediately in front of the driving-band groove to indicate that the driving-band groove is correct and ready for the band.



OPERATION 21. MARKING THE SHELLS

Machines Used—London air marker A
Special appliances—Font of steel type B.
Gages—None.
Production—Two men and one machine, 125 per hr.
Reference—Fig. 36.

2. A second work mark is stamped above the first if the shell is found correct to body gaging and visual examination. (As an alternative these work marks may be placed in the rear of the driving-band groove, the one indicating the correctness of the groove being next to it.)

3. A work mark is stamped on the shoulder to indicate that the threads in the head are correct.

TABLE 2. INSPECTION OF HIGH-EXPLOSIVE SHELLS

Operation No.	Operation	Per Cent. to Be Done on 18-Pounder
1	Examination of fractures and work marks on billets	100
2	Internal and external examination before varnishing	100
3	Undercut in groove for driving band	100
4	Low diameter of groove for driving band high and low	100
5	Examination of threads in base and head	100
6	Concentricity of cavity	100
7	Depth and flatness of recess for base plate	100
8	Examination of base plate before insertion	100
9	Examination of base recess for flaws	100
10	Base calipers	100
11	Wall calipers	50*
12	Diameter of body high and low	100

*When a shop has been turning out satisfactory work for some time, the percentage of shells inspected for wall thickness is only from 10 to 20.

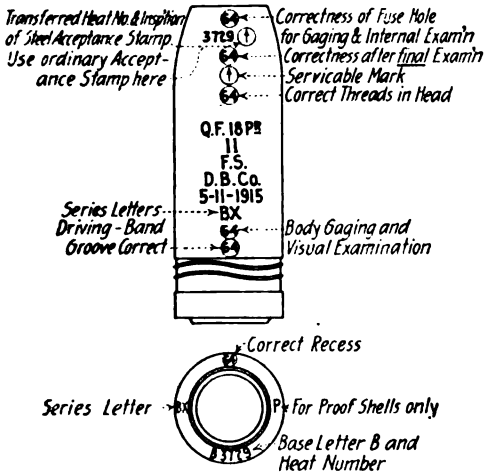
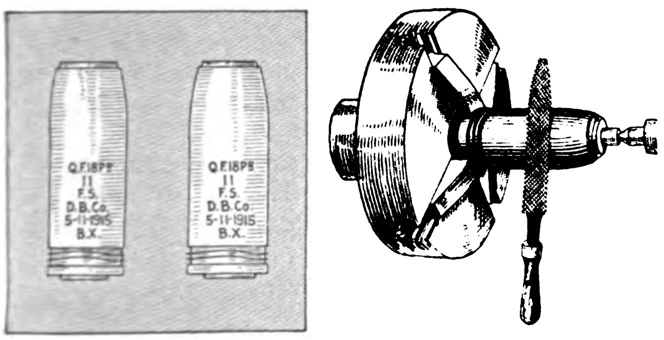


FIG. 37. MARKING CHART FOR GOVERNMENT INSPECTOR

4. A work mark is stamped in the bottom of the base-plate recess and one on the base of the shell near the edge of the recess to indicate the correctness of the recess.

5. A work mark is, in the case of threaded base plates, stamped on the inner face of the base plate to indicate flatness and freedom from flaws.

If the manufacturer desires, the selection of a shell for proof is permitted at this stage, a distinguishing mark *P* and his work mark being put on its base by the inspector. The completion of the shell can now be hastened. When completed it is subjected to the usual final examination and forwarded by the contractor to the Chief Inspector of Arms and Ammunition Cartridge Factory, Cove Fields, Quebec, for proof. The preparation of the shell for proof is done at Quebec.



OPERATION 22. FIRST GENERAL SHOP INSPECTION AND HOSPITAL WORK

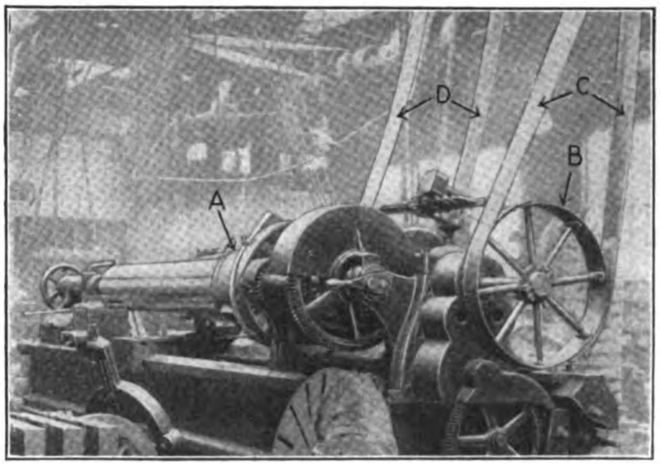
Machines Used—Lathes for filing off marking burrs and reaming noses of damaged shells.
Special Appliances—Tanks for hot caustic soda and for hot water.
Gages—All gages that have been used in the operations which have preceded this operation.
Production—8 inspectors and 4 men in the hospital gang put through 350 shells per hr.
References—None.

Grinding the Columns of Radial Drilling-Machines

By E. A. Thanton

To rough-turn and then grind is an ideal way to finish radial drilling-machine columns. To turn a column in a lathe and then remove it to a cylindrical grinder for finishing is not only a nuisance, but it is impossible to set a heavy column in the grinder in exactly the same position in which it was turned. To obviate this difficulty, the Mueller Machine Tool Co., Cincinnati, Ohio, turns and grinds in the same machine, as shown in the accompanying illustration, which shows the piece chucked in position.

The column is first rough-turned and then a heavy electric grinder is used on the cross-slide to grind with, as shown at *A*. The grinding wheel runs down as usual,



GRINDING A RADIAL DRILLING-MACHINE COLUMN ON THE LATHE

so the column must be made to revolve in the opposite direction from that used in turning. This is done by placing a pulley at *B*, which is run by means of a cross-belt *C* from a small pulley on the countershaft above. While this is being used, the regular cone drive-belt *D* is simply allowed to hang loose on the cone. The grinding drive is direct, as the pulley shaft is pressed into the rear end of the lathe spindle, and the pulley *B* mounted upon it is shown.

The column shown is 11 in. in diameter and 9 ft. overall, with a length to be ground of 7½ ft. In grinding, the column revolves about 25 r.p.m., and a 12-in. wheel is used on the electric grinder. A pan of water is set on the cross-slide directly under the grinding wheel and catches all the abrasive and grinding chips as they are thrown downward by the wheel, keeping the lathe ways and other parts free from grit.

The entire rig is simple in design, construction and application and is a good example of the adaptation of a regular plain machine tool to an unusual job which otherwise would require a large expensive machine tool.

Effect of Feed and Diameter on Cutting Speed of Drills

By A. Lewis Jenkins*

SYNOPSIS—A formula for the cutting speed of twist drills is derived from experimental work on other cutting tools, the practical experience of shops that have systematized their drilling practice and proposed tables of feeds and speeds from reliable sources. It combines a constant, the drill diameter and feed, in an expression that equals the speed. An alignment chart gives an easy method for using the relations of the formula.

Through the mass of literature on drills and drilling covering proposed feeds and speeds for different diameters, these two questions come to the top: How much does a given change in the feed of a drill affect the allowable cutting speed? What is the relation between diameter and cutting speed?

These questions were answered by Dr. Frederick W. Taylor for lathe tools, but no definite statements of laws or theories have been proposed for these relations when applied to drills. In an editorial, Vol. 33, page 843, the *American Machinist* very forcibly called attention to the fundamental principles to be considered in drilling, and emphasized the fact that "too little real study is given to it in many shops." Our present knowledge of these laws is more a result of evolution from, than a systematic study of, fundamental principles.

The data on which the proposed equations given in this article are based were taken from the experiences of well-systematized shops, makers of drills, proposed tables of speeds and feeds, and the results of Doctor Taylor's research.

Effect of Diameter on Cutting Speed

Proposed tables for cutting speeds are at variance in regard to the relation between cutting speeds and diameters of drills. Some suggest a constant cutting speed for all diameters when working in cast iron and a lower speed for the larger sizes when cutting steel. Others propose a constant cutting speed for steel and a variable one for cast iron.

This variance may be partly accounted for by the fact that cutting speed depends upon the feed as well as the diameter, and by changing the values of the feeds it is possible to increase or decrease the speed with the diameter or to use a constant cutting speed for all diameters. These laws for lathe tools are exemplified in the tables for Taylor's cutting speeds (see Halsey's handbook), where he gives speeds for various feeds for each depth of cut. By examining these tables or the equations from which they were derived, it is easily seen that a constant cutting speed may be used for any depth of cut by selecting the proper feed.

The breadth of a drill chip is equal to the length of the cutting edge, which is proportional to the diameter of the drill. The cutting edge is a straight line and the thickness of the chip before it is removed is constant throughout its breadth. According to Doctor Taylor the cutting speed V (ft. per min.) for a straight-edge lathe tool cutting a chip of constant thickness from a steel forging is

$$V = \frac{constant}{L^{0.22}} \qquad (1)$$

where L is breadth of chip in inches.

The action and working conditions of a drill in this respect are quite different from those of a lathe tool. Increasing the diameter of a drill increases its ability to conduct the heat away from its point. The differences in lip angles, wear, formation of chips, etc., have the effect of greatly reducing the value of the exponent of L, and the equation may be written

$$V = \frac{constant}{d^{-0.08}} = constant \times d^{0.08} \qquad (2)$$

where d is the diameter of the drill in inches.

According to this equation, the cutting speed increases with the diameter when the feed is constant.

It has been generally observed that for a given drill working in a given material the cutting speed may be increased when the feed is decreased, and *vice versa*. The cutting speeds of small drills are often limited by the spindle speeds of the machines, and the feeds are limited by the strength of the drill or the feeding mechanism. For large drills the maximum allowable feed is usually limited to the stiffness of the work and the machine. It is frequently necessary to use small feeds in order to obtain the required degree of accuracy for holes of considerable depth.

The feed is directly proportional to the thickness of the chip and, according to Doctor Taylor, the relation between cutting speed and thickness of chip for a straight-edged lathe tool, when the chips are of constant breadth, is

$$V = \frac{constant}{T^{[illegible]}} \qquad (3)$$

for mild steel, and

$$V = \frac{constant}{T^{[illegible]}} \qquad (4)$$

for hard steel.

In these equations V is the cutting speed in feet per minute and T is the thickness of the chip in inches before it is removed.

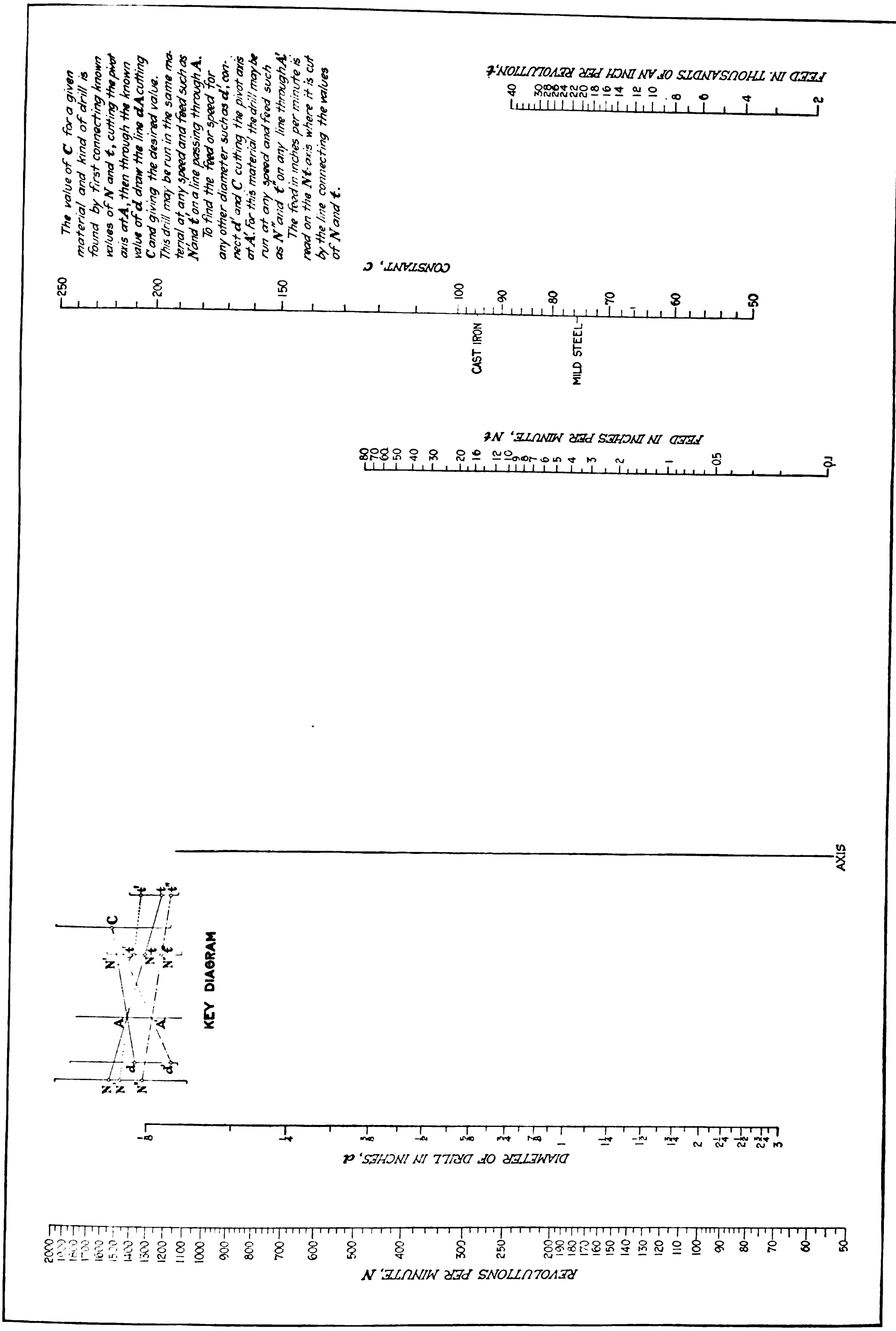
Doctor Taylor's exponential equation for cutting speeds for a ¾-in. round-nosed tool working on cast iron shows that the relation between cutting speed and feed, when the feed is small, may be represented by

$$V = \frac{constant}{F^{0.38}} \qquad (5)$$

where F is the feed per revolution of the round-nosed tool.

The data from which these equations were derived were for lathe tools taking much heavier cuts than used for drilling. For very light feeds or thin chips the cutting action of the tool is somewhat different. The cutting angle of a drill is different from that of a lathe tool, and the latter is not encumbered with the "chisel point."

*Associate professor of mechanical engineering, University of Cincinnati.



ALIGNMENT CHART, SHOWING RELATION BETWEEN FEED, SPEED AND DIAMETER OF TWIST DRILLS—BY A. LEWIS JENKINS

The cutting speed at a point on the edge of a drill varies with the radius, whereas it is practically constant for a lathe tool.

Drills are run at speeds that cause them to fail by "wear of the first class," or by friction without heat, whereas lathe tools fail by "wear of the second class," or friction and heat combined (see "Art of Cutting Metals" Par. 175). Doctor Taylor's equations are based on "wear of the second class," and the laws of governing this condition are different from those for "wear of the first class."

The action of the "chisel point" when a drill is in operation has never been explained, but it probably affects the cutting speed in the same sense as increasing the hardness of the material, which means that it decreases the exponents in the above equations.

The effects of the modifications found by comparing a lathe tool with a drill are not definitely known, and they would be very difficult to find by direct experiment. In view of these considerations and in the light of the discussions of Taylor, Nicolson, Lindner, Herbert and others, the relation between feed and cutting speed for drills cutting cast iron, steel or brass may be expressed with a fair degree of accuracy by the equation

$$V = \frac{constant}{t^{0.24}} \qquad (6)$$

where t is the feed in inches per revolution.

By a careful study of the proposed feeds for drills it was found that the relation used when the cutting speed is constant for all diameters is represented by the formula,

$$t = \frac{d^{\frac{1}{3}}}{K} \qquad (7)$$

where K is a constant depending upon the material drilled, the shape and construction of the drill, and whether it is made of high-speed or carbon steel. There is considerable variation in the values used for K; the values given in the table are an average. This formula (7) has been in use for several years and its adoption has been rather general.

TABLE OF VALUES OF FACTOR K IN FORMULA FOR DRILL FEEDS

Kind of Drill	Cast Iron	Hard Steel	Medium Steel	Soft Steel	Brass
High-speed......	80	115	125	140	105
Carbon..........	64	92	100	112	84

By combining equations (2) and (6) we obtain the following:

$$V = constant \times \frac{d^{0.08}}{t^{0.24}} \qquad (8)$$

This reduces to $V = constant$ where $t = \frac{d^{\frac{1}{3}}}{K}$.

By substituting $\frac{\pi d N}{12}$ for V, we have

$$dN = \frac{\pi}{12}\left(constant\,\frac{d^{0.08}}{t^{0.24}}\right),$$

or

$$dN = constant \times \frac{d^{0.08}}{t^{0.24}}$$

Substituting C for this constant, the revolutions per minute are expressed by the equation

$$N = \frac{C}{d^{0.92}t^{0.24}} \qquad (9)$$

where C depends on the drill, the work and the feed.

The alignment chart shown on page 153 solves equation (9) and also shows the feed in inches per minute when the revolutions per minute and feed in inches per revolution are known.

The values of C for cast iron and mild steel specified on the chart represent an average performance of ordinary high-speed twist drills driven by a vertical drilling machine. The cutting speed varies greatly with the grade of material, kind of drill and kind of machine used. Tables of cutting speeds for high-speed drills working in cast iron show a range in cutting speed from 45 to 100 ft. per min. and a variation as great as 300 per cent. in the feeds. Hence, for a single material such as cast iron several values of C are required to cover the variations due to high-speed or carbon drills, whether driven by a radial or vertical drilling machine or a turret lathe, depth of hole, coolant and strength and stiffness of the work.

For a given class of work it is necessary to do more or less experimenting in order to find the best feeds and speeds to use, and after these have been determined it is not always possible to get them from the machine. The value of C for a given material may be found by knowing the permissible speed N for a given diameter d and feed t, by drawing a line through the values of N and t on the chart, cutting the "pivot axis" at A and then through d and A drawing a line cutting at C. This value of C may be used for any diameter of drill and permissible feed for the same conditions, such as material and machine. Any line through A cutting the N and t axes, such as $N't'$, give permissible feeds and speeds for the diameter d. For any other diameter, such as d', connect d' and C, cutting the "pivot axis" at A'. Then any speed and feed, such as N'' and t'', may be used.

By reading the values of Nt, $N't'$ and $N''t''$, it is easily seen which gives the greatest feed in inches per minute.

Very small feeds may permit the drill to cut intermittently because of the spring of the work or the machine, and too large a feed causes the drill to split or injures the point. The values given by formula (7) and in the table are well within safe limits.

The feed in inches per minute when using a feed per revolution of $t = \frac{d^{\frac{1}{3}}}{K}$ is

$$Nt = \frac{Cd^{\frac{1}{3}}}{Kd^{0.92}t^{0.24}} = \frac{C}{Kd^{0.59}\left(\frac{d^{\frac{1}{3}}}{K}\right)^{0.24}} = \frac{E}{d^{0.67}} \qquad (10)$$

where

$$E = \frac{CK^{0.24}}{K} = \frac{C}{K^{0.76}} = constant$$

This shows that the permissible feed is greater for small than large drills. The cubic inches of metal removed per minute is

$$\frac{Nt\pi d^2}{4} = \frac{E\pi d^2}{4d^{0.67}} = 0.7854Ed^{1.33} \qquad (11)$$

which shows that the volume is increased 2.5 times when the diameter is doubled.

From Dempster Smith's equation for torque the

$$Horsepower = F\,d^{1.8}t^{0.7}N$$

where F is a constant for a given kind of drill and material. The amount of metal removed per horsepower per unit of time is

$$\frac{MNtd^2}{Fd^{1.8}t^{0.7}N} = Hd^{0.2}t^{0.7} = Hd^{0.2}\,(d^{\frac{1}{3}})^{0.7} = Hd^{0.43} \qquad (12)$$

where M, F and H are constants depending upon the material and kind of drill used. This indicates that a large drill is more efficient for removing metal than a small one.

Three-Inch Russian Shrapnel--II*

By John H. Van Deventer

SYNOPSIS—After coming from the heat-treatment operation and having their base ends formed to finished size, the shells are carried through a number of operations which bring them to the point where the balls, smoke powder and rosin are inserted. This article follows the process up to and including the operation in which the copper band is pressed into the band groove.

The contingent account of a shell manufacturer must contain many items, among which that of defective and rejected shells has an important place. It is impossible to tell in advance how many shells will prove defective; but conservative practice is to make the allowance for this not less than 10 per cent. of the entire product. Shop defectives and rejections in the plant that I am describing run way under this amount, and yet the original estimate of defectives of 20 per cent. is still maintained. This discrepancy between the estimated loss and what actually occurs is simply an example of conservative contingent-fund practice. While it has fortunately not yet happened that a batch of finished shells from this plant has been rejected at the Canadian proving ground, there is always the possibility of this happening, and the expense of having 5,000 shells rejected at one blow would go a long way toward drawing off some of the surplus of the contingent fund. If a thing of this kind should not happen and the low percentage of shop loss should not be augmented by a rejected batch, it is an easy matter eventually to transfer the balance of unused contingency surplus into the profit account.

While on this subject, it will be of interest to point out some of the requirements that govern the acceptance of finished shells at the proving ground, since it will qualify the reader's judgment of the necessary care and attention given to each of the operations described.

Factory inspection by no means determines the final acceptability of the shells. This final decision is made under what is known as a controlling test, in which test specimens are actually fired from guns. For each batch of 5,000 shells which have passed the Government inspector located at the factory, a selection of 10 shells is made for a tensile test. Three flat longitudinal strips are cut from a cylindrical part of the shell, parallel to its axis, immediately above the band groove. The test requirements are a breaking strength not under 8,000 atmospheres (117,600 lb. to the square inch) and a final lengthening distention not less than 8 per cent.

In addition to these 10 shells which are tested for tensile strength, 50 projectiles from each batch are given a firing test. After being fired without explosive charges in the shell itself, the projectiles are gathered and tested by exploding them in a pit, those shells being used which have received no damage during the firing test. Ten of these shells are thus tested by exploding. An idea of the strictness of the controlling-batch test may be gathered by the following requirements: No breakage must occur in the bore or in front of the muzzle of the gun during firing. There must be no separation of the head from the case of the shrapnel in the bore or in front of the muzzle of the gun. No traces of the rifling must be apparent on the cylindrical part of the butt of the projectile picked up after firing, although weak traces of the rifling on the bourrelet, extending over not more than one-half the circumference, are not considered causes for the rejection of the batch.

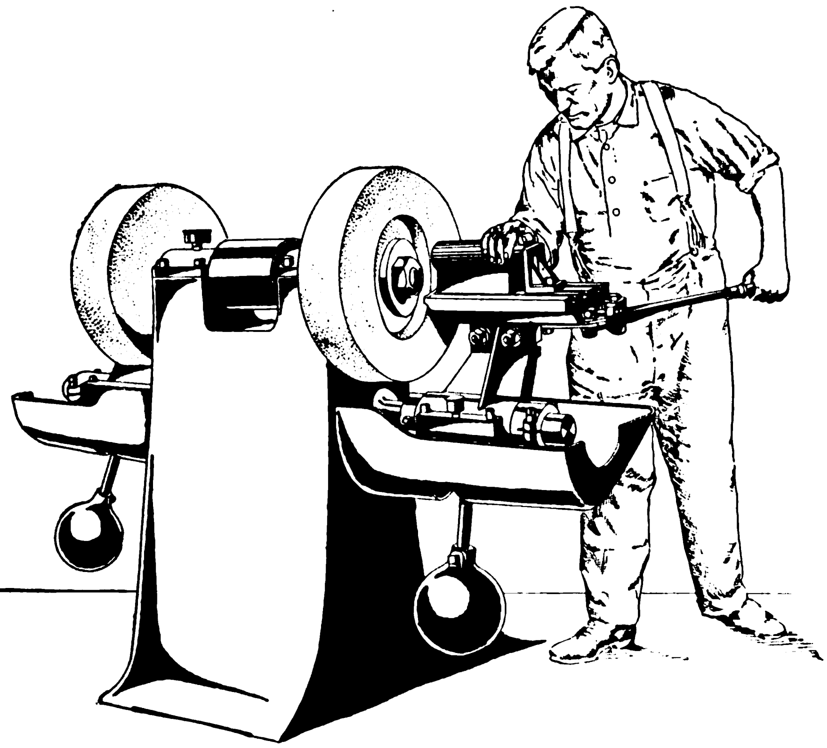


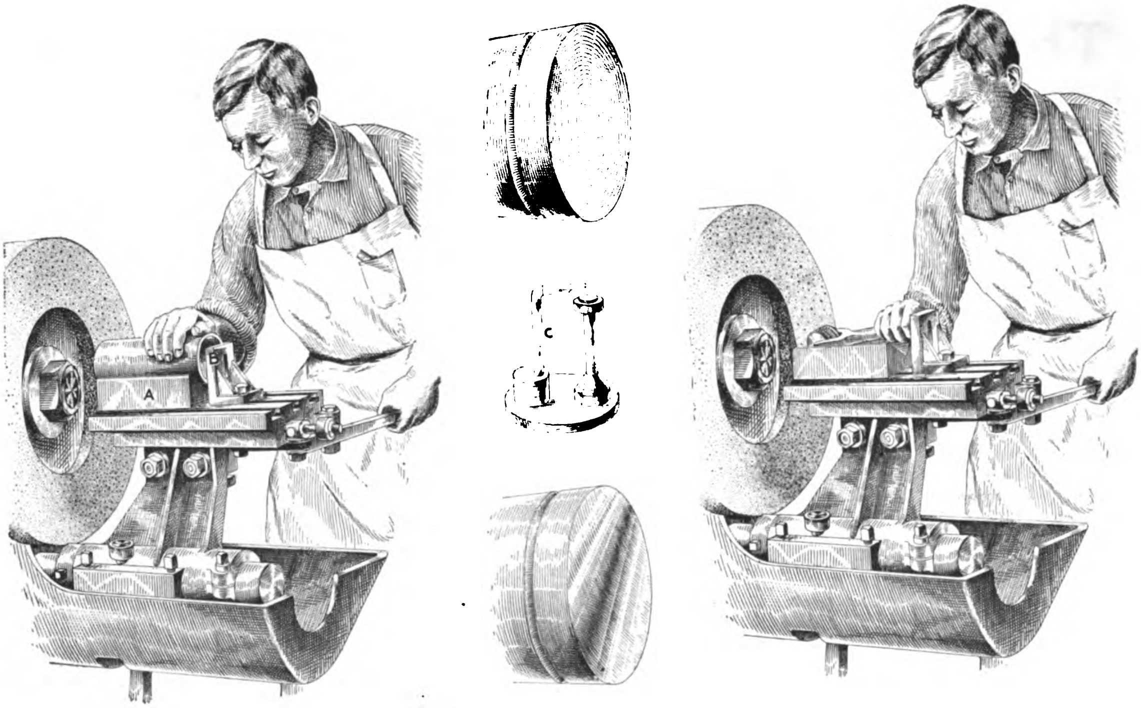
FIG. 5. GRINDING BASE END OF THE RUSSIAN SHRAPNEL

There must be no curving of the base of the shell, nor an increase of the diameter of its cylindrical part, in excess of one point. Among the shells that are given a firing test there must not be over 20 per cent. in which the upper end of the powder tube has issued from the socket of the copper plug. In addition to this there must be no considerable crimping of the central tubes, cracks on these tubes or a penetration of the tubes themselves into the powder chamber.

In the explosion test there must be no tearing off of the bases of the shell, and the bodies of the cases must remain entire in at least 70 per cent. of those tested.

As far as the copper drive bands are concerned, there must be no tearing off or displacement of these during the firing test, and the rifling marks left upon them must have a regular appearance and not be broadened.

*Previous installment appeared on page 89.



OPERATION 8. GRIND BASE END

Machine Used—Gardner No. 4 double-disk grinder.
Special Fixtures and Tools—Regular equipment used. Vee-block for shell A, length stop B.
Gages—Straight-edge to test base for flatness. Swing gage to test for thickness of base C.
Production—One machine with two operators can grind the bases of 250 shells per hr.
Note—This operation is performed both dry and wet. The use of a coolant is not necessary, as the amount of metal removed is only one or two thousandths of an inch. The heat-lot number is replaced on the shell base after grinding. This operation and the following operations are often reversed in sequence to suit shop conditions.
Reference—See Fig. 5.

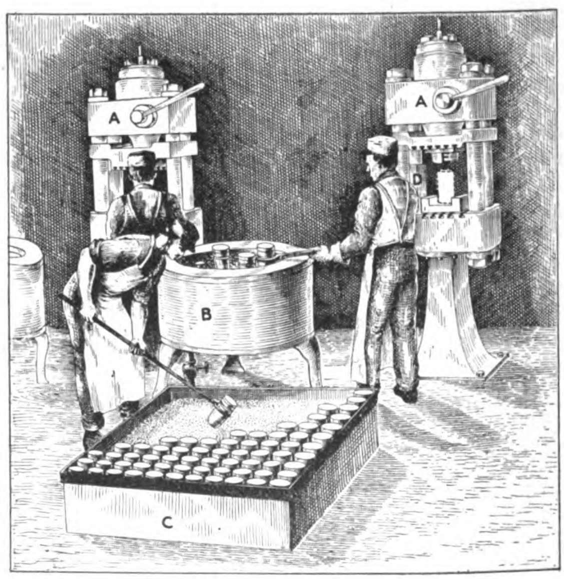
If any shell during the firing test breaks in the bore of the gun or in front of the muzzle, the entire batch of 5,000 shells is at once unconditionally rejected.

The failure of a test batch to meet some of these requirements does not necessarily mean the immediate rejection of the entire lot. The manufacturer is permitted to present more test shells at his own expense; but if these do not prove satisfactory, the chances are that he will find 5,000 unusable shells left on his hands.

These strict requirements may explain why manufacturers who anticipate a factory defective loss of from 2½ to 5 per cent. allow as much as 20 per cent. for a rejection contingency.

One of the noticeable features of the Russian shell is its highly polished base. This finish is secured in the eighth operation by means of a Gardner No. 4 double-disk grinder. Two operators work on this machine, one at each disk, the shell being merely held in a V-block on the swing table and secured by the operator's left hand, his right being used to traverse the shell across the surface of the disk. No lubrication is needed to take care of the light cut, which amounts to but 0.001 or 0.002 in. at the most.

In the illustration accompanying this operation sheet, the method of truing up the special abrasive wheel is shown at the right. Special abrasive wheels are shown mounted on this disk grinder, but the ordinary type of grinding disk is also used with good success and in fact seems to be preferred by the operators. This operation definitely determines the thickness of the base of the shell. A careful gaging follows it, the apparatus shown at *C* being used for this purpose. The shell is placed over the vertical spindle with its powder pocket resting upon the spindle enlargement; and the surface gage, shown at the left, which has plus and minus ground measuring surfaces, is passed over the base of the shell.



OPERATION 9. BOTTLING AND ANNEALING

Machines Used—Watson-Stillman hydraulic punching press A, Frankfort crude-oil fired lead pot B, galvanized-iron annealing trays C.
Special Fixtures and Tools—Distance stops D, heading die E, locating piece F.
Gages—None.
Production—Two men, with one lead pot and one press, head and anneal 240 shells per hr.
Note—Flake mica used for annealing.
Reference—See Fig. 6.

Bottling and annealing are combined in the ninth operation. The perspective illustration accompanying this operation sheet shows another example of nicely timed handwork. Two men are kept busy at each pot, one of them working from the pot to the machine and back to the pot again, while the other works from the pile of shells on the floor to the melting pot and from the melting pot back to the annealing trays of flake mica. The die used on the heading press is not water-cooled, yet does its work without causing the shells to stick.

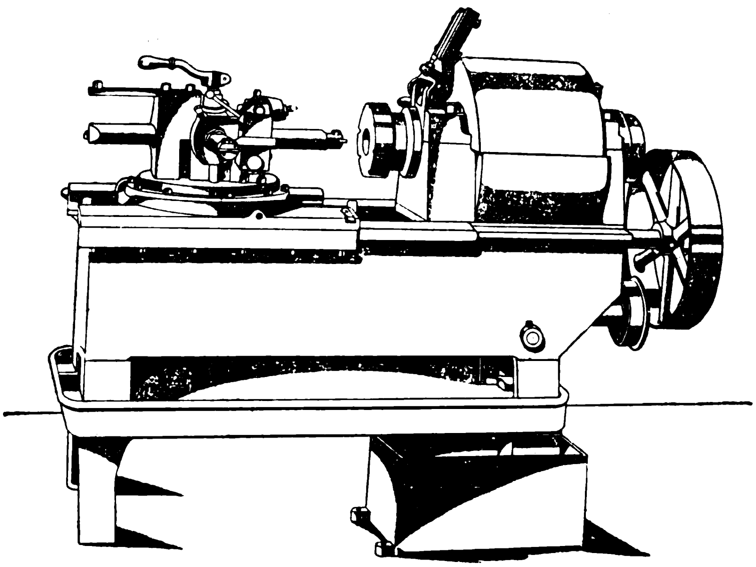
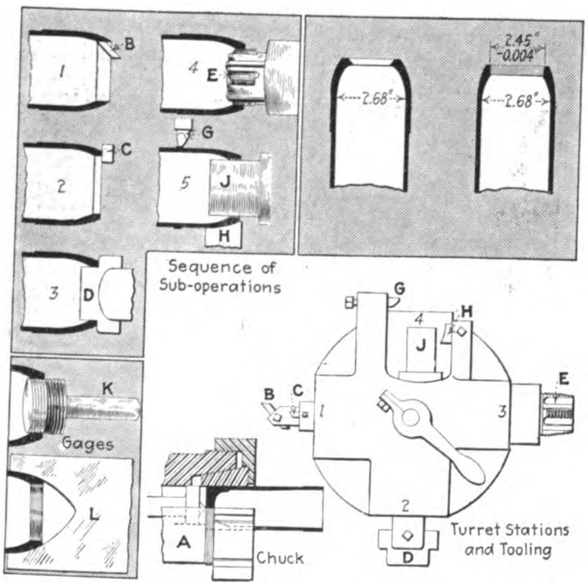


FIG. 6. REAR VIEW OF SPECIAL CHUCKING LATHE



OPERATION 10. BORE, FACE, TURN AND TAP NOSE

Machines Used—Special-purpose chucking lathes.
Special Fixtures and Tools—Special shell chuck A. Cutting tools: 1—Tool for rough-boring thread seat B, rough-facing tool C. 2—Finish cutter D for thread seat and facing end. 3—Collapsing tap E. 4—Turning and forming tools G and H, roller rest J.
Gages—Thread gage K, go and not go; templet for profile L.
Production—From one man and one machine, 18 per hr.
Note—Soap-water lubrication used. The third and fourth suboperations may be reversed in sequence if desired. The form of Whitworth thread prevents injury to threads in nose by the roller rest in the sequence as shown.
Reference—Special-purpose chucking lathe, shown in Fig. 1.

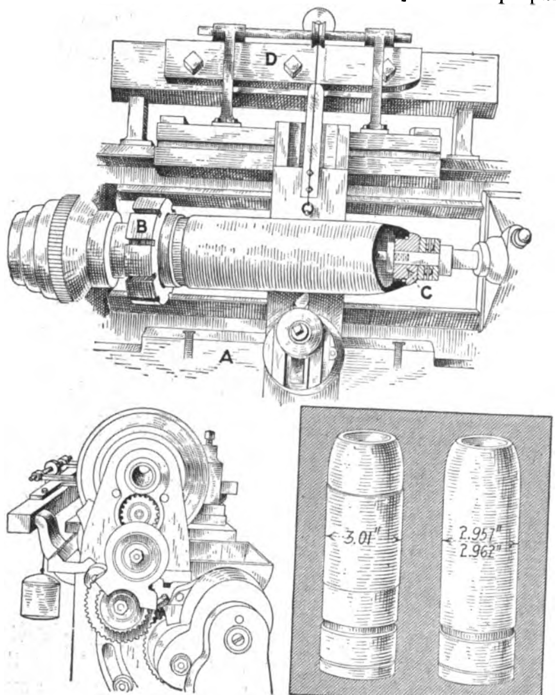
The operation of bottling and annealing is often reversed in order with respect to that of grinding the shell base, this depending upon shop conditions. It makes no difference whether bottling precedes or follows the grinding operation. The rough stock that has been left upon the body and bourrelet of the shell is removed in the eleventh operation. Each man who does this finishing work runs two engine lathes of simple but rigid construction, which are equipped with form-turning templets corresponding to the contour of the Russian shell. From each lathe the operator gets 10 shells an hour, or a total of 20 per hour per man per two machines. This is remarkably fast production, considering the fact that the material is heat-treated nickel steel. Fast cutting must be done to obtain this result; as a matter of fact the cutting speed is over 118 ft. per minute, and the lineal feed is 3 in. per minute. The finish-turning operations leave approximately 0.002 in. for the succeeding filing and polishing operations. A clever tail-end centering device is used on these lathes. It incorporates in its design a plug that fits the finished end of the shell nose and a ball thrust bearing that removes friction which would otherwise result in heating at this high speed. This same centering device is also used on the tailstock of the speed lathe in the following operation. This ball thrust bearing saves considerable power and loss of time, both of which are items worth putting on the right side of the profit ledger.

It has already been stated that the finish equivalent of British shells would be considered entirely too rough for Russian standards, and this fact is impressed strongly upon one who watches the operation of file-finishing and polishing the body. It is hard to realize why the body of the shell, which does not come in contact with the bore or rifling of the field gun, must be subject to such a fine degree of finish; but it must be admitted that the appearance is far superior to that of shells in which the tool marks are permitted to remain. Possibly this fine appearance exerts its influence over those who handle and use these shells, making them unconsciously more careful in their use of the shells. It is hard to imagine any other reason for the insistence on this fine body finish.

The speed lathes used in this operation are examples of effective simplicity. They are mounted upon wooden beds and driven from below through belts tightened with idler pulleys. Brakes are provided to bring the head spindles to a quick stop. The tail spindles of these lathes are actuated by springs, so that all that it is necessary for the operator to do is to release the lever handle, whereupon the ball-bearing centering plug forces the shell into the taper cup chuck, where it is held and driven by friction. This filing and polishing are confined to the body and bourrelet of the shell and do not extend to the nose, which will receive attention after the fuse-socket plug has been inserted and the screws put in.

In tracing the work through the factory, one must at this point leave the shell shop and return to the disk and powder tubes. Unlike that of the British shell of

corresponding size, the powder tube of the Russian shrapnel is not threaded upon the disk end, but is held into the disk by expanding the sides of the tube, which are thinned down at one end for this purpose. There are a number of distinct hand operations required in preparing the disk and tube for insertion in the shell, all of which are shown in operation sheet 13. The illustrations show these steps so clearly that it will be unnecessary to describe any of these suboperations, except the one which has to do with the actual expanding and riveting of the tube. The apparatus used here is extremely simple, consisting of a cast-iron hammering block, a special punch to protect the upper end of the tube, and a hammer. A steel pin the size of the hole in the outer tube is fixed in the hammering block at *B*. At *D* will be noticed two conical stubs. These are expanding plugs. They are used for opening up the end of the tube which is to be inserted. One plug is a little larger than the other and is used when the tubes run undersize. A small drilled hole in the hammering block holds a wad of waste saturated with red lead.



OPERATION 11. FINISH-TURN BODY
Machines Used—Special 16-in. engine lathes fitted with form templets for guiding crossfeed travel A.
Special Fixtures and Tools—Special split collet chuck B, special ball-bearing thrust tailstock plug C, feed templet D.
Gages—Limit snap gages for roughing and finishing.
Production—One operator running two lathes finishes 20 shells per hr.
Note—No lubrication. Cutting speed, 118 ft. per min. Feed per min., 3 in.

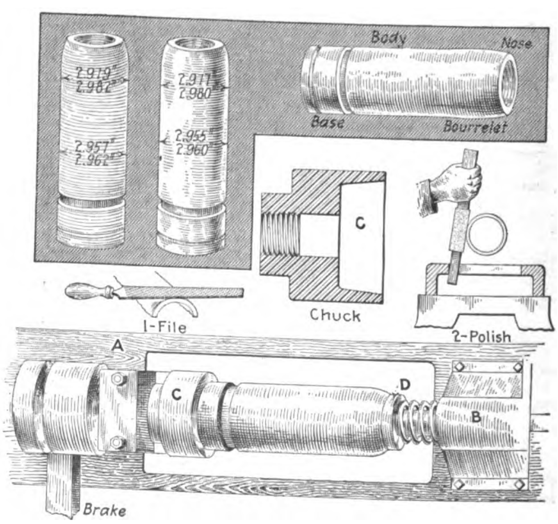
To show the actions making up this suboperation in sequence more clearly, the steps have been laid out in a straight line, beginning with the dropping of the disk over the steel pin, followed by the expanding of the tube, the dipping of the expanded end into red lead and the final riveting of the tube into the disk. The simplicity of the ways and means employed enables this operation to be performed at a remarkably high speed.

The inspection of disks and outer tubes, shown as suboperations 2 and 3, while it has been combined as a part of operation 13, can be dispensed with provided these pieces are otherwise inspected upon receipt. All of the material entering into the shell is furnished to the subcontractor, but unfortunately the degree of inspection exercised at the supplying factories is not sufficiently rigid for it to be neglected and for the goods to be accepted as received. Considerable variation is found in these parts, and especially so in the thread sizes of the fuse sockets and copper fuse plugs.

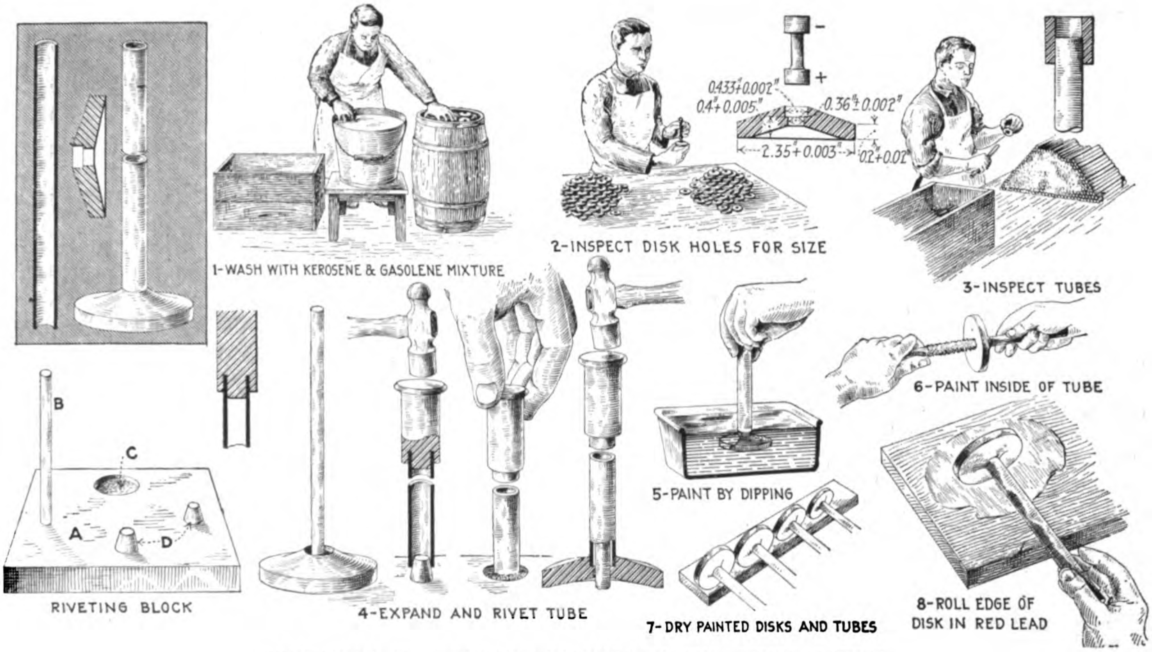
Coating the edge of the disk with red lead, as shown at 8, is done just previously to inserting the completed disk and tube in the shell, but not before the paint on the exterior of the disk and on the interior of the tube has become thoroughly dried.

While the preparation of the outer tube and disk has been in progress, the shell itself has been thoroughly washed, cleaned and delivered to the Government inspectors. In this first official inspection it receives practically the same tests as those described in volume 42, page 499, for the British 18-pounder. Particular stress is laid upon the inspection of the interior of the shell at this point, for it is the last opportunity for the Government inspectors to examine this part of the shell, unless they take the completed shrapnel apart or saw it in half. Cracks, scratches, scale, or hair lines on the interior or outside surfaces of the shell are carefully watched for during this inspection.

The painting of the interior of the shell becomes simply a matter of arranging the handling in order to get as high an output as desired from the apparatus shown in operation 14. The machine used is a compressed-air shell-painting machine made by the Spray Engineering Co., of Boston. Pressing the inverted shell over the discharge tube of this apparatus causes it to inject a measured quantity of paint, which is forced up into the powder pocket by compressed air. The air is delivered in such a way that the paint is uniformly distributed and drops



OPERATION 12. FILE AND POLISH
Machines Used—Special polishing lathes A, with spring-actuated tailstock spindles B.
Special Fixtures and Tools—Cup chuck C for base end of shell; ball-bearing tail center D, same as used on body-finishing lathes in operation 11.
Gages—Limit snap gages for bourrelet and body. Body limits, 2.955 to 2.960 in. Bourrelet limits, 2.977 to 2.980 in.
Production—From one machine and one operator, 20 per hr.
Note—Body and bourrelet are both filed and then polished with emery cloth, from 1/1000 to 3/1000 in. having been left for this operation.

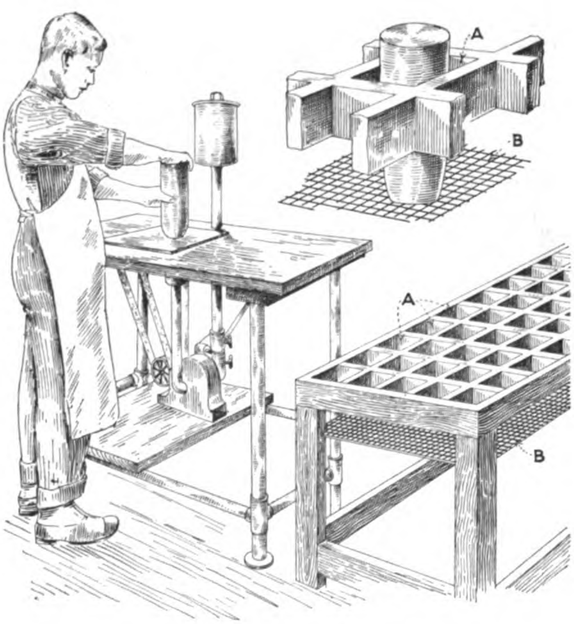


OPERATION 13. PREPARE DIAPHRAGM AND CENTRAL TUBE

Machines Used—Hand operations.
Special Fixtures and Tools—For suboperation 4, a special cast-iron expanding and riveting block D.
Gages—For suboperation 2, a go and not go plug gage A. For suboperation 3, a ring gage B.
Production—No definite rate can be put on this or the succeeding hand operation No. 16. One man and two boys easily handle both operations for 2,500 shells per 10 hours.
Note—The red lead is applied just previous to operation 15 and after the asphaltum paint has dried.

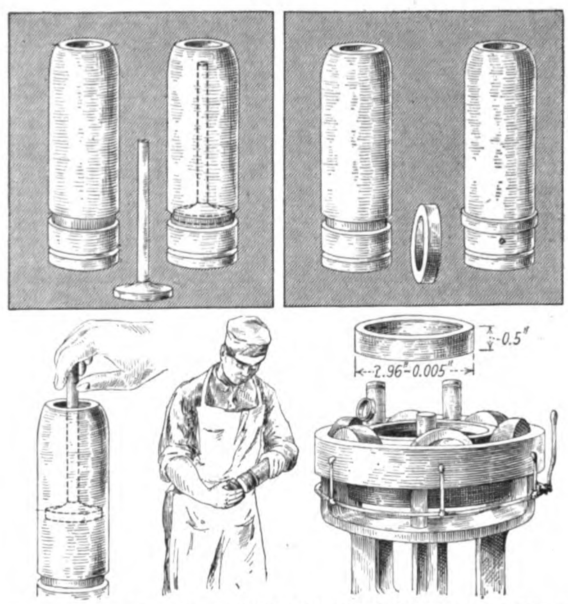
are prevented from running down and gumming up the finished thread surfaces.

One of the conveniences designed to facilitate the handling of shells during the painting operation is shown in this operation sheet. It is a drying rack mounted on wheels, and it may be readily pushed back and forth to bring it into convenient location with respect to the



OPERATION 14. BLOW OUT AND PAINT INSIDE OF SHELL

Machines Used—Spray Engineering Co.'s compressed-air shell-painting machine A.
Special Fixtures and Tools—Portable drying racks B.
Gages—None.
Production—One machine will coat the interior of 250 to 400 shells per hour, depending on the method of handling.



OPERATION 15. PUT ASSEMBLED DIAPHRAGM AND TUBE IN SHELL

Machines Used—Hand operation.
Special Fixtures and Tools—None.
Gages—None.
Production—Included in operation 14.
Note—The assembled diaphragm and tubes are simply dropped in by hand. They must fit loosely, and tight ones are rejected. The succeeding operation, crimping the drive band, must not cause the shell to pinch the diaphragm, and this acts as a check on the distortion of shell wall due to crimping.

OPERATION 16. SET OR CRIMP DRIVE BAND

Machines Used—West hydraulic band-crimping machine A, 6 plungers 6 in. in diameter, operated from accumulator.
Special Fixtures and Tools—None.
Gages—None. The test for crimping is made by tapping the band with a light hammer.
Production—One machine and one operator produce from 30 to 40 pieces per hour.
Note—A maximum unit pressure of 1,000 lb. per square inch is required.

painting machine. The shells rest upon heavy wire netting, which permits free circulation of air to their interiors and helps to dry them quickly.

In the Russian shell, any disks which fit tightly into the disk seats are at once rejected. The disk must be a loose, easy fit and must readily drop into its place. It is inserted before the shell goes to the band-crimping machine and serves as a check upon this operation, for upon coming from this machine the disks must still be free within the shell. Any distortion of the metal due to compression would of course be noticed by a binding of the disk, and this arrangement is made to serve as a convenient gage upon an operation which would otherwise be rather difficult to check up. An additional reason for this free fit is to insure that the disk and outer tube will be readily discharged from the exploded shell and thus serve to back up and give impetus to the discharge of its content of lead balls, acting in this way something like the wad back of the charge of shot in a shotgun shell.

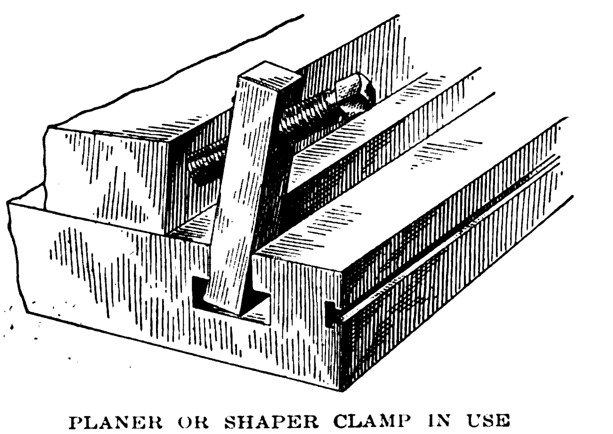
Considerable attention is given to the inspection of the copper drive band. The metal must be of such a character than it may be folded upon itself and may be then flattened with a hammer without signs of breaking. It must be capable of being forged in a cold state until reduced to one-half of its thickness, without giving indications of tearing. The correct seating of the copper band in the band groove of the shell is determined after the crimping operation by tapping the band with a hammer and noticing the clearness of the ring. In addition to this the inspector has the privilege of removing rings from 1 per cent. of the total number of projectiles for the purpose of seeing that they are properly seated. Under the present conditions and large batches, this test is restricted to a much smaller percentage of shells, but is carried out faithfully on the lesser quantities.

(To be continued)

Handy Planer or Shaper Clamp

By H. H. McCray

The planer or shaper clamp shown in the illustration is as dependable and convenient as any I have ever seen. The body is of cold-rolled steel, with the hole for the cup-pointed setscrew tapped through at an angle of 35



PLANER OR SHAPER CLAMP IN USE

to 40 deg. The lower end is notched to fit the edge of the T-slot. The clamp may be withdrawn from the slot after one or two back turns of the setscrew, the head of which is always accessible.

For planing almost any class of work, even comparatively thin pieces, it is surprising how heavy a cut such clamps will hold if a thrust pin is also provided. In a set of four or six the clamps should not cost over 25c. apiece. They will pay for themselves in a very short time.

Methods of Quenching Steel

At a recent meeting of the Huddersfield Engineering Society, S. N. Brayshaw lectured on the quenching of steel. The lecturer first of all discussed the properties which determined the value of any liquid as a quenching medium, and pointed out that the main items of consideration in this direction are specific gravity, specific heat, boiling point, conductivity and fluidity, and gave some interesting information in connection with experiments which he had carried out in the hardening of tools in various ways and by means of various quenchers.

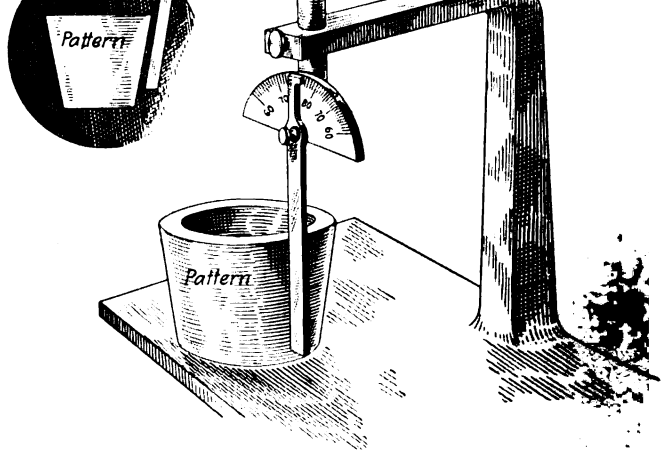
He described the effects of stirring the quenching medium, and also the use of jets for throwing a strong stream against the articles to be cooled. He referred to the use of brine and freezing mixture of snow and salt. He pointed out that the age of water has a great deal to do with its quenching powers and instanced the carrying away of water in barrels from the River Don, in Sheffield, even as far as the United States for this purpose, owing to some peculiar property which it possesses.

The uses of oil, mercury, fusible oils and fusible salts as quenching media were next dealt with, and the lecturer laid down as the ideal medium for quenching, one which is from fluid at 100 deg. C., at a high boiling point of practically 800 deg. C., fairly high specific gravity and of fairly good specific heat. This will give a glass-like hardness to the tools, but the quenching should be carried out at such a temperature that the heat left will prevent breakage.

Draft Indicator for Patterns

By A. E. Holaday

The illustration shows a device which I have found very useful in showing the amount of draft on small



DRAFT INDICATOR FOR PATTERNS

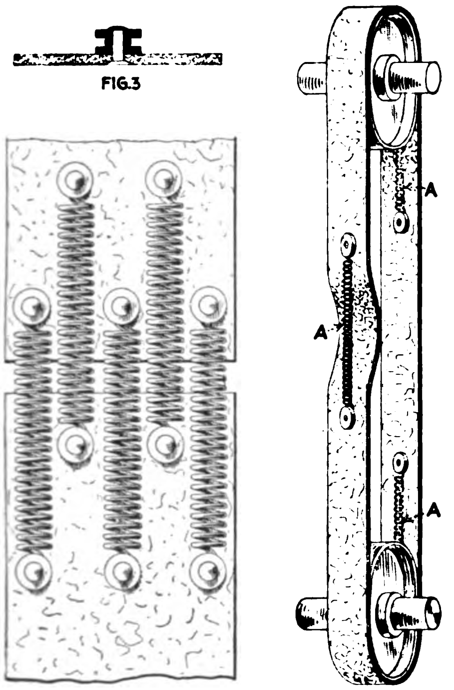
patterns. Having the indicator at the end of a long overhanging arm makes it easy to use on a great variety of patterns.

Letters from Practical Men

Keeping Uniform Belt Tension by Use of Springs

Having had considerable trouble with a short 5-in. belt located in an exposed position, I first joined the ends with five short coil springs, as shown in Fig. 1. A smooth running joint was made, but I noticed that when pulling hard, the belt would slip when the springs were on the tight side but pull well when they were on the slack side.

This suggested that by limiting the stretch of the springs and arranging them so that there would always be a spring on the slack side, the belt would drive well with only a few pounds' tension. Three pairs of light springs *AAA* were fastened to the endless belt as shown in Fig. 2. In operation a loop *B* (shown somewhat exaggerated) would form on the slack side. This loop when arriving at the driven pulley would transfer the "take-up" to the springs following, thus making the belt on the tight side travel with a uniform speed.



MAINTAINING UNIFORM BELT TENSION

Fig. 3 shows a sectional view of the fastener used to hook the springs on. It can be made out of a rivet and three washers, and conceals the hooks so that it is safe to handle the belt with the hands. E. E. Larson.

Thompson, Iowa.

Punch Press Used as a Miller

The small shop making a variety of products often gets a job that is a difficult proposition on account of not having the proper tools with which to handle it. Recently a rush order for some fixtures that required a $\frac{3}{8}$-in. square bar, Fig. 1, formed at right angles $1\frac{1}{2}$ in. from one end, with the end turned down to a $\frac{3}{16}$-in. round shoulder, $\frac{3}{16}$ in. long, and with 47 teeth cut 0.100 × 0.100 in. along the flat side, furnished such a problem.

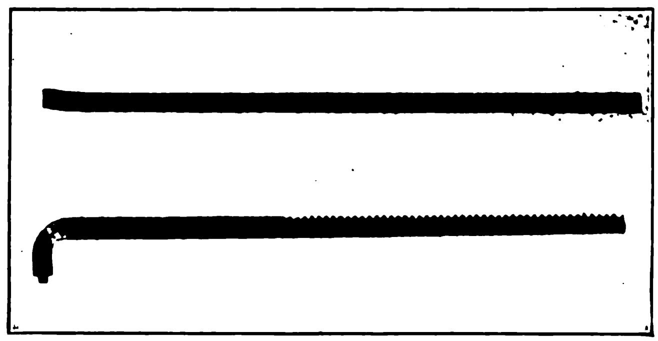


FIG. 1. THE FINISHED ARTICLE

To turn down the end in a screw machine, a special square collet was necessary; so one was turned up the

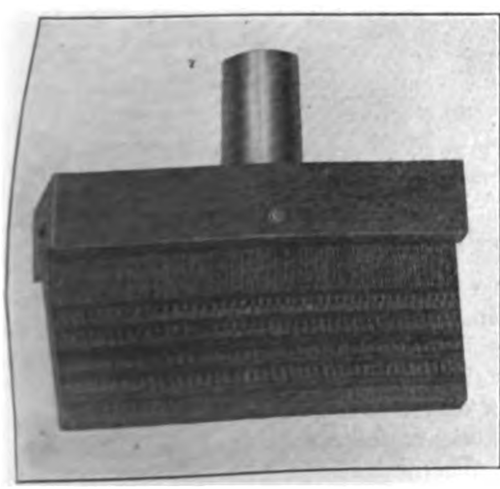


FIG. 2. PUNCH AND HOLDER

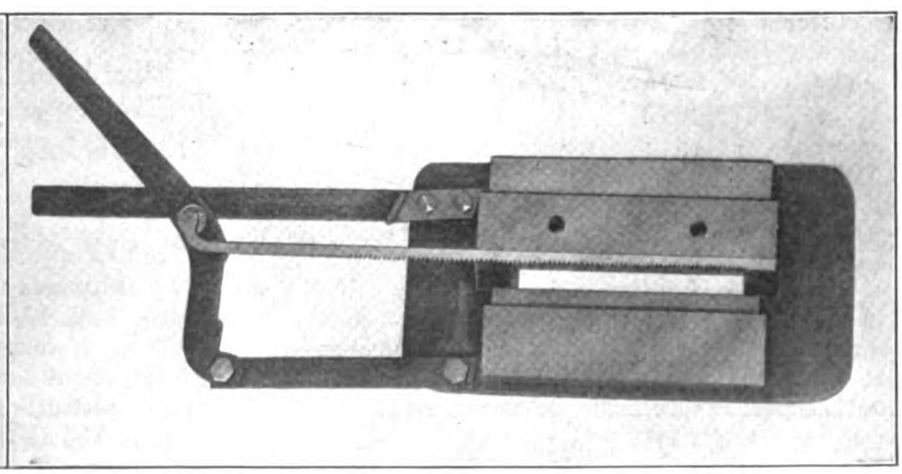


FIG. 3. DIE WITH STRIPPER REMOVED

proper outside dimensions, and the slots were cut with a hacksaw. The square hole through the center was produced by making a small broach from 3/8-in. square tool steel, driving it through by hand and filing to size.

The right-angle forming was done with an ordinary V-die in a punch press, using a round punch. The stock was somewhat distorted, however, so that it was necessary to smooth off the pieces on a grinder.

To cut the teeth, a punch and die, Figs. 2 and 3, were made with teeth exactly the size of the finished cut, the teeth on the punch being about 2½ in. long. The punch was then taken to the milling machine, where four horizontal cuts, ½ in. apart, were made to a depth of about 1/16 in. beyond the bottom of the teeth. This gave five different rows of cutting teeth. The bottom row was then cut down to within 0.02 in. of the bottom of the teeth. The row above it was cut down to 0.04 in. of the bottom; the one above that, 0.06 in.; the next, 0.08 in., while the last was left full size.

The result was that when put in operation each row of teeth cut off 0.02 in. until the last row, being full size, completed the cut.

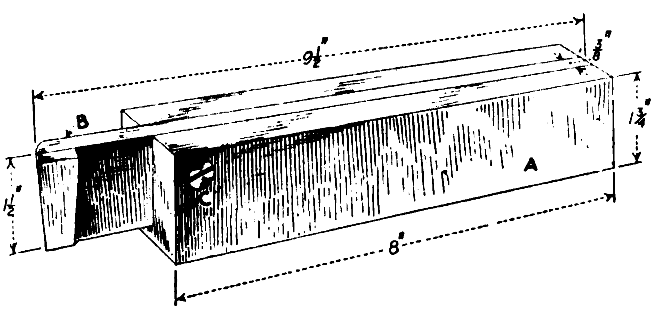
The punch had a pilot sufficiently long to engage in a slot in the die at all times, to prevent the punch from backing away when it struck the work. The die also had a heavy backing to hold the work to the punch, and a thick stripper to prevent the work from turning and binding on the return stroke. The work was slid into place endwise, a toggle lever being used for the purpose.

In operation the die was very satisfactory, except that care had to be taken to provide a stream lubrication sufficient to carry away the chips from the horizontal slots in the punch. The original intention was to have the chips fall away, the slots in the punch being cut so that the teeth had square corners on the bottom and a curve on the top, for this purpose; but as they sometimes stuck, the stream was provided.

Rochester, N. Y. GEORGE AVERY.

Convenient L-Tool Holder

The illustration shows a convertible L- or T-slot tool holder for lathe or planer use. In many shops we find steel used for tools that is double the size of the L- or T-slot, necessitating an added amount of labor in forging and a corresponding loss or waste of steel. When a 5/8-in.



A CONVENIENT TOOL HOLDER

L-tool is required, the blacksmith or tool dresser is instructed to use a piece of a 5/8x1 5/8-in. bar of steel, whereas the same tool can be made, as shown, from 3/8x1½-in. steel.

Tool holder *A* can be made of either cold-rolled steel or something better; the cold-rolled is, however, good enough. The piece should be approximately 1¾x1½x8 in. for T-slots ranging from 5/8 to ¾ in. neat. The length of the holder of course varies with the length of the tool block. When used on a lathe, it can be considerably shorter. The piece *A* should be slotted 3/8x1 5/16 in. deep to admit the 3/8x1½ tool *B*. This can be used equally well for 5/8, 11/16 or ¾ L- or T-slotting tools, and right- or left-hand tools can be used in the same holder.

The headless setscrew *C* can be either ¼ in. or 5/16 in. This screw is located well toward the top, at the end of the holder nearest the cutting point. The slotting tool is made of 3/8x1½-in. tool steel 9½ in. long, the tool being 1½ in longer than the holder and 3/16 in. higher than the depth of the slot in the holder. It is provided with about 15 deg. rake, and ground with about 7-deg. clearances on all sides. Much less time is taken in dressing these tools than is needed for solid tools.

Covington, Ky. F. A. CALDEHOFF.

An Improved Rapping Plate

Fig. 1 shows the ordinary form of pattern rapping plate which is attached by two flat-head wood screws after the pattern has four holes countersunk in the parting line. If the pattern is in constant use, these screws work loose and the wood splits out along the edges of the plate.

Fig. 2 shows a form of rapping plate that will last about three times as long before needing replacement or change

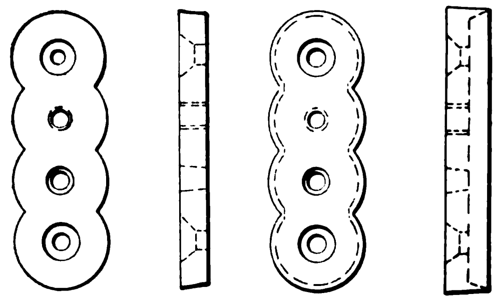


FIG.1 FIG.2

COMMON AND IMPROVED FORM OF RAPPING PLATE

of position. The lower edge is extended to a knife-edged corner on the periphery about 3/16 in. in height. The plate is located in the usual manner except that it is driven down into the wood the depth of the knife edge and is then drawn down by the two wood screws. This gives about double the surface to resist rapping as well as acting as a lock on the wood screws, the advantages of which are self-evident. H. B. MCCRAY.

Charles City, Iowa.

Drawing and Punching Die

The illustrations show a method of making in two operations the shell shown at *A*.

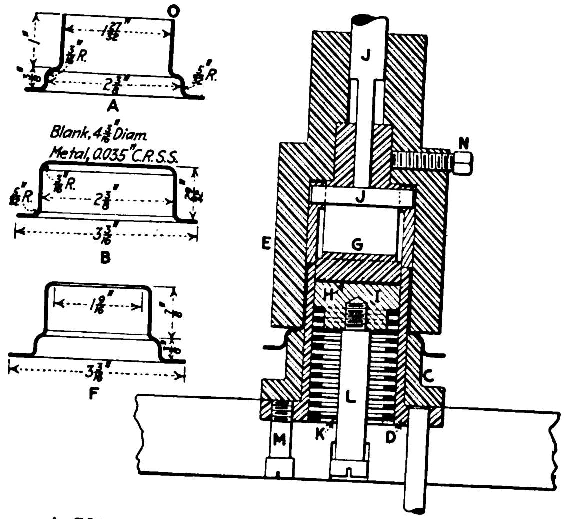
The first operation *B* is made in a regular combination die, which needs no explanation. The shell *B* is made from a blank 4 3/16 in. in diameter, the metal being 0.035 in. thick, of cold-rolled strip steel.

The principle of the die is also illustrated. It is of recent construction and does not seem to be generally known. The die works as follows:

Ring *C* is under rubber pressure just as any combination die would be, and when the press goes back to its proper

stroke, or the full height of the press, the ring C comes up level with the top of the cutting edge D.

Shell B is placed upon C, which fits around the outside of D. Punch E descends and draws the shell down ⅞ in., producing the shell F. At that point of the draw the punch G comes in contact with the shell and cuts out the top as shown at H. Punch E goes on down and draws the shell F into the shell as shown at A. This reduces the shell from B to the shell at A, cuts the top and also flanges it up at right angles. When the press goes back on its next stroke, the pad I ejects the scrap, or disk H,



A COMPOUND DRAWING AND PUNCHING DIE

out of the die D, leaving it free to be pushed away with the next shell going in. Should the shell A stick in the punch, the knockout pin JJ will eject it from the punch.

This makes a positive working die from top to bottom. Pad I is worked by the spring K, and screw L prevents it from working up too high in die D. Die D is held down by three screws M. Ring C is hardened and ground and works around the outside of D with a nice sliding fit. Punch G is held in the outer punch E by setscrew N.

All the steel parts on a die of this character should be hardened, properly tempered and ground. In my judgment there can be no better working die for doing this class of work than that shown by this principle.

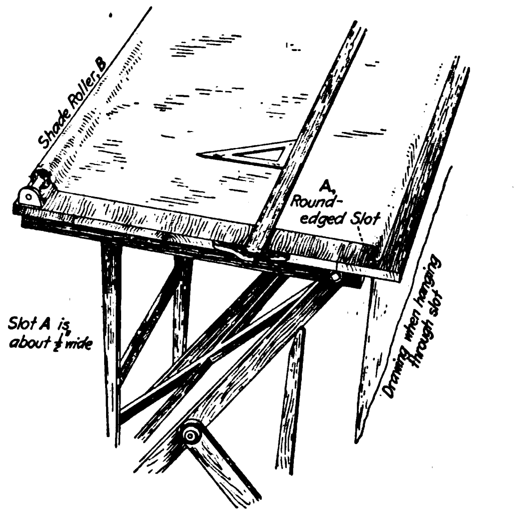
Dies of this kind very often eliminate one or two operations and do not put as much strain upon the metal as ordinary drawing operations do. The shell is perfectly level at the top, or at O, making a very neat shell.

Toledo, Ohio. JOHN R. SMITH.

Additions to a Drawing Board

It is a common thing for a tracing to come from the drafting room with a lot of creases and wrinkles on the surface. They will naturally show on the blueprints. These defects are caused by the tracing being pressed against the sharp edge of the board by the draftsman while lettering the drawing. Additions to the drawing board, shown in the illustration, should therefore prove valuable.

The slot A receives the drawing while it is being lettered, so that the draftsman cannot come in contact with the edge of the tracing and the board, thus eliminating the chances of creasing or wrinkling. The shade roller B receives the drawing as it moves up on the board, thus



ADDITIONS TO A DRAWING BOARD

keeping it from dropping to the floor. The roller, which can be made of wood, is attached to the board by two brackets.

New York, N. Y. G. WEBER.

A Lever, Its Fulcrum and the Machinist's Strap

When a farmer wants to pry up something, he takes a crowbar, a scantling or a fence rail for a pry, and a stone or a solid lump of something for a bait. He puts the bait, or fulcrum, as close up to the thing he wants to lift as possible and gets out as near the end of his pry, or lever, as he can. Why is it that the machinist and often the designer lack the sense to do the same thing?

Go into almost any machine shop and notice how work is strapped on the planer or the faceplate of the lathe; see where the bolts are placed in the straps. Nine times out of ten they are in the middle, where half of the strain on the bolt goes to hold the work and half to hold the blocking. If they were placed at one-fourth the way from the work and three-fourths from the blocking, three-fourths of the strain would go to hold the work; and if they were close up to the work, the strain would go almost wholly to hold the work.

Fig. 18, page 1160, Vol. 43, shows a design for a jig for holding a piece to be machined, where the bolt is in the middle of the strap. Of course the designer will say, "It does the job, and why kick?"

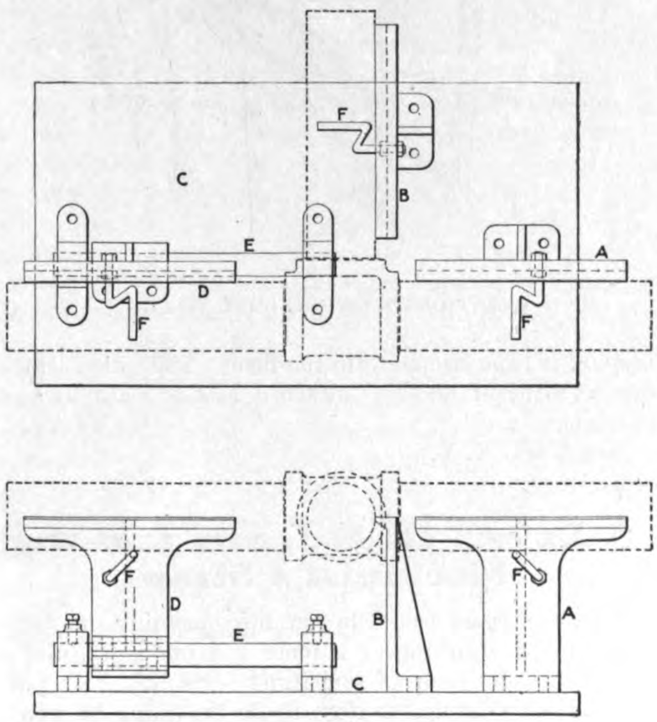
I have also seen cuts in the *Machinist* of straps for sale which showed a boss in the middle and a bolt hole central with the boss. I fancy the best all-around strap is one made of a square bar bent in the middle into a yoke, as in this the bolt can be placed anywhere along the entire length. It does require a washer on the bolt, which is no more inconvenient than sticking the bolt

up through a hole in the strap. With T-head bolts for the slots in the planer, the nuts do not have to be removed from the bolts at all. JOHN E. SWEET.

Syracuse, N. Y.

Device for Testing Fittings

The illustration shows a device for testing screwed fittings to see if they have been tapped straight. The two brackets *A* and *B* are bolted to the cast-iron table *C* at right angles to each other. The third bracket *D* slides on a cold-rolled steel shaft *E* and is bolted to the table so that the edge is parallel with the bracket *A*. The bent iron rods *F* support the pipes which are screwed into the



DEVICE FOR TESTING SCREWED FITTINGS

fitting as shown. These rods are just tight enough for a slight knock with the hand to swing them up or down. The bracket *D* can be rocked on the shaft in the same way to suit reducing sizes.

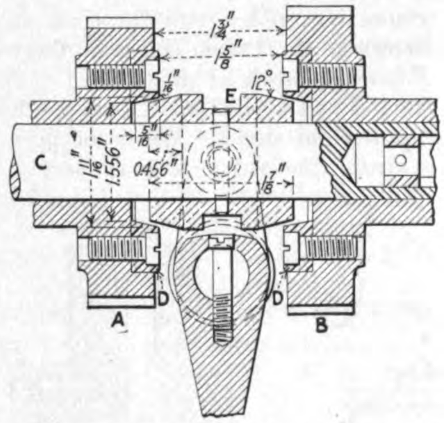
The man doing the testing needs no vise or square; he merely screws in his test piping and lays it on the machine which shows if the fitting is tapped out of alignment. This device is suitable for all sizes of fittings and will accommodate 90-deg., 45-deg. and 60-deg. elbows, straight or reducing; tees, reducing on run or outlet, or both; and bullhead tees and reducers, straight or eccentric.

Paterson, N. J. F. J. HIBBERD.

Two-Speed Friction Clutch

In adapting a machine for drilling and tapping, where it was found desirable to perform both operations without removing the work from the fixture, the two-speed clutch shown in the illustration was designed to meet the conditions.

The two driven gears *A* and *B* are keyed to the shaft *C*. The gears have a different number of teeth, according to the speed it is desired to obtain. On the inside of the gears is bored a recess, and the hardened and ground steel rings *D* are inserted, against which is forced the clutch roll *E*. This roll is keyed to the shaft and operated



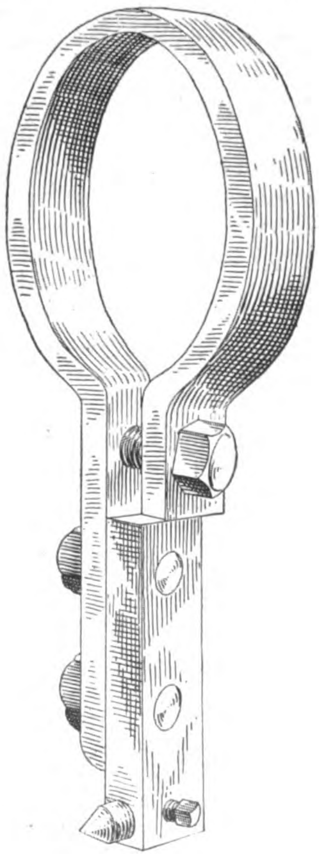
FRICTION CLUTCH FOR DRIVING TWO-SPEED SHAFT

by a foot treadle. The mechanism proved both efficient and economical. CHARLES F. SCRIBNER.

Hartford, Conn.

Miller Overarm Bracket

We wanted a light overarm bracket for a miller to hold a center for an arbor support, so that we could use a small-diameter mill and bring the center close down to



MILLING-MACHINE ARM BRACKET FOR HOLDING ARBOR IN CENTRAL POSITION

the work. The device was made of $2\frac{1}{2}$x$\frac{1}{2}$-in. strap iron and a few screws, as shown in the illustration

Naugatuck, Conn. A. E. HOLADAY.

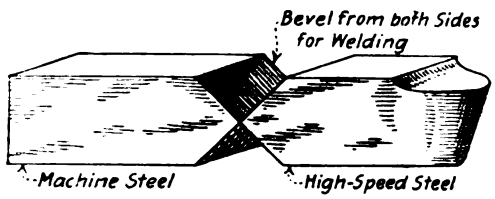
Discussion of Previous Question

Methods for Making High-Speed Steel Go Farther

The interesting article on page 123, in which various methods of conserving the limited available supply of high-speed steel are described, suggests recording some experiences that the Prest-O-Lite Co. has had along this line in welding high-speed steel tips to carbon-steel tool shanks.

The weld is made in the following manner: Both the machine steel and the high-speed steel are beveled from two sides by grinding, as shown in the illustration. It is important that this bevel extend clear to the center of the piece and that the angle be a generous one—at least 90 deg. It has been found that a nickel-steel welding rod made of a low-carbon steel containing about 3 per cent. nickel gives the best results, and no flux is used.

The weld should be executed just as though both pieces were of machine steel, except that greater care should be taken to insure the penetration clear to the center



BEVELING FOR WELDED TOOL

of the parts being welded; and it will probably be found necessary to "puddle" or "work" the molten metal with the filling rod, as some grades of high-speed steel do not flow readily under the torch. Wherever possible, the weld should be built up or reinforced, although in some cases this is impossible, as when the welded portion is inside the tool holder. In such cases the weld has to be ground off level. After the weld is completed, the tool can be ground and tempered in the usual manner.

A tool 1x1 in. can be welded, if properly beveled, in about 10 min. with a No. 6 tip. The oxygen consumption for this operation is about 5 cu.ft., and the acetylene consumption is approximately the same. On this basis the labor costs are 5c., acetylene and oxygen 10c. each, and filling material 5c.

I have never welded on any points of high-speed steel less than about an inch and a half long; but if the material is properly handled, I believe that this length could be reduced. It will be noticed of course that the procedure here described is somewhat different from the methods given in the article referred to and that a somewhat larger piece of high-speed steel is used. The process here shown, however, is, I believe, much easier for an inexperienced operator to carry out.

When it is remembered that since the beginning of the war the price of high-speed steel has risen from about 85c. to $4 per pound, the practice is worth considering.

Further, there are oftentimes short ends of high-speed steel that are not long enough for use. They are usually sold for scrap at about 35c. per pound, but may be used to advantage by this method. A. F. BRENNAN.

Indianapolis, Ind.

Spacing Grooves by Means of Lead Screw

On page 994, Vol. 43, Mr. Limbrunner describes a method of spacing grooves by means of the lead screw, and on page 1177 Mr. Miller offers another way.

We have been using in our shop for some time a method of spacing grooves which is simpler than either of those suggested. The lathe is geared up as if to cut a thread of the pitch of the grooves to be cut, and the tumbler is thrown into neutral position. We make a mark on the feed pulley and also a mark on the head of the lathe to correspond. After one groove is cut, the pulley is turned one revolution to bring the marks to register again, whereupon the next groove is cut.

This method is quicker that the others and requires no preparation except the making of two marks. It is as accurate as the lathe is, and any pitch may be divided without calculation. JAMES ELLIS.

Memphis, Tenn.

Best Way To Do Certain Things--Fastening a Lever

Prof. John E. Sweet's suggestion to compile all the best ways to do certain things is an excellent idea. There are, however, serious doubts as to what should and what should not be included, as the subject could be made so broad that no book could contain it all.

Concerning his best way of fastening on the end of a shaft a lever that is to be taken off quite frequently, there is a question in my mind whether a taper pin would not be better than a nut for fastening this particular lever. M. JACKER.

Stockton, Calif.

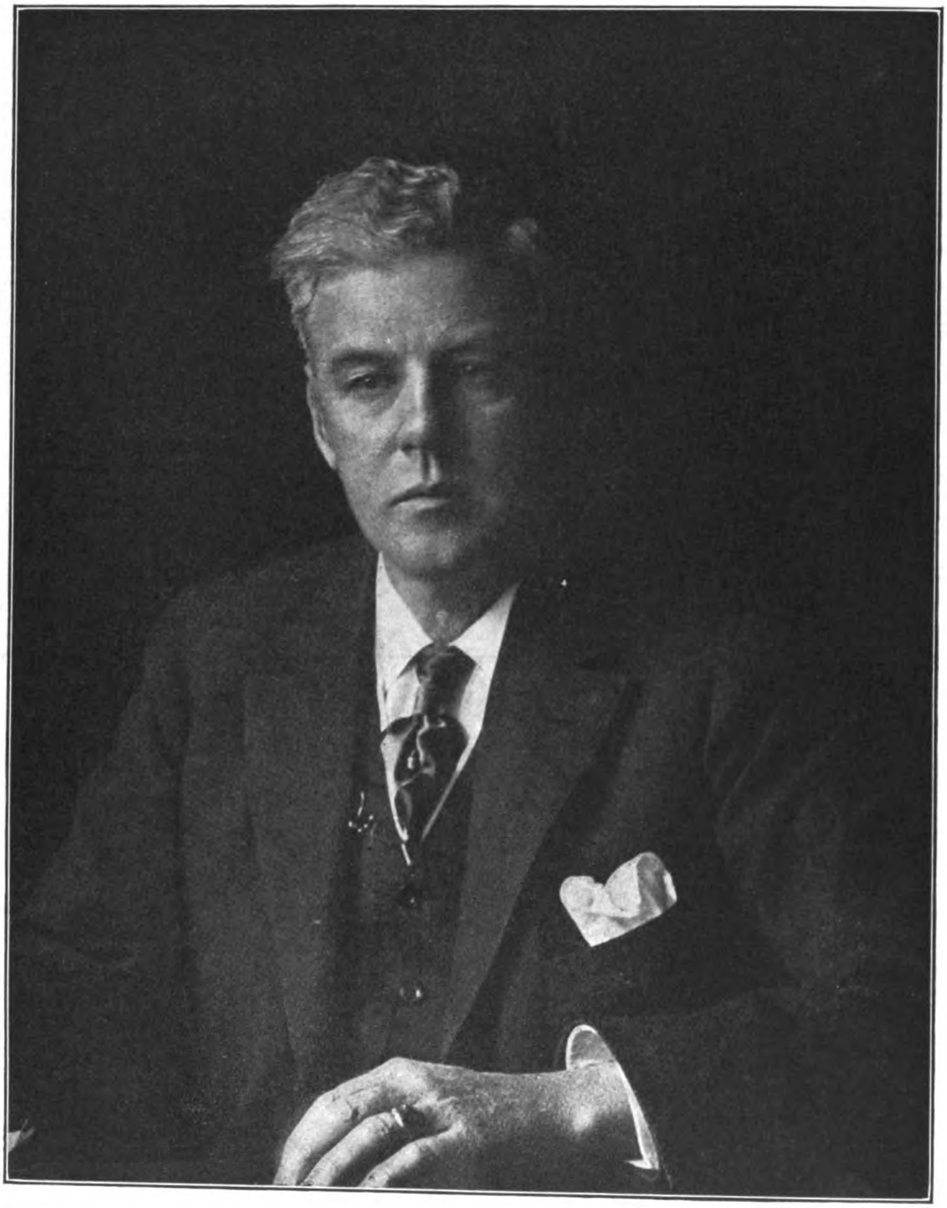
Patterns for Temporary Work

On page 1129, Vol. 43, I notice an article by L. M. Francisco on how to make a cheap pipe-elbow pattern, by building up in skeleton form and covering inside and out with a coating of tin or other thin metal and painting afterward.

It appears to me that the making of the skeleton pattern is O. K., but why the covering of tin? Is not this rather expensive, and would not the separate strips of tin represent a series of flats instead of a round shape, which I suppose is wanted in pipe work of that nature.

It would appear that such tin work would have to be formed into shape before being nailed to strips; after

(Continued on page 175)



John A. Hill

John Alexander Hill

John A. Hill, President of the Hill Publishing Co., died suddenly from heart disease on Monday morning, Jan. 24, while traveling in his motor car from his residence in East Orange, N. J., to his place of business. Mr. Hill had been engaged as usual in business affairs and was to all outward appearances in perfect health. Very few, even of his intimate associates, knew of the affection of the heart that resulted in his sudden death.

Mr. Hill was 57 years of age, having been born on Feb. 22, 1858, on a remote hill farm in the town of Sandgate, near Bennington, Vt. While he was a young lad, his parents emigrated to central Wisconsin, settling at Mazomanie. His childhood was that of the average boy on a small farm, and when eight years old he was intrusted with the care of a flock of 300 sheep. His education was that of a country school, which he attended for a few months during each of five winters. He early learned to shift for himself, and at 14 years of age went to work in a country printing office, of which he was foreman at 17. He had a Yankee boy's liking for mechanics, however, and after some years in the printing office he became half owner of a machine shop, where he carried on repairs to a variety of local machinery. At 20 he was seized by the "Leadville Fever" and spent about a year roughing it and prospecting. He then obtained a position as a fireman on the Denver & Rio Grande R.R., being promoted to engineer within a year. This was in the early days of that road and just before the great "Santa Fe war," when to drive a locomotive up the mountains and around the edges of canyons required both nerve and courage. Very soon the young engineer gained a reputation for more than ordinary ability and cool-headedness. These same qualities later on made him round-house foreman and assistant superintendent of motive power.

An opportunity for study presented itself to the young engineer when he was put in charge of the engine of a snow-plow. Its irregular runs gave him time for study, and he applied himself to railroad work and mechanics. Soon he began to contribute articles to the railway-engineering department of the *American Machinist*. His first article was published in the issue of May 23, 1885, under the title of "Oil for Locomotive Motions." The encouragement that came to him from the generous reception given to his contributions turned his thoughts more and more away from railroading and toward technical writing. In 1885 he founded the *Daily Press*, of Pueblo, Colo., and edited it for some time.

As a writer he had a forceful and breezy style and a thorough familiarity with practical matters. These qualifications, combined with a knowledge of the ideas and needs of the men in railroad work, enabled him to write articles which not only were well received in their day, but which live in book form.

At the end of the year's venture on the *Daily Press* he returned to the Denver & Rio Grande and ran an engine until 1887, when the *American Machinist*, deciding to start a monthly journal, the *Locomotive Engineer*, called him to be its editor. This brought him to New York in time to prepare for the first issue of 1888. Three and a half years later, in company with Angus Sinclair, Mr. Hill bought the *Locomotive Engineer* from the American Machinist Publishing Co. and changed its name to *Locomotive Engineering*.

The success of this journal under the new management was immediate, and was due in large measure to Mr. Hill's ability to give human and general interest to articles on mechanical and engineering subjects. Two notable series of stories that attracted wide attention were called "Jim Skeever's Object Lessons" and "Stories of the Railroad." Both of these were afterward reprinted in book form. His experience as an engineer had taught him the evils and showed him the inherent weakness of the old rule of railroad promotion—according to length of service. He strongly advocated a system under which specific subjects were studied each year and promotions made according to efficiency. This system he embodied in his work, "Progressive Examinations for Locomotive Engineers," which was later adopted by the American Railway Master Mechanics' Association as a standard form of examination on American railroads.

During the early years of *Locomotive Engineering* Mr. Hill was both editor and publisher. Although its success was phenomenal, his keen business insight showed him that a journal appealing largely to locomotive runners had not the elements for the largest kind of business achievement. He perceived a larger opportunity in the *American Machinist*, a journal of good standing and reputation, but which for years had been conducted along ultra-conservative lines. So in 1896, with Mr. Sinclair, he bought the *American Machinist* and a year later sold his interest in *Locomotive Engineering* to his partner, thus becoming the owner of the technical journal with which his name has been longest associated. This connection was the foundation for one of the largest enterprises ever established in the field of technical publishing.

At this time, 1896, practically all business publications had their printing done by contract and were limited by such facilities as the printers were willing to provide. Mr. Hill's early experience as printer and publisher had given his a strong liking for the mechanical, or manufacturing, side of the work, and he was ambitious that his publication should own and operate its own printing plant. In order, however, for such a plant to be commercially successful, its expense and effort must be spread over a number of journals.

It was this situation among others that led Mr. Hill to add to the already successful *American Machinist* other well-established technical journals of high reputation. His first purcahes was *Power*, in 1902. At that time this publication was a monthly journal devoted to the field of power transmission. Mr. Hill at once changed it to its present form and in 1908 made it into a weekly. In 1905 he became the owner of the *Engineering and Mining Journal*. A fourth journal, *Coal Age*, was established in 1911 to cover a field which had become too broad to be successfully reached by the *Engineering and Mining Journal*, which is chiefly devoted to metal-mining interests. In 1912 he purchased a fifth journal, the *Engineering News*, from its founder and chief owner, George H. Frost.

Meanwhile the influence of the *American Machinist* had been spreading abroad to such an extent that in

1900 a British company was formed to publish the European edition. Nine years later a German company was formed to translate it into German and publish it from Berlin. This made the *American Machinist* the most representative of the international technical journals.

An enterprise of Mr. Hill's last years, in which he took great pride and to which he devoted his best energy, was the construction on the west side of New York City of the great building to house his publications. This structure was completed in the latter part of 1914. It was characteristic of him that not only did he plan at every point to suit the convenience and economy of manufacturing in the printing and publishing business, but that he also made unusual provision for the safety, comfort and health of the army of workers that the building houses daily.

His initiative and leadership in the field of technical publishing are forcefully shown by the fact that many features of what is now considered best practice were inaugurated by him.

He was first in printing a circulation statement in each issue, in adopting the standard magazine size of page—9x12 in.—in discontinuing the acceptance of copies returned by news companies, in establishing an advertisers' service department, in discounting exchange advertising, in refusing to pay agents' commission on advertising contracts, in selling display advertising space on a flexible contract and in publishing a buyer's cyclopedia. Numerous mechanical improvements and developments in printing machinery are also to his credit. Both the rotary sheet-feed presses and the web presses used in his own shop were built by manufacturers according to his suggestions.

In addition to carrying on his own business he acted as mechanical engineer from 1900 to 1902 for the General Manifold Co., Franklin, Penn. Here he had charge of the building and superintending of the plant, the designing of special machinery and the development of continuous manifolding machines.

Mr. Hill was married in Wisconsin in 1882 to Emma B. Carlisle, who with one daughter survives him.

The story of Mr. Hill's life is a remarkable illustration of a man winning his way by sheer strength and ability. Born in the humblest surroundings and with only such education as was afforded by the country schools in the woods of Wisconsin nearly half a century ago, he well proved the saying of the president of one of the leading American engineering colleges that "life itself is an education." From his early boyhood, in whatever occupation he was engaged his personality was such that his associates instinctively recognized him as a leader, as a forceful organizer. In fact his capacity for organization was so great that he developed about him an organization for carrying on the manifold responsibilities of his five journals which easily carried all burdens during absences of several months at a time. The impression he made on those who met him was invariably that of a man of strength and force. While he was typically a self-made man, he had none of the objectable conceit which is simetimes supposed to characterize men who have risen to power from humble beginnings.

Mr. Hill was by nature modest and retiring. He was a genial man, fond of companionship and with an endless fund of good stories, but social life and club life had little attraction for him, and his two chief interests were the enterprise he had created, in which he took such pride, and his home. For many years it had been Mr. Hill's custom to write a Christmas greeting that reached every employee on the afternoon before the holiday. The one for last Christmas is so typical of his kindly interest in those around him, as well as showing the individuality of his literary style, that it is quoted below:

"The year 1915 is almost gone; it has brought more loss, suffering, death and despair to the human race than any other year of all recorded time, and yet, it has been good to us.

"We have not done so well as in former years, yet we have done well.

"We are all here—not a funeral or a serious illness in our ranks. Most of us are warm and eat regularly—Allah be praised!

"All signs are favorable for better times, the optimist is in charge and the pessimist has been run over by the steam roller that is making the road to business clear—this concern is full of hope and that 'Christmas feeling.'

"Most people dislike to get a bill at this time of the year, but here's one that you need not pay, so we think it will be welcome.

"With it goes a 'thank you' for every little item of service you have furnished this past year which has gone to make up the million-dollar mosaic that this company has made out of all our little items of service combined.

"If your heart and mind be charged with as much good-will, love and respect for the Hill Publishing Company as the institution has for you, the next year will be comfortable and happy for the whole works—big wheels, little wheels, case and fob."

Mr. Hill was essentially a man of broad human sympathies. He took a fatherly interest in the welfare of his employees and delighted to have them refer to him as "The Old Man," a term to which he indeed gave wide currency in his early writings on experiences in machine shops and locomotive roundhouses.

Mr. Hill was a member of the Engineers' Club, of New York City, Vice-President and charter member of the Machinery Club, member of the Railroad Club and of the Campfire Club. In 1913 he was elected a member of the American Society of Mechanical Engineers, among his references being Thomas A. Edison and James Hartness. He was first and only president of the McGraw-Hill Book Co., chairman, Hill Publishing Co., Ltd., of London, and president, Deutscher Hill Verlag, A. G., Berlin, publishers of Maschinenbau, the German edition of the *American Machinist*. As a young man he was greatly interested in the National Guard, although not a member. During the last year he was Vice-Chairman of the Committee of Engineer Reserve Corps of the American Society of Mechanical Engineers, charged with the duty of working out the details of a plan to create a corps of civilian engineers for emergency service for the United States Army.

The esteem in which Mr. Hill was regarded by his employees was put into words engraved on a bronze tablet over an ornamental fountain presented to him soon after the new Hill Building was completed. This is the inscription:

"Within this monument to independence, truth and service in engineering journalism the employees of the Hill Publishing Company have placed this tablet—an appreciation of the man and employer, John A. Hill."

Shop Equipment News

Heavy-Duty Projectile Lathe

Although the lathe shown was designed particularly for the heavy duty imposed by shell turning, its rigidity and general operating details are calculated to provide a machine well adapted for a variety of other classes of work.

In the headstock, to obtain unusual rigidity, the lower gear casing is designed to form connecting members between the front and rear main spindle and driving-shaft bearings, insuring a section free from longitudinal vibration. The spindle is of special steel, ground to standard size and bored from the solid forging. It runs in renewable phosphor-bronze bearings. The thrust bearing is formed by alternately arranged heat-treated steel and phosphor-bronze washers. Driving gears on the spindle are of cast steel with cut teeth. The driving shaft also journals in bronze-bushed bearings. The two pinions are integral, being cut from a solid forging. They slide on a feather key and are operated by a hand lever.

The proportions of the bed, combined with U-shaped internal bracing, provide rigidity. To facilitate quick removal of the tailstock, or turret, the bed is cut away at the rear end.

The apron is shouldered into the carriage over its entire length. It is held by six screws. All apron gears are of steel; those running on steel studs are phosphor-bronze bushed.

The tailstock is braced, and the construction of the nose clamp is such that the tailstock spindle is always in its correct position. The spindle is of large diameter and has a phosphor-bronze nut on a medium-pitch screw, which, with the large handwheel, facilitates easy drilling of holes of large diameters. Adjusting screws permit use of the tailstock for taper turning. The tailstock is moved along the bed by a removable pinion engaging the rack.

The lead screw is of high-carbon steel, chased to standard size. The nut is of the split pattern and is babbitted. Thrust in both directions is taken by heat-treated steel and phosphor-bronze washers alternately arranged.

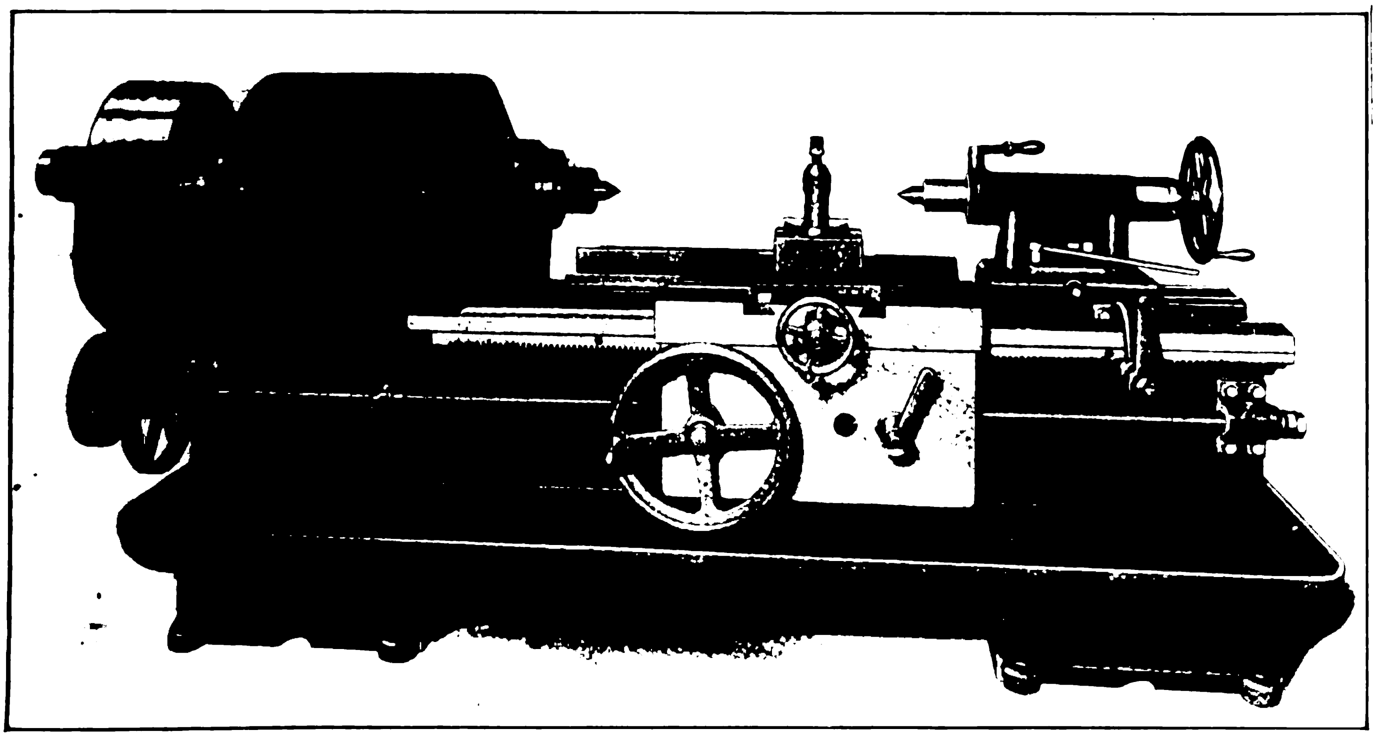
A wide variety of special equipment particularly adapted for shell work can be supplied, a most noteworthy attachment consisting of a four-way turret tool post. The lathe may also be secured with four-speed selective headstock and quick feed-change gear box.

The machine, with 8-ft. bed, weighs 8,000 lb. It is a recent product of the General Ordnance Co., Denver, Colo.

Plain Bench Miller

While primarily intended for light work, the machine shown is heavily proportioned for its size.

The spindle is machined from a 3-in. solid steel bar and has a $\frac{3}{4}$-in. hole taking a No. 10 Brown & Sharpe taper. The bearings are provided with adjustment for wear, and lubricated by a felt wick extending the entire length of the box and down into the oil wells provided.

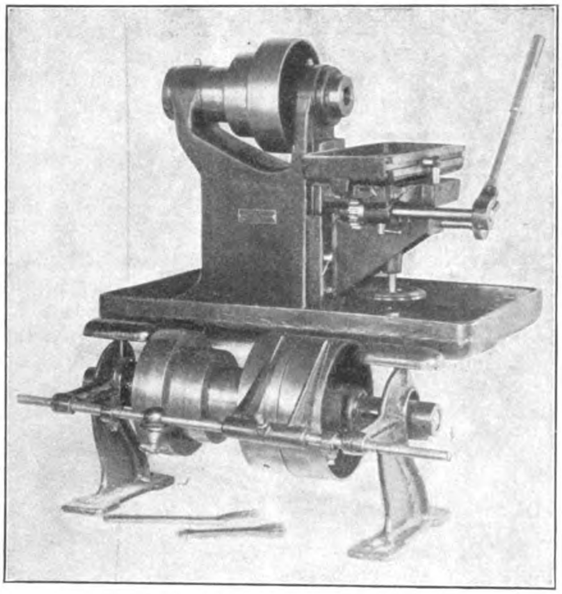


HEAVY-DUTY SINGLE-PURPOSE PROJECTILE LATHE

Swing over shears, 22 in.; swing over carriage, $13\frac{3}{4}$ in.; distance between centers, 3 ft. 2 in.; hole through spindle, $1\frac{1}{2}$ in.; pulley diameter, 20 in.; width of belt, 8 in.; feeds, $\frac{1}{16}$, $\frac{1}{32}$, $\frac{1}{64}$ in. per revolution; for cutting speed of 75 ft. per minute on 6-in. shell; main spindle, 44 r.p.m.; driving shaft, 220 r.p.m.

The table has a T-slot through the center and is arranged in a pan form to catch the oil and chips. The table is actuated by a steel rack and pinion with a hand lever on the pinion shaft which can be set so as to bring the handle in the most convenient position for the operator. A table stop is also provided.

The part of the saddle that protrudes in front of the table is machined, making it convenient to attach such



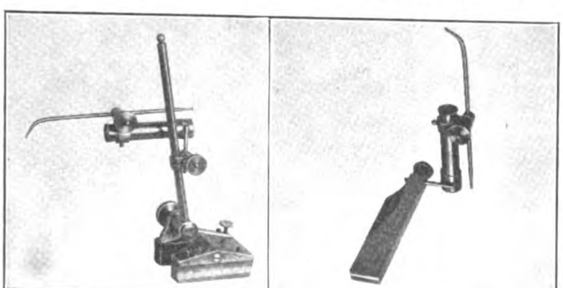
PLAIN BENCH MILLER
Table 4 in. wide, 12 in. long; 3-step cone pulley in spindle; largest diameter, 8 in. for 2-in. belt

fixtures as are often necessary in the manufacture of special classes of work. The knee is elevated by the handwheel underneath.

The machine is set in an oil-pan base and is regularly furnished in two forms—namely, with cone pulleys and countershaft, or with plain 6 in. diameter pulley on the spindle to be belted from a 6-, 8- or 10-in. pulley under the bench. On the latter the belt is entirely incased within the machine by guards and hood, the belt passing down through a special pan.

Electric Test Indicator

The feature of the universal test indicator shown is the electric-light attachment designed to avoid eye-strain and insure certainty in watching the contact of the needle of the surface gage with the work to be accurately finished.



UNIVERSAL ELECTRIC TEST INDICATOR

At the instant the ball point of the needle touches the highest point of the job, either internal or external, the light in the end of the tube flashes, indicating the direction in which the job must be moved. After the work is trued, the light will burn continuously.

The lightest touch of the needle will cause the light to flash. The indicator is self-contained, as the battery to produce the light is inclosed in the main body of the indicator in direct contact with the bulb, without any wires or connectors, and can be renewed at small expense.

As shown in the illustration, a holder is supplied to use the indicator in a toolpost where it would be inconvenient to use a surface gage. The tool is a recent product of J. G. Xander, Reading, Penn.

Electric Rivet Header

So much is said about electric spot welding that few realize that an electric machine may be used to advantage for heating and heading rivets, where spot welding is impracticable. Such a machine, used for riveting gears and plates together, is shown in Fig. 1. This machine is made by the Toledo Electric Welder Co., Cincinnati, Ohio.

The rivets are inserted in the holes, each in turn placed under the dies of the machine, and the current turned on by means of a switch in the operating lever. In a fraction of a second the rivet is heated a bright red, the

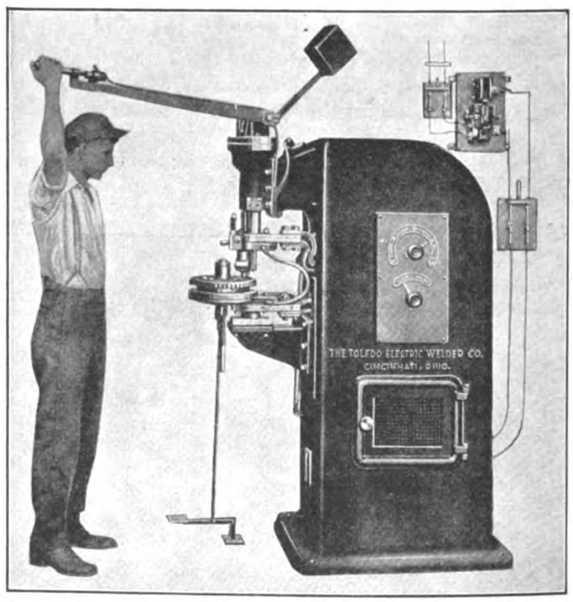
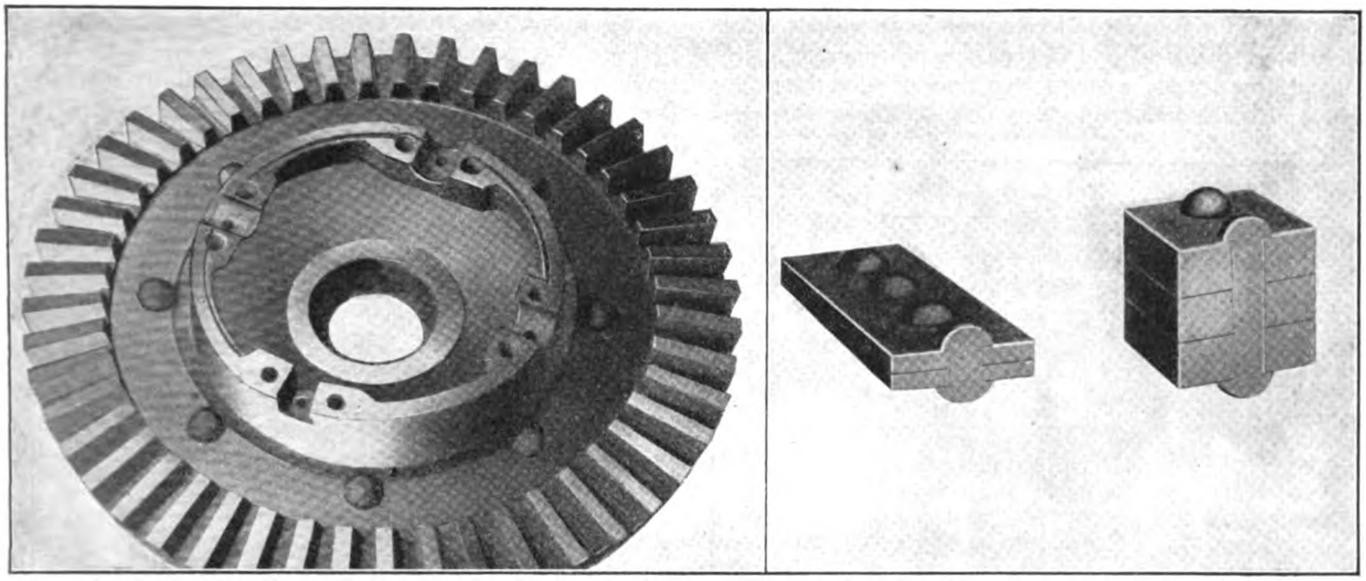


FIG. 1. ELECTRIC RIVET HEADING MACHINE

operator pulls down on the handle, and the head is formed. The current heats the rivet from the center to the outside, which is just the reverse of the ordinary way of forge heating. There is no overheating or burning of the rivet, as the operator turns off the current the instant he sees it is hot enough.

A view of one of the gears riveted in this machine is shown in Fig. 2, and Fig. 3 shows some pieces that have been riveted and the end rivets sawed endwise to illustrate the perfect heads thus formed.



FIGS. 2 AND 3. SAMPLES OF RIVETED WORK DONE ON ELECTRIC HEADER

By means of a special regulator at the side of the machine the current is under control, and rivets may be heated to a dull cherry red of about 1,200 to 1,300 deg. F. By changing the setting of the regulator they can be brought to a bright cherry red equal to about 1,500 or 1,600 deg. F. If desired, they may be heated still hotter, or about 2,000 deg. F. The operator has the current under control, and any rivet of the same size will be heated to the same temperature in the same length of time.

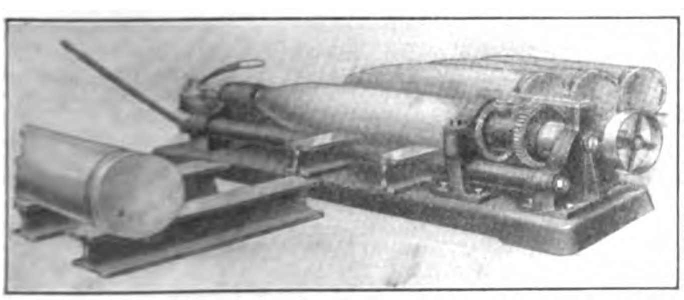
Machinist's Foot-Lever Vise

A quick-acting machinist's vise operated entirely by foot power represents a recent development of Fisher & Norris, Trenton, N. J. The foot control is designed to enable both hands to be used freely in lifting and inserting work in the vise.

The vise consists of a standard bench vise equipped with a pedal attachment which provides the movement for the jaw. It can be used with any bench, the length of the standard being varied to suit conditions. The use is made in a number of sizes.

Large Shell Marker

The machine shown represents the latest addition to the line of marking machines made by the Noble & Westbrook Manufacturing Co., Hartford, Conn. It has been developed especially for marking the base ends of heavy shells.



LARGE SHELL MARKER

A platform or rack can be built on each side, and the shells will then roll into the machine. Only a few seconds are required for the marking, after which the operator pulls the lever provided with cam adjustment, which automatically raises the shell from the machine, and another shell falls into place.

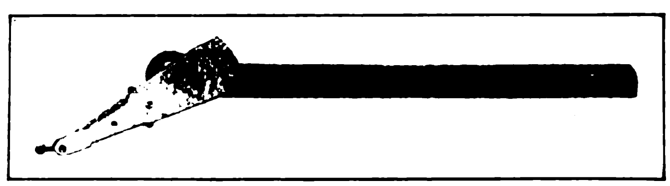
Another feature is in the die. Each letter is separate in the machine and can be removed or replaced without substituting a new die.

The machine runs by power with tight and loose pulley, and no countershaft is required.

Universal Test Indicator

The universal test indicator shown requires little explanation as to design and application.

The contact point can be turned to any desired position in relation to its axis, in order to provide readings for the wide variety of work to which a tool of this kind can be



UNIVERSAL TEST INDICATOR

applied. To reverse the direction of the reading, it is only necessary to grasp the indicator by the two ears, shown projecting from the indicator body.

A friction device protects the contact point from accident, so that if the work to be tested is jammed or pressed too hard against the contact point the latter automatically swings out of the way.

The scale is graduated in thousandths, with divisions $\frac{1}{16}$ in. apart. All bearings are bronze-bushed to prevent sticking.

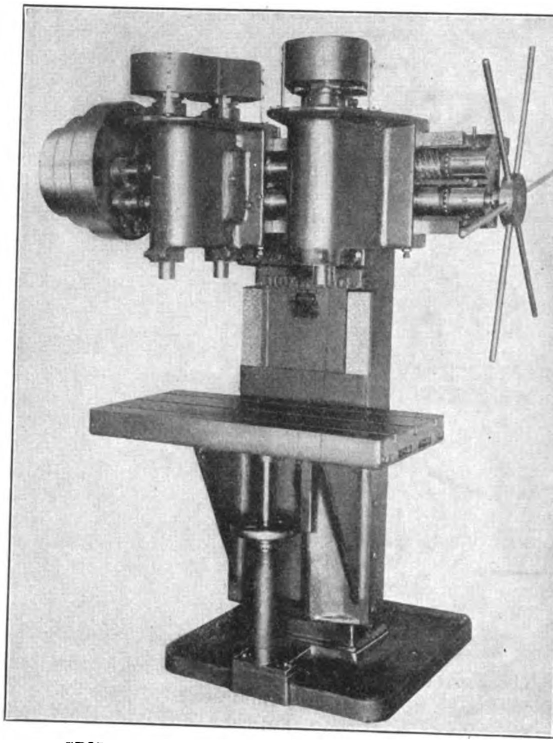
The indicator is a recent product of Johnson & Miller, 42 Murray St., New York, N. Y.

Four-Spindle Miller

The four-spindle miller shown is a recent adaptation of the drilling machine made by the Moline Tool Co., Moline, Ill.

The spindles are driven by the standard spiral drive incorporated in the drilling-machine line made by the builder mentioned. The heads are traversed to and from

each other by right and left cam grooves in a shaft below the driving spiral. Hand feed only is provided, as operations ordinarily done on a machine of this kind are light and quick-action and power feed seldom necessary.



SPIRALLY DRIVEN FOUR-SPINDLE MILLER
Table, 32x15 in.; length of rail, 3 ft.; maximum distance between spindles, 3 ft.

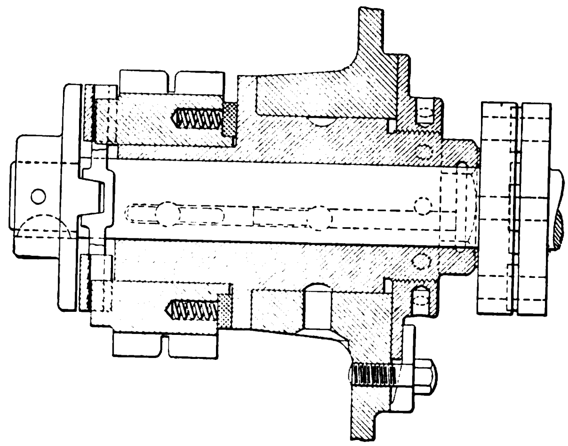
Special heads with any desired arrangement of spindles can be provided. The table is plain or oil grooved and is provided with T-slots.

Improved Oldham Coupling

Often a simple modification in an old, well-known but only partly successful device for certain purposes makes it completely serviceable in the newer applications. When we find such a development, we are apt to ask why no one thought of it before.

The Oldham coupling has been known for generations. Its early applications were on transmission shafts in mills and on propeller shafts of steamships. To a limited extent it has been used in general machinery. In its regular form the jaws are straight-sided and fit into grooves of similar shape. There must of necessity be some looseness between the male and female portions to permit movement, and as a result a greater pressure exists on the largest periphery of the driving portion as it tends to take a position at a slight angle to the groove, and in effect produces substantially line contact. This results in quick beveling off of the outer driving face of the male portion and carries the point of contact back toward the center. Again this process of wear produces a rounding or convex surface, and as the point of contact moves toward the center the pressure of driving constantly increases, with the result that the old type of Oldham coupling may quickly become loose, rattle and cause trouble. As a result it has been substantially discarded from all points in automobile construction where a material movement of the floater exists, and its use has finally been restricted to places where a lack of alignment of a few thousandths of an inch must be cared for.

The Morse Chain Co., of Ithaca, N. Y., has just put on the market an improved form of this coupling provided with a beveled driving member, which bears only on



IMPROVED OLDHAM COUPLING

the adjoining sides of the beveled edges, the total angle being 15 deg. There is no bearing on the bottom, as it is cleared at this point for take-up purposes. The two members are held in intimate contact by spring pressure the amount required being about 5 per cent. of the total amount of the drive; that is, if the pressure on the sides is 100 lb., a spring pressure of 5 lb. will always keep contact. The device has been run up to 3,000 r.p.m. and is efficient for power transmission up to pressures, for phosphor bronze, of 250 lb. per square inch, and for hardened steel, or 450 to 500 lb.

The illustration shows this coupling as part of an adjustable sprocket wheel for a chain drive. The amount of adjustment is enough to keep the chain at proper tension until the stretch is equal to the length of one link. A link is then removed and the adjustment of the sprocket set for the new chain length; further adjustments are made as they become necessary through further stretch.

Cast-Iron Castings, as indicated in a paper read before the International Engineering Congress, are chiefly used where great strength is not required of the material or where light weight is not necessary, so that the weakness of the material can be allowed for by increasing the size of the sections. There are two general classes of iron castings—plain gray iron and chilled iron. The latter material is produced by casting gray iron of suitable composition against heavy iron "chills," whereby the part chilled is rendered extremely hard and, incidentally, brittle. The somewhat gradual transition from chilled to gray iron in the casting and the soft gray-iron part of the piece give sufficient strength to the casting, as a whole, to prevent its breaking in service. Of course a casting chilled all the way through would generally be too brittle to be of any use. Chilled castings are largely used for car wheels; rolls for rolling-mill, paper-making and other machinery; for wearing parts of crushing and grinding machinery, etc.

What's the Matter With Our Methods of Threading?

By P. W. Abbott

SYNOPSIS—A study of the various elements entering into the production of good threads, both internal and external, which points out the reasons for defects and the remedies for correcting them. The taps and dies, the speed, the amount of metal removed at one cut, the size of the blank, the effect of the machine and lubricant are all considered, and the suggestions given should prove very helpful in many shops.

"What's the matter with our methods of threading?" Your editorial on page 1092 touches a very vital issue and one that has been neglected in most shops in this country. Yet the fundamental rules governing the producing of threads on threading or tapping machines, automatic or hand screw machines are no different from those for producing accurate turning, forming or reaming. But just as long as manufacturers of parts and machines could get by with the class of threading which they have been doing, this all-important subject has not had the study that other machine-shop operations have had.

I have investigated the threading problem very extensively and have seen the class of threading done by most of the representative firms in this country, and there are very few who really know the fundamental essentials of producing clean, accurately cut threads. Whenever exacting interchangeable threading limits are mentioned to the average firm doing this line of work, the first answer is, "Impossible!" The next is, "It cannot be done without hand dieing or hand tapping;" and the next, "Think of the cost!"

Just as accurate work can be done in machining threads as on plain cylindrical work, at no greater cost than poorly cut threads and without the necessity of any hand work. The first item that needs consideration is the tap and die. Accurate work cannot be done with the commercial taps and dies sold by the tap and die manufacturers at the present time. This condition is in a measure the fault of the users, as they have not been trying to produce high-grade threads, contending that they are doing as good threading as can be done and maintaining the attitude, "Threads is threads."

All of this munition and other work on which our manufacturers have found it necessary to do hand threading or tapping could be done satisfactorily on the machine with the proper tools. The first thing necessary is to use the correct dies and taps. In speaking of dies, round adjustable or button dies are meant, as they are the most economical for use on automatic screw-machine work up to 1 in. in diameter.

Specifications for Accurate Dies

The following specifications will insure good results: The threads in dies shall be burnished smooth after hardening, to remove the hardening scale and to correct the lead. After this the dies shall be ground on outside diameter and on both sides true with pitch diameter. That means that they shall be ground from the thread itself.

The die should be 0.005 in. oversize on pitch diameter, as a die can be closed to make the thread smaller but cannot be opened successfully to cut a thread over the size the die was originally made. It should cut a thread whose lead will not vary over 0.002 in. either way, in one inch. The adjusting slot in the die will be a 60-deg. V and perfectly plain on the outside diameter, with no depressions for the points of the adjusting screws. Taps should be straightened after hardening, to be within 0.002 in. on the pitch diameter and to show correct for lead within 0.002 in. either way, in one inch.

For use in the automatic screw machine for accurate threading, the round adjustable or button die is the most suitable, self-opening die heads being applicable only to automatics on large, slow-moving work.

Desirable Limits of Accurate Work

By accurate work I refer to threading or tapping done to the following limits: Pitch diameter to be within 0.002 in. for size, and for lead to be within 0.002 in. either way, in one inch, up to $\frac{9}{16}$ in. in diameter; beyond that a 0.003-in. limit on pitch diameter. There is not one thread maker in one hundred who could make parts commercially to these limits; yet it can be and is being done on a large scale by two manufacturers in the Middle West, one a screw maker and the other an automobile manufacturer, representing both phases of the question.

For hand screw machines the time element for threading has to be considered, as time is lost in letting the die run off from the work; therefore it is an advantage to use self-opening die heads. However, the problem of cutting accurate threads with a die head is a much harder one. It requires more care to cut good threads with a self-opening die head than with round adjustable dies, as we then have the errors in the die head to contend with, particularly after it begins to wear. Die heads and taps are made which will give accurate results, but they cost more than many are willing to pay.

Use Roughing and Finishing Cuts

Coming to the question of roughing and finishing threads, no one would think of turning accurate plain cylindrical work without taking more than one cut. Yet the average manufacturer will scoff at the idea of taking roughing or finishing cuts on threaded or tapped work, as the force of habit is so strong. His attitude is that as dies and taps are made to thread a piece or tap a hole in one cut, it ought to be done in that way.

Accurate holes cannot be tapped in one cut, either by hand or machine, but they can be tapped with a roughing and a finishing tap, the roughing tap being 0.010 in. smaller than the finishing tap. On large work of, say, 12 pitch, two dies should be used—a rougher and a finisher—and there are very few automatics that cannot be rigged up to do this with the exercise of a little ingenuity. Some makers make a regular outfit for an

extra threading spindle, which on the multiple-spindle machines means no extra time for doing the operation and gives a superior finish.

The choice of lubricant is not so vital as is the matter of proper dies and taps and the holding equipment for them, for if the dies and taps actually cut, almost any lubricant will do. For screw stock, ordinary paraffin oil is as good as anything. For the low phosphorus and sulphur and higher-carbon stocks, use any of the good mineral lard oils and screw-cutting compounds. None of the fancy high-priced oils are needed.

This so-called great question of lubricant has arisen from the use of taps and dies which do not cut, but push or force the metal off and out of their way. If the tools are actually cutting, all that is needed is something to keep the work and tools cool, the freer flowing the better—and lots of it. The correct method is to direct the oil under pressure through the threading spindle and out of the front, or cutting side, of the die, preventing chips from getting into the die and holder to clog and damage the die and threads. This is the fault with a great deal of our poor threading.

The average manufacturer's idea of a lubricant on a die is a small stream about 1/8 in. in diameter falling by gravity from overhead. For machine tapping, one or two squirts from an oil can are considered sufficient. But for machine tapping holes, say, up to 1/2 in., a stream about 3/8 in. in diameter under pressure should be directed on the tap at the edge of the hole. As for the lubricant's affecting the size—if the die is actually cutting, any lubricant could be put on successive threads and they would all be of the same size. If there is a variation from thread to thread cut with a die, the fault lies with either the machine or the holder, or there is a wide variation in the hardness of stock being used.

The Question of Correct Lead

There is just one thing that affects lead, and that is the tools doing the thread cutting. If the taps, dies or chasers have the correct lead, the work will also be correct. I have seen different schemes tried for changing the lead of external threads cut with dies or chasers, with absolutely no results, the thread simply being distorted in form but the lead remaining the same. When a manufacturer starts to buy his dies and taps to lead specifications he can forget his lead troubles. To know what one is doing on the lead question, means must be provided for measuring the lead.

The saw-tooth gages are good, as they will show whether the lead is good or bad, but not how good or bad. By these gages I do not mean those that fold up like a pocket-knife, as they are only good to give the number of threads per inch. What is wanted are those about 1 in. wide and 1 1/2 in. long, with the teeth milled the full length. These give the operator the proper length to measure. They should be just as long as possible up to 1 in., which is plenty long enough. There should also be a lead-testing fixture in every department cutting external threads. This fixture reads the lead in thousandths, showing the error in a minimum of time.

It is not cataloged, but it is the last word in lead measurement. If the lead on the thread looks bad to the operator with the saw-tooth gage, or at all off, he tries it in the lead-testing fixture; if it is beyond the limit, he removes the die and sets another.

There is a tendency to do threading too fast on multiple-spindle automatics. This is usually the fastest operation anyway. All the time possible that the other operations allow should be taken for threading. If the other operations are shorter, they should be sacrificed rather than have the threading done beyond a sane, conservative speed.

A little thought on comparing the accuracy wanted with the amount of stock removed will show the folly of trying to do threading at too fast a speed, and the same is true of tapping. It is very necessary that the proper size of tap drill or boring size be used for each size of hole to be tapped. This matter should be worked out very carefully, giving the maximum size of hole for each particular diameter and pitch.

The same is true of the outside diameter, which should be turned smaller than the size of the screw—that is, the size for a 3/8-in. by 16-pitch screw would be 0.368-0.372 in.; and for a 3/8-in. by 20-pitch screw, it would be still different. These sizes should be worked out carefully, as they are very important and materially affect the accuracy of the threads being cut. They should be held within a close limit. To the average screw maker or manufacturer, a 3/8-in. screw is one turned 3/8 in. with a pair of calipers set to a scale. It is just as liable to be 0.010 in. over as under.

The Spring of Dies and Die Heads

A die or die head is held together by parts that can spring under pressure, and this pressure is exerted when the die passes over the work. Naturally if the work is oversize, more pressure is exerted, the die springs open, and the thread is large. If the next setting of the box tool is so that the work is small, the thread will be small also, as the die does not spring so much. For work up to 1/2 in. the outside diameter for threads should be held within a 0.004-in. limit; for 1/2 in. up to 1 in., within 0.005 in.; and for 1 in. up, within 0.006 in.

Another factor along the same lines is the quality of stock. If this varies in hardness, the threads will vary also, due to the spring of the dies. Stock should be purchased to exact analysis and Brinnel hardness within reasonable limits for both bar stock and forgings. Accurate threads cannot be expected on forgings if the analysis is not the same in each lot, or if they have not been properly annealed or heat-treated to bring them within a close range of even temper or homogeneity. The same is true of the material to be tapped, if it is not even in temper or structure.

Tools Should Be Held in Alignment

The holes will also vary if the size of the tap drill hole varies. Tap drill holes should be held within a limit of 0.004 in. up to 1/2 in.; and within 0.006 in., beyond that size. If the tap drill hole runs large, the tap will cut to size, but part of the thread will be lost. If it runs small, however, the tap will cut oversize, due to the crowding of the metal, even though the tap is properly made. The average manufacturer, if one size of drill is out of stock, decides that the next one will be just as good; and then he wonders at the variation in the size of tapped holes.

Next in importance to the tools to do the work with is the manner in which they are held and how well they are kept in alignment. The average die holder on screw machines or turret lathes is usually in very poor con-

dition, mostly home-made and poorly made. There is, however, one good die holder made in this country, with careful thought as to cutting accurate threads. All parts are hardened and all vital parts ground after hardening. The front end of the holder or body, which is so vital, is ground true with the shank, and the shank is of ample length, insuring that the die will be presented squarely to the work.

To make sure that the die will line up centrally, a plug should be made, hardened and ground. This screws into the cap, a projection on the end of the plug being ground the exact diameter of the outside diameter of the die. The adjusting screws in the cap are screwed down until they just touch this plug, the plug is then unscrewed from the cap and the die pressed by hand inside the adjusting screws. If adapters have to be used between the die holders and the hole in the turret, they should be hardened and ground; and they should have long shanks so that they will not tip when the turret clamps tighten on them.

It is of vital importance that the turret holes be in line with the work, as the less "float" you have to use in the die holder the better the threads will be cut. For with the holder tipped at an angle when it starts on the work, to make up for nonalignment, the die will not cut properly. If the die holder is used in the type of automatic in which the die revolves, it is of prime importance that the spindle run true, and of equal importance that the work run true. Accurate threading cannot be done if either the work or the die runs out of true, yet in the average shop one will find both these errors existing.

The same is equally true in the tapping of holes. The hole and the tap should be so held as absolutely to line up with each other, yet in the average shop this receives the least attention as long as the tap finally strikes the hole. That is all that is looked out for, and very little attention is paid as to whether the tap is straight or crooked.

Little Trouble with Machines Themselves

We come next to the least of our worries in producing good threads—that is, the machine they are to be produced in. Accurate threading or tapping can be done in any of the recognized types of machine tools, providing they are in such condition that the spindle doing the threading or tapping can be kept in alignment with the work. That is all that is necessary.

Most of the manufacturers making war munitions have learned that their thread cutting is not good enough. The next step will be for them to learn that it can be made good enough without hand dieing or hand tapping—that it can be done right in the machine.

I would also call attention to the fact that there are inherent defects in both the V and the United States Standard forms of thread, preventing parts made to either of them from being as accurately fitting as they might be, owing to the interference at the top and bottom of the thread. No clearance is allowed in either. Some trouble is also due to the different tap and die manufacturers' interpretations of these two forms of threads. The best way out of this trouble would be to use the form of thread that has been discussed in your columns under the title of "The Cadillac Form of Thread." It has no interference, but fits on the pitch diameter.

PERSONALS

Edward Kountz, who has been general foreman of the Cincinnati Shaper Co., has been made acting superintendent, succeeding N. B. Chase.

Maynard D. Church has been appointed chief engineer of the Terry Steam Turbine Co., Hartford, Conn. Mr. Church was formerly chief engineer of the Dayton Turbine Pump Co., Cleveland, Ohio.

N. B. Chase, for many years general superintendent of the Cincinnati Shaper Co., Cincinnati, Ohio, has been elected vice-president and general manager of the Fosdick Machine Tool Co. of that city, succeeding William Herman, who on account of ill health has retired from active management.

OBITUARY

Austin D. Mixsell, vice-president and director of the Bethlehem Steel Co. and president of the Dietrick & Harvey Co., of Baltimore, a subsidiary concern, died Jan. 14.

J. F. Conradi, supervising engineer of the Maxim Munitions Co., died in New York City on Jan. 12 as the result of an attack of pneumonia. Mr. Conradi came to the United States several years ago after an extended experience with the Maxim-Vickers Co. of England.

George H. F. Schrader, well-known inventor, and formerly president of A. Schrader's Son, Brooklyn, N. Y., which was founded by his father in 1844, died en route from Iceland to Norway about two months ago. Mr. Schrader was inventor of the universally used valve for pneumatic tires. Since his retirement from active business he has devoted his time and fortune to philanthropic purposes.

Asa S. Cook, president and treasurer of the Asa S. Cook Co., Hartford, Conn., died on Jan. 13. Mr. Cook was born in Sandwich, N. H., in 1823, and when 27 years old went to Hartford to take up work in the Colt's Armory. Shortly thereafter he became interested in wood-screw manufacture and invented several machines for their production. In 1858 he established his own business for the manufacture of wood-screw machinery.

Edward Wright, founder of the Wright Machine Co., and for half a century a resident of Worcester, Mass., died at his home in Worcester, Sunday, Jan. 9, 1916. Born at Glen Cove, Conn., in 1835, he began work at the early age of six years as a mill hand. He moved to Worcester in 1855 when he began his career as a mechanic and inventor. He was granted over 60 letters patents in the United States and in foreign countries, many of which are in extensive use at the present time. Among the best known are improvements in textile machinery, wool-carding machines, water-wheel and steam-engine governors. He was the originator of the self-operating spinning machine which in the early seventies founded the business of Johnson and Bassett and which revolutionized the wool-spinning industry. Later he invented another form of spinning machine somewhat different in character now built by the Davis and Furber Machine Co., of North Andover, Mass., and for some years was connected with this firm as mechanical expert and inventor in the design and perfecting of textile machinery.

Patterns for Temporary Work

(Continued from page 165)

being applied, would there not be danger of their being flattened by accident of some kind or by the molder's rammer?

A pattern of this kind should be made up of straight pattern form for standard use; but if wanted for use only once or a very few times, it could be made up to be swept out of sand, or it could be made up in skeleton form (much as Mr. Francisco describes, with the exception of the tin) and both core and mold strickled out. Flanges or any side or other outlet or inlet parts that come off loose might be held on the skeleton pattern by long dowels.

Boston, Mass. John Parker.

Prices--Materials and Supplies

Pig Iron—Quotations were current as follows at the points and dates indicated:

	Jan. 21, 1916	Dec. 23, 1915	Jan. 22, 1915
No. 2 Southern foundry, Birmingham	$15.00	$14.50	$9.50
No. 2 X Northern foundry, New York	19.75	19.00	14.25
No. 2 Northern foundry, Chicago	19.50	18.00	13.00
Bessemer, Pittsburgh	21.45	19.45	14.55
Basic, Pittsburgh	18.70	18.95	13.45
No. 2 X, Philadelphia	20.00	19.50	14.25
No. 2, Valley	18.50	18.50	13.00
No. 2 Southern, Cincinnati	17.90	17.40	12.40
Basic, Eastern Pennsylvania	19.50	18.50	13.50
Gray forge, Pittsburgh	18.45	18.10	13.45

Miscellaneous Metals—The present New York quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	Jan. 21, 1916	Dec. 23, 1915	Jan. 22, 1915
Copper, electrolytic (carload lots)	24.50	21.00	14.00
Tin	41.62½	38.75	34.75
Lead	5.90	5.40	3.70
Spelter	19.00	18.00	6.75
Copper sheeets base	30.50	26.00	19.00
Copper wire (carload lots)	30.50	29.25	14.25
Brass rods, base	36.00	29.25	15.25
Brass pipe, base	40.00	34.00	14.25
Brass sheets	36.00	29.25	14.50
Solder ½ and ½ (case lots)	26.00	26.25	22.50

In St. Louis, lead sells at 5.77½ and spelter at 18.75. Lake copper in New York is quoted at 24.50c. cash and delivery is not promised until July.

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	31.50	32.00	32.50	33.00	36.00
¼ to 5/16	31.25	31.75	32.25	32.75	35.75
⅜ to 1⅞	31.00	31.50	32.00	32.50	35.50
1 15/16 to 2⅞	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3 7/16	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3½ to 3 15/16	32.25	32.75	33.25	35.75	36.75
Squares					
3 1/16 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4 15/16	33.00	33.50	36.00	36.50	37.50
5 to 6 15/16	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Standard Pipe—On carload lots f.o.b. Pittsburgh, the discounts follow:

	Black Jan. 21, 1916	Black Jan. 22, 1915	Galvanized Jan. 21, 1916	Galvanized Jan. 22, 1915
¾- to 2-in. steel butt welded	76%	81%	60½%	72½%
2½- to 6-in. steel lap welded	75%	80%	59½%	72½%

At these discounts, the net prices in cents per ft. follow:

Diameter, In.				
¾	2.76	2.20	4.54	3.15
1	4.08	3.24	6.72	4.67
1¼	5.44	4.38	9.09	6.30
1½	6.60	5.25	10.86	7.55
2	8.88	7.05	14.62	10.15
2¼	14.63	11.70	23.69	16.70
3	19.13	15.25	30.98	21.80
4	27.25	21.80	44.05	31.00
5	37.00	29.60	59.94	42.20
6	48.00	38.40	77.76	54.60

Cold Drawn Steel Shafting—From New York warehouse to consumers requiring fair-sized lots the price is 20% off list.

Sal Soda—These quotations are per 100 lb. at the places designated:

New York	$1.35
Philadelphia	1.10

Babbitt Metal—In New York, quotations are as follows in cents per pound:

Best grade	55@60
Commercial grade	25@30

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse, New York:

	Jan. 21, 1916	Dec. 23, 1915	Jan. 22, 1915
No. 28 black	3.50	3.15	2.60
No. 26 black	3.40	3.05	2.50
Nos. 22 and 24 black	3.35	3.00	2.45
Nos. 18 and 20 black	3.30	2.95	2.40
No. 16 black	3.45	2.90	2.34
No. 14 black	3.35	2.80	2.25
No. 12 black	3.30	2.70	2.20
No. 28 galvanized	5.50	5.25	3.50
No. 26 galvanized	5.20	4.95	3.20
No. 24 galvanized	5.05	4.80	3.05

Zinc Sheets—The following prices in cents per pound prevail at New York:

Carload lots, f.o.b. mill	23.00
In casks, New York	24.00
Broken lots, New York	25.00

Seamless Drawn Tubing—The base price per pound from New York warehouse is 37c. for brass and 37c. for copper. For immediate stock shipment 3c. is added, which gives the following quotations:

Diameter, In.	Copper Jan. 21, 1916	Copper Jan. 21, 1915	Brass Jan. 21, 1916	Brass Jan. 21, 1915
¾ to 2½	40.00	20.00	40.00	16.00
3	40.00	21.00	40.00	17.00
3½	41.00	21.50	41.50	17.50
4	42.00	22.00	42.50	18.00
4½	44.00	23.00	44.50	19.00
5	46.00	24.00	46.50	20.00
6	47.00	27.00	47.50	23.00
7	49.00	29.00	49.50	25.00
8	51.10	31.00	51.60	27.00

Old Metals—In New York, the following are the dealers' purchasing prices in cents per pound:

	Jan. 21, 1916	Dec. 23, 1915
Copper, heavy and crucible	19.00	16.75
Copper, heavy and wire	18.50	16.25
Copper, light and bottoms	16.50	14.25
Lead, heavy	4.75	4.50
Lead, tea	4.50	4.25
Brass, heavy	12.50	11.25
Brass, light	10.00	9.25
No. 1 yellow rod turnings	12.50	11.50
No. 1 red brass or composition turnings	12.00	11.00
Zinc	12.00	11.00

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Jan. 1	Jan. 8	Jan. 15	Jan. 22
Prompt furnace	$3.00@3.50	$3.25@3.50	$2.50	$3.00@3.25
Prompt foundry	3.50@4.00	3.50	3.75@4.00	3.50@4.00

Steel Shapes—The following prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger from jobbers' warehouse, New York:

	Jan. 21, 1916	Dec. 23, 1915	Jan. 22, 1915
Steel angles, base	2.50	2.40	1.85
Steel Ts, base	2.55	2.45	1.90
Machinery steel (bessemer)	2.50	2.40	1.80

Tin Plates—The following prices are in effect from warehouse, New York:

Coke tin plate, 14x20:

100-lb.	$4.45
I. C. 107-lb.	4.60

Terne plate, 20x28:

Base Weight	Net Weight	Coating	Price	Base Weight	Net Weight	Coating	Price
100-lb.	200	8	$8.30	I. C.	226	20	$13.50
I. C.	214	8	8.60	I. C.	231	25	14.25
I. X.	270	8	10.60	I. C.	236	30	15.50
I. C.	218	12	12.00	I. C.	241	35	17.00
I. C.	221	15	13.00	I. C.	246	40	19.00

Roll Sulphur in 360-lb. bbl. sells in New York at $2.15 per 100 lb.

Cotton Waste—In New York, the prices in cents per pound are as follows:

White	8.50@9.50
Colored mixed	6.50@8.00

Copper Rivets from warehouse, New York, sell at 35 and 5% off list and burs at the net list price.

Antimony—For Chinese and Japanese brands the quotation is nominal at 43c. per lb., duty paid.

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire

[illegible]	8.50
No. 8, 3/32 and No. 10	9.25
⅛	10.00
No. 12	11.00
5/64, No. 14 and 1/16	12.00
No. 18	14.00
No. 20	16.00

Cast-Iron Welding Rods

¼ by 19 in. long	22.00
5/16 by 12 in. long	26.00
⅜ by 19 in. long	20.00
½ by 21 in. long	20.00

Special Welding Steel

¼	33.00
3/16	30.00
5/32	28.00

Vanadium Wire in Coils or Sticks

1/16	15.50
3/32	15.00
⅛	14.00
5/32	12.00
3/16 and larger	11.00

These prices are subject to change according to quantity and shipment desired.

Wrought Washers—From New York warehouse, the base price on fair-sized orders is $4.50 from list price. At this rate the following prices hold in cents per 100 lb.:

Diameter, In.		Diameter, In.	
5/16	$9.50	1½	$4.80
¾	7.70	1¾	4.70
⅞	6.90	2	4.60
1	6.00	2¼, 2½, 2¾	4.50
1⅛	5.30	3¾, 4, 4¼, 4½	5.00
1⅜	4.90	3, 3¼, 3½	4.70

For cast-iron washers, the base price is $2.50 per 100 lb.

Carriage Bolts—On ⅜ by 6 in. and smaller 60 and 5% off list is allowed; for larger and longer sizes 50 and 5% off list is charged. For fair-sized orders from New York warehouse the following net prices at this rate would be charged:

Length, In.	Diameter ¼	5/16	⅜	7/16	½	⅝	¾
1½	$0.38	$0.53	$0.72	$1.05	....	....	....
2	.41	.58	.78	1.14	....	....	....
2½	.46	.62	.84	1.24	$1.54	$2.73	$4.04
3	.49	.67	.90	1.33	1.68	2.91	4.28
3½	.53	.71	.97	1.43	1.81	3.09	4.51

Machine Bolts—From New York warehouse, the base price for fair quantities are as follows: From ⅜ in. by 4 in. and smaller, 60 and 10% off list is discounted; for larger and longer sizes up to 1 in. by 30 in., 50 and 10% is allowed. At this rate prices per 100 are as follows:

Length, In.	Diameter ¼	⅜	⅝	¾	⅞	1 In.
1	$0.61	$0.86	$2.34	$3.47	$4.73	$6.80
2	.64	.92	2.51	3.71	5.04	7.20
2½	.67	.98	2.68	3.96	5.36	7.61
3	.70	1.04	2.85	4.21	5.67	8.01
3½	.73	1.09	3.02	4.46	5.99	8.42

Base prices on other sizes would be as follows: 1⅛ and 1¼ in. by 3 in. and up to 12 in. take 40% off list. On longer lengths a special pound price is quoted. For cold punched square nuts, 40% is discounted from list; for hot pressed hexagon nuts up to 1 in. by 30 in., 50%; up to 1 in. diameter, cold punched nuts, 40%. Buttonhead with hexagon nuts, 40% off list, as do hexagon head with hexagon nuts.

Tap Bolts—The following prices are base per 100 for fair-size orders of tap bolts with hexagon heads, delivered from New York warehouse, the present discount being 25% from list:

Length of Screw	Diameter ¼	5/16	⅜	7/16	½	⅝	¾	⅝	1
1½	$0.73	$0.95	$1.11	$1.32	$1.65	$2.47	$3.47	$4.95	$6.60
1¾	.86	1.03	1.17	1.39	1.73	2.57	3.59	5.12	6.81
2	.91	1.05	1.23	1.47	1.82	2.67	3.71	5.28	7.01
2¼	.95	1.10	1.29	1.54	1.90	2.77	3.84	5.45	7.22
2½	.99	1.15	1.34	1.62	1.98	2.87	3.96	5.61	7.43
2¾	1.03	1.20	1.40	1.69	2.06	2.97	4.08	5.78	7.63
3	1.07	1.25	1.46	1.77	2.15	3.03	4.20	5.94	7.84
3¼	...	1.30	1.52	1.83	2.23	3.17	4.33	6.11	8.04
3½	...	...	1.58	1.91	2.31	2.27	4.46	6.27	8.25
3¾	...	...	...	1.99	2.39	3.37	4.58	6.44	8.46
4	...	...	...	...	2.47	3.47	4.70	6.60	8.66

Coach or Lag Screws from New York warehouse sell at 65 and 10% from list. This is for fair-sized orders and at this rate the following net prices per 100 hold:

Length, In.	Conical or Gimlet Point ¼ and 5/16	⅜	7/16	½	9/16 and ⅝	¾	⅞	1
1½	$0.69	$0.85	$0.99	$1.18	...	...	...	...
2	.77	.93	1.09	1.29	$1.89	...	...	...
2½	.83	1.01	1.19	1.41	2.05	$2.90	...	...
3	.90	1.10	1.29	1.52	2.21	3.12	$4.73	...
3½	.96	1.18	1.40	1.63	2.36	3.34	5.04	$6.93
4	1.02	1.26	1.50	1.75	2.52	3.56	5.36	7.34
4½	1.09	1.34	1.60	1.86	2.68	3.78	5.67	7.75
5	1.15	1.42	1.70	1.98	2.84	4.00	5.99	8.16
5½	1.21	1.51	1.80	2.09	2.99	4.22	6.30	8.57
6	1.28	1.59	1.90	2.20	3.15	4.44	6.62	8.98

Nails—Wire nails f.o.b. Pittsburgh sell at $2.10; galvanized 1 in. and longer, $4.10, and shorter, $4.60. These prices are to regular customers and delivery is made at the mill's convenience.

Swedish (Norway) Iron—This material sells at $4.25 base per 100 lb. f.o.b. New York. In coils an advance of 50c. is charged.

Wire Rope—On this material the following discounts are for warehouse delivery, New York:

Galvanized	35 and 2½%
Bright	50 and 2½%
Special brands, bright	40%

Nuts—On hot pressed nuts $3 off list is allowed and on hexagon $3.20. At this rate the base price per 100 lb. for fair-sized orders from New York warehouse is as follows:

Hot Pressed Square Short Diam.	Blank	Tapped	Hot Pressed Hexagon Short Diam.	Blank	Tapped
½	....	$12.00	½	....	$17.70
11/16	$8.00	9.50	11/16	....	11.30
13/16	6.00	6.90	⅞	$6.40	7.40
⅞	5.00	5.70	1¼	5.20	5.80
1¼	4.50	4.90	1 7/16, 1⅝, 1 13/16, 2	5.10	5.70
1 7/16, 1⅝, 1 13/16, 2	4.40	4.80	2 3/16	5.20	5.90
2 3/16	4.50	5.00	2⅜	5.50	7.30
2⅜	4.80	5.40			

Semifinished nuts are sold at 70 % from list price.

On cold punched square nuts $3 from list is deducted and on hexagon $3.75. At this rate the base price on fair-sized orders from New York warehouse is as follows in cents per pound:

Bolt	Square Blank	Square Tapped	Hexagon Blank	Hexagon Tapped
¼	17.00	19.00	23.25	25.75
5/16	15.00	16.50	20.25	22.25
⅜	11.50	12.60	14.75	16.35
7/16	11.00	11.90	14.25	15.55
½	8.30	9.00	10.25	11.25
9/16	8.30	8.90	10.25	11.15
⅝	7.00	7.50	8.75	9.45
¾	6.70	7.10	7.65	8.25
⅞	6.60	7.00	7.35	7.95
1	6.60	7.00	7.35	7.95

The base price for fair-sized orders of case-hardened nuts from New York warehouse is 70% from list price.

Rivets—The following are the base quotations for fair quantities from New York warehouse:

	Discount from List
Steel 7/16 and smaller	65 and 10%
Tinned	65 and 10%

	Price per 100 Lb.
Button heads, ¾, ⅞, 1 in. diam. by 2 in. to 5 in.	$4.25
Cone heads, same sizes	4.35

	Extra per 100 Lb.
1⅛ to 1⅞ in. long, all diameters	0.25
⅝ in. diameter	0.15
½ in. diameter	0.50
1 in. long and shorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

Turnbuckles—From New York warehouse, on sizes smaller than 1¼ in. diameter, 50% off list is charged, and on 1¼ up to 2 in. diameter 40%. At this rate prices follow:

Size		Size		Size	
⅜	$0.20	⅞	$0.375	1½	$0.90
7/16	.21	1	.44	1⅝	1.05
½	.23	1⅛	.50	1¾	1.20
⅝	.25	1¼	.75	1⅞	1.35
¾	.32	1⅜	.83	2	1.59

These prices are for buckles having right and left stub ends and with openings between the heads measuring 5½ in.

Bolt Ends with hot pressed nuts sell at the base price of 50 and 10% from list price. This is for fair-sized orders from New York warehouse.

Boiler Tubes—From Pittsburgh the following are the less-carload basing discounts for lap-welded boiler tubes:

1¾ and 2 in.	55%	3½ to 4½ in.	64%
2¼ in.	52%	5 and 6 in.	57%
2½ and 2¾ in.	58%	7 to 13 in.	54%
3 and 3¼ in.	63%		

These discounts apply to standard gages and to even gages not more than 4 gages heavier than standard. For long tubes charge 10% net extra as follows: 1¾ in. size over 18 ft. and not exceeding 22 ft.; 2 to 3 in. sizes over 22 ft. and not exceeding 24 ft.; 3¼ to 13 in. sizes over 22 ft. and not exceeding 25 ft.

Linseed Oil—Raw, in barrels sells at 77c. per gal. and in 5-gal. cans at 87c. Boiled, it is 1c. per gal. higher.

White Lead, dry and in oil, in cents per pound sells as follows:

100-lb. keg	8.25
25- and 50-lb. kegs	8.50
12½-lb. keg	8.75
1- to 5-lb. cans	10.25

Red Lead, dry, in cents per pound sells as follows:

100-lb. keg	8.25
25- and 50-lb. kegs	8.50
12½-lb. keg	8.75

In oil, the price in cents per pound is as follows:

100-lb. keg	8.75
25-and 50-lb. kegs	9.00
12½-lb. keg	9.25

Bar Iron—Prices are as follows in cents per pound at the places named:

Pittsburgh, mill	2.10
New York	2.20@2.25
From storehouse, New York	2.50@2.60

Copper Sheets—In New York, hot rolled 16 oz. (large lots) base per lb. is 30c.; cold rolled, 14 oz. and heavier, add 1c. extra per lb. to the above; polished takes 1c. per sq.ft. extra for 20 in. widths and under; add 2c. per sq.ft. for over 20 in.

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

The Edison Electric Illuminating Co., 39 Boylston St., Boston, Mass., has awarded the contract for the construction of a factory at Boston. Estimated cost, $15,000.

The Overland Stores Co. plans to construct a garage at 109 Brookline Ave., Boston, Mass.

Fire recently damaged the factory of Cornelius W. Walls, manufacturer of architectural iron, 44 Lagrange St., Worcester, Mass. Loss, $7,000.

Ellen French Vanderbilt has awarded the contract for the construction of a 2-story, 50x100-ft. garage at Newport, R. I. Estimated cost, $20,000.

Eugene A. Burnham, Pawtucket, R. I., has awarded the contract for a machine shop on Central St.

Plans are being prepared for the construction of a 3-story, 63x98-ft. factory at Bridgeport, Conn., for the Blue Ribbon Auto and Carriage Co.

The R. E. Parsons Co., Bridgeport, Conn., has purchased a site at North Washington Ave. and Frederick St. on which it plans to construct an iron foundry.

The Alloyed Metals Co., New York, N. Y., has purchased the plant of the United Foundry and Machinery Co., East Bridgeport, Conn., Bridgeport post office, and will build a 1-story, 95x100-ft. addition.

Plans are being prepared for an addition to the plant of the Hopkins & Allen Arms Co., Norwich, Conn., to be used as a gun factory.

The John Underwood Co., New York, N. Y., operating a factory at Hartford, Conn., for the manufacture of adding machines, has been reorganized with $3,500,000 capital stock. The company plans to remove its factory at Brooklyn, N. Y., to Hartford and combine it with the local plant and also contemplates the construction of a new plant. John T. Underwood and E. C. Eachel are interested.

MIDDLE ATLANTIC STATES

The contract has been awarded for the construction of an addition to the foundry of the American Radiator Co., Elmdale Ave. and New York Central R.R., Buffalo, N. Y. Estimated cost, $50,000. Noted Jan. 6.

The Ferguson Steel and Iron Co., Buffalo, N. Y., is enlarging its plant.

J. H. Williams & Co., manufacturer of drop forgings, New York, N. Y. (Borough of Brooklyn), has awarded the contract for several additions to its plant at Buffalo, N. Y.

The contract has been awarded for the construction of an addition to the plant of the Geneva Cutlery Co., Geneva, N. Y., manufacturer of razors, shears, etc. L. H. Henry is Mgr.

The George Haiss Manufacturing Co., 141st St. and Rider Ave., New York, N. Y. (Borough of Bronx), will construct a 1-story brick factory at Canal St. and 141st St. for the manufacture of coal-handling machinery. Estimated cost, $3,000.

Plans are being prepared by Brook & Rosenberg, Arch., 350 Fulton St., New York, N. Y. (Borough of Brooklyn), for a 2-story garage for William B. Storer, 430 Atlantic Ave. Estimated cost, $20,000.

Thomas F. Devine, 83 West End Ave., New York, N. Y. (Borough of Manhattan), will construct a 5-story, 75x100-ft. garage. Estimated cost, $50,000.

The R. E. Dietz Co., manufacturer of lanterns, Greenwich and Laight St., New York, N. Y. (Borough of Manhattan), has acquired a building adjoining its present factory and will equip it for the manufacture of its specialty. John E. Dietz, Vice-Pres. and Gen. Mgr.

A 3-story factory will be constructed on Cherry near Main St., Niagara Falls, N. Y., by the Trigger Lock Co.

Plans have been prepared for the construction of an addition to the plant at Oswego, N. Y., of the New York Air Brake Co., 165 Broadway, New York, N. Y. Estimated cost, $50,000.

The contract has been awarded for the construction of a group of factory buildings at Poughkeepsie, N. Y., for the Percival Smith Co., manufacturer of automobile accessories. Estimated cost, $100,000. Grant Smith is Pres.

The contract has been awarded for the construction of several additions to the plant of the Gleason Works, University Ave., Rochester, N. Y., manufacturer of gear generators.

Bids are being received by the Dynetto Electric Co., Wolf and Park St., Syracuse, N. Y., for the construction of an addition to its plant. Estimated cost, $4,000. Noted Jan. 13.

The contract has been awarded for the construction of additions to the plant of the Globe Malleable Iron and Steel Co., Syracuse, N. Y.

Sanderson Bros. Steel Co., 104 Magnolia St., Syracuse, N. Y., will rebuild its mills. Estimated cost, $500,000. E. I. French is Gen. Mgr.

The Electro Dynamic Co., Bayonne, N. J., manufacturer of interpole motors, has awarded the contract for the construction of an addition to its plant.

The contract has been awarded for the construction of a group of factory buildings for the Samuel L. Moore & Sons Corporation, a subsidiary of the Bethlehem Steel Co., at Elizabethport, N. J. (Elizabeth post office). Estimated cost, $1,000,000. Noted Dec. 30.

Fire, Jan. 10, destroyed the automobile body and carriage manufacturing plant of D. B. Dunham & Son, Inc., Newark, N. J. Loss, $30,000. The plant will be rebuilt at a new location.

The Orange Manufacturing Co., Newark, N. J., manufacturer of badge bars and similar specialties, will improve its plant on Emmet St.

William Reinhardt, Newark, N. J., will construct a garage and repair shop on North 3rd St.

The Sloan & Chase Manufacturing Co., Newark, N. J., manufacturer of machinery, will enlarge and improve its plant on 6th Ave.

The contract has been awarded for the construction of an addition to the plant of the Zeh & Hahnemann, Ave. A and Vanderpool St., Newark, N. J., manufacturer of presses, automatic sheet metal, machinery, etc.

Fire, Jan. 10, destroyed the automobile and motor-boat repair plant of Brunt Bros., Rahway, N. J. Loss unknown.

The American Bridge Co., a subsidiary of the American Steel Corporation, will improve and enlarge its plant at Trenton, N. J. Estimated cost, $500,000. Alfred C. Funk, Gen. Mgr.

A company is being organized at Apollo, Penn., with $500,000 capital stock to be known as the Apollo Electric Steel Co. The new company plans to construct a plant for the manufacture of alloy and tool steels. Robert Lock and J. Arthur White, Pittsburgh, Penn., are interested.

The contract has been awarded for an addition to the plant of the Donaghmore Iron and Steel Co., Lebanon, Penn.

Plans are being prepared by F. P. Kellar, Arch., for a garage at Monongahela, Penn., for J. F. Forsythe. Estimated cost, $25,000.

The contract has been awarded for the construction of an addition to the plant of Henry Disston & Sons, Inc., Tacony St., Philadelphia, Penn., manufacturer of saws. Noted Dec. 16.

The Miller Lock Co., Philadelphia, Penn., has awarded the contract for the construction of a 1-story, 70x195-ft. factory. Estimated cost, $23,000. Noted Dec. 23.

A1-story, 100x120-ft. garage will be constructed at Wayne Ave. and Louden St., Philadelphia, Penn., by Simons & Arnold.

The P. M. Walton Manufacturing Co., Philadelphia, Penn., recently incorporated with $31,000 capital stock, will establish a foundry and machine shop. Wray C. Arnold, 121 North 20th St., Philadelphia, is interested.

Hubbard & Co., Pittsburgh, Penn, is in the market for a punch and shear power press of about 500 tons capacity, an upright hammer from 90 to 120 lb. capacity, small electric hoist from 500 to 1,000 lb. capacity and 1 or 2 inclinable power presses weighing from 4,000 to 8,000 lb.

The Pittsburgh Gear and Machine Co., Pittsburgh, Penn., recently incorporated with $20,000 capital stock, is building a plant at 27th and Smallman St. for the manufacture of cut gears. Frank H. Rea and John Jackson, interested.

Plans have been prepared by William A. Fink, Arch., 426 Franklin St., Reading, Penn., for a 4-story, 100x210-ft garage for the Arcade Garage, Reading. Estimated cost, $20,000. William Young, Reading, is interested.

George Wood, Wawa, Penn., has awarded the contract for the construction of a garage. Estimated cost, $60,000.

The Jones & Laughlin Steel Co. has awarded the contracts for the construction of a pipe plant at Woodlawn, Penn. Estimated cost, $3,000,000. Noted Sept. 30.

The Penn Foundry and Manufacturing Co., Reading, Penn., manufacturer of gray-iron castings, etc., recently incorporated with $15,000 capital stock, is in the market for a second-hand jib crane or traveling crane and a second-hand mono-rail hand hoist for the foundry which it has established at Wyomissing, Penn. Edward K. Mark, Mgr.

Plans are being prepared by J. A. Dempwolf, Arch., Cassat Bldg., York, Penn., for a 3-story, 60x85-ft. garage for R. P. Anderson, 56 South George St. Estimated cost, $15,000.

The Delaware Steel and Ordnance Co., Wilmington, Del., will expend about $10,000 for improving its plant. H. T. Wallace is interested.

The Baltimore Oil Engine Co., Baltimore, Md., is having plans prepared for two 1- and 2- story, 100x150-ft. factory buildings. A. W. Gieske is Pres.

A machine shop will be established at Whitmore and Westwood Ave., Baltimore, Md., by the Consolidated Engineering Co., Calvert Bldg.

SOUTHERN STATES

The Pulaski Iron Co., Pulaski, Va., will construct a new blast furnace. Horace L. Haldeman, Real Estate Trust Bldg., Philadelphia, Penn., is Pres.

The Richmond Forgings Corporation, Richmond, Va., will construct an addition to its machine shop at Acca Station. Estimated cost, $7,500.

Carl Reger, Arch., 83 West Virginia Traction Bldg., Morgantown, W. Va., is preparing plans for a 2-story, 80x90-ft. garage for the West Morgantown Improvement Co., Morgantown.

The Louisville & Nashville R.R., Louisville, Ky., plans to improve and enlarge its shops at Pensacola, Fla. W. H. Courtenay, Louisville, Ky., Ch. Engr.

The Tampa Foundry and Machine Co., Tampa, Fla., will construct a reinforced-concrete machine shop. Estimated cost, $10,000.

The Standard Foundry Co., Anniston, Ala., is in the market for 2 power drill presses, 28- to 32-in., new or second-hand.

The Ingalls Iron Works, Birmingham, Ala., will construct several additions to its plant. Estimated cost, $50,000.

The New Orleans Steel and Iron Co., 610 Audubon Bldg., New Orleans, La., recently incorporated with $100,000 capital stock, plans to establish a rolling mill at New Orleans. B. W. Seidel, Pres.

Press reports state that a factory will be established at Chattanooga, Tenn., by W. B. Boaz, Hamilton, Ohio, for the manufacture of heating equipment.

L. L. Stone plans to construct a garage and repair shop at Pikeville, Ky.

MIDDLE WEST

The Ford Motor Co. will construct a 2-story, 50x120-ft. garage at 87 Bowery St., Akron, Ohio. Estimated cost, $30,000. W. A. Johnson is interested.

Plans have been prepared by B. F. Goodrich Co. for the construction of a 6-story garage on South Main St., Akron, Ohio. Estimated cost, $450,000.

The Buckeye Twist Drill Co. is constructing an addition to its plant at Alliance, Ohio. Noted Jan. 20.

The Sterling Nail Co., Ashland, Ohio, is in the market for machinery for coating of nails with cement for use in the manufacture of boxes.

It is reported that plans are being prepared for the construction of a 4-story plant for the Sommer Motor Works at Bucyrus, Ohio.

Plans are being prepared by Bert L. Baldwin & Co., Mechanical Engr., for the construction of a 3-story, 100x300-ft. foundry addition to the plant of the Lunkenheimer Co. at Cincinnati, Ohio. Noted Jan. 20.

Plans are being prepared by Zettel & Rapp, Arch., Cincinnati, Ohio, for the construction of a 2-story, 78x108-ft. garage at 422 John St., for the Sandman Estate, Cincinnati.

The Barrett Manufacturing Co., manufacturer of roofing materials, Illuminating Bldg., Cleveland, Ohio, contemplates the construction of additions to its plant at Willey and Walworth Ave. A. T. Perry is Vice-Pres.

The Electric Railway Improvement Co., 2070 East 61st St., Cleveland, Ohio, will construct an addition to its plant at Cleveland, Ohio.

Plans are being prepared for the construction of a 3-story factory on East 34th St., Cleveland, Ohio, for Mustee Bros., 3008 Cedar Ave., Cleveland, manufacturer of hot-water heaters. Estimated cost $30000.

H. J. Harrold, manufacturer of tools, plans to construct a 50x150-ft. factory at Columbiana, Ohio.

We have been advised that the Seneca Wire and Manufacturing Co. is constructing additions to its plant at Fostoria, Ohio. Estimated cost, $100,000. Noted Jan. 20.

The contract has been awarded for the construction of an addition to the plant of the East Iron and Machine Co. at Lima, Ohio, for the manufacture of cartridge-making machinery. Noted Nov. 18.

We have been advised that the Farrell-Cheek Steel Foundry Co. is constructing an addition to its plant at Sandusky, Ohio. Noted Jan. 13.

The contract has been awarded for the construction of a 4-story factory at Springfield, Ohio, for the Robbins & Myers Co., manufacturer of electric motors, generators and fans. Estimated cost, $150,000. Noted Dec. 16.

The Swayne-Robinson Co. has awarded the contract for the construction of a foundry at Richmond, Ind. Estimated cost, $10,000.

The contract has been awarded for the construction of a 2-story, 125x200-ft. garage and automobile repair shop for Albert Hershfelt at Shelbyville, Ind. Noted Dec. 16.

The Covel Manufacturing Co., manufacturer of saw machinery, is constructing additions to its plant at Benton Harbor, Mich. Estimated cost, $15,000.

The contract has been awarded for the construction of a 4-story addition to the plant of the National Twist Drill and Tool Co. at Detroit, Mich.

The Grand Trunk Ry. will build car shops at Flint, Mich. Joseph Hobson, Montreal, Que., is Consult. Engr.

The Grand Rapids & Indiana Ry., Grand Rapids, Mich., plans an expenditure of about $10,000 for machine tools. H. Sullivan, Grand Rapids, Pur. Agt.

The contract has been awarded for the construction of an addition to the plant of the Keeler Brass Works at Grand Rapids, Mich.

Work will soon be started on the construction of a motor-truck factory at Greenville, Mich., for the Tower Iron Co. Noted Jan. 13.

The G. T. Eames Co. will construct a 80x150-ft. foundry at Kalamazoo, Mich., in the spring.

The Harrow Spring Co., manufacturer of steel and springs, will construct an addition to its plant at Kalamazoo, Mich.

We have been advised that the Gier Pressed Steel Co. is constructing a 180x600-ft. plant at Lansing, Mich. B. S. Gier is Gen. Mgr. Noted Jan. 6.

An addition will be constructed to the plant of the Colonial Manufacturing Co., manufacturer of clocks, at Zeeland, Mich.

Plans have been prepared for enlarging the shops of the Chicago, Burlington & Quincy R.R. at Aurora, Ill.

The contract has been awarded for the construction of a 1-story, 115x138-ft. garage at Bloomington, Ill., for A. E. Prince. Noted Dec. 2.

The Ryan Car Co. will construct a 1-story, 60x100-ft. steel car shop at Burnham, Ill. Estimated cost, $10,000.

Bids are being received for the construction of a 2-story, 106x136-ft. garage for C. B. Wiggins at Champaign, Ill. Hubbard & Pankow, Swannell Bldg., Champaign, is Arch. Noted Dec. 2.

The contract has been awarded for the construction of a 2-story garage and store at 6715 Stony Island Ave., Chicago, Ill., for E. I. Bloom. Estimated cost, $40,000.

The Chicago, Great Western R.R., Chicago, Ill., plans to purchase 1 tool room lathe, 1 Sturtevant fan, 1 2,500-ft. electrically driven air compressor and 1 high-speed rail saw. B. Briard, People's Gas Bldg., Chicago, Pur. Agt.

An expenditure of $50,000 contemplated by Chicago & Northwestern Ry., Chicago, Ill., for tools. L. S. Carroll, Chicago, Gen. Pur. Agt.

Plans are being prepared for the construction of a 1-story, 40x50-ft. factory at Chicago, Ill., for the Planer & Sticker Bolt Supply Co. Estimated cost, $40,000. Joseph H. Klafter, 64 West Randolph St., Chicago, Arch.

Plans have been prepared for the construction of a 1-story, 42x125-ft. garage and machine shop at Kedzie Ave. and West 23rd St., Chicago, Ill., for L. A. Ruda. Estimated cost, $18,000.

The Western Steel Car and Foundry Co., 136th St. and Brandon Ave., Chicago, Ill., has awarded the contract for the construction of a 1-story brick foundry. Estimated cost, $35,000. Noted Jan. 13.

The contract has been awarded for the construction of a 1- and 2-story, 100x100-ft. foundry at Clearing, Ill., for the Chicago Clearing and Transfer Co. Estimated cost, $35,000. Noted Jan. 6.

The American Power and Truck Co. contemplates the construction of an addition to its plant at Elgin, Ill.

The American Can Co. will enlarge its plant at Hoopeston, Ill. Estimated cost, $60,000.

The Russell, Burdsall & Ward Bolt and Nut Co. is constructing an addition to its plant at Rock Falls, Ill.

The Northern Boiler and Structural Iron Works contemplates the construction of a plant at Appleton, Wis.

The E. I. Du Pont de Nemours Power Co. will construct 8 additional buildings to its plant at Barksdale, Wis. F. T. Beers is Supt.

The Berlin Machine Works plans to construct a 2-story, 300x300-ft. addition to its plant at Beloit, Wis.

William A. Rupiper has purchased the plant of the Ripon Canning Co., at De Pere, Wis., and will remodel it for a garage and machine shop.

The contract has been awarded for the construction of a 2-story addition to the factory of the Western Steel and Iron Co. at De Pere, Wis. Noted Dec. 23.

The contract has been awarded for the construction of a 3-story, 74x315-ft. asembling plant at Hartford, Wis., for the Kissel Motor Car Co.

The Chain Belt Co., 736 Park Ave., Milwaukee, Wis., is constructing an addition to its plant at Milwaukee.

Bids are being received by Herman J. Esser, Arch., 402 Camp Bldg., Milwaukee, Wis., for a plant on Park St. for the Fitzsimmons Steel Products Co. Estimated cost, $60,000. Noted Jan. 6.

T. W. Thiesen, Mayor, has submitted a report to the Common Council for the construction of a municipal garage and machine shop at Racine, Wis.

Work will soon be started on the construction of a foundry at West Allis, Wis., for the Electric Steel Casting Co. Noted Dec. 30, under "Milwaukee, Wis."

WEST OF THE MISSISSIPPI

The Northwestern Auto Co., Minneapolis, Minn., will build a 3-story garage and service building at Willow and Harmon St., Minneapolis. William E. Wheeler is Mgr.

The Borreson Manufacturing Co., St. Paul, Minn., contemplates building a plant for the manufacture of machinery. Estimated cost, $25,000.

The Midcontinent Tire Manufacturing Co., Wichita, Kan., will establish a new plant for the manufacture of tires. Noted Jan. 13.

Ellingson Bros., local agents for the Overland Automobile Co., plans to construct a garage at Bigtimber, Mont.

The Serlis Motor Co., Kansas City, Mo., recently incorporated with a capital of $20,000, will build a machine shop.

Plans are being prepared for the construction of a garage for Theodore Gary, Macon, Mo.

The Busch-Sulzer Bros. Diesel Engine Co., St. Louis, Mo., will build an addition to its plant. Estimated cost, $40,000.

The Liberty Foundry Co., St. Louis, Mo., will build an addition to its plant at 314-20 East Stein St., St. Louis. Estimated cost, $25,000.

The Fred Medart Manufacturing Co., St. Louis, Mo., will build a factory at 2nd and Portamos St. for the manufacture of steel ladders.

The Quick Meal Stove Co., St. Louis, Mo., will build an addition to its plant. Estimated cost, $10,000.

The St. Louis Brass Manufacturing Co., St. Louis, Mo., has awarded the contract for an addition to its plant. Noted Jan. 20.

Fire, Jan. 15, destroyed the McBride garage, at West Plains, Mo. Loss ,$12,000.

S. J. Sullivan, Hot Springs, Ark., will equip a foundry and machine shop at Argenta, Ark.

The Willys-Overland Automobile Co., Toledo, Ohio, will build a plant at Dallas, Tex.

Carl Maer contemplates building an aëroplane factory at Ft. Worth, Tex.

The Midland & Northwestern Railway Co., Midland, Tex., will construct machine shops at Midland. T. J. O'Donnell is Pres.

The Victoria Safe and Lock Co., Victoria, Tex., will construct a new plant.

Plans have been prepared for constructing a plant for the Osage Iron and Steel Co., Sand Springs, Okla., for the manufacture of reinforced steel. Estimated cost, $65,000. Noted Dec. 9.

WESTERN STATES

J. D. Davidson, 403 West Comstock St., Seattle, Wash., will construct a garage and machine shop at 700 Jackson St., Seattle. Estimated cost, $10,000.

The Electric Heating and Manufacturing Co., Seattle, Wash., recently incorporated with $75,000 capital stock, will equip a plant at 1812 9th St. for the manufacture of patented electrical specialties. J. G. Eddy, Everett, is Pres.

The Skinner & Eddy Shipbuilding Corporation, Seattle, Wash., will construct a shipbuilding plant at Railroad Ave., S., and Atlantic St.

The Commercial Club, La Grande, Ore., is interested in a movement to construct a plant at La Grande, for the manufacture of canning machinery and farm tools.

Graham & Son is constructing a 40x80-ft. addition to its garage at Monmouth, Ore.

K. D. Goltra and Louis Kuehn will construct a garage and machine shop at Oregon and East 1st St., Portland, Ore. Estimated cost, $10,000.

The Llewellyn Iron Works, Main and Redondo St., Los Angeles, Calif., has purchased a site at Torrance, near Los Angeles, and will construct a foundry. Estimated cost, $400,000.

The Hanlon Drydock and Shipbuilding Co. will construct a 2-story machine shop on 5th Ave., Oakland, Calif.

John Bartella, 1717 Stockton St., San Francisco, Calif., will construct a 2-story reinforced-concrete garage on Mission St., San Francisco.

CANADA

W. H. Covert is interested in a company which plans to construct a plant at Dartmouth, N. S., for the manufacture of cables.

Wilson Bros., Collingwood, Ont., will build an addition to its plant for the manufacture of hardware, doors, etc. Estimated cost, $35,000.

Bids will soon be received for the construction of a factory at Guelph, Ont., for the manufacture of stoves for W. A. Mahoney, Telephone Bldg., Guelph.

The Burlington Steel Co. has been granted a permit for the construction of an addition to its plant at Hamilton, Ont. Estimated cost, $4,800.

The Ottawa Brass Foundry Co., Ottawa, Ont., will remodel a building on Wellington St., Ottawa, as a foundry and install new machinery.

GENERAL MANUFACTURING

NEW ENGLAND STATES

Fire, Jan. 6, damaged the plant of Pratt & Forrest, manufacturer of wooden boxes, at Fletcher and Dutton St., Lowell, Mass. Loss, $100,000.

Fire, Jan. 16, destroyed the plant of the Sprague Hathaway Co., manufacturer of picture frames, at Somerville, Mass. Loss, $15,000.

The New England Manufacturing Co., Woburn, Mass., manufacturer of explosives, contemplates an expenditure of $1,000,000 for improving and enlarging its plant.

The contract has been awarded for the construction of a 3-story, 80x120-ft. addition to the Home Bleach and Dye Works at Pleasant View, R. I. (Westerly post office). Estimated cost, $20,000.

The Hope Co. plans to construct a 1-story, 230x264-ft. weaving mill in connection with its cotton manufacturing plant at Scituate, R. I. Estimated cost, $130,000.

The Manhassett Manufacturing Co., manufacturer of tire cloth, has awarded the contract for the construction of a 2-story, 120x180-ft. plant at Putnam, Conn. Noted Dec. 9.

MIDDLE ATLANTIC STATES

The A. P. W. Paper Co., Colonie and Montgomery St., Albany, N. Y., has awarded the contract for the construction of a new factory. Estimated cost, $200,000.

Fire, Jan. 14, damaged the linseed-oil plant of Spencer Kellop & Sons, Buffalo, N. Y. Loss, $100,000.

The contract has been awarded for alterations to the factory of the Bishop Gutta Percha Co., 420 East 26th St., New York, N. Y. (Borough of Manhattan). Estimated cost, $8,000. Noted Jan. 13.

The Acme Land and Chemical Co., Califon, N. J., recently organized, will establish a plant at Califon for the manufacture of chemicals and cleaning compounds. Edward B. Emery is Pres.

The Clark-Milo End Spool Coton Co., East Newark, N. J. (Newark post office), will improve its plant. Estimated cost, $13,600.

SOUTHERN STATES

A handle factory will be established at Memphis, Tenn., by the Kelly Axe Manufacturing Co., Charleston, W. Va.

The contract has been awarded for the construction of an addition to the plant of the Walker County Hosiery Mills, La Fayette, Ga. Estimated cost, $1,500.

The Wilson & Toomer Fertilizer Co., Jacksonville, Fla., will establish a fertilizer plant near Tampa, Fla. Estimated cost, $200,000.

The plant of the Texas Oil Co., Birmingham, Ala., recently destroyed by fire, will be rebuilt. Estimated cost, $150,000.

MIDDLE WEST

The Willard Storage Battery Co. has awarded the contract for the construction of 11 factory buildings at Cleveland, Ohio. T. A. Willard, East 131st St., Cleveland, is Gen. Mgr. Noted Jan. 20.

The Centaur Rubber and Supply Co. will construct a 3-story, 70x300-ft. factory at Gallipolis, Ohio.

Bids will soon be received for the construction of a 2-story, 52x196-ft. and 42x115-ft. factory at Kent, Ohio, for the Mason Tire and Rubber Co. Estimated cost, $35,000. Noted Jan. 20.

It is reported that the Fox Paper Co., Lockland, Ohio, has increased its capital and contemplates enlarging its plant at Lockland.

The contract has been awarded for the reconstruction of the plant of the Champion Carbon Co. at Loveland, Ohio.

The United States Playing Card Co. has awarded the contract for the construction of a 4-story, 32x60-ft. addition to its plant at Norwood, Ohio.

WEST OF THE MISSISSIPPI

Plans are being prepared for the construction of a factory for the Des Moines Hosiery Mills, Boone, Iowa. Estimated cost, $15,000.

The Des Moines Milk Co., Des Moines, Iowa, contemplates building a plant on 2nd St., Des Moines. Estimated cost, $25,000.

The Carr-Trombley Manufacturing Co., Dubuque, Iowa, has purchased the sash and door plant of the Hafner Manufacturing Co., St. Louis, Mo., and will improve and extend same.

Fire, Jan. 10, destroyed the plant of the Rate Glove and Mitten Co., Iowa City, Iowa. Loss, $35,000.

The Faribault Packing and Provision Co., Faribault, Minn., has awarded the contract for constructing a plant, at $300,000. M. E. Brooks is Supt. Noted Jan. 13.

WESTERN STATES

Bids will soon be received for the construction of a sugar refinery at Ashland, Ore., for the Oregon-Utah Sugar Co., Salt Lake City, Utah. Estimated cost, $500,000.

W. A. Boole Jr., Oakland, Calif., is interested in a movement to construct a shipbuilding plant at Oakland. Estimated cost, $25,000,000. The project is backed financially by New York interests.

The contract has been awarded for the construction of a canning plant on Fish Harbor, San Pedro, Calif., for the California Fish Co., 430 South Broadway.

Plans have been prepared for the construction of a reinforced-concrete packing plant on Seventh St., San Francisco, Calif., for the Workman Packing Co. Estimated cost, $25,000. C. H. Workman, 180 Erie St., San Francisco, is Pres.

CANADA

Fire, Jan. 11, destroyed the factory of the Rock Shoe Manufacturing Co., 166th St., Quebec, Que. Loss, $75,000.

T. Hudgson, 9 Tecumseh St., Orillia, Ont., will construct a chemical plant at Lindsay, Ont. Estimated cost, $60,000.

The Owen Sound Shoe Manufacturing Co., Ltd., Owen Sound, Ont., will remodel the Pacific Hotel for its purposes.

The Auburn Woolen Mills will enlarge its plant at Peterborough, Ont.

Classified Advertising

The Classified Advertising section appears on pages 162, 163, 164, *of this issue and will in future appear in the same relative position in the paper.*

American Machinist

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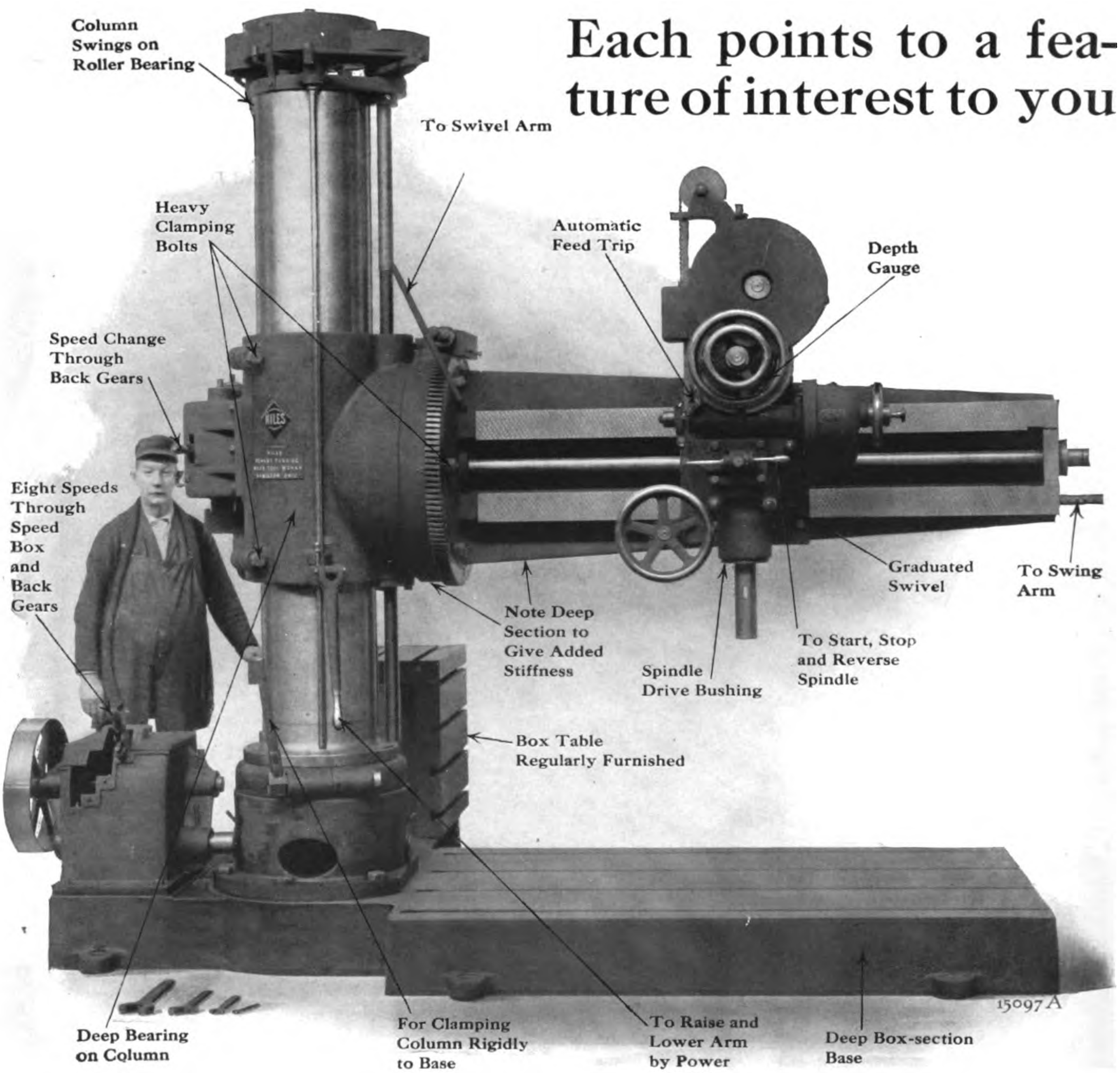
Each points to a feature of interest to you



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CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormsay processes, protected by United States patent issued June 22, 1915, and another pending

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A Manufacturer On Advertising

By W. L. SAUNDERS, *Chairman of the Board*, INGERSOLL-RAND CO.

Extracted from an address before the Technical Publicity Association, N. Y.

GOOD technical advertising is essentially concrete. It is an exact science and knowledge of the subject is the first qualification; everything else is secondary to this. Technical advertising involves salesmanship of the highest order. It is not the gift of gab that counts; is not a polished manner or a pleasing presence, but it is familiarity with the thing advertised in all its bearings, which involves a wide general knowledge of the product and business; next a faculty of clear, brief and direct expression. Proper display is not to be neglected, but this is easy.

Advertising affords a means by which the man who knows most about the business may imprint his ideas effectively upon the minds of thousands. His audience is the world, and in no other way can he bring up the average efficiency in productive results. He may not do as much good in each case as though he met the customer personally, but on the whole he creates a greater general impression and paves the way for personal interviews that follow. I speak as one of experience in these matters. Up to recent years I have personally been the advertising man of the interests in my charge.

I realize that the head of the business can well afford to spend his time and energies directing the fundamental conditions that govern good technical advertising. I also realize that there is no fire of genius whatever in this matter, and here we must distinguish between technical and general advertising, just as we must distinguish between technical and general salesmanship. A good talker can sell patent medicines regardless of whether they do the customer any good or not. A genius can put a patent medicine on the market and make a fortune out of it regardless of its merit, but in technical advertising, as in technical selling, the gift of gab is one of the lesser, not greater virtues.

No one with common sense doubts the value of advertising —the only doubt is the value of the man who advertises. You must first establish confidence in the product that you are handling or you can never be successful on large lines. It is just as important that you should thoroughly believe in the thing that you are advertising as it is that the man who hires you should thoroughly believe in you. Confidence is the key-note of it all.

It has been said that such concerns as Tiffany, the Singer Company, the Bell Telephone, and others, do not need to advertise because their superior position in the trade is well known. Never was there a greater fallacy. It is true that it is not necessary in the immediate present for such concerns to advertise, because they can travel a long period of years on their reputation, but the business that does not go forward will some day fall backward, and advertising enables such concerns to progress, to cover larger fields, to establish the roofs of business on deeper grounds and to prosper, not today, but for a long period of time —in fact, so long as that confidence is maintained and the business is extended by efficient management, which includes publicity. I mention the Bell Telephone advisedly because it is practically a monopoly, and without competitors why should one advertise?

Let the Standard Oil Co. and the American Tobacco Co. answer this question, for they can do so on lines of experience. I have always believed that had the Standard and the Tobacco Co. not been so exclusive they would not have been attacked. The Bell Telephone Co. advertises, I have no doubt, because, in the first place, it pays to enlarge its field through putting in the minds of the people of the whole world the advantages of telephone service, and for the other and very important reason, that when a concern is a monopoly and comes out into the open, keeping its name and its business before the public by seeking public patronage in the common democratic way of advertising, it challenges criticism and quiets unrest.

Three-Inch Russian Shrapnel--III*

By John H. Van Deventer

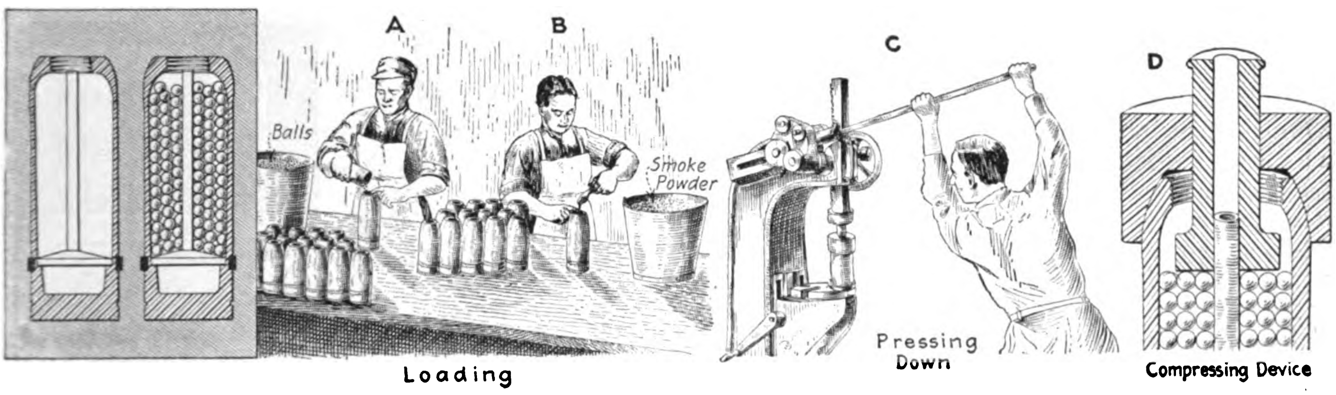
SYNOPSIS—A series of hand operations interrupting the sequence of machine operations on the three-inch Russian shells are described in this article. They include the loading with balls, the insertion of the fuse socket and copper plug and the filling of the shell with rosin.

With the exception of operation 13 the work on the Russian shrapnel described in the previous issues had to do only with the steel shell itself. The steel disk and powder tube in operation 13 added two other elements, which did not, however, materially affect the shop procedure as far as the projectile as a whole is concerned. At the seventeenth operation—that of loading or filling the shrapnel—which begins with this article, a number of elements are introduced which do have considerable effect on the further handling of the shell. Owing to the design and construction of these parts and the limitations of the requirements concerning them, it is no longer possible to handle the Russian shell mechanically, but its completion through the next six operations becomes an example of handwork pure and simple, quite a bit more so than in the case of the British shell of corresponding size, in which loading is a semimechanical proposition.

One of the causes for this difference is the fact that Russian specifications call for the insertion of "smoke powder" after five rows of balls are introduced into the shell. This composition is a mixture of metallic antimony and magnesium, the former producing dense black smoke and the latter a brilliant light, so that the explosion of the shell may be traced either by day or by night. The purpose of this smoke powder is to serve as a guide to the artillery observer who takes care of the range-finding, and of course has nothing to do with assisting in the explosion of the shell itself.

Russian shrapnel balls are cast from a mixture of four parts by weight of lead and one part by weight of antimony. The diameter of the balls is $\frac{5}{12}$ in., and the average weight of one is 6 drams. They are tested by being struck a slight blow with a hammer and must not crack under this test. A shell is supposed to contain from 256 to 265 balls, but in some cases in this country special provision reducing the number has been made by the inspectors, since the density of the metal employed made it impossible to get the full number of given-sized balls within the allotted space in the interior of the shell.

In order even to get the reduced number of balls into the shell, it is necessary to press them down by means of an arbor press, such as shown at *C* in operation 17. The first pressing down occurs after the smoke powder has been introduced, and in some cases a second and even a third pressing at certain stages of the filling are necessary in order to make the required weight. The tool shown at *D* in this operation sheet is used to facilitate this work. It consists of a plunger having a hole through its center, to admit the powder tube, and running in a guide the bottom of which conforms to the outside shape of the shell. Considering the restrictions and disadvantages under which this operation must be handled, three operators do well to produce 250 shells per hour.



OPERATION 17. LOAD WITH BALLS AND SMOKE POWDER

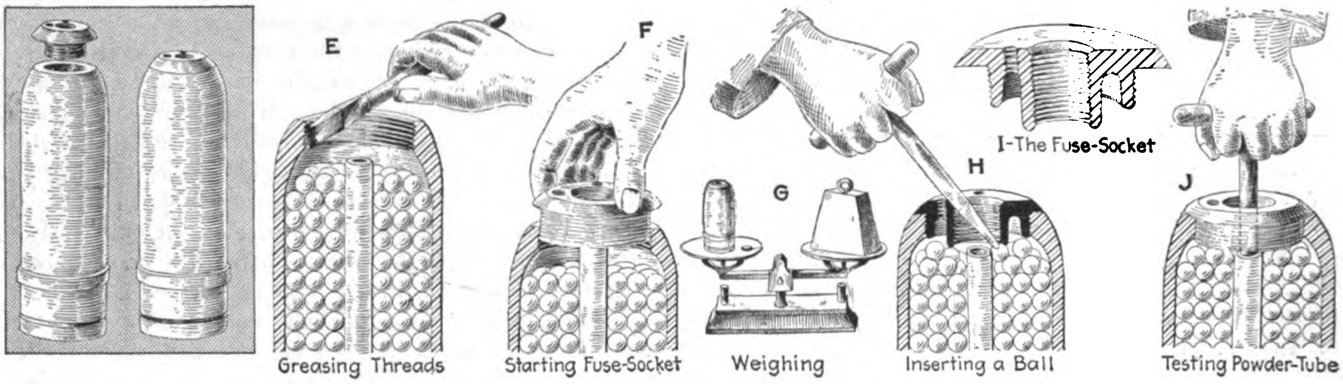
Machines Used—Hand operation with exception of arbor press C for pressing the balls into the shell.
Special Fixtures and Tools—Ball presser and guide D.
Gages—None.
Production—Three men and two arbor presses, 250 shells per hr.
Note—Five rows of balls are first inserted, then 13 drams 5 grains of a smoke powder composed of 55 parts of metallic antimony and 45 parts of magnesium.

The fuse socket of the Russian shrapnel is shown at *I* in operation sheet 18. It differs in many respects from the British shrapnel fuse socket, and most notably in the coarse pitch of the thread that receives the fuse. After the thread in the shell nose has been daubed with grease, as shown at *E*, the fuse socket is entered by hand; then the projectile is put upon a pair of scales so that the weight may be brought up to 13 lb. 5.6 oz., within the limit either way of the weight of one ball. Should the weight be found not sufficient, a ball is introduced, as shown at *H*, this process requiring considerable skill and manipulation. If the weight is excessive, there is nothing to do but remove the plug and take out a ball. It must be said that very few corrections need to be made, as experience soon teaches those who handle the assembling of shells to judge weight by "heft" almost as accurately as scales will measure it.

One of the most essential precautions in hand assembling is to make sure that the powder tube has not been distorted or crimped or otherwise injured. Therefore as

*Previous installments appeared on pages 89 and 155.

soon as the weight has been found to be correct, a rod gage is run down through the powder tube. It must go all the way to the bottom of the powder pocket. This gage consists simply of a tool-steel rod of a diameter equal to that of the interior of the tube and provided with a handle at the top, such as is shown at J in operation cork is inserted in the powder tube of each shell and remains there during the succeeding operations as an insurance against the entrance of dirt or other foreign material. Just before the fuse-hole plugs are inserted, these corks are withdrawn and returned to the bench at which this operation is performed, to be used over again.



OPERATION 18. START FUSE SOCKET AND MAKE WEIGHT

Machines Used—Hand operations.
Special Fixtures and Tools—Brush E for smearing grease in threads; drift H for inserting balls.
Gages—Scales G for weight; rod J for testing powder tube.
Production—Three men take care of 250 shells per hour.
Note—Weight at this operation is held to 13 lb. 5.6 oz. plus or minus the weight of one of the small lead balls.

sheet 18. After the weight of the loaded shell and the condition of the powder tube have been found to be correct, the fuse socket is screwed down. This process is like the operation of a miniature treadmill and is shown in operation sheet 19. The shell is held securely in a hinged vise mounted upon a pedestal, and the socket is driven home through the exertions of an operator who walks backward in a circle, pulling the pipe extension handle after him. One feature of this operation is the wrench used, which is a screw plug wrench conforming to the thread of the fuse socket and having an extension pilot that projects into and protects the central powder tube.

A difference in design between the British and the Russian shrapnel is noticed in the means used for sealing the upper end of the powder tube to the fuse socket. In the British shell the brass powder tube was soldered direct to the bronze fuse socket after the loading was completed. In the Russian shrapnel the joint is made by means of a copper plug, shown at K in operation sheet 20, which screws down within the fuse socket and has a recessed central hole that fits over the central powder tube. No solder is employed to make this joint, but the plug is screwed down in such a way that the powder tube is securely held. For this purpose a wrench, shown at L, is employed. It is quite similar in principle to that used in operation 19, for screwing down fuse sockets, except that it has a screw-slot key projection instead of threads.

Since this joint is not made tight with solder or other packing, it is essential to seat the copper plug squarely against the tube. This is tested by means of a gage, shown at Q, which has a double purpose—first, to indicate whether the copper plug has been screwed down the correct distance; and second, to show whether it is squarely seated. This latter test might seem unnecessary, but is called for because the threads on the copper plugs are not always accurately or squarely cut.

A box of apothecary's corks appears to be rather out of place in a shrapnel-manufacturing plant, but starting with this operation its contents become very useful. A

OPERATION 19. SCREW DOWN FUSE SOCKET

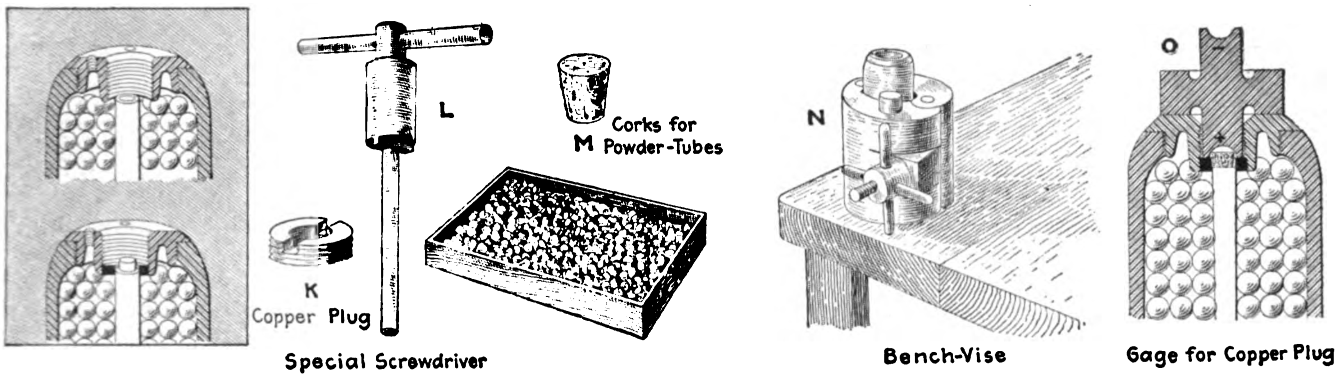
Machines Used—Hand operation.
Special Fixtures and Tools—Hinged chuck vise mounted on pedestal; double-ended screw-plug wrench with guide to fit powder pocket.
Gages—None.
Production—One man screws down from 40 to 60 sockets per hour.
Note—The production rate is variable, caused by the variation of threads on the fuse sockets as received.

At this stage one is apt to question how the shell is to be filled with rosin, since all openings available for this purpose seem to have been closed by the insertion of the fuse socket and copper plug. However, this filling is taken care of by two small holes, shown at A and B in suboperation P on operation sheet 21. The larger hole

is for the admission of melted rosin, and the smaller one for the escape of air.

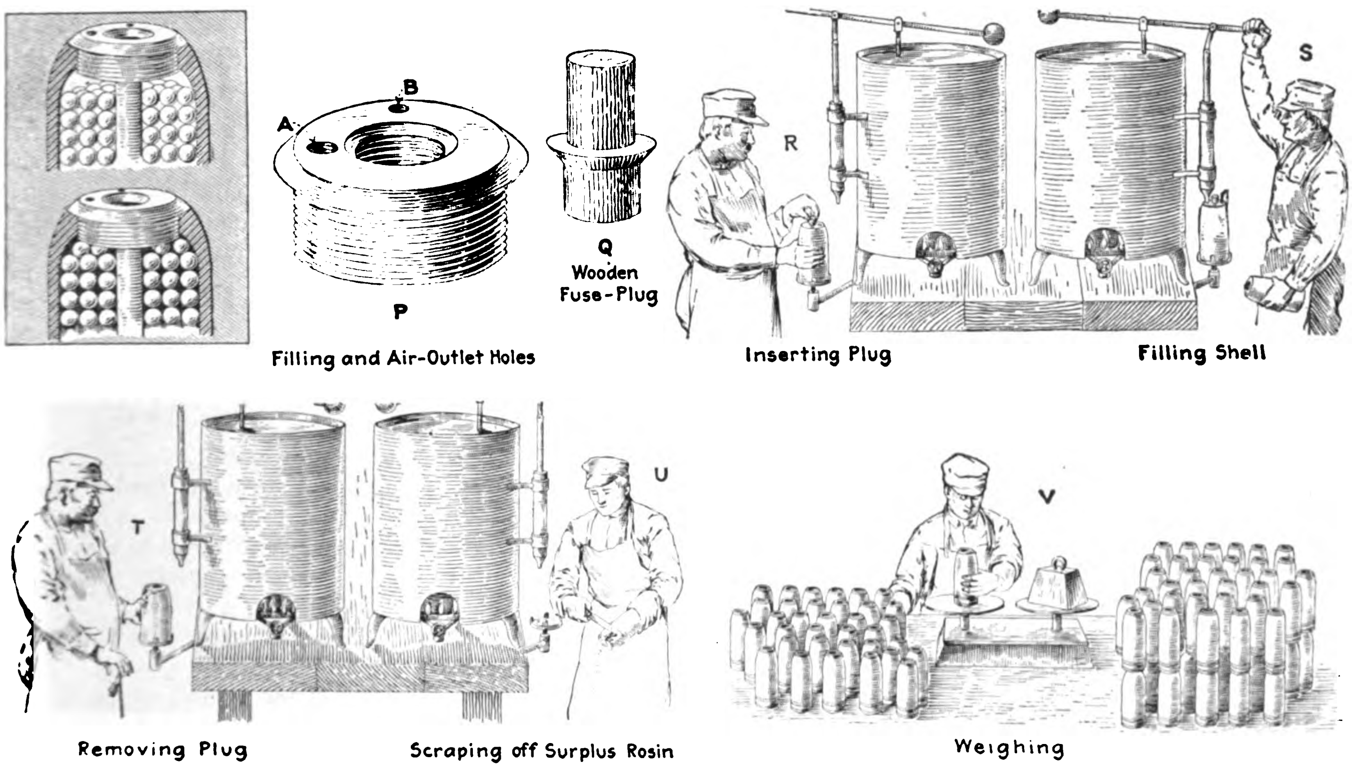
In order to introduce the rosin through such a small opening as has been left for it, a force pump is provided on the side of the rosin kettle, as shown at R in this operation sheet. The nose, or discharge opening, of this force pump is made to fit inside of the hole A in the fuse socket. One stroke downward of the pump lever fills the shell with rosin and causes a little to flow over, which

It is necessary to remove the few drops of rosin which overflow through the air outlet, and this is done by means of one or two passes of a hand scraper, as shown at X in this operation sheet. Next, the shell is placed upon a pair of scales to determine its weight. One advantage of the Russian method of filling shells with rosin is the fact that the operator does not need to exercise an unusual degree of haste in entering and screwing down the fuse socket before the rosin becomes solidified. In the British



OPERATION 20. INSERT COPPER PLUGS AND CORKS AND TEST COPPER-PLUG SEATING

Machines Used—Hand operations.
Special Fixtures and Tools—Special plug screwdriver L, with pilot extension to fit powder tube; hinged chuck N used as a bench vise in order to provide ample holding power.
Gages—Limit snap gage O, to test depth and squareness of copper-plug seating.
Production—Two men handle from 175 to 250 shells per hour.
Note—Variations in the threads varies production rate.



OPERATION 21. FILL WITH ROSIN AND WEIGH

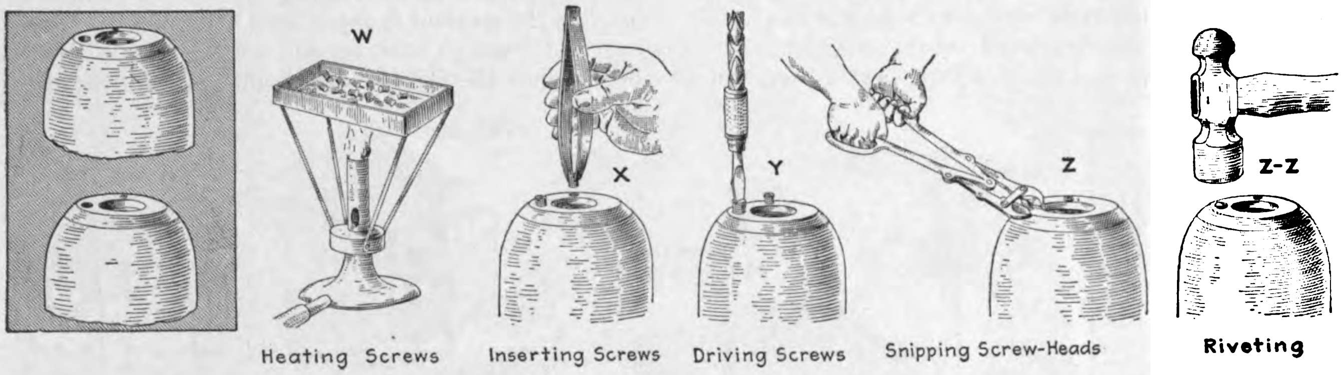
Machines Used—Hand operations.
Special Fixtures and Tools—Wooden plugs Q for fuse sockets; rosin kettles R and S, fitted with force pumps.
Gages—Scales for checking weight, shown at V.
Production—One operator at each kettle can produce 50 to 60 loaded shells per hour.
Note—The rosin kettles are gas-fired and are provided with handy tapping device.

is necessary to indicate that the shell is completely filled. The rosin is prevented from entering the threads by means of wooden plugs, such as shown at Q, which fill up the thread nose and prevent the necessity of cleaning out these threads later on. The rosin kettles are heated by means of gas burners and are arranged to be supplied from above by means of a rosin storage supply.

shell it is important that this be done, and the necessity of doing so in a hurry does not add to the convenience of the operation.

The next step following the filling of the shell with rosin consists in plugging the rosin-admission and air-outlet holes, this work being shown in operation sheet 22. The screws used in plugging these holes are kept at a

blue heat by means of the apparatus shown at *W*, it being necessary to have them at this temperature in order that they may melt whatever rosin remains in these two holes and thus clear the way for themselves without the necessity of cleaning the holes out otherwise. An operator becomes quite expert at handling these hot screws, having a pair of tweezers as an aid in starting them. They are driven home by means of a Yankee screwdriver, after which the protruding heads are snipped off with a pair of hand snips, and whatever remains is riveted down with a hammer. This operation completely seals up the interior of the shell and its contents of balls and smoke powder, leaving an opening, however, to the powder pocket through the central powder tube, which has been and is still during this operation closed with a cork.



OPERATION 22. INSERT PLUGGING SCREWS, SNIP HEADS AND RIVET

Machines Used—Hand operations.
Special Fixtures and Tools—Heating pan and gas burner W; tweezer pliers X; Yankee screwdriver Y; hand snips Z.
Gages—None.
Production—Two men insert screws, screw down, snip heads and rivet 250 shells per hour.

There are a number of checks upon the proper filling of the Russian shell. One of these is the weight of the complete shell, which indicates whether it contains the required number of balls. In addition to this a certain number of shells are unloaded or disassembled, the inspector having the right to disassemble not over one-half of one per cent. of the entire number of finished shells. Sometimes instead of disassembling a shell, a section is sawed out longitudinally upon a milling machine, exhibiting the cross-section of the interior of the shell and showing the regularity of loading. Points that are observed or looked for in these examinations are as follows: The proper fastening of the fuse socket to the body of the shell; the correct seating of the upper end of the powder tube into the copper plug; the regularity of the powder tube, and whether it has been mashed through loading; the proper filling of rosin and smoke powder; the position of the diaphragm in its seat, and whether the proper number of balls has been inserted. This latter point is established by the actual count of the contents of the disassembled shrapnel.

The hand operations do not lend themselves to that strict regulation that is possible with machine operations, especially on a product which has been manufactured for such a short time that a balance of skill, as it might be called, has not been established. Hand operations are always more difficult to bring to a point of relatively high efficiency than are machine operations. It is here that the greatest fluctuations in production rate take place, but there is one compensation to offset this—it is much easier to add men than it is to add machines, and such fluctuations therefore, although they may throw the production slightly out of balance, are quickly and easily corrected. It is quite possible, however, to conceive of a shrapnel so designed that hand operations as such could be almost entirely eliminated and their place taken by machine operations. When such a shell is designed, it will eliminate many of the harder problems that are now encountered by those making projectiles of English and Russian design. Those who are now working on war contracts, however, must take things as they find them and make the best of conditions that cannot be bettered.

Chart to Determine Maximum Unit Repeated Stress

By J. B. Kommers*

At the meeting this year of the American Society for Testing Materials, H. F. Moore and F. B. Seely, of the University of Illinois, presented a paper on "The Failure of Materials Under Repeated Stress." In this paper they derived the two following formulas:

$$S = \frac{B}{(1 - Q)\, N^{\frac{1}{8}}} \qquad (1)$$

$$S = \frac{B}{(1 - Q)\, N^{\frac{1}{8}}}\,(1 + 0.015\, N^{\frac{1}{8}}) \qquad (2)$$

where

S = Maximum applied unit stress;
B = A constant depending upon the kind of material;
Q = The ratio of minimum unit stress to maximum unit stress (Q becomes negative when the stress is reversed);
N = The number of cycles of stress that will cause failure.

Formula (1) is to be used for structural parts and machine members when failure would endanger life; formula (2) is to be used when failure would not endanger life.

The alignment chart on the following page has been plotted for formula (2).

The paper gives the following tentative values of *B* for the common metals:

Material	Values of B
Structural steel and soft machinery steel	110,000
Cold-rolled steel shafting	275,000
Steel, 0.45 per cent. carbon	175,000
Wrought iron	100,000
Hard steel	250,000
Hard steel wire	400,000

*Assistant professor of applied mechanics, University of Wisconsin.

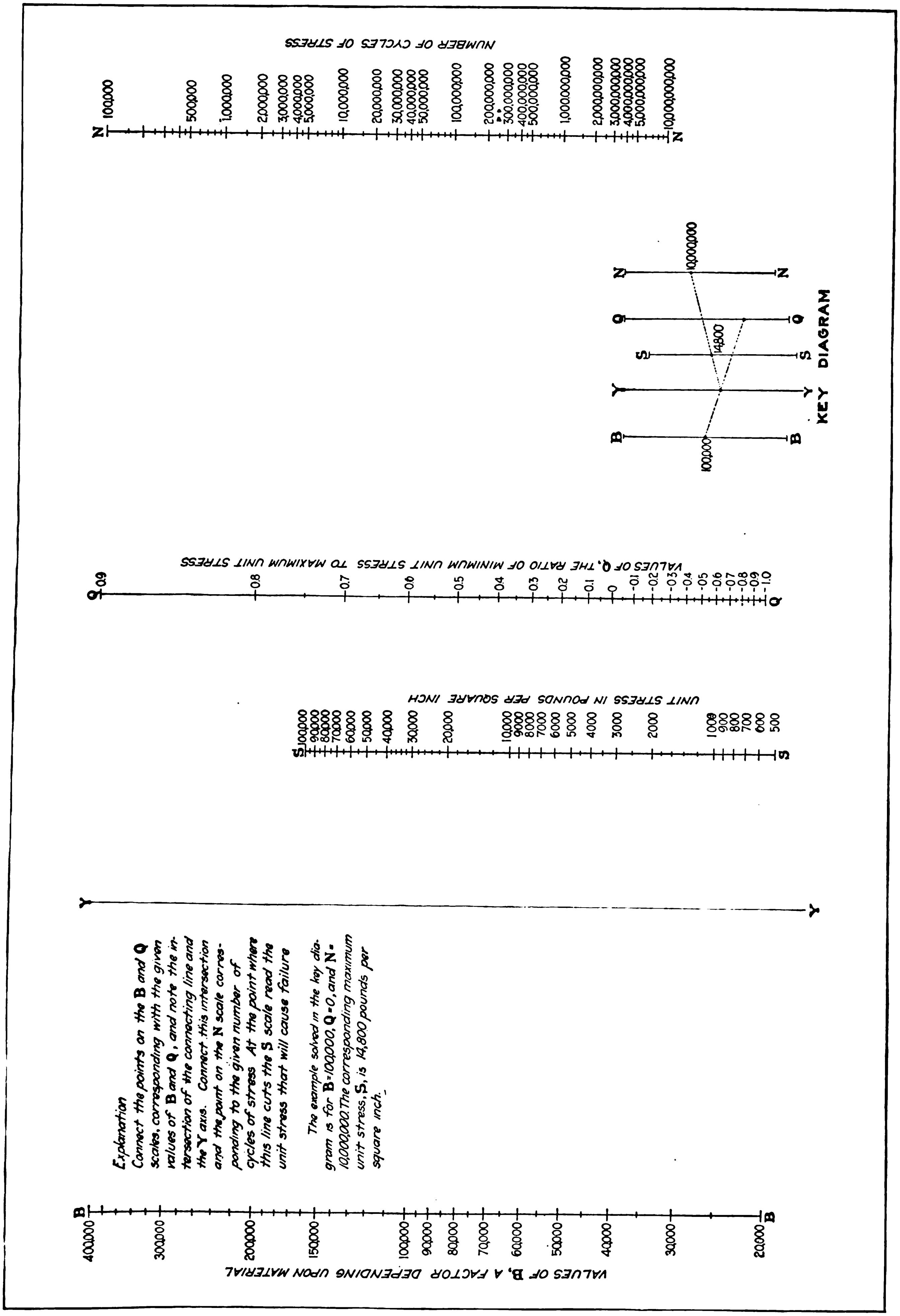


CHART TO DETERMINE MAXIMUM UNIT REPEATED STRESS—BY J. B. KOMMERS

Welding Pipe Parts with the Oxyacetylene Torch

The Prest-O-Lite Co., Indianapolis, Ind., employs the oxyacetylene torch extensively for welding and cutting operations on a wide variety of sheet-steel work.

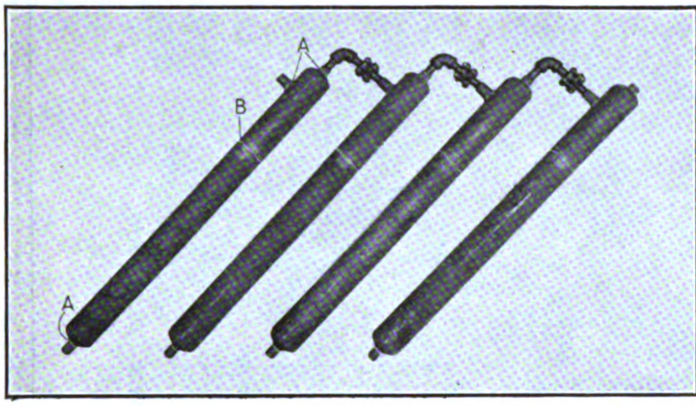


FIG. 1. A WELDED OIL SEPARATOR

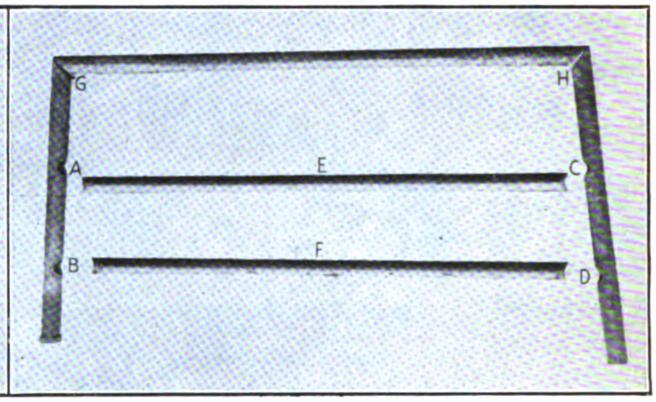


FIG. 2. THE PIPES AS PREPARED

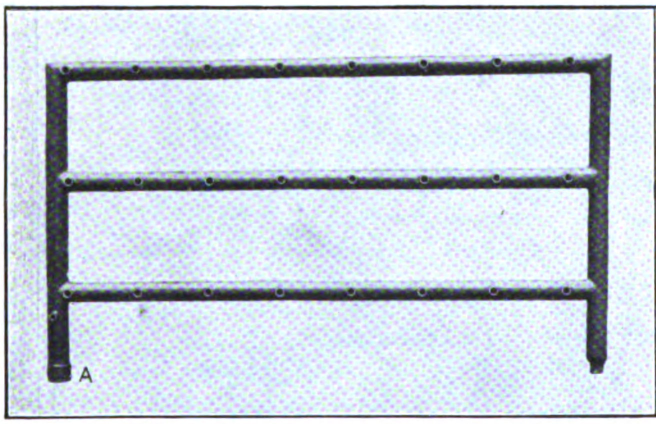


FIG. 3. THE FINISHED DISTRIBUTOR

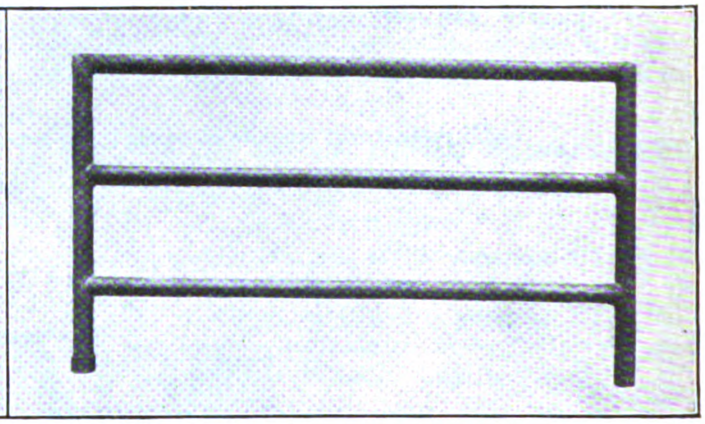


FIG. 4. THE PIPES AS WELDED

In Fig. 1 is shown an oil separator which has been manufactured by the use of the welding torch. The separator is 4 in. in diameter by 45 in. long, and the walls are $\frac{3}{16}$ in. thick. Three nipples, two for $\frac{3}{4}$-in. pipe and one for $\frac{1}{2}$-in. pipe, are welded on the separator at *A*. The two parts of the separator body are also welded at *B*.

The different welded elements are then fastened together with couplings until the required number is obtained. When making one of these elements, 25 in. of welding is made, and the time required is $\frac{1}{2}$ hr. The approximate amount of gas needed is 22 cu.ft. each of oxygen and acetylene.

The next example is the welding of a meter distributor. The work was done in California, the torch used being one manufactured by the Prest-O-Lite Co.

This distributor is made from 4-in. piping and tees. After the piping has been cut to the correct lengths, holes are made with the torch at *A*, *B*, *C* and *D* to suit the ends of the pipes *E* and *F*. The piping is then welded at the corners and at the cross pipes *E* and *F*.

The finished welded distributor is shown in Fig. 3. It will be seen that one end *A* has a threaded union fastened to it. This is used for connecting to the service from the street piping.

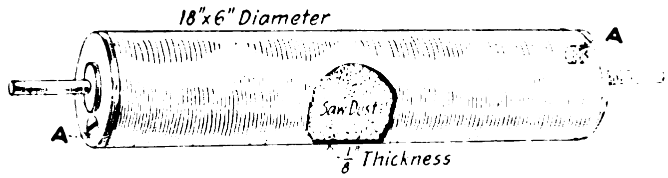
The part then assumes the shape shown in Fig. 4. Openings are cut with the torch in the cross pipes, and sockets with the desired size of outlets are welded in place.

When welding the main joints one hour's time was occupied and 25 cu.ft. of each gas—oxygen and acetylene—was used. For the 25 small joints two hours' time was taken and 50 ft. of each gas consumed. When performing the cutting operations, 45 min. was required and 30 cu.ft. of oxygen and 10 cu.ft. of acetylene.

A Simple Turning Kink

By Harold E. Green

The roll shown in the sketch is an ink roll that is used in a paper-bag machine. It is made of brass pipe with the heads forced in, after which a truing cut is taken across it. It is so light that no matter how the turning tool is ground, it will chatter.



A SIMPLE TURNING KINK

To obviate this, I drilled and tapped a hole in each end *A* for a pipe plug and then filled the roll with sawdust, which added enough weight so that the job was done satisfactorily, the sawdust then being let out.

Painting Small-Shop Products--I

By John H. Van Deventer

SYNOPSIS—This article is one of a number that will deal with methods of painting and finishing products made in the small shop. In this issue the desirability of good finish is described, and points are given on the selection of colors and the preparation of castings.

"If you wish to enjoy a funny show at the theater, don't let an optimist tell you about it in advance."

Dave Hope was responsible for this bit of wisdom, and said that it is human nature to like an agreeable surprise not only in matters of pleasure, but also in business. Rather a funny way for him to answer my question about painting and finishing small-shop products, I thought at first, but changed my mind after he went a bit farther into the matter and related a personal experience.

"Did you ever have a real swell salesman call on you," he asked, laying aside his surface gage; "one of the kind that wears patent-leather shoes and gray spats, fuzzy green hats and diamond scarf-pins?

"About a month ago I was in the market for a new machine, and one of these birds flew in to answer my inquiry. He didn't have to announce himself, for his clothes were loud enough to speak for themselves. Before I had time to recover from the shock, he pulled out a leather cigar case, offered me a Ruy Elegancia and insisted that I take dinner with him at the Castor House.

An Elaborate Catalog in Embossed Leather

"After we had eaten about four dollars' worth, and the waiter had made off with the remains of the fivespot, my fancy friend got down to business. He pulled out an elaborate catalog bound in embossed leather and began to show me the pictures. First was a bird's-eye view of the factory, and over the page a front elevation of the executive offices, with gardens and automobiles attractively arranged in the foreground. On another page was the interior of the president's private office, done in mahogany with tapestry hangings. After I had sufficiently admired this elegance, he turned to the secretary's sanctum, the stenographer's studio and the directors' room. Next he called attention to the designing department and engineering office, each the last word in finish and equipment. Coming to the factory, he pointed out the recreation and lunch rooms and also the first-aid department, with its white-enameled furniture and its white-upholstered attendants. A few more pages brought us to the chemical and physical laboratories, with bottles and test-tubes and ovens and thermometers arranged for 100 per cent. efficiency. Next came some elegant views of the foundry and various shop departments, the latter having individual motor drive and electric transportation trucks.

"Finally we got to the last part of the book, where it said a few words about what they made in the plant; but the poor fellow was all tired out by this time, so that I had to pick out the machine I wanted and sell it to myself.

"Two days later I received an engraved card thanking me for the order and promising shipment within three weeks. Ten days after that the shipping bill arrived, and along with it was a book of instructions about operating and taking care of the machine. That book was a work of art, printed in three colors and containing some of the slickest pictures you ever saw. Mrs. Hope made me keep it on the parlor table.

"I could hardly wait to get the machine from the freight house and rip off the crate and packing paper to see the slick piece of work that such an uptodate and enterprising firm must have produced.

Feeling Like a Nickel's Worth of Radium

"Say, you could have swapped me for a nickel's worth of radium when I saw that machine. Foundry sand was sticking to it here and there; and from the looks of the sloppy single coat of machine-gray paint, a bush-league painter's apprentice must have thrown a brushful of paint at the thing from center field, and almost missed the mark at that.

"I wrote a letter to the firm, asking them if that was the regular finish on their machine, and this is what I got in reply," exclaimed Dave, fishing a letter out of his pocket:

Dear Sir—In reply to yours of Jan. 6, with reference to the finish on machine shipped on your order No. 776 beg to state that this is our regular finish.

Our policy in this respect is to embody the highest mechanical skill in building these machines; and since fancy painting will not make it operate any better we prefer not to sacrifice quality for looks and therefore keep down expense on this less important feature. Yours very truly,

BLANK MACHINE WORKS.

"And here is my reply," said Dave, handing me the following letter:

Gentlemen—I have noted what you say with regard to finishing your machines.

I am not a stickler for style, but if a man whom I know to be in comfortable circumstances pays a call at my house dressed like a dilapidated hobo, with dirty face and hands, he won't get any farther than the kitchen steps, no matter how many engraved advance calling cards he has sent me.

I take as much pride in my shop as I do in my home; and while your machine has good working qualities, its poor finish has caused me to install it in a dark corner where I hope no visitors will see it. Yours very truly,

DAVID HOPE.

Efficiency Has Not Eliminated Human Nature

A few large shops have built up purchasing organizations that can lay aside all thought of anything except the ultimate dividend-earning capacity of a proposed purchase. They don't care whether a machine is pink, green yellow or black, as long as it will operate with a certain guaranteed efficiency on a certain product for a certain number of days in the year. Those who build things that are bought only by such concerns do not need to add fine finish as a selling point. But remember, where there is one purchaser who comes in this class, there are nine hundred and ninety-nine others not so far advanced, who look upon the purchase of each machine as a red-letter event—something to be thought about a long time in advance and admired for a long while afterward. Give a man of this type an article that he can be proud to show as well as to use, and he will go out of his way to boost it.

Science has done a good deal during the past few years, but it hasn't succeeded as yet in making a silk purse out

of a sow's ear nor a well-finished machine—a durably finished one—from poor castings. Holes can be plugged with filler, and foundry sand covered with pigment until the surface is perfect to all appearances; but by and by a spot will scale off here and there, taking with it as many coats as have been applied and transforming an attractive machine into an imitation of a mangy dog.

The small-shop man as a rule buys his castings and is thus in a good position to pick and choose, much better than the man who operates his own foundry and who is tempted to use anything therein made that has a faint resemblance to the original pattern. In buying castings, usually from a large jobbing foundry, it is possible to insist upon and to get good, clean, smooth castings. If the people you deal with can't give you satisfactory castings at the right price, try someone else—sticking to one thing isn't always a virtue, as the fly remarked to the fly-paper. Therefore if you are aiming at quality finish, make sure of a fair start toward it in the matter of castings and have them sand-blasted.

Sand-blasting makes the best surface for paint or enamel that can be had. The small shop with a sand-blast apparatus is an exception, and I should not advise installing one in such a shop unless conditions are quite unusual and there are a number of other profitable uses for compressed air. But the jobbing foundry of any size that has no sand-blast apparatus is also an exception, and thus the small-shop man may have sand-blast cleaned castings if he calls for them.

Getting Pickled Has Its Disadvantage

Some shops get clean castings by pickling them in an acid dip. The solution that is most commonly used for cast iron is one part of the commercial sulphuric acid to eight parts of water. Pickling will remove the scale and sand, but has the disadvantage that some of the solution may remain in the pores of the casting, resulting in the painted surface flaking off in such places. It is not enough to wash the pickled casting in water if this catastrophe is to be prevented; the acid must be neutralized by an alkaline solution such as sal soda dissolved in water in the proportion of ½ lb. to the gallon, preferably kept and applied hot. This in turn must be washed from the piece with water, alkali not being any more friendly toward paint than it is toward oil or grease or acids.

Assuming that the small-shop man has by hook or crook, luck, sand-blast or pickle secured a fair start toward a fine finish by getting smooth, clean material, what further steps he must take will depend on whether he is going to brush, dip or spray; whether the finish is to be dull, semi-gloss or full gloss; whether it is to be air dried or baked, and somewhat upon the color.

Color Affects the Sale of Machines

Color is a more important thing than a great many imagine, as applied to machine finishing. A pea-green lathe or a bright-yellow miller would have small chance of leaving a jobber's display floor, whereas these same bright colors are favorable to disposing of hand pumps and farm tools. Black is the color of dignity; the machine shop must be a dignified place, judging by the color of its equipment—if you find it too oppressive, take a walk into the engine room and have a look at the frivolous red engine.

The choice of color that will make an article salable is far from being simply a matter of good taste. It really calls for a mixture of genius and a deep knowledge of psychology, diluted with considerable good luck. It is easier to tell what not to do in this matter than to say what should be done. For one thing, do not depart too widely from what has been more or less accepted as general practice for the product. Make it similar, but better. A pioneer in the choice of colors has a hard row to hoe. When in doubt, paint it black, for this color in paint as well as in clothes is suitable for all occasions.

Green and Yellow Bringing Home the Bacon

The painting of articles for export is an art in itself, especially where the goods go to tropical countries. This is not because of the difficulty in getting a finish that will stand the heat, but of getting one that will suit the natives. Having at various times been connected with two factories making quite different lines of mechanical goods, both of which had large sales in South America, I am in position to pass out a bit of advice that is the result of observation. If you make machines for this trade, paint them bright green with yellow stripes and decorate the larger surfaces liberally with florid transfers; then you are sure to make a killing. This may sound like a joke, and in fact the machine thus treated looks like one; but notwithstanding this, green and yellow will bring home the bacon from South America.

The choice between dull finish, semi-gloss and full gloss is not as difficult as that of the proper color. Size has a good deal to do with this. A large machine or surface looks better with the dull finish, largely because this tones down all large irregularities or waves which cannot be corrected by applying filler. Semi-gloss, or eggshell, finish, while taking considerable skill to apply properly, is effective for medium-sized machines where cast iron is the main material, and has the advantage of not showing splotches of oil. Full gloss, or enamel, finish is most effective on small articles such as may be made part of a machinery jobber's window display; when well executed, this finish will help to attract the eye of a possible customer.

Fine Finish Must Be Consistent

To be really fine, the finish selected must be consistent with the use of the machine or part, in other words must serve some purpose aside from mere decoration. It is disappointing, to say the least, to buy an engine or pump attractively painted and then have its color darken and turn dead and muddy when the thing is subjected to its working heat. Nor is it altogether pleasing to have a tool that is meant to be handled shed its coat like a locust. Japan and baked enamel finishes have reasons for use other than to simply give the article a shiny appearance. Resistance to heat and resistance to handling are among the reasons for the employment of these more durable finishes, which, it will be found, are not beyond the reach even of small shops.

Protection against rust is one reason for painting those parts of machines that do not show—here the ornamental side is forgotten altogether and the purpose becomes strictly utilitarian. The interior of oil chambers of bearings are painted with another purpose in view—to keep sand from the cast surfaces from dropping into the oil and thus damaging the bearing. A paint made of red lead and linseed oil is best for this purpose, not being softened by lubricating oils.

Machine-Forged Beading Tools*

By J. C. Breckenridge†

The evolution of a beading tool as made in an Ajax forging machine is as follows: First, flattening; second, punching; third, forming; fourth, grinding off fins,

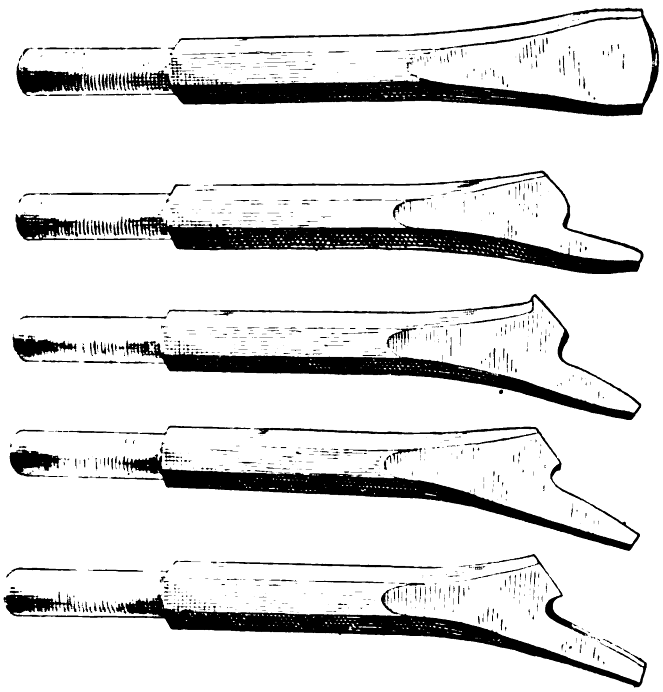


FIG. 1. MACHINE-FORGED BEADING TOOLS

and rounding off edges with file; fifth, hardening and tempering. As it is made from ⅞-in. octagon steel, the upsetting of the steel with its resulting evils is entirely avoided.

The hardening of the tools is accomplished with an oil-burning tool furnace and a pyrometer to register the proper hardening temperature. In drawing the temper, an oil-tempering bath with an indicating thermometer is used. The tools are handled in lots of 500 at a cost of 25c. per tool. The average amount of service from a beading tool is 4,000 flues beaded before it has to be re-formed. The forging-machine dies are made from ma-

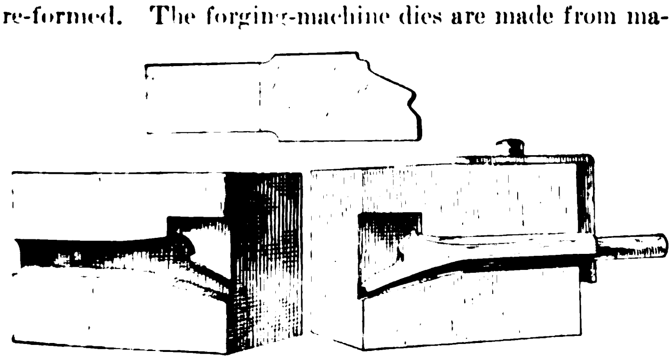


FIG. 2. DIES FOR BEADING TOOLS

chinery steel with vanadium-alloy tool-steel inserts at a total cost of $50.

The success of this tool is chiefly due to the methods employed in its manufacture. It is made from annealed low-carbon tool steel. The blanks are first cut to length from the stock bars in a power shear, four blanks being cut off at each stroke. The round shank end, $1\frac{1}{8}$ in. in diameter, 2½ in. in length, is next turned in a lathe with the aid of box tools. The blanks are taken to the forge shop and heated in an oil-burning furnace and formed in a 2-in. Ajax forging machine. The illustrations make the work clear.

*From "Proceedings," American Railway Tool Foremen's Association.

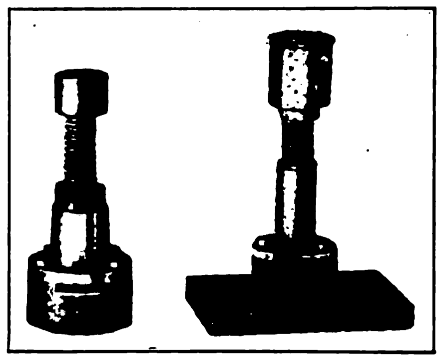
†Supervisor of tools, Frisco Railway.

Making Fiber Washers

By E. V. Allen

The illustration shows two tools used in the shop of the F. W. Lindgren Co., Rockford, Ill., for cutting out fiber thrust washers. They are used in a common mandrel press, and a boy can easily run out several hundred in a short time.

The tool at the left blanks the washer out of a strip of fiber sheared to the proper width. It also pierces the



MAKING FIBER WASHER

center hole of the washers, which are thrust into it one at a time against a stop and then pushed out from the back. The bases of these tools, or dies, are made of cast-iron scrap pieces. The dies, plungers and guides are made from scrap steel. Each plunger or punch is shouldered at the upper end, so that a spring may be placed on it to force it upward as the press ram releases it.

Grinding-Operation Kink for Hardened Rollers

By W. L. Conklin

A small job that I had to do recently in a grinder may be of interest to some readers.

The work consisted of five tool-steel rollers, $\frac{3}{16}$ in. in diameter by $1\frac{3}{16}$ in. long, with as small a center as possible in each end. They were to be hardened and ground. This seemed all right until I tried to decide upon the way to drive the rollers so that a cut clear across the face could be taken.

I put the hardened roller on the centers of a cutter grinder, locked the head center so that it would rotate with the work, then placed the tailstock center in position. Before starting, I regulated the tension of the compensating tailstock spring with a wooden wedge placed between the center release latch and the frame of the tailstock so that enough pressure could be got on the center to hold the work steady and yet allow it to rotate very freely. After this adjustment a soldering iron was used to put a small amount of solder on the head center close up to the face of the roller. By this means the work was locked tight enough to allow the grinding of the rollers to the finished size.

Machining Exhaust Manifold and Details of V-Motor

By Robert Mawson

SYNOPSIS—In this article is shown the fixture used in milling the exhaust manifold. For machining the front bearing housing, two milling and one drilling operation are described. The rocker arm has a multiple milling operation and a simple drill jig. Two indexing jigs are used in machining the cylinder, other tools for which were shown in a previous operation. These tools represent advanced ideas in tool designing and manufacture.

On page 19 was shown and described the Ferro eight-V-motor manufactured by the Ferro Machine and Foundry Co., Cleveland, Ohio. This motor is of a novel construction employing a single casting which takes the place of the upper crank case and cylinder casting. The gas operating mechanism, the motor being of the valve-in-the-head type is carried in a separate casting attached to the cylinder being known as the cylinder head.

Over the head is fastened the cover the function of which is to hold the spark plugs. A light pressed steel stamping is used for the oil pan or lower crank case. On pages 14 and 98 are shown some of the special small tools used in manufacturing the motor. It will be observed that these tools illustrated the latest types of jig and fixture design and the times required for performing the machining operations, speeds and feeds, of cutters and other data are included. In this article are described the tools used when machining three other smaller elements used on the motor. It will be seen that these illustrations, as well as those given in the previous article, represent high-grade jig and fixture design and construction working out satisfactorily under commercial conditions.

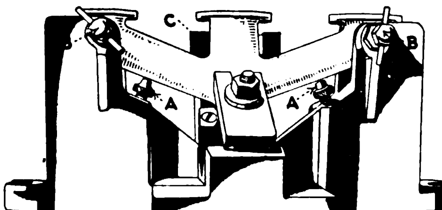


FIG. 2

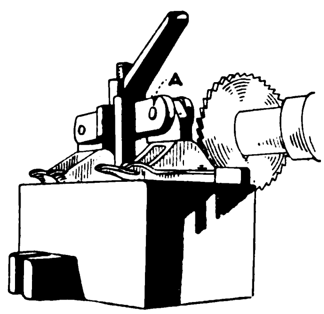


FIG. 4

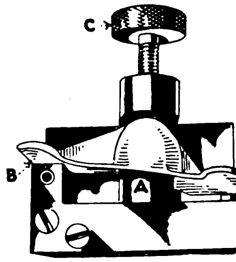


FIG. 5

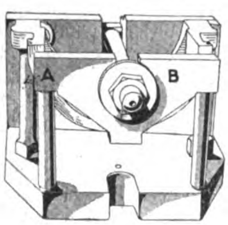


FIG. 7

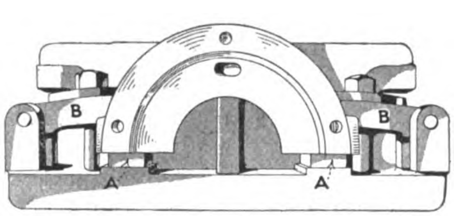


FIG. 8

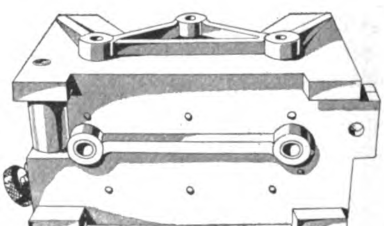


FIG. 9

JIGS AND FIXTURES USED IN MACHINING V-MOTOR DETAILS, WITH WORK IN POSITION

FIGS. 2 AND 2-A

Operation—Milling exhaust manifold, Fig. 1. Casting is located in steel V-block and knurled-head screws A are tightened against it; screws B and strap C are tightened to hold it securely.

Surface Machined—Joint surfaces, using 4-in. end mill; speed, 76 r.p.m.; feed, 0.083 in. per revolution.

FIGS. 4 AND 4-A

Operation—Milling slot in valve rocker arm, Fig. 3. Forgings are located on finished plugs, which rest in machined recess. Clamps A are operated by a handle and hold down four pieces at one setting.

Surface Machined—Notch, using 4-in. diameter by $\frac{3}{16}$-in. thick cutter; speed, 85 r.p.m.; feed, 0.03 in. per revolution.

FIGS. 5 AND 5-A

Operation—Drilling hole in rocker arm. Forging is located on plug A and fin B, which is set in slot of jig. Knurled-head screw C holds it in position.

Hole Machined—No. 48 hole through web.

FIGS. 7 AND 7-A

Operation—Milling parting line of front bearing housing. Fig. 6. Rough casting is placed on two pins as A and held in position with strap B.

Surface Machined—Joint surface, using 5-in. cutter; speed, 62 r.p.m.; feed, 0.015 in. per revolution.

FIGS. 8 AND 8-A

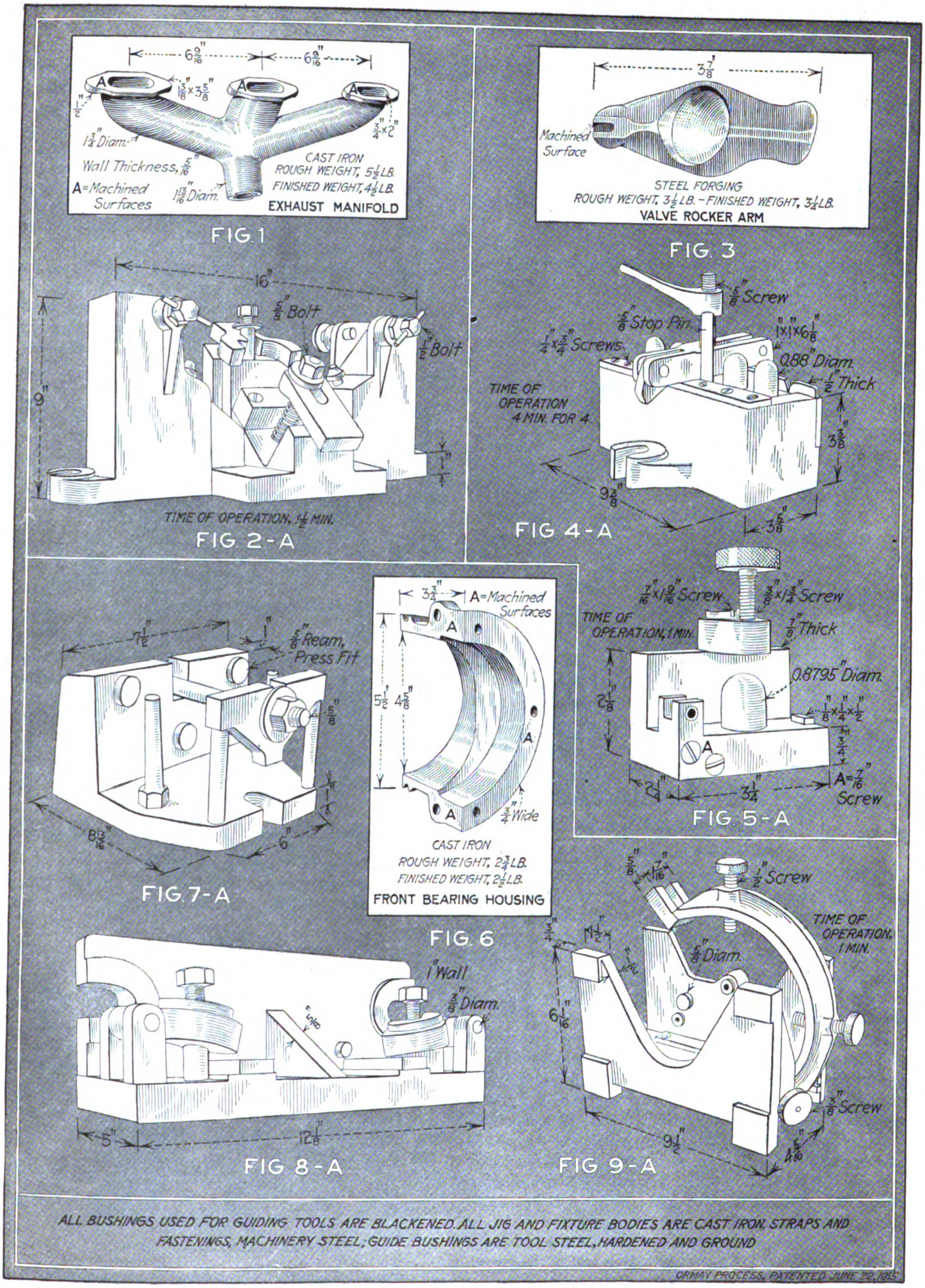
Operation—Milling face of front bearing housing. Casting is located on two hardened-steel pads A and is held down with straps B.

Surface Machined—Front face, using 3-in. end mill; speed, 100 r.p.m.; feed, 0.03 in. per revolution.

FIGS. 9 AND 9-A

Operations—Drilling holes on face and bolt holes in front bearing housing. Casting is placed on steel pads and the cover dropped down and fastened with knurled-head screw, two screws holding it in position.

Holes Machined—Three ¼-in. in face and two $\frac{11}{32}$-in. for joint bolts. The three ¼-in. holes are later tapped with $\frac{5}{16}$-in. 18 U. S. F. threads.

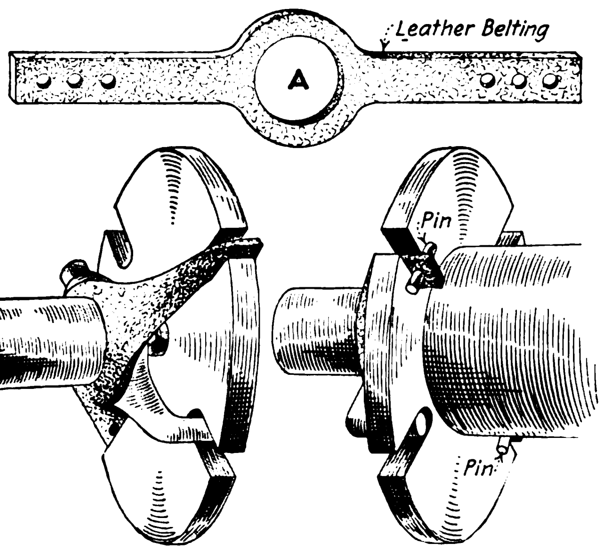


DETAILS OF JIGS AND FIXTURES USED IN MACHINING EIGHT V-MOTOR PARTS

Device To Hold Center Work to Faceplate of Lathe

By William C. Betz

We had a lot of spindles to be steadyrested for boring, and one of the boys devised a leather strap, *A* in the illustration. To use this strap, the lathe faceplate is backed away from the spindle shoulder about four threads, as when using a belt lace. The strap is put on the piece to be machined and a lathe dog fastened in place. The strap



SPECIAL STRAP FOR CENTER WORK

ends are then slipped through the driver slots, brought up tight and pins slipped through the holes, as shown. The faceplate is screwed back against the spindle shoulder, which brings the work tight against the headstock center.

This strap is much more convenient to use than the belt lace.

Dies for the Manufacture of Piston-Rod Nuts*

By B. Henrickson†

On all its new and heavy power the Chicago & Northwestern Ry. has done away with the key type of crosshead and is using the design in which the piston rod is held in place by a large castellated nut. As these nuts have worn out in service the mechanical department has been confronted with the problem of replacing them. The dies shown in the accompanying illustrations have been instrumental in solving the problem.

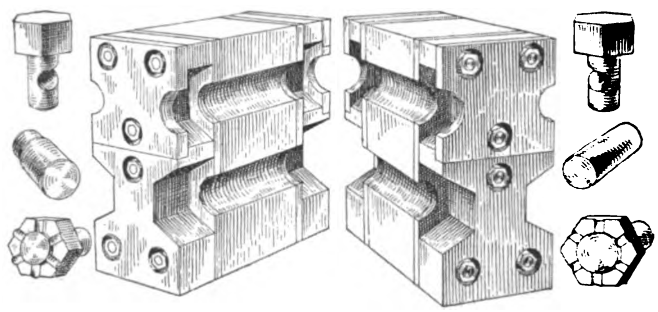
The illustration shows the dies with the various headers used for making both blank and castellated nuts. The dies in this case are made to fit a 6-in. Ajax forging machine. As is readily seen, they are sectional; each half-die consists of seven distinct pieces, and also each die may be said to be two-faced. They may be turned end for end in the machine, or the two outside faces may be made the two inside faces. This design is to accommodate a variety of sizes of nuts, which will be named later. The main body of the die as shown is made of cast iron. All the remaining pieces should be made of either soft steel or tool steel. If made of tool steel, the various laminations should be tempered; if soft steel is used, they should be case hardened. The four end plates shown bolted to the ends, serve to protect the cast-iron sections. As they wear away, they may easily be replaced or built up by the oxyacetylene process. As

Size of Nut, In.	Across Flats, In.	Style	Width of Nut, In.
4¼	6⅛	Hex—castle	3
3½	5½	Hex—castle	2⅛
4¼	6½	Hex—plain	3
3½	5½	Hex—plain	2½
3½	5⅜	Hex—plain	3

may be noticed, some parts are recessed out to carry plates. The object of this design is to facilitate replacement of these pieces in case of accident. The laminations are bolted to the body of the die by 1-in. studs.

A separate plunger to fit the crosshead of the machine is not made for each size of nut. One main body only is made, and the various plunger heads, shown in the photograph, are fastened to this main body by setscrews.

The sides show the results of the two operations necessary to form a complete nut. The pieces are formed



DIES FOR PISTON-ROD NUTS

in the bottom recess of the dies. The bar stock is upset, and by the use of the proper plunger either a plain or a castellated nut is formed. The completed nut is shown below. It is formed in the top recess of the dies by punching out the center of the piece. One heat only is necessary.

The accompanying table shows the different nuts made in these dies.

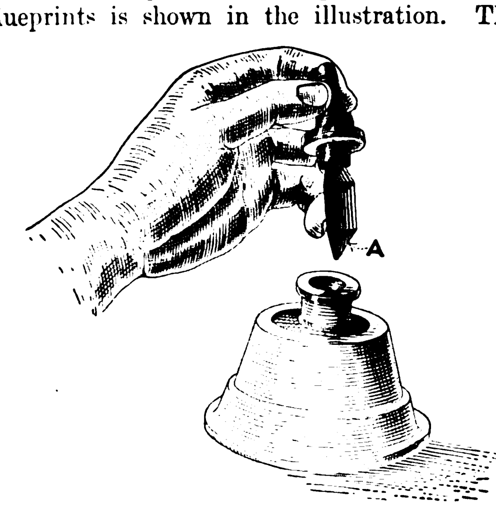
*Presented to the American Railway Tool Foremen's Association.

†Tool foreman, Chicago & Northwestern Ry., Chicago, Ill.

Helpful Drafting-Room Kink

By William J. Gaffke

A good and inexpensive drafting-room kink for changing blueprints is shown in the illustration. The quill



HELPFUL DRAFTING-ROOM KINK

A is made from either sheet brass or copper about 0.01 in. thick and ¼ in. wide. It is inserted in the stopper as shown.

Machining and Gaging Methods From Pelton Shop

By Fred H. Colvin

SYNOPSIS—Methods which have been found satisfactory both as to quality and cost of apparatus in moderate quantities always contain suggestions for shops similarly situated. The methods here described include gaging the relative location of surfaces of a waterwheel governor base, a drilling base for waterwheel buckets, boring formed surfaces in a lathe and a drilling and filing jig for square holes.

One of the interesting products of the Pelton Waterwheel Company, San Francisco, Calif., is the Doble hydraulic governor, used in connection with the Pelton waterwheel, for controlling the flow of water to the wheel itself. Without going into the mechanism of this governor, it presents several interesting machining problems, some of which will be round in connection with the various surfaces of the governor base.

The top is first bored and faced, as shown in Fig. 1, all the other surfaces being gaged from this point. The base of this gaging is the located plate *A*, which is held in position by the four projecting lugs shown, while the two knurled handles afford an easy means of handling the center plate. The use of the gage *B* is shown in Fig. 2.

This figure shows the gage *B* in position in the plate *A*, the outer end giving the correct distance from the center of the governor base to the face of the side opening *C*.

The manner of gaging the opening on the opposite side, as well as the relative position of the rear bearing, is shown in Fig. 3. Here an arm *D* has been substituted for the gage *E* for gaging the height of the bearing with relation to the upper face of the base. The gage *E* locates the relative position of the end of the side bearing

Fig. 1 Fig. 2 Fig. 3

FIGS. 1 TO 3. LOCATING GAGES FOR THE BASE OF WATERWHEEL GOVERNOR

Fig. 1—Center plate in place. Fig. 2—Locating the side outlet. Fig. 3—Gaging bearing surface and other side outlet

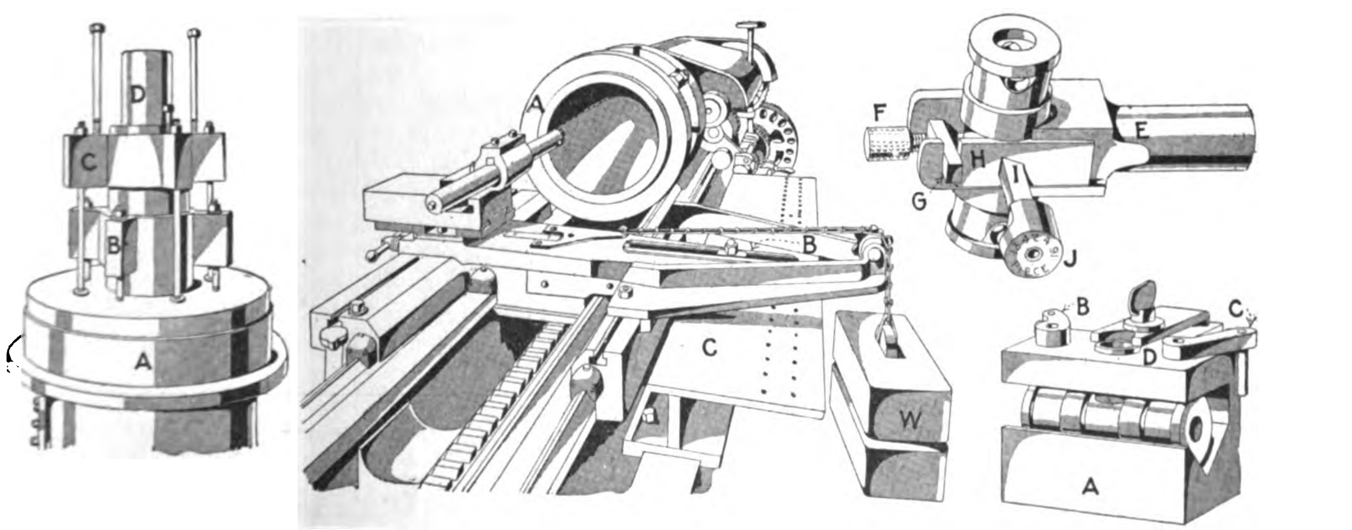


Fig. 4 Fig. 5 Fig. 6

FIGS. 4 TO 6—HAND AND MACHINE OPERATIONS ON GOVERNOR PARTS

Fig. 4—Post for wheel centers. Fig. 5—Boring the curved nozzle. Fig. 6—Drilling and filing jig for needle valve

and the face *F* of the opening on this side. Both of these gages have adjustable hardened points to allow for wear and to keep the setting accurate at all times.

For holding the waterwheel spiders, or centers, while they are drilled to receive the buckets, the stump, or post, shown in Fig. 4 is used. It consists of a base *A* which is strapped to the floor plate of a large radial drilling machine. This carries the pair of four-winged arms *B* and *C* on the central post *D*. The spider fits on these arms, which locate it in a central position while it is being drilled for the bucket.

The nozzle tips of the governor are bored to a special curve for controlling the flow of water to the best advantage, a central needle, curved somewhat similarly, being used inside the curved nozzle tip *A*, shown in Fig. 5. This is bored by means of a former, shown very slightly at *B*, this former being bolted to the plate *C* in the correct position to control the boring of the nozzle. The crossfeed screw is disconnected in the usual way, the cross-movement of the carriage being controlled by the weight *W*, through the chain belt shown. The curve on the governor spindle is turned in a similar manner.

The governor contains a floating valve, which has a square hole across the center, and which must be very accurate. Not being made in sufficient quantities to warrant broaching, these valves are drilled and filed, as shown in Fig. 6. The drilling jig is shown at *A*, carrying three bushings *B*, *C* and *D*. Only the central hole is filed square, the work being done in the filing fixture. The illustration shows very clearly how the piece is held by means of the knurled screw *F*, acting through the small strap *G*, which is easily handled in the notched plate *H*. The edges of the square hole *I* of the fixture are hardened, so that it makes the filing of this square hole a comparatively simple matter. The gage for testing the hole is shown at *J*.

Dressing a Wheel for the Grinding of Splines

By E. A. Thanton

One of the large automobile companies grinds its splined gear shafts all over after they are machined and hardened. These shafts are of the six-splined type, and in milling out the splines a small channel is cut down into the bottom of each side of the spline. This is done on account of the tendency of the edges of a grinding wheel to round over quickly. By milling in this way, a strip is left down the middle of the bottom, so that the wheel has a strip on the bottom and each side to grind, but no sharp corners.

After the shaft has been hardened, it is ground on a cylinder grinder and all the cylindrical surfaces finished. It is then placed in a Brown & Sharpe planer-type grinder, as shown in Fig. 1. The indexing is done with a regular dividing head, the same as in the milling operation. By the use of three specially mounted diamonds the wheel is dressed to the exact size and shape to grind the splines. These diamonds are carried in a fixture that is set on the grinder table in line with the shaft to be ground, as shown at *A*. By using this fixture the wheel is dressed to exact shape in a very short time with little trouble.

The method of mounting the diamonds is better shown in Figs. 2 and 3. In Fig. 2 the two diamonds used for dressing the beveled edges of the wheel are shown in position on the fixture. Each diamond is carried in a separate slide, as shown at *A* and *B*. The diamonds themselves are held in small plugs which are held in the slides by means of setscrews. The slides are permanently set in grooves cut at the correct dressing angle. They

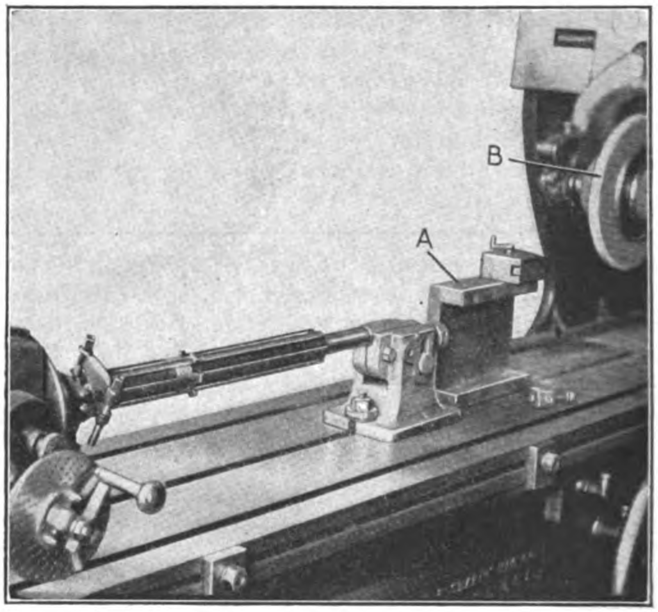


FIG. 1. DRESSING FIXTURE IN POSITION ON PLANER TYPE GRINDER

are each cut half away at the back so that they can cross each other. On the inner edges of the cut-away parts, teeth are cut like those of a rack, and into these teeth a small pinion meshes. This pinion is so set as to be turned by means of the handle *C*. By swinging this handle one way or the other, the slides carrying the diamonds are alternately fed out or in, and if in correct position the wheel will be dressed to correspond.

After the bevel edges, the radial periphery must be dressed. This is done without changing the position of the wheel or fixture. The double diamond holder is

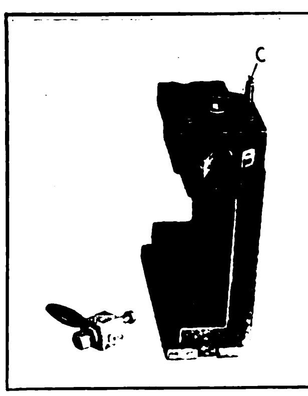


FIG. 2. THE SIDE DRESSING DEVICE

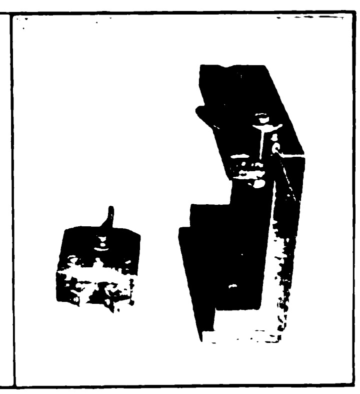


FIG. 3. THE RADIUS DRESSER

simply lifted upward off the engle plate and the single diamond holder put in its place, as shown in Fig. 3. As the diamond is held at *A*, the radius is dressed by simply swinging the handle *B* from side to side.

Effect of Varying Sulphur in Basic Openhearth Steel*

By J. S. Unger†

SYNOPSIS—Report of an investigation into the properties of a large number of steel specimens, including three different carbon contents and six or more sulphur contents for each carbon. Tests and observations were made in the laboratory, steel mill and shop. Summarizing, the author states, "I do not advocate paying no attention whatever to sulphur content of steel, but I firmly believe that a steel containing more than 0.100 per cent. is not necessarily bad and that it will show little, if any, difference in quality when compared with the same steel of much lower sulphur, other conditions being the same."

The purpose of this investigation was to prepare steels of different degrees of hardness, each containing varying amounts of sulphur, then work these steels into finished products and examine them carefully during the manufacture and after completion for difference in quality.

Three heats of steel of 68 tons each were made. These were low-sulphur basic openhearth steels of soft, medium and moderately hard varieties of approximately 50,000, 70,000 and 90,000 lb. per sq.in. tensile strength, the carbon contents being 0.09, 0.32 and 0.51 per cent. respectively. No selection of stock or furnace was made, the furnaces being taken at random. The heats were cast into twenty-four 18x20-in. ingots of 6,300 lb. each. Twelve ingots from each heat were used in the investigation, or a total of 100 tons. After a discard had been made to eliminate any highly segregated or streaked condition in the steel and the regular waste provided for, about 50 tons of steel was used in the tests carried out.

The sulphur content of the ingots was increased progressively by adding amounts of sulphur to different ingots from the same heat, raising the amounts in the higher-sulphur ingots of the series greatly beyond that ordinarily found in commercial steels, until a point was reached at which it was difficult, if not impossible, to roll the ingots by the usual heating and rolling operations commonly practiced at the mills.

The sulphur additions were made in the pure powdered form to the ingots during pouring. Pyrites was considered but discarded as a possible means of introducing variables. The additions were regulated to secure as nearly as possible a uniform increase of 0.030 per cent. sulphur from one ingot to the next higher. The aim was to obtain steels that, excepting sulphur, would be alike in manufacture and composition, thus keeping out any variables and furnishing an opportunity to study the effect of sulphur alone.

The ingots were rolled into such sizes as would be needed to fabricate the different steels, either by hot or cold working, into such finished articles as they were best adapted to by composition. Sheets, wire products, rivets, chains, tubes, channels, plates, rails, axles and drop forgings were made. In this paper I refer only to such steels as are of particular interest to the automobile industry.

Owing to the great variety of materials made, it was not always possible to use steel of the exact composition ordinarily employed for a certain purpose, as the steel was sometimes a little harder or softer than required. This feature does not, however, influence the comparative results.

The manganese of the three heats was 0.43, 0.62 and 0.67 per cent. respectively. Attention is called to this point, as large quantities of steel containing from 0.70 to 0.120 per cent. sulphur and 0.75 to 1 per cent. manganese are made regularly for consumers who must have a steel especially fitted for rapid drilling, turning or threading purposes. The comparatively high manganese in this screw or nut stock has an appreciable effect on the hot-working properties. This was not the case in the low-manganese steels studied in this investigation.

The ingots were heated to 1,250 deg. C. and then rolled in the regular way, no attempt being made to give the higher sulphurs any preference. All ingots were rolled, except the two highest-sulphur ingots of the 0.09 per cent. carbon heat, containing 0.250 and 0.254 per cent. sulphur. These ingots cracked badly in rolling and were removed from the roll tables and scrapped. In rerolling from the blooms, billets or slabs into finished material, no trouble was experienced nor any difficulties met.

TABLE 1. CHEMICAL ANALYSES AND PURPOSES FOR WHICH STEEL WAS USED

Basic Openhearth Heat No. 81,160:
- Chemical Analysis—Carbon, 0.09; manganese, 0.43; phosphorus, 0.012; sulphur, 0.031.
- Sulphur Content in Ingots—0.030, 0.031, 0.050, 0.060, 0.090, 0.116, 0.140, 0.160, 0.180, 0.250, 0.254.
- Purposes for Which Used—Rivets, chains, sheets, wire, tubes and pipe.

Basic Openhearth Heat No. 71,163:
- Chemical Analysis—Carbon, 0.32; manganese, 0.62; phosphorus, 0.014; sulphur, 0.032.
- Sulphur Content in Ingots—0.032, 0.068, 0.108, 0.146, 0.190, 0.230.
- Purposes for Which Used—Drop forgings, channels, plates and tubes.

Basic Openhearth Heat No. 76,185:
- Chemical Analysis—carbon, 0.51; manganese, 0.67; phosphorus, 0.015; sulphur, 0.025.
- Sulphur Content in Ingots—0.025, 0.055, 0.095, 0.135, 0.167, 0.230.
- Purposes for Which Used—Axles, drop forgings, rails and wire rope.

Table 1 shows the chemical composition of each heat and the sulphur content of each ingot.

Hot-Working Properties of the Steel

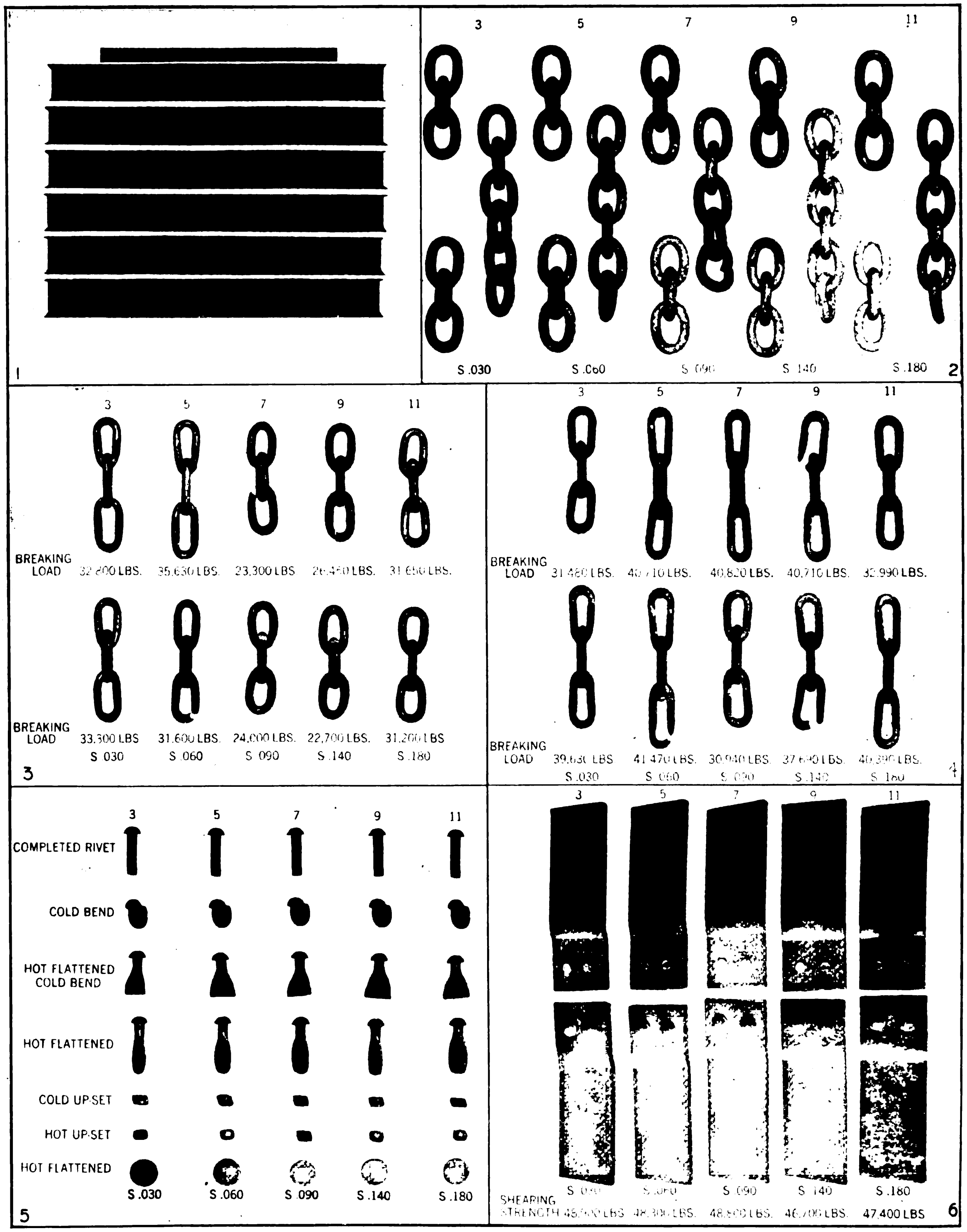
The rolling properties of these steels are shown in several of the illustrations, which give a general idea of the rolled finished material.

Channels enter into the construction of automobile-truck frames. Fig. 1 shows six pieces 6 ft. long, each of 8-in. channels, of 0.32 per cent. carbon steel, with the corresponding sulphur of each piece stenciled on the channel. No tearing or red shortness is noticeable on the thin flanges of the higher sulphurs.

The ability to weld the soft steel of 0.09 per cent. carbon is shown in Fig. 2 (3/4-in. machine-made chain).

*Presented at the 1916 annual meeting of the Society of Automobile Engineers. Slightly condensed.

†Manager, Central Research Bureau, Carnegie Steel Co.



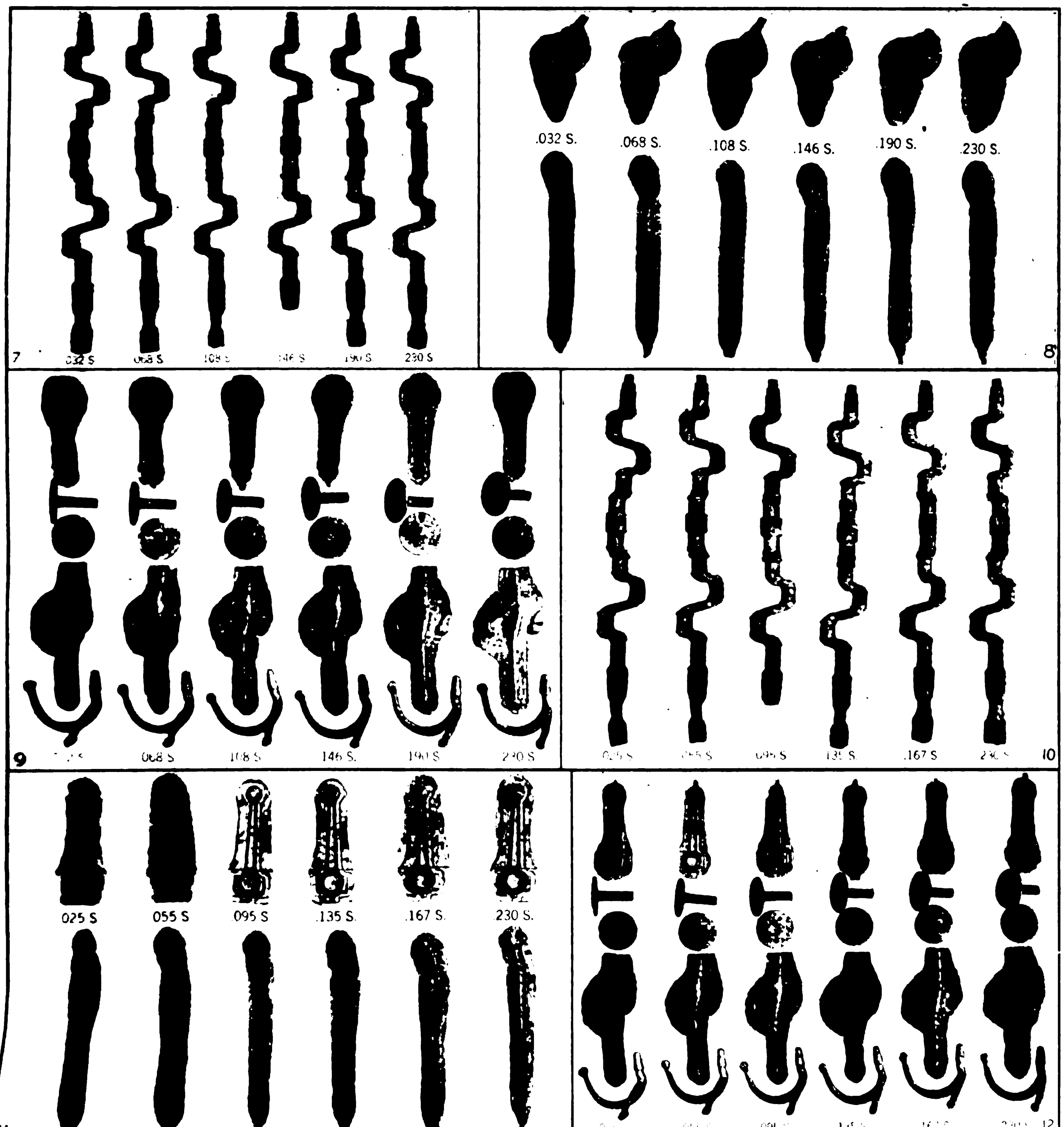
FIGS. 1 TO 6. TEST SPECIMENS OF CHANNELS, CHAIN AND RIVETS USED IN INVESTIGATION OF INFLUENCE OF SULPHUR IN STEEL

Fig. 1—Samples of 8-in. channels. Fig. 2—Welded ¾-in. machine-made chain. Fig. 3—Machine-made chain tested to destruction. Fig. 4—Hand-made chain tested to destruction. Fig. 5—Rivets subjected to hot and cold tests. Fig. 6—Riveted joints tested to destruction

Three pieces of each sulphur content were made. The short pieces of three links each were tested to destruction, with results shown in Fig. 3. Additional chain, hand-made, shown in Fig. 4, was tested. The stock for these chains was rolled $^1/_{64}$ in. light in gage, in order that this size could be used in making the rivets. This is not the usual practice, as machine-made chain stock is rolled $\frac{1}{32}$ in. over gage to provide for scaling and to fill out the welding dies of the hammer. This smaller diameter has given lower results than is ordinarily obtained on standard chain, but the results are truly comparative.

The greater average strength of the hand-made chain over the machine-made is not due to better workmanship, but to the fact that the lap in the hand-made chain is almost twice as long

No trouble was experienced in either the hand- or the machine-made chain until No. 9, or 0.140 per cent. sulphur, was reached, No. 11, of 0.180 per cent sulphur, acting similarly. It was found that both could be welded perfectly at the regular temperature and did give good results, but that lowering the welding temperature about 100 deg. C. prevented any cracking or crumbling of the steel in welding. The evidence seems to show that good and bad welds are more a question of heating and workmanship than of either high or low sulphur, as either kind of weld is found in any of the various chains tested.



FIGS. 7 TO 12. DROP FORGINGS MADE FROM STEELS CONTAINING DIFFERENT AMOUNTS OF SULPHUR

Fig. 7—Drop-forged crankshafts. Fig. 8—Automobile drop-forged parts. Fig. 9—Automobile drop-forged parts. Fig. 10—Drop-forged crankshafts. Figs. 11 and 12—Automobile drop-forged parts

The results of the tests to destruction are given in Table 2.

TABLE 2. BREAKING LOAD OF ¾-IN. CHAIN

Carbon Content, Per Cent.	Sulphur Content, Per Cent.	Breaking Load of Hand-Made Chain, Lb.	Breaking Load of Machine-Made Chain, Lb.
0.09	0.030	31,480 39,630	32,800 33,300
0.09	0.060	40,710 41,470	35,630 31,600
0.09	0.090	40,820 30,940	23,300 24,000
0.09	0.140	40,710 37,690	26,450 22,700
0.09	0.180	32,990 40,390	31,650 31,200

A number of rivets, ¾ in. in diameter by 2 in. long under the head, of the 0.09 per cent. carbon steel were made and subjected to the various hot and cold tests shown in Fig. 5. To determine if these rivets were of the same strength under shearing stress, 10 bars, having two $\frac{13}{16}$-in. holes drilled 2 in. from one end, were riveted together by machine at an estimated temperature of 1,200 deg. C. These bars were then tested with the results shown in Fig. 6 and in Table 3. Practically no difference is observed in the tests.

TABLE 3. SHEARING STRENGTH OF RIVETED JOINTS

Carbon Content, Per Cent.	Sulphur Content, Per Cent.	Shearing Strength, Lb.
0.09	0.030	48,900
0.09	0.060	48,300
0.09	0.090	48,800
0.09	0.140	46,700
0.09	0.180	47,400

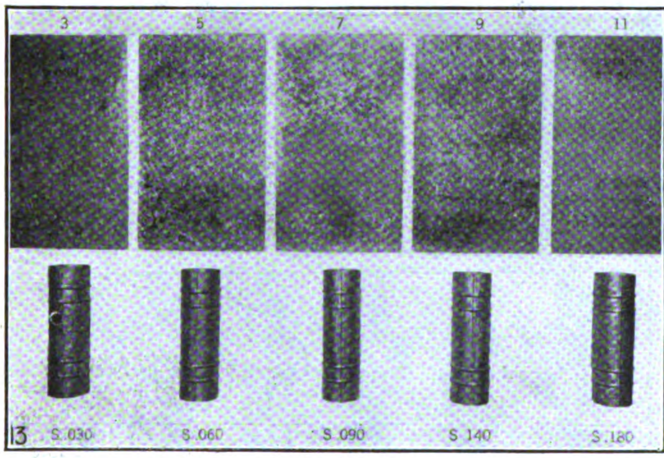


FIG. 13. SHEET STEEL GALVANIZED AND FORMED

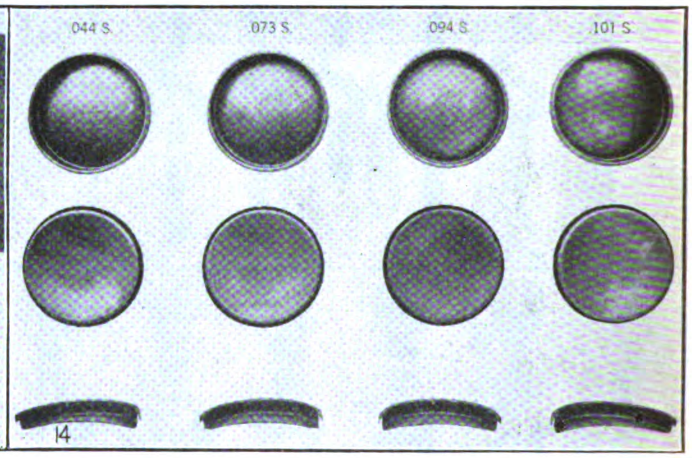


FIG. 14. MILK-CAN BASES WITH 0.09 CARBON

A number of bars from both the 0.32 per cent. and the 0.51 per cent. carbon heats of various sulphur contents, 2x2 in. by 16 ft. long, were rolled and sent to two prominent automobile manufacturers with a request to drop forge them in accordance with their regular practice, into such shapes as would indicate if any difficulties would be encountered in the heating or forging.

The author was present when this work was done. Crankshafts, connecting-rods, steering knuckles and other parts were forged. These are shown in Figs. 7, 8, 9, 10, 11 and 12. The flash or excess metal forced out between the dies was not always sheared off, it being allowed to adhere to the forging to show any tearing at the thin outside edges. The appearance of the flash seems to furnish the strongest evidence of the ability of the high-sulphur steels to stand severe hot work.

The size, 2x2-in. bars, furnished the manufacturers was of too large a section to do the best work for a number of the smaller forgings. As a consequence, more actual work, or greater reduction, than in the regular practice was necessary to produce the forgings under the drop hammer. In the case of the crankshafts the regular stock used is 3½ in. in diameter, but in this case it was 2 in. square which did not give enough metal to fill the forging dies properly, leaving parts of the forgings in an unfinished condition. This is of no importance in these tests, as the object was to determine if the higher-sulphur steels would stand the severe bending necessary to forge these crankshafts.

When finished, these forgings were cleaned by dilute acid or the sand blast and then carefully inspected by the manufacturers and the author to detect any surface or other defects, but no differences could be observed in the high- and low-sulphur steels of either carbon.

Fig. 13 is presented to give an idea of the cold-working quality of soft steel. A number of No. 26 gage sheets were rolled, then galvanized and afterward made up into spouting. In seaming and beading the spouting, no cracks developed on any specimen, while the coating adhered as closely to one sheet as to another. This work bears a close relation to the stamping or drawing of automobile mudguards, hood covers, bodies or other parts.

Another example is represented in Fig. 14 of a number of milk-can bases of 0.09 per cent. carbon steel of different sulphur contents. These bases were intended for 5-gal. cans, are 11 in. in diameter and of No. 16 gage sheet. The work done is very severe, being a reverse draw with two operations in the press. The illustrations show both sides of the bases, and in addition a cross-section of the base after cutting apart to show character of bend. No differences were noticed in stamping any of the specimens.

Tensile specimens were machined from the drop-forged steering knuckles of 0.32 per cent. carbon, shown in Fig. 8, after they had been subjected to the heat-treatment given in Table 4. Similar tests after treatment were made from the 1¼-in. diameter rounds used in drop forging the clutch pilots from the 0.32 and 0.51 per cent. carbon steels, shown in the third and fourth rows of Figs. 9 and 12. The results obtained are given in Table 5.

Short pieces of ¾-in. diameter rounds from the 0.09 per cent. carbon steel were packed in ordinary case-hardening compound in the same container, then heated to 900 deg. C. for 12 hr., afterward reheated to 860 deg. C. and quenched in cold water. The surface of the bars was roughly polished and the scleroscope hardness determined at several points on the surface. The depth of case and

hardness, which are the same for each bar regardless of the sulphur content, are found in Fig. 15.

Where any machining was done on the finished material, or in preparing test specimens before and after treatment, no material differences were found. The only noticeable thing was that the higher-sulphur steels of any carbon gave a smoother machined surface than the lower-sulphur under the same condition of feed, speed or depth of cut. In cutting threads on some 1¼-in. pipe a test was made by attaching an arm 22½ in. long to the die, the opposite end of the arm being attached to a dynamometer which registered the load in pounds. Table 6 gives the results on the 0.09 per cent. carbon steel. This shows the average power required while cutting 11½ threads per inch in ten samples of each sulphur content.

TABLE 4. TENSILE TESTS OF HEAT-TREATED STEERING KNUCKLES*

Carbon Content, Per Cent.	Sulphur Content, Per Cent.	Elastic Limit, Lb. per Sq.In.	Tensile Strength, Lb. per Sq.In.	Elongation in 2 In., Per Cent.	Reduction of Area, Per Cent.
0.32	0.032	62,250	83,250	30.0	60.0
0.32	0.068	49,375	78,375	31.5	62.8
0.32	0.108	52,750	77,750	30.0	58.0
0.32	0.146	58,875	77,875	27.0	61.3
0.32	0.190	51,875	76,875	28.0	53.8
0.32	0.230	57,250	76,250	29.0	53.8

*Annealed at 900 deg. C., reheated to 829 deg. C., quenched in water and drawn at 538 deg. C.

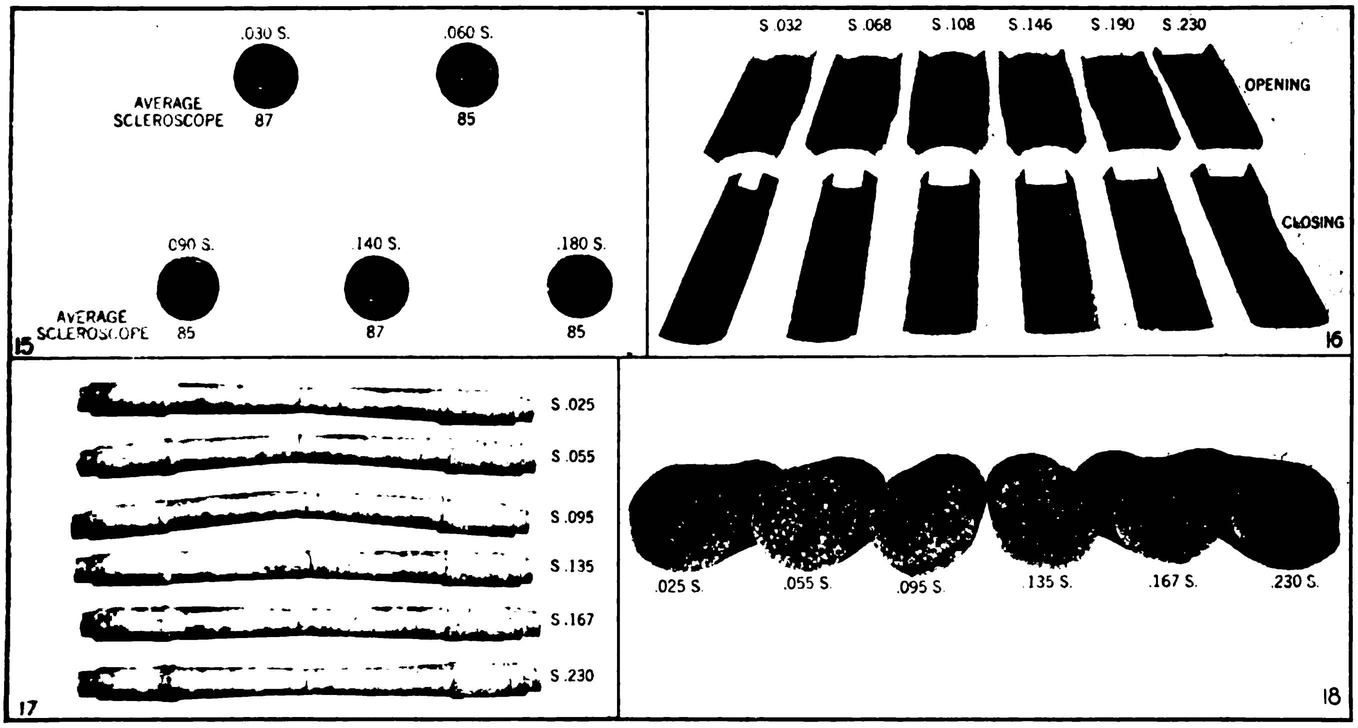
TABLE 5. TENSILE TESTS OF HEAT-TREATED 1¼-IN. ROUNDS FORGED FROM 2x2-IN. BILLETS.

Carbon Content, Per Cent.	Sulphur Content, Per Cent.	Elastic Limit, Lb. per Sq.In.	Tensile Strength, Lb. per Sq.In.	Elongation in 2 In., Per Cent.	Reduction of Area, Per Cent.
0.32*	0.032	48,650	80,250	30.5	70.1
0.32*	0.068	48,550	75,550	32.8	68.8
0.32*	0.108	46,400	75,800	30.2	68.7
0.32*	0.146	46,700	73,350	31.5	67.3
0.32*	0.190	45,450	71,550	33.2	66.3
0.32*	0.230	45,850	70,100	31.5	65.0
0.51†	0.025	70,400	111,900	20.3	56.8
0.51†	0.055	76,300	120,800	19.7	51.3
0.51†	0.095	73,950	119,400	19.5	51.5
0.51†	0.135	76,800	120,600	18.3	49.2
0.51†	0.167	73,200	111,750	17.5	45.4
0.51†	0.230	66,350	106,550	20.5	44.7

*Heated to 830 deg. C., held for 20 min., quenched in water drawn at 600 deg. C., for 40 min.
†Heated to 816 deg. C., held for 20 min., quenched in water drawn at 565 deg. C., for 30 min.

Tensile tests of ¾-in. diameter rounds of 0.09 per cent. carbon, of 8-in. channels of 0.32 per cent. carbon and of axles of 0.51 per cent. carbon, all in an untreated condition, are shown in Tables 7, 8 and 9. The results on the soft steel, Table 7, are the same. In the medium steel, Table 8, there is a slight falling off in the physical properties when the sulphur exceeds 0.100 per cent. The highest carbon, Table 9, giving the results on specimens taken at the edge and halfway to center of axles, shows that as the sulphur rises there is a decrease in the ultimate strength, but an increase in the toughness, as shown by the reduction of area.

The bending quality of the 0.09 per cent. carbon steel is shown in the tests of rivets, Fig. 5, the bending quality of the 0.32 per cent. carbon steel in the opening and closing tests of the 8-in. channels, Fig. 16. Bending tests were not made on full-size material made from the 0.51 per cent. carbon steel.



FIGS. 15 TO 18. SPECIMENS OF STEELS CONTAINING DIFFERENT AMOUNTS OF CARBON, USED IN CASE-HARDENING, BENDING AND DROP TESTS

Fig. 15—Showing hardness of case-hardened rounds. Fig. 16—Eight-inch channels after opening and closing tests. Fig. 17—Axles after drop test. Fig. 18—Ends of axles broken in drop test

TABLE 6. THREADING TESTS OF 1¼-IN. STEEL PIPE.

Carbon Content, Per Cent.	Sulphur Content, Per Cent.	Power Required for Cutting Lb.
0.09	0.031	73.5
0.09	0.050	70.6
0.09	0.090	68.5
0.09	0.116	62.3
0.09	0.160	61.2

TABLE 7. TENSILE TESTS OF UNTREATED ¾-IN. DIAMETER ROUNDS

Carbon Content, Per Cent.	Sulphur Content, Per Cent.	Elastic Limit, Lb. per Sq.In.	Tensile Strength, Lb. per Sq.In.	Elongation in 8 In., Per Cent.	Reduction of Area, Per Cent.
0.09	0.030	31,360	50,460	30.8	64.2
0.09	0.060	32,740	50,900	30.2	65.3
0.09	0.090	30,890	51,400	31.2	62.5
0.09	0.140	31,600	50,700	32.5	64.2
0.09	0.180	31,530	50,960	30.7	62.3

In addition to the tests already mentioned, deflection tests were made on the full-size channels and drop tests on the axles. The results of the deflection tests on the

channels are shown in Table 10, and the results of the drop tests on axles in Table 11. Fig. 17 shows the appearance of the broken axles, and Fig. 18 the fracture of each axle after breaking under drop.

The tables and illustrations in this paper present the actual evidence obtained in investigating steels of different degrees of hardness with varying contents of sulphur. Wherever possible, variables which might affect the results

TABLE 8. TENSILE TESTS OF 8-IN. STEEL CHANNELS

Carbon Content, Per Cent.	Sulphur Content, Per Cent.	Elastic Limit, Lb. per Sq.In.	Tensile Strength, Lb. per. Sq.In.	Elongation in 8 In., Per Cent.	Reduction of Area, Per Cent.
0.32	0.032	45,300	71,580	25.5	54.8
0.32	0.068	45,000	70,060	26.2	54.8
0.32	0.108	47,110	70,670	24.2	52.9
0.32	0.146	46,210	70,060	26.2	50.9
0.32	0.190	48,930	70,060	24.2	48.4
0.32	0.230	47,250	67,920	24.5	47.9

TABLE 9. TENSILE TESTS OF 0.51 CARBON UNTREATED AXLES*

	Specimen Cut from Edge of Axle				Specimen Cut Halfway from Center of Axle			
Sulphur Content, Per Cent.	Elastic Limit, Lb. per Sq.In.	Ultimate Strength, Lb. per Sq.In.	Elongation in 2 In., Per Cent.	Reduction of Area, Per Cent.	Elastic Limit, Lb. per Sq.In.	Tensile Strength, Lb. per Sq. In.	Elongation in 2 In., Per Cent.	Reduction of Area, Per Cent.
0.25	44,320	92,160	22.0	34.5	45,390	95,270	20.5	29.4
0.055	41,250	91,670	20.5	35.7	41,470	92,460	20.5	34.0
0.095	43,220	85,650	22.0	35.8	43,300	84,360	20.5	39.9
0.135	35,770	81,330	23.0	35.9	35,260	80,370	23.5	37.8
0.167	35,400	80,340	22.0	34.3	39,630	81,760	20.5	33.1
0.230	36,930	80,060	22.0	34.6	35,070	77,770	24.0	35.2

*Axles 4¾-in. in diameter at center. Journal 4¼x8 in.

TABLE 10. DEFLECTION TESTS ON 8-IN. STEEL CHANNELS*

Carbon Content, Per Cent.	Sulphur Content, Per Cent.	Load to Deflection, Lb.	Permanent Deflection, In.
0.32	0.032	22,400	0.04
0.32	0.068	21,900	0.04
0.32	0.108	22,500	0.04
0.32	0.146	22,300	0.04
0.32	0.190	23,200	0.04
0.32	0.230	23,100	0.04

*Deflection tests made on full-sized 8-in. channels, 11.25 lb. per sq.ft., 48 i . between centers. Load applied at center.

have been avoided. In practically every case, finished articles in common everyday use were made. The work was carried out by the ordinary methods practiced, and in such sizes as are manufactured in the mills or shops.

The results presented speak for themselves and need very little comment. I do not advocate paying no attention whatever to sulphur content of steel, but I believe firmly

TABLE 11. DROP TESTS OF 0.51 CARBON UNTREATED AXLES*

Sulphur Content, Per Cent.	Number Blows to Break Axle	Deflection in in. after each blow. Axles turned over after every second blow.						
		First Blow	Second Blow	Third Blow	Fourth Blow	Fifth Blow	Sixth Blow	Seventh Blow
0.025	33	4⅝	5⅞	3⅛	5½	3¼	5⅝	3
0.055	29	4⅝	5⅞	3⅜	5¾	3⅝	5½	3⅝
0.095	30	4¼	5⅞	3⅝	5¾	3⅞	5⅞	3⅞
0.135	30	4⅞	6	3¾	6	3¾	5⅝	3¾
0.167	21	4¾	5⅜	3⅞	5½	3½	5¼	3¾
0.230	14	4⅜	5⅝	4	5¼	4	5⅜	5⅝

*Axles rough turned. Size 4¾-in. in diameter at center. Journal 4¼x8-in. Weight of tup, 2,200 lb. Height of drop, 16 ft.

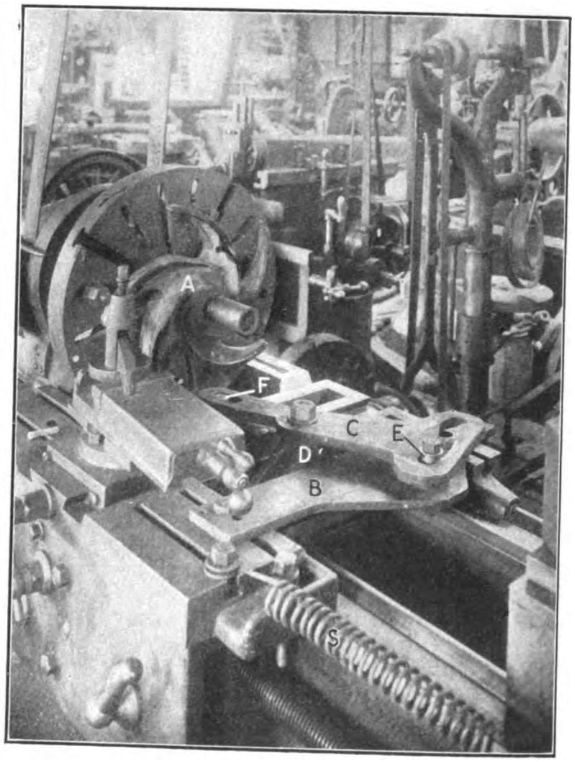
that a steel containing more than 0.100 per cent. is not necessarily bad, and that it will show little, if any, difference in quality when compared with the same steel of much lower sulphur, other conditions being the same.

Side-Forming Device

An interesting and unusual forming device is used to get a special shape on the blade of a pump impeller. This special shape comes on the side of the impeller, eliminating the usual forming arrangement at the back.

The plate *B* is bolted across the wings of the carriage and carries the stud and roller *E*. The plate *C*, having the curved form of a slot in the end, is pivoted at *D*, the slot in the other end working on the pin *F*. The crosspiece *D* is clamped rigidly to the bed and forms the fixed point from which the carriage is moved. The spring *S* takes up all slack between the roller and the formed slot.

As the tool is fed into the work by the cross-slide, the pin *F* forces the plate *C* to move around the pivot *D*.



TURNING A FORMED PUMP IMPELLER

This forces the curved slot in the end of plate *C* against the roller *E*, and as the pivot *D* is stationary, the carriage carrying the tool is moved to conform with the shape of the slot. This type of forming device is out of the ordinary and is one which should have numerous applications. It is from the shop of Meiss & Gottfried, San Francisco, Calif.

Savings Bank Life Insurance

At the Norwood Engineering Co., Northampton, Mass., a mutual benefit association has been formed, providing sick benefit of $5 a week.

The Norwood Engineering Co. has agreed to furnish $100 life insurance for each employee who becomes a member of the association. This insurance is taken out through the Massachusetts Savings Bank Life Insurance, under a group insurance contract by which all members of the association are protected. On these group insurance contracts this year the savings insurance banks are paying a dividend of 50 per cent. of the year's premium.

This is a businesslike form of coöperation between employer and employee. The employee provides for his own sickness insurance and the employer provides for his life-insurance protection.

Already 170 of the employees of the Norwood Engineering Co. have become members of this association.

Personal Reminiscences of James Mapes Dodge--II.*

By Charles Piez†

SYNOPSIS—In this second part the author reveals the lasting influence of Mr. Dodge in softening and humanizing the Taylor system of management at the time it was installed in the Philadelphia plant of the Link-Belt Co. A number of important inventions in the conveyor and power-transmission field were also brought out after 1900. But important as all these achievements are, his friends will remember Mr. Dodge longest for his magnetic personality, quick sympathy and never-hesitating helpfulness.

In the midst of his activities in development and invention Mr. Dodge never failed to pay attention to the human side of the industrial problem. His sunny optimism, his personal interest in every employee and the ease with which he could be approached on personal or business grounds made him a prime favorite among the men. His office door was always open to any employee, no matter how lowly, and tales of unfairness whether of rates or treatment received earnest attention and resulted in prompt and corrective action. His invariable injunction to his aids concerning the treatment of workmen was, "In case of doubt decide against the company and in favor of the man." Men brought to him stories of their personal troubles, and he always lent a helping hand to tide them over a difficulty. Under such even-handed and considerate treatment no threat of strike ever appeared on the horizon of our Philadelphia plant, and even the radical changes involved in the installation of the Taylor system were met with tolerance and coöperation. Mr. Dodge described his relationship with his men in unusually happy fashion when, in answer to the question, "What is your relation with your men?" put to him by a member of the Federal Commission on Industrial Relations, he said, "Well, I don't know exactly, but I think most of them are more inclined to call me Jim than they are Mr. Dodge." "Training men into our methods and habits costs money, so don't fire a man unless you have a good reason, and not then until after you have talked it over with the superintendent," was his constant admonition to those in charge of employees.

He was equally sane on the treatment of customers. "We are prepared at any time to send out a salesman at an expense of a hundred dollars or more to secure a customer, and our accounting department will break with him over a difference of 40 cents." "If we allowed every demand that was made by our customers without question, we would save time, create good will and be money ahead in the end," were some of his business maxims.

His directness of method was well illustrated in his treatment of our Philadelphia purchasing department. This department, while under able management, had so buried itself under a mass of records that an investigation was ordered. The examination revealed that the large purchases were all made on yearly contracts and that, eliminating these, the cost of purchasing the remainder ran about 15 per cent. Soon after, during one of our morning conferences, he said, addressing our buyer, "Ed, do you believe in the honesty of the average man?" "Of course," replied Ed. "Well, suppose we distribute our orders each morning without asking for price, would we have to pay 15 per cent. more than we pay now?" "No," said Ed, "I believe most of the sellers, in their desire to retain our business, would sell much closer to the market than that." "Then we can save money by abandoning our purchasing department," said Mr. Dodge, and with a few additional words of enlightenment Ed decided to return to simpler methods.

Mr. Dodge's Interest in Taylor-White Steel

It was but natural that Mr. Dodge, with his strong leaning toward the new and untried, should evince intense interest in so epochal an event in the mechanical world as the discovery of Taylor-White tool steel. From the very first he was an ardent champion of its possibilities and was eager to give it a trial in our Nicetown plant. We secured shop rights for its use at both Chicago and Philadelphia and immediately proceeded to test its possibilities when applied to the machining of cast iron. Mr. Taylor's own experiments had up to that time been confined largely to the turning of steel, and it was at our Nicetown plant that the feed and speed possibilities of Taylor-White tool steel applied to cast iron were first determined. Under the infection of Mr. Dodge's enthusiasm our entire organization suffered for a time from a mild form of speed mania, and officials and machinists vied with each other to establish new records in the amount of metal removed per hour. Our line-shaft speeds were doubled, our power plant had to be materially enlarged, and as a final step to secure the desired flexibility in both power and speed, the line shafts were abandoned and individual motor drives introduced in their place.

For a year or more the orderly procedure of our machine shop was seriously disarranged by the attempt to drive the machine tools to the limit of the tool-steel capacity. The output was increased, but breakdowns were so frequent that the increase in expenses more than outweighed the advantage of added output. It was then that Mr. Dodge realized that the burden of changing equipment and methods to meet the possibilities of the new tool steel was too severe to impose on an organization already fully absorbed in looking after the needs of the company's regular business. He consulted Mr. Taylor about our predicament, and Mr. Taylor suggested that we employ Carl Barth, one of his aids, to assume charge of the changes brought about by the use of the Taylor-White tool steel. Mr. Barth had had considerable experience in the machining of steel, but realizing that we were suffering from the lack of accurate data

*The first installment of this article was published beginning on page 101.

†President, Link-Belt Co.

on the speeds and feeds possible on cast iron, he at once inaugurated an exhaustive series of tests. While these were being carried on, saner cutting speeds were advocated, the toolroom was thoroughly reorganized and machine tools rearranged and rebuilt. Under Mr. Barth's intelligent direction both equipment and men were well prepared before the first actual step of producing work at high speed was undertaken. And his work was thoroughly done, for once begun, the work of changing over to the new feeds and speeds proceeded rapidly.

While this work was going on, Mr. Dodge became much enamored of the Taylor system, which had but shortly before been outlined in Mr. Taylor's famous paper presented before the American Society of Mechanical Engineers. At Mr. Dodge's request Mr. Taylor agreed to assume general direction of the introduction of the system, and Mr. Barth was retained to undertake the actual work.

While the work Mr. Barth began with proceeded rapidly and very satisfactorily, and while the actual reorganization of toolroom and machine-shop equipment, the installation of functional foremanship and the establishment of rates based on unit time study and supported by instruction cards were accomplished in remarkably good time and with less embarrassment than was thought possible, the rest of the work gave considerable trouble before a perfect scheme of routing and of coördination of the various functions and departments was established. Much of our trouble arose from the facts that the attempt was made to fit the business to the system and that insufficient advantage was taken of methods which years of experience in our peculiar line had developed. Rigidity in any system is a serious if not a fatal disadvantage, and this truth was as much impressed on Mr. Taylor as on the rest of us before the work was completed, for it was only after we made certain departures from the rigid formula of the system that difficulties began to disappear and progress became rapid. It must be remembered that ours was the first plant of any size that was thoroughly systematized on Taylor lines, and difficulties were therefore to be expected. We had all labored under the impression that the system was a complete entity that required but a thorough understanding to work miracles. We were all inclined to stand aside and let it work until we found that, after all, it accomplished nothing of itself, that it merely indicated the easiest lines along which work could be accomplished.

Mr. Dodge's contribution to Mr. Taylor's work, while not reflected in any of the forms or details of the system, was nevertheless an important one, for his influence lay wholly on the side of recognizing the human side of the management problem. Mr. Taylor's mind was essentially analytical and mathematical. He was inclined to consider workmen as wholly impersonal beings and to disregard the effect of prejudice and sentiment on output. His tendency originally was to concentrate all direction and initiative in the planning room and to insist that the men follow the strict letter of their instructions. It was due largely if not wholly to Mr. Dodge's influence with Mr. Taylor that the Taylor system lost its seeming asperities and harshness. And this was brought about not by any distinct modifications in the system itself, but rather by cultivating in the men who applied the system an appreciation of the human factor in scientific management. For after all there is nothing inherent in the Taylor system that marks it as an especially attractive instrument in the unwholesome process of grinding blood money out of the workers. Like every other method or system of industrial organization, it can be used to the disadvantage of the men, but that abuse lies in the application and not in the system itself. As a matter of fact the greater preparation which a management must undergo to install the system, the greater accuracy with which the various steps must be taken and the greater dependability of its records, all make for greater honesty and a broader and more liberal attitude in its application. Certain it is that in our own plants the system has proved highly satisfactory. That it has worked no hardship on our workmen is attested by the fact that although a very active campaign has been waged in Philadelphia to secure machinists and tool makers for several new munitions plants, and although high wages and exceptionally liberal bonuses have been offered, not a single machinist or tool maker has been lured away from our Philadelphia plant.

But interested as Mr. Dodge was in the installation of the Taylor system, his active mind could not find entertainment in the slow and tedious process of teaching an

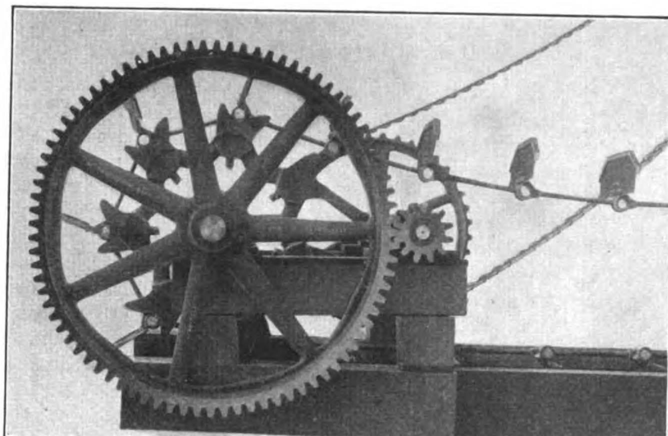


FIG. 1. EQUALIZING GEAR FOR LONG PITCH CONVEYOR CHAIN EXTENSIVELY USED

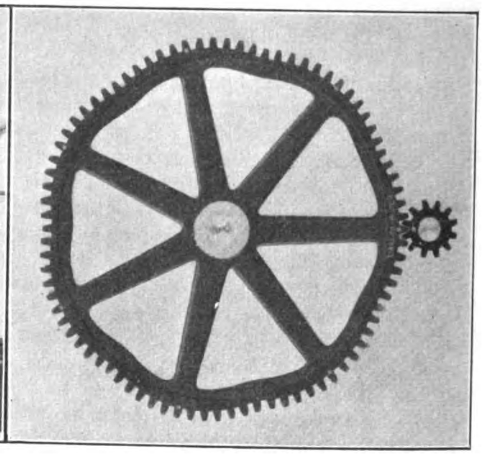


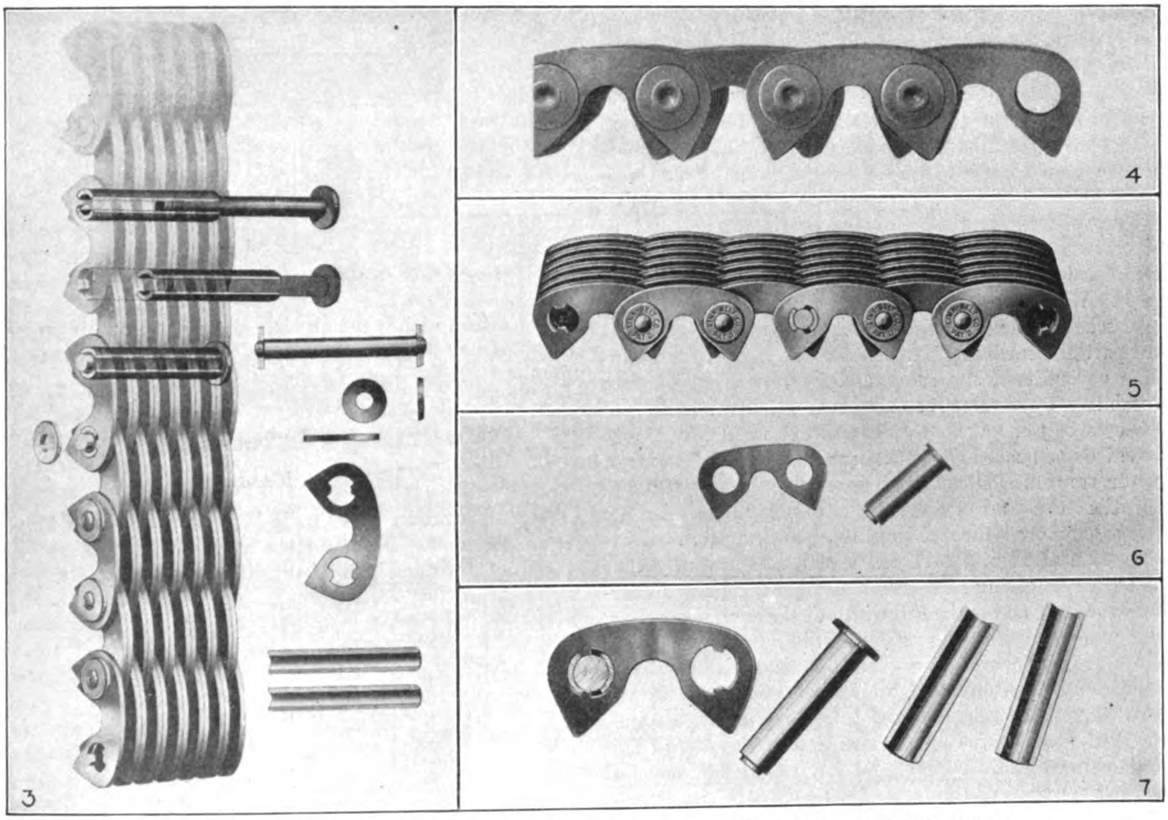
FIG. 2. LOBULAR GEAR AND ELLIPTICAL PINION OF EQUALIZING MECHANISM

old organization new habits; and so he reverted constantly to the realm of invention and improvement. During the development of our conveyor business we had shown an increasing tendency toward the use of chains of a pitch of 18 in. and more. These chains were adopted both because they were cheaper and because, in such cases as bucket carriers, they lent themselves better to the purposes of the conveyor structure. One serious drawback to the use of these chains arose from the fact that wheels of relatively small diameter, which had to be used to economize head room, imparted a very irregular motion, or surge, to the conveyor.

A popular size of wheel for an 18-in. pitch chain is 41 in. in diameter and has 7 teeth. By looking at Fig. 1, it will be seen that as the link enters engagement with the sprocket it is carried forward along that part of the arc that has a large horizontal and a very small vertical component. As the wheel revolves, it carries the link up the ascending arc, where the horizontal component lessens and the vertical component increases. If the link in engagement is considered as a connecting-rod between the revolving sprocket and the remainder of the conveyor chain, the analogy between its operation and that of an engine connecting-rod becomes apparent. The only difference is that the chain link is carried through an arc of about 51½ deg. when the next link engages, while the connecting-rod head describes the full arc of 360 deg. But in spite of the small arc passed through, there is a decided acceleration and retardation during the engagement of each chain link. In a conveyor employing 18-in. pitch chain and running at 120 ft. per minute these pulsations occur 80 times per minute; and when the conveyor is long, they become greatly magnified by the elasticity of the chain. The resulting surging of the conveyor is decidedly destructive to the integrity of the conveyor mechanism, besides being unsightly in appearance.

Mr. Dodge solved this problem in characteristically simple fashion by imparting pulsations to the rotating conveyor shaft which completely counteracted the pulsations in the conveyor.

This was accomplished by using between the head and the countershaft a set of gears, of which the pinion was elliptical and the gear lobular, the number of gear lobes corresponding to the number of teeth in the conveyor sprocket, see Fig. 2. The gears imparted the desired corrective action to the shaft, and the conveyor chain at once assumed habits of regularity. Equalizing gears, as we call these compensating gears, have been almost universally adopted for driving long-pitch chain conveyors.



FIGS. 3 TO 7. STEPS IN THE DEVELOPMENT OF MR. DODGE'S BUSHED SILENT CHAIN

Fig. 3—Ghost view of Dodge bushed silent chain. Figs. 4 and 6—English type using plain link and pin. Figs. 5 and 7—Elements of Dodge type of bushed silent chain

In spite of the great varieties of chain which we manufactured and in spite of the very considerable contributions which Mr. Dodge's inventive genius had made to this part of the work, he remained under the impression that the universal chain had not yet been developed. He had a theory that if you kept yourself in a receptive mental condition, some thought wave carrying the solution of

the problem confronting you would strike a sympathetic chord in your mind, and he had a habit of sensitizing his mind to possible impressions.

Some time in 1899 he conceived the idea of the silent chain—that peculiar form of link which greatly reduced the noise of engagement with the sprocket. When he got to the patent office, however, he found that Hans Renold, of Manchester, England, had anticipated him. So highly did Mr. Dodge value the opportunities that this type of chain offered that I was immediately dispatched to England to secure the American rights from Mr. Renold. This was done in 1900, and in the following year we placed upon this market the first American-made Renold silent chain. Our business in this new line developed rapidly—more rapidly at first than our experience warranted—but we learned rapidly, and with Mr. Renold's experience to draw on, avoided many of the pitfalls that usually beset new ventures. But we were unwilling to proceed as cautiously in the application of the chain as Mr. Renold was proceeding, and with the daring that is characteristic of American business we soon launched into the field of large power transmissions.

The inherent weakness of the original English type of chain rapidly developed in these larger installations, for pins began to cut and the holes in the links to enlarge. We tried high-carbon steel links and then turned to casehardening both links and pins; but these proved but partial remedies. Mr. Renold, who had in the meantime encountered the same difficulty, tried to increase durability by forcing casehardened steel thimbles into the eyes of the links, But it was not until Mr. Dodge invented the bushed silent chain that this new medium of power transmission achieved general and successful application. Instead of adhering to circular bushings, Mr. Dodge employed through bushings, or liners, as an examination of Figs. 3 to 7 will reveal, and by this means succeeded in giving to each set of opposing links a bearing extending across the full width of the chain—a unique and heretofore unheard-of result in the cylindrical bearing of a multi-leaf chain. With both pins and bushings hardened and with avenues of lubrication opened up by the peculiar construction of the joint, the difficulties standing in the way of the rapid expansion of the silent-chain business were cleared away, and Mr. Dodge had achieved another conquest of the impossible.

As an evidence of the versatility of his genius it is interesting to recall that in 1873 he secured a patent on a chain-oiling street-car axle bearing, perhaps the very first self-oiling bearing employing a chain to lift and distribute the lubricant. The folding theater seat, in which the back assumes a vertical position when the seat is folded up, and the wire hat-rack so universally used under the seats of theater chairs are both contributions of Mr. Dodge to the convenience of the public.

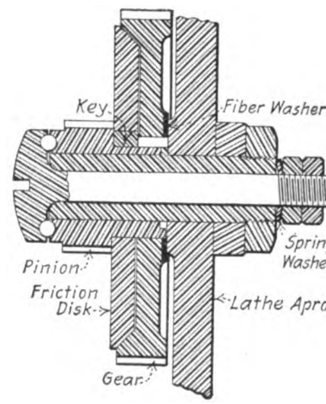
But his friends will longest remember his singularly magnetic personality, his quick sympathy, his never hesitating helpfulness; and they will remember too his buoyant good-fellowship, his unfailing wit and his unusual ability as a raconteur. His conception of duty to his family, to his employees and associates and to the public was a broad and generous one, and he strived conscientiously to discharge it. His life was therefore a full one, and measured by accomplishment, by public and personal duties well performed, a highly successful one.

Friction Crossfeed for Lathe

By A. F. Svensk

The illustration shows a friction adjustment that may be interesting to the users of the Reed-Prentice all-gear feed lathe.

Having quite a lot of trouble with gears breaking, owing to positive feed, we made this device. After fitting



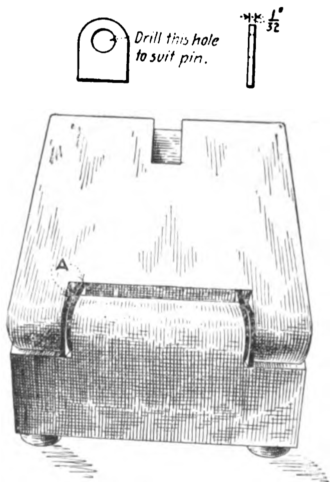
FRICTION CROSS-FEED FOR LATHE

the crossfeed with it the problem was solved, and it proves amply strong to operate for any chip that the lathe makes.

Wearing Plates for Jigs

By B. Maxim

The illustration shows a jig body equipped with hinge wear plates A. These plates have the same shape as the hinge, with a hole to suit the diameter of the pin.



WEARING PLATES FOR JIG

The ends of two of the plates fit in a slot in the lid, and the other plates fit in the slots in the body. These slots prevent the plates from turning.

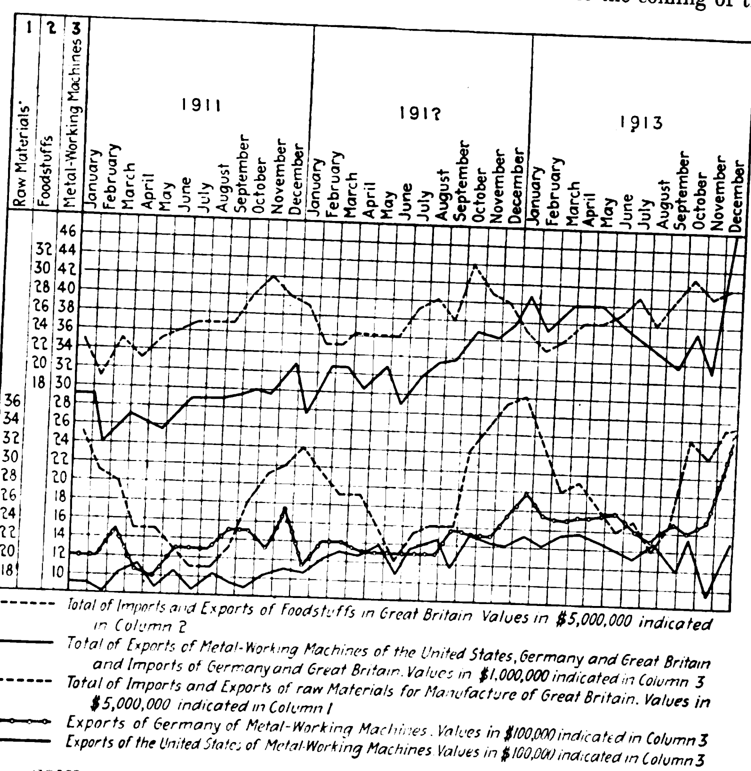
The plates are used only on jigs where the work is very accurate and when life of the jig is considered. They are made of tool steel, hardened and ground.

Relation Between Foodstuffs and Machine Tools

By Ludwig W. Schmidt

SYNOPSIS—An attempt to discover the relation, if one exists, between the demand for foodstuffs and for machine tools. Statistics for 1911, 1912 and 1913 are analyzed. Comparison seems to show that the demand for machine tools rises and falls with the demand for foodstuffs, with a lag in point of time of some two or three months.

In Vol. 43, page 197, of the *American Machinist* was reported an investigation into the forces which influence the demand for metal-working machines. Proof was brought to show that while the ultimate reason for an increase in the demand for metal-working machinery is an increased activity in the manufacture of other kinds of machinery, this increase is invariably preceded by an increase in the demand for foodstuffs. The investigation was based on figures from the years 1904 to 1913 and included especially the foreign field. An investigation of this sort, however, necessarily must remain only an academic enjoyment if there is no possibility of employing in practical life the experience gained. This condition would be the case if it were impossible to predict, by a close watching of certain happenings in other economic fields, a coming increase or decrease in the demand for machinery. It is further clear that such a prediction can only be of use to the manufacturer of metal-working machines when it comes in time for him to prepare for what is to follow. Therefore figures for any one year are of little value because they come too late.



COMPARATIVE FLUCTUATIONS IN TRADE IN FOODSTUFFS, RAW MATERIALS AND METAL-WORKING MACHINES

To complete this line of economic research, the experiment has therefore now been narrowed down to a small field. An investigation has been made into the comparative relation of the demand for foodstuffs and for metal-working machines for the years 1911, 1912 and 1913. This investigation was carried on month by month, and the reader will see that valuable information has been gained which may lead ultimately to the establishment of an index figure for a coming metal-working machinery demand. Such an index figure at first may only indicate a coming decrease or increase without stating how large the movement promises to be. But even if so much may be gained, mistakes in manufacturing policy may be prevented.

The years 1911, 1912 and 1913 were selected because they were fairly normal years, showing in general a steady increase of business with the usual fluctuation which will always take place during any one year. It may be added that a short investigation covering the six months before the outbreak of the European War and the last twelve months since the coming of that event have proved to some extent the correctness of the rule gained by the analysis of former years. I do not like to lay too much stress on this fact, however, as it may be only a coincidence. Certainly the record of the disturbed months of the war should not be used for proving any elementary economic fact. To allow the reader to check the figures and results by his own experiences, I will explain briefly how the statistics have been obtained and grouped. It is impossible to gain any exact figures relating to the turnover inside the boundaries of any of the large metal-working machinery producing countries like the United States, Germany or England. The only fairly reliable figures are those relating to foreign trade, and they have been used again in this study, as in the case in the former experiment described in the article previously mentioned.

Table 1 is a detailed statement of the imports and exports of metal-working machines during each month from January, 1911, to December, 1913, for England and Germany. In the case of the United States only the export statistics are given, for the reason that the bulk

of the imports into the United States are contained in the English and German export figures. The sixth column of the table shows the total turnover of imports and exports of England and Germany and the exports of the United States, giving approximately two-thirds of the total foreign turnover of metal-working machines of the world. These totals should be comprehensive enough to allow for a deduction with regard to the movement of the business done in metal-working machines in the world. A manufacturer might possibly be able to deduce from his own records how far those movements are reflected in his own sales. He would have to take into consideration the fact that the American market is less dependent as a rule upon the general trade fluctuation of the world than other markets, especially the English.

Table 1 is interesting not only because of its relation to the present investigation, but for the purpose of comparison. Especially is the comparison with Germany instructive, showing as it does that in many cases the German exports of metal-working machines have gone rapidly ahead and American exports have declined. This fact to some extent seems to prove that the American

TABLE 1. FOREIGN SALES OF METAL-WORKING MACHINES OF THE UNITED STATES, ENGLAND AND GERMANY DURING 1911, 1912 AND 1913

	Imports		Exports			Total
	Germany	Great Britain	Germany	Great Britain	United States	Total Turnover in Foreign Trade
1911						
January	142,000	60,285	1,161,000	603,685	829,455	2,796,425
February	150,500	44,730	1,137,500	234,290	748,084	2,351,104
March	165,000	155,560	1,477,750	348,580	935,865	2,631,675
April	125,000	133,295	1,013,000	261,120	1,007,920	2,540,335
May	236,750	109,880	931,750	305,170	879,985	2,463,535
June	134,750	80,740	1,201,000	329,125	936,653	2,682,268
July	190,750	62,665	1,218,500	257,140	789,846	2,728,268
August	219,500	76,515	1,271,750	292,515	912,759	2,773,039
September	191,500	38,285	1,475,250	266,620	838,282	2,809,937
October	210,500	68,865	1,413,250	421,675	804,468	2,918,758
November	151,250	125,140	1,202,500	442,450	967,608	2,898,948
December	105,750	105,155	1,641,500	339,855	1,094,210	3,262,563
1912						
January	205,400	106,140	1,012,000	363,645	989,353	2,676,538
February	208,000	136,255	1,372,000	403,410	1,134,925	3,254,590
March	219,000	120,495	1,334,250	357,420	1,207,787	3,238,952
April	188,000	146,225	1,205,250	335,980	1,164,910	3,040,365
May	190,250	114,365	1,276,750	325,165	1,272,536	3,279,066
June	200,500	144,805	1,225,000	300,845	975,135	2,846,285
July	188,250	115,775	1,209,000	332,255	1,244,932	3,120,212
August	164,750	112,195	1,269,250	382,150	1,384,832	3,313,177
September	231,000	66,690	1,570,000	430,355	1,076,058	3,374,103
October	181,500	93,755	1,473,500	492,615	1,415,261	3,656,631
November	189,250	125,825	1,412,000	507,350	1,346,524	3,580,949
December	152,000	130,690	1,639,750	445,155	1,313,986	3,691,581
1913						
January	162,750	95,825	1,898,500	498,155	1,402,563	4,057,793
February	186,000	105,230	1,623,250	387,410	1,315,891	3,617,781
March	212,250	122,570	1,633,750	451,355	1,477,635	3,897,560
April	272,250	187,020	1,637,250	420,650	1,439,634	3,956,804
May	221,250	233,155	1,689,250	388,335	1,387,278	3,919,268
June	180,750	182,660	1,649,000	371,755	1,292,721	3,676,886
July	186,250	154,330	1,545,250	428,605	1,207,527	3,521,962
August	147,500	115,105	1,405,250	357,295	1,375,923	3,401,073
September	141,250	121,650	1,595,250	347,595	1,081,606	3,287,351
October	113,250	185,040	1,505,750	419,620	1,418,577	3,637,337
November	139,500	127,455	1,624,250	505,960	809,287	3,206,452
December	173,250	176,960	2,649,000	479,165	1,349,570	4,827,945

manufacturer has not been so well informed as the German about the future development of foreign business.

Table 2 is for comparative purposes only. It was made with the intention of finding an indicator for the foreign demand for foodstuffs, raw materials and manufactured materials. As in the first article, the English figures have been used for this purpose. The reason for doing so is that the free-trade market of England gives the best impression of the fluctuation of demand and supply in most commercial commodities sold in world markets.

It seemed quite possible that a demand for half-manufactured articles suitable for industrial purposes might in some way be reflected in the demand for metal-working machines. A close comparison of the monthly progress of the turnover in that class of goods, however, with the demand for metal-working machines as indicated in the last column of Table 1 seems to prove that this connection is rather incidental, and that the demand for such materials seems to rise and to decline in about the same way and during the same time as the demand for metal-working machines. This relation was already proved to some extent by the results obtained in the earlier article.

The thesis on trial is the connection between the demand for foodstuffs and like materials and the following demand for metal-working machinery. The best way to present the evidence is by a diagram; see diagram.

This diagram shows the development of the sale of metal-working machinery in the foreign markets, as ob-

TABLE 2. COMPARATIVE TURNOVER IN THE FOREIGN TRADE OF ENGLAND IN FOODSTUFFS, RAW MATERIALS AND MANUFACTURED GOODS—1911, 1912 AND 1913

	Foodstuffs		Foodstuffs, Total of Imports and Exports	Raw Materials		Raw Materials Total of Imports and Exports	Manufactured Articles		Manufactured Articles Total of Imports and Exports
	Imports	Exports	Exports	Imports	Exports	Exports	Imports	Exports	Exports
1911									
January	20	2	22	28	4	32	13	30	43
February	17	1	18	24	4	28	13	29	42
March	20	2	22	23	4	27	15	33	48
April	19	1	20	18	4	22	13	29	42
May	20	2	22	18	4	22	14	29	43
June	21	2	23	16	4	20	13	29	43
July	22	2	24	15	3	18	13	27	40
August	22	2	24	14	4	18	13	29	42
September	22	2	24	16	4	20	13	28	41
October	24	3	27	21	4	25	14	34	48
November	26	3	29	24	4	28	14	31	45
December	25	2	27	25	4	29	14	29	43
1912									
January	24	2	26	27	4	31	15	32	47
February	20	2	22	24	4	28	14	29	43
March	20	2	22	24	2	26	15	34	49
April	21	2	23	24	2	26	14	27	41
May	21	2	23	18	5	23	15	29	44
June	21	2	23	15	4	19	13	27	40
July	24	2	26	17	5	22	15	32	47
August	24	3	27	18	5	23	16	34	50
September	23	2	25	18	5	23	15	33	48
October	28	3	31	25	6	31	17	37	54
November	25	3	28	29	5	34	15	33	48
December	25	2	27	31	5	36	15	32	47
1913									
January	22	2	24	32	5	37	16	36	52
February	20	2	22	27	5	32	15	32	47
March	21	2	23	22	5	27	16	33	49
April	23	2	25	22	6	28	16	33	49
May	23	2	25	21	5	26	16	35	51
June	24	2	26	18	5	23	15	33	48
July	26	2	28	18	6	24	16	36	52
August	23	2	25	16	5	21	15	35	50
September	25	3	28	19	5	24	16	32	48
October	27	3	30	27	6	33	17	35	52
November	25	3	28	27	5	32	15	33	48
December	26	3	29	28	6	34	15	32	47

tained from the English, German and United States statistics, compared with the development of the turnover in raw materials and foodstuffs represented by the total turnover of imports and exports in the English market. The upper long-dash line is the curve representing foodstuffs; the following full line represents the total English, German and American foreign trade in metal-working machines. The lower long-dash line represents the turnover in raw materials, while the lower full line shows the participation of American exports of metal-working machines in the total turnover of the years on record. The dotted line indicates the German exports during the same period.

The first of the three columns on the left side of the diagram, giving figures from 18 to 37, represents the total value of the turnover of the raw-material class in units of $5,000,000. The second column represents the total value of the foodstuff class at the same rate. The third column, running from 7 to 50, indicates the value of both the full lines in units of $100,000.

The close observer of the two upper curves will notice a certain connection between them. For instance the high mark of the foodstuff curve in January, 1911, finds

its counterpart in the rise in the sales of metal-working machinery in March, 1911. A second high point in the sales of foodstuffs is reached during March of the same year, which seems to be reflected again in the June and July sales of metal-working machines. From then on, the business in metal-working machines is fairly steady until the end of the year, which brings in December a high point with a sudden rise from the month of November. The diagram shows that this movement is fairly well predicted by a slow increase in the sales of foodstuffs until September, when a quick rise takes place in October and November, followed by a drop during December, which is promptly repeated during the next month in the sales of metal-working machines. The varying movements of the turnover of foodstuffs during the months of February to June, 1912, is followed by rather erratic changes in the turnover of metal-working machines, until foodstuffs begin suddenly to rise to a new high point in August. This later change becomes visible for metal-working machines in September of the same year. In the meantime foodstuffs decline again, sharply followed by a decline in metal-working machines two to three months later, but only to rise quickly to the highest altitude obtained up till then. Three months later, in January, 1913, we find metal-working machines climbing up to a record point.

Having followed the relative movements of both lines so far, it is not surprising that the sharp fall in foodstuffs beginning in November, 1912, brings about a drop in metal-working machines, until finally the increase in the sales of foodstuffs, beginning with August, 1913, and ending in another high figure in October, 1913, ends the year with a new high record in the sales of metal-working machines.

Little Value of Inquiry Into Raw Materials

Little of value for the present inquiry can be learned from a comparison of the metal-working machine curve with the one indicating the progress of raw materials for manufacture, etc. In fact the latter seems to move about in an erratic way, most likely influenced by speculative buying, and especially by such factors as the heavy buying of cotton during certain parts of the year, wool sales, etc. If there is a connection, it seems to be rather between the foodstuffs and the raw-material curve, whereby the latter appears to follow the first in about the same way as the demand for metal-working machines appears to follow that for food.

To facilitate comparison, two other curves have been added to the diagram, showing the respective participation of the United States machine-tool exports and those of Germany in the world's trade. There is nothing to be revealed by those two curves. The German exports as a rule are larger, but during the last few years this country has touched the German figures repeatedly and has even done better than Germany under certain conditions. The fact that the German curve as a rule follows more pronouncedly the demand for foodstuffs than the American seems to indicate that the German manufacturers have a better understanding of the hidden causes behind the demand for machine tools. But this may be a mere coincidence. Coincidence may also explain the peculiar likeness of the foodstuff curve and that of the American export curve during the months of July to November, 1912. Naturally one must be careful not to take everything which might fit into a theory as proof for it and these two points are better dismissed without further comment.

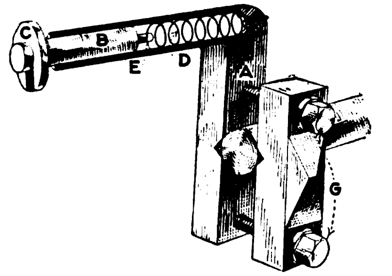
However, the contention that there exists a close connection between the sales of foodstuffs and the demand for metal-working machines seems supported by this investigation and appears to hold good even if applied to the much more rigid test of a monthly comparison. As far as can be seen, the reaction seems to take place about two to three months later. When we have a foodstuff-sale index figure of 36 in September, 1911, we have the figure 28 in November of the same year for metal-working machines. We then find a rising index figure for foodstuffs up to November, from 36 to 39 and ultimately to 40, while the index figure for metal-working machines climbs up to 31 or 32. The coming decline is also indicated in the same way by a decline in the index figure for foodstuffs in December, 1911, and January, 1912. During the first half-year of 1912 not much can be learned from the comparative movements of the two curves. A like combination of index figures might be worked out on several other different places.

Unfortunately there is insufficient material on hand to establish any sort of rule, if one exists at all, to indicate the size of a coming increase or decrease in the use of metal-working machines in relation to an increase or decrease in the output or demand for foodstuffs. It was pointed out in the former article that undoubtedly much unnecessary or uneconomic buying takes place, and that in consequence the turnover in metal-working machines often seems to be entirely out of proportion to the actual needs of the industry. This fact alone would prevent the discovery of a quantitative formula.

Device To Tie Center Work to Faceplate of Lathe

By A. A. Stucke

The illustration shows a clamp dog which I have used with success in machining operations on small tools or machine parts, such as boring a recess or other internal work where it is necessary to use a steadyrest tie strap. I find it a time saver, doing away with the troublesome



CLAMP DOG FOR CENTER WORK

tie which is often difficult to use when work is small and short. Then too the straps soon become oily and hard to tie. This clamp dog does away with these troubles. It is a simple operation to take the work out and replace it. Simply release the faceplate 1/8 to 1/4 in., place the work in the rest and on center, tighten the

faceplate, and the spring in the hold-on dog does the rest.

To explain the device: The tail of the dog *A* is bored to receive the plunger *B*, which is grooved at the outer end for the slotted washer *C*. The spring *D* connects the plunger to the dog through the pin *E*. To attach to the faceplate, simply push the plunger through the faceplate slot and slip the washer over it; the spring then draws the dog and the work against the faceplate.

Interesting Planer Job

The planing of the inside bearing spots on printing-press side housings, as shown in Fig. 1, has proved interesting in several ways. The work is performed on a big Cincinnati planer, and an outline of the casting may be seen projecting over the edges of the angle plate against which it is bolted. A rectangular opening is provided in the angle plate to make room for the end of the extension tool used while planing. It will be seen that the work is very close to the heads when the tool is through the cut. In fact there is but ⅞ in. to spare. That the work was successfully performed proves the effectiveness of the planer reverse mechanism.

The tool used is shown on a larger scale in Fig. 2. To hold the extension tool, a hole was drilled through the lower end of the regular clapper block and countersunk at the back. The extension block used had in one end a stud that was fitted into the hole drilled in the clapper block. A nut in the countersunk hole held the extension block at any angle desired. A small clapper block set into the end of the extension block carried the cutting tool and allowed relief on the return stroke.

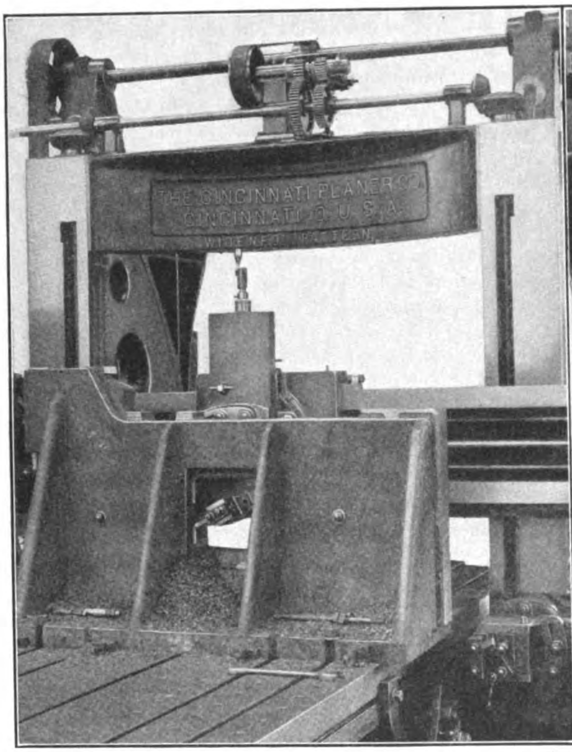


FIG. 1. PLANING BEARING SPOTS ON HOUSING

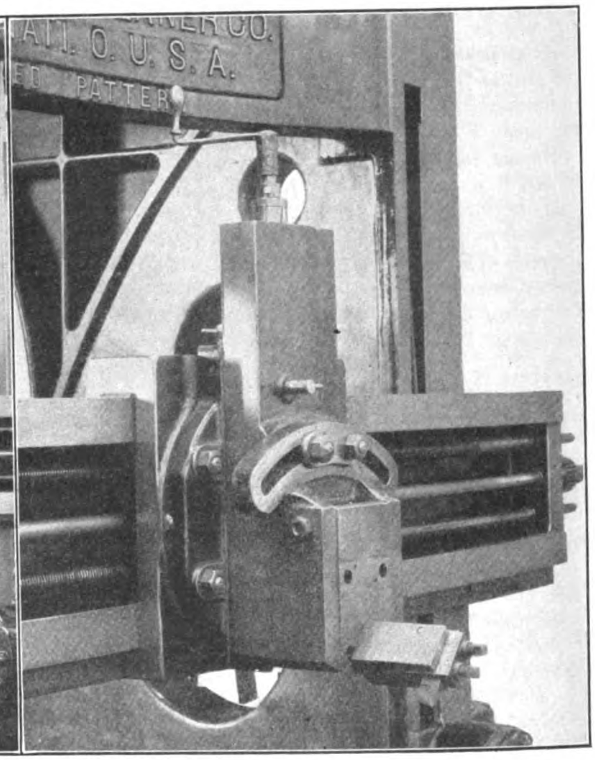


FIG. 2. THE SPECIAL EXTENSION TOOL USED

Improvised French Curve

For scribing master cams, irregular dies or similar work a coil of clock-spring steel, about ⅝ in. wide, and from 0.015 to 0.030 in. thick is a helpful tool. It is as useful and convenient as a French curve, according to the experience of John Huntting.

When the inner end of the coil is clamped to the other coils close to its extremity, a practically perfect circle of any desired diameter may be obtained, while clamping longer or shorter strips of stiff metal inside of the coil will yield almost any irregular curve ordinarily desired.

Novel Use for Dynamite

Somebody bobs up almost every day with a new idea for the advantageous use of dynamite. The *Du Pont Magazine* tells of a question received in a letter from a Nebraska blaster, who asks, "You wouldn't think a man could use dynamite in rebuilding a steam engine, would you?"

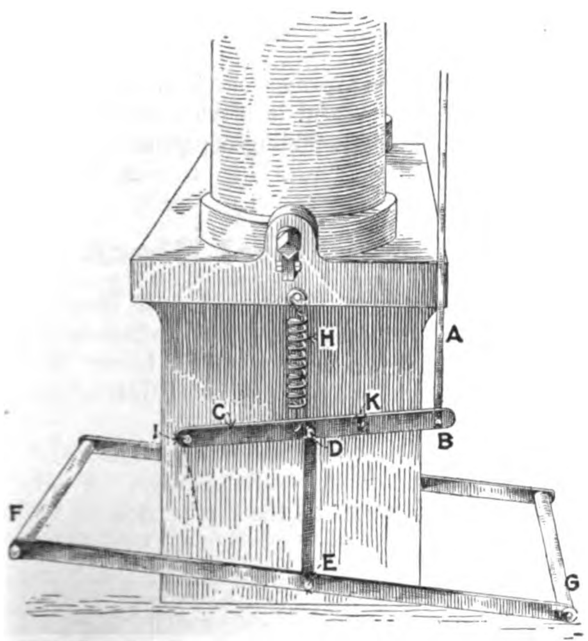
He then goes on to explain that he is an engineer by trade, that he has always had a lot of trouble in removing keys from pulleys, but that his troubles are now over because he has discovered that he can jar a tight key loose simply by placing a teaspoonful of 40 per cent. Red Cross dynamite against the end of the key, mud-capping the charge and letting the dynamite do the rest in very short order.

Of course care would have to be exercised in placing a charge of this kind to avoid breaking the pulley or the key.

Letters from Practical Men

Drop-Hammer Safety Trip for Two-Man Operation

There are some kinds of work in which it is necessary to work the hammerman on one side of a drop hammer and his helper on the other. To avoid possible injury to the helper, the hammerman, before tripping the drop, has to look and be sure that the helper is clear. One day while watching a job requiring this arrangement, I schemed a simple change in the pedal and linkage which allows either the hammerman or his helper to prevent the starting of the hammer, or after it has been started permits either to stop it at the end of its stroke.



DOUBLE SAFETY TRIP FOR A DROP HAMMER

In the illustration *A* is the trip rod, operating downward to start by pressure through the joint *B*. At *C* is a lever, fulcrumed at *I* and connecting through the link *DE* to the treadle frame. This frame nearly balances around the point *E*, being slightly heavier on the helper's side, so that his pedal normally rests on the floor. A coiled spring *H* carries the weight of the treadle and linkage.

In operation the work is put in the die, the helper putting his foot on the treadle at *G*, and the hammerman steps on *F*, bringing down the hammer. Should the hammerman press his side of the treadle too soon, he would only succeed in raising the side *G* off the floor, the helper not having placed his foot on it to hold it down. As soon as he is ready, the helper depresses *G* and starts the hammer. Either can hang the hammer up at the end of the stroke by lifting his foot, although the helper should do this only in an emergency, the control being normally with the hammerman.

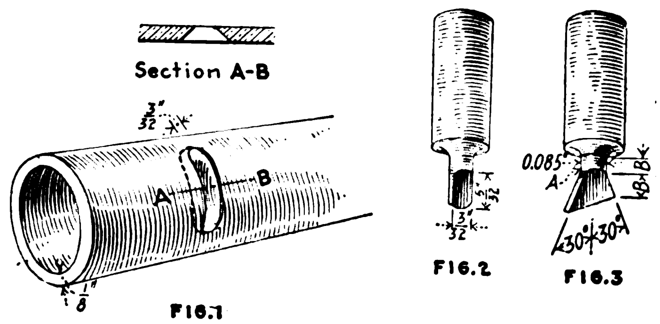
An advantage not originally looked for is the case of changing the control for one-man operation from one side of the hammer to the other by hooking either *F* or *G* to the floor. The control is on the opposite side. For hammers operated by an upward movement of *A* the only change necessary is to move the fulcrum of the lever *CD* to *K*. The lever then becomes *DB*, with its fulcrum at *K*. HARRY W. JOHNSON.

Poughkeepsie, N. Y.

Undercutting a Tube Slot

It is sometimes surprising to find what simple answers can be found to problems which at first seem very difficult. Almost anyone can do a hard piece of work with elaborate fixtures and plenty of time to get ready, but the real test of a man's ability is in getting equally good results by a shorter method.

As an example of this, a job of undercutting some slots in a brass tube, as shown in Fig. 1, comes to mind. These slots were near the middle of the tube and were impossible to reach from the inside. They were also too narrow at the top to admit of the use of any ordinary



UNDERCUTTING A TUBE SLOT

cutter by dropping in and milling one side at a time, and as there was a large number of them filing was out of the question.

The slots were first cut through straight with an end mill, as shown in Fig. 2; a two-lipped cutter, Fig. 3, was dropped down through while the cutter was standing still, then raised up carefully after the mill was started. This cutter head had a shank at *A* slightly smaller in diameter than the width of slot already cut, and a length *B* about $\frac{1}{32}$ in. more than the thickness of the wall of the tube. The tube was then revolved past the cutter, giving a good finish and getting the job out in record time, as both sides were beveled at once. M. V. DECKER.

Rochester, N. Y.

Grinding Die Setting-Pins

In most good shops dies are fitted with setting-pins. In order to grind their entire length accurately, a shank is usually turned at one end to accommodate the carrier, as shown in Fig. 1.

Fig. 2 shows a simple and effective method of grinding setting-pins and similar work without the aid of a

shank or carrier. The center marked A should be at least twice as large as B. Center A is placed on the live center of the grinder, and the tail center of the grinder is set so that the live center will carry the work with it, owing to the friction being much greater at center A than at B.

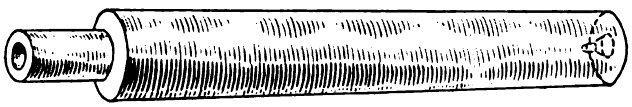


FIG. 1

FIG. 2

DRIVING PIN WITHOUT EXTENSION

A little chalk rubbed on the live center of the grinder will increase the friction. Center B should be well oiled. It is surprising what fairly heavy grinding cuts may be taken in this way. JACOB KIRCHMER.

Brooklyn, N. Y.

Assembling Stand for Automobiles

The International Motor Co., Saurer Plant, Plainfield, N. J., has designed and is using in its motor-assembling department an interesting erecting stand. One of these stands, with a motor unit in position, is shown in Fig. 1.

The support A is first fastened on the crankcase with bolts. The motor unit is then dropped into the erecting stand. The starting crankshaft passes through a slot B and sets in the bearing C. The support which carries the rear end of the unit has two turned gudgeons, which rest in bearings as D, one on each side. The flange E is fitted with eight holes, into which is set a plunger forced down with a spring and cam operated by the handle F. This arrangement permits the fixture holding the unit to be swung around with the handle G and held in eight different positions. Details of this stand are shown in Fig. 2. The handle and cam arrangement is shown at A. This stand has proved very useful in service, a number being employed in the motor-assembling department.

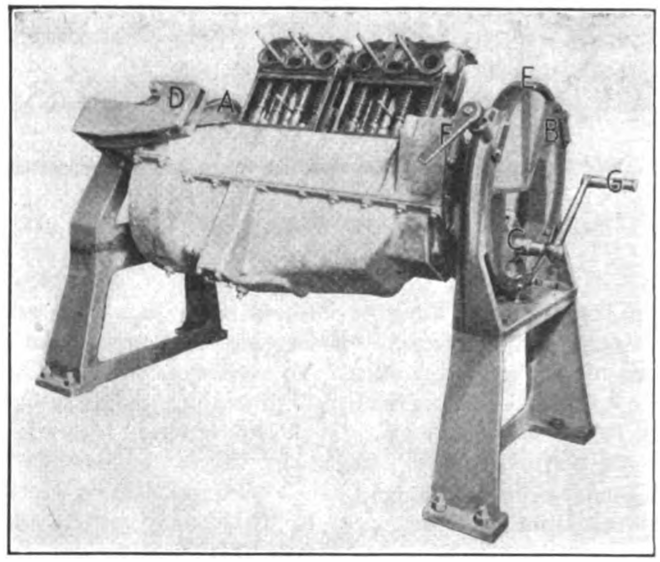


FIG. 1. ASSEMBLING STAND FOR MOTORS

New York City. A. TOWLER.

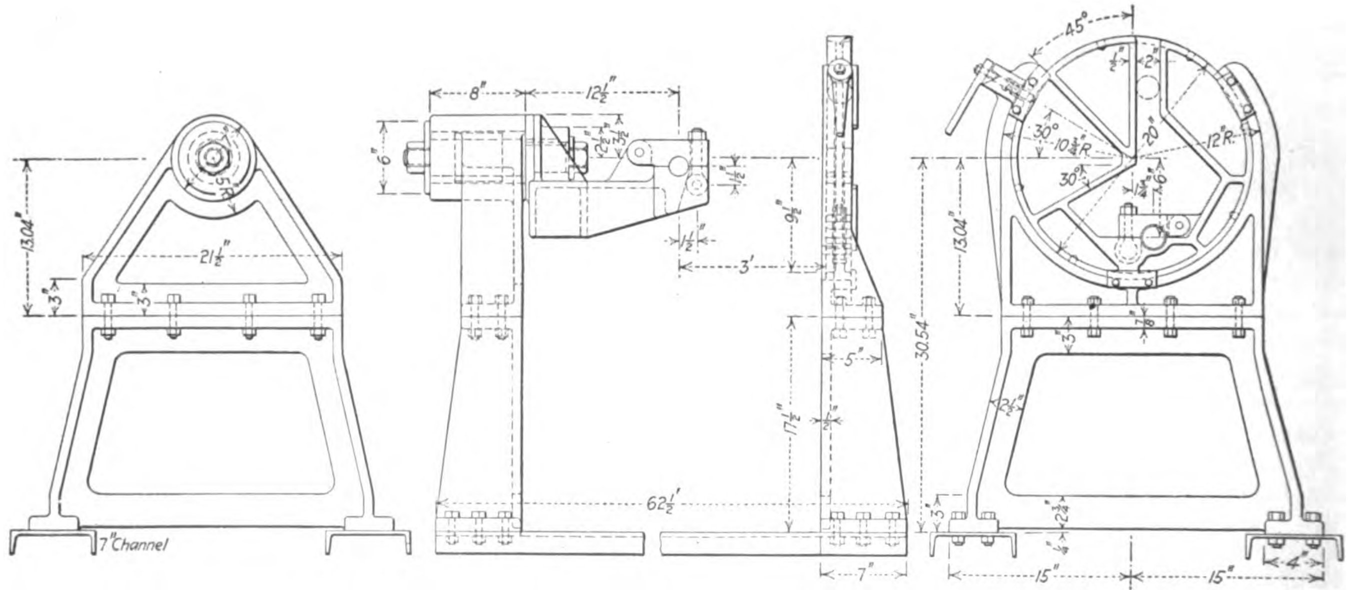


FIG. 2. DETAILS OF HANDY ASSEMBLING STAND FOR AUTOMOBILE MOTORS

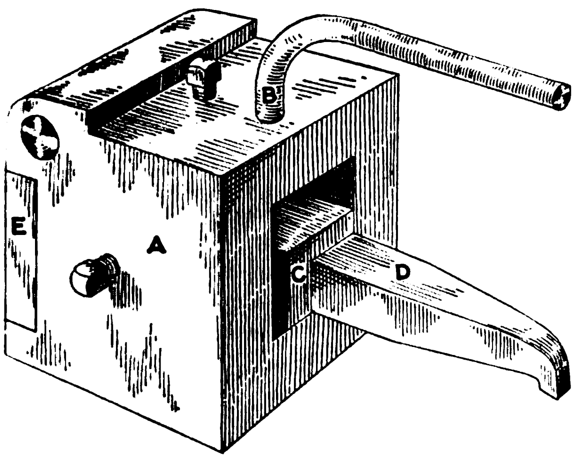
A Shaper Tool Block

The illustration shows a tool holder, or block, which I have found very successful on different shapers in place of the usual clapper block provided for tools. It takes the place of the usual clapper, the same pin being used in both cases.

It will handle almost any size of forge tool and will also handle light work very satisfactorily. A setscrew on the side at A and two on the top at B serve to hold the small angle block C firmly in position against the tool D. The dimensions shown are those which have proved very successful in my own case.

At the back of the holder is a steel plate E, which is inset and screwed flush as shown. This takes the end thrust of the tool.

To hold the tool down when taking a cut, a hole was drilled in the top and a $\frac{5}{16}$- or $\frac{3}{8}$-in. rod put in and then bent to a horizontal position. This gives a good leverage, and the operator simply lays his hand on the



HANDY HOLDER FOR SLOTTING TOOLS

end of this rod, which holds the tool down in position while light cuts are being taken. This device has proved very satisfactory in our shop. R. W. CRAGIN.
Brookline, Mass.

Making a Small Rack and Rolls

In Fig. 1 is shown a 94-pitch rack, of 0.032-in. brass $\frac{3}{32}$ wide and 1 in. long, which was to be made. Not having a milling machine, we devised the following method.

The brass was cut to length and width, the pieces placed side by side on edge on a steel block $\frac{3}{8}$x2x4 in. and sweated in place. The tool post was removed from a small lathe and the steel block fastened down on the slide

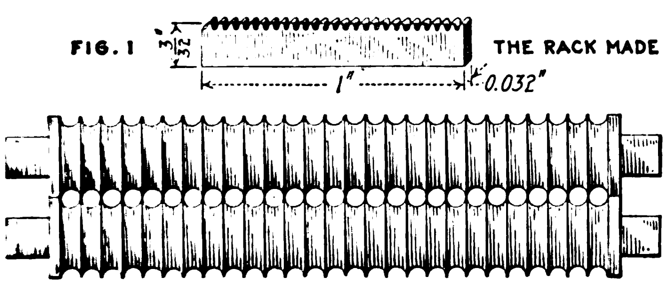


FIG. 2 THE STEEL ROLLS

MAKING A SMALL RACK AND ROLLS

rest, the longest dimension at right angles to the shears and parallel front and back. A piece of $1\frac{1}{2}$-in. cold-rolled steel was swung between the centers and driven by a carrier. A fly cutter was inserted and held in place by a setscrew.

The cutter was made of $\frac{1}{2}$-in. drill rod and formed to cut over three teeth of the rack. The first tooth blocked out, the second roughed and the third finished. The advance of the rack was figured out in thousandths. The intermediate gear and the gear on the lead screw were removed, and from the rack was selected a gear which had the correct number of teeth to give the proper advance of the carriage. A spring attached to the end of the lathe, engaging the teeth of the gear, served as an index. The depth of the cut was obtained by adjusting the cutter in the bar. The carriage was brought into position for blocking out the first tooth and clamped to the lead screw, the crossfeed to the back of the lathe so that the work would feed against the cutter.

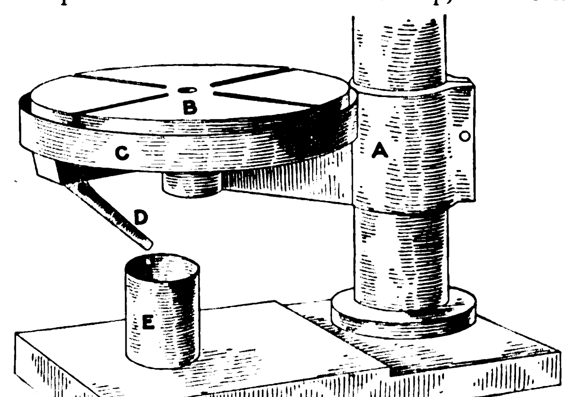
After the first tooth was blocked out across all the pieces, the gear was turned, counting the teeth as they passed under the spring until the predetermined number had advanced. The next cut was then taken, blocking the second tooth and roughing the first. The next operation finished the first tooth, and each succeeding operation produced a finished tooth in each of the hundred racks mounted.

We recently had occasion to use the same method on another class of work—two steel rolls, Fig. 2, $\frac{3}{4}$ in. in diameter, 4 in. long, with semicircular evenly spaced grooves $\frac{1}{8}$ in. wide, $\frac{9}{64}$ in. from center to center. The two rolls were geared together and supported so that the edges of the grooves just touched one another. It is evident that any variation would be intolerable. At each advance of the lead screw the tool, a semicircular former $\frac{1}{8}$ in. across, was fed in $\frac{1}{16}$ in., using the micrometer on the crossfeed to get the depth of cut. This method produced the two rolls identical in spacing, the edges being perfectly aligned. R. BURTON WHITESIDE.
Philadelphia, Penn.

An Oil Reservoir for Machines

The illustration shows, fitted on a drilling machine, a simple device for catching oil or cutting compound.

The ordinary support on the drilling machine for carrying the revolving table is shown at *A* and *B*. A circular pan *C* was made about 2 in. deep, a little larger



OIL RESERVOIR FOR MACHINES

than the table, and a hole was cut in the bottom so the shank on the bottom of the table could extend through the hole in the bottom of the pan and down under the pocket of the machine arm. The shoulder on the bottom of the table clamped the pan securely against the face of the arm. By soldering a little pocket on the bottom of the pan a lead pipe *D* extended from this inwardly to near the center. The bucket *E* was set under the center of the table. Whatever lubricant ran down through the center hole went directly into the bucket, and what ran over the edge of the table was caught by the pan, led into the pocket on the bottom and conducted by the pipe into the bucket.

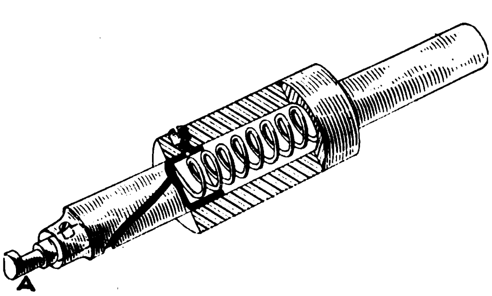
We were also troubled in the same way by an old-fashioned milling machine and adopted a similar scheme.
Portland, Ore. E. P. ARMSTRONG.

A Neat Recessing Tool for Percussion Caps

A recessing tool that is simple in construction and that can be easily kept in good working condition is shown in the illustration. It was designed for forming the recess for the cap chamber in the Russian percussion cap.

For such a recess of a width of about 0.040 in. a left-hand spiral with a lead of approximately 3 in. on a $\frac{3}{4}$-in. diameter should be given. This spiral is cut for only half a revolution, which revolves the cutter holder *A* the full throw of the eccentric.

Owing to the fact that the cutter is revolved through pressure on its end, no clearance should be given at this point. This feature enables the tool to cut a recess at the



RECESSING TOOL FOR PERCUSSION CAPS

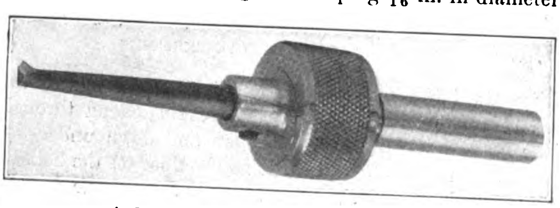
extreme bottom of the hole without any stop being used, and also to burnish the bottom of the hole as well as to press out any teat left by the previous tool.

The tool is equally adaptable for use in a lathe, hand-screw machine or drill press. When used in a drill press through a jig, it can be actuated through pressing on the bushing instead of on the cutter itself.

Mount Vernon, N. Y. R. F. NOWALK.

Simple Boring-Tool Holder

The illustration shows a boring-tool holder which is both simple and efficient. The holder body, which has a taper shank to fit the milling-machine sockets, is $1\frac{1}{8}$ in. in diameter, $\frac{3}{4}$ in. long and has a hole $\frac{13}{16}$ in. Into this hole is fitted with a good fit a plug $\frac{13}{16}$ in. in diameter



A SIMPLE BORING-TOOL HOLDER

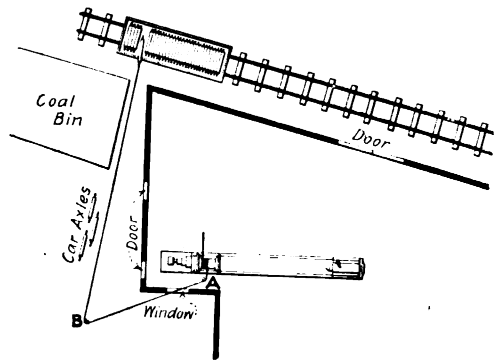
and $1\frac{1}{8}$ in. long, which may be locked by the headless screw shown.

The outside of the plug is then trued up, and a $\frac{5}{16}$ in. hole is bored and reamed through the plug and about $\frac{1}{16}$ in. into the body, so that when a $\frac{5}{16}$-in. boring tool is inserted to the full depth of the hole it will automatically bring everything perfectly true. The protruding eccentric part of the plug is turned down to $\frac{1}{2}$ in. in diameter and flush with the end of the body. The plug is graduated halfway around and two zero marks placed on the body. A No. 10-32 screw in the turned-down part of the plug is sufficient to hold the boring tool used.

Brooklyn, N. Y. OSCAR HALVORSEN.

Unloading Car Axles with an Engine Lathe

I had a carload of car axles to unload, and as the space was limited they had to be unloaded endwise. So I rigged up a 20-in. lathe in the manner shown herewith.



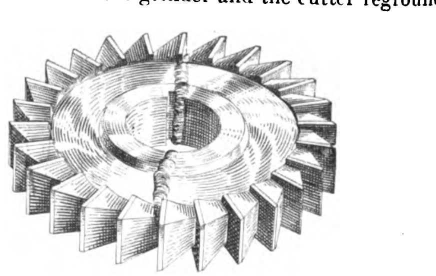
UNLOADING CAR AXLES WITH AN ENGINE LATHE

I chucked a capstan head in the lathe and ran the rope over two small sheaves *A* and *B*. In a short time I had the car axles piled all around. Perhaps some others may be able to use this method to advantage.

Beaumont, Tex. F. A. LINCOLN.

Unusual Autogenous Welding Tool Job

During one of the milling operations in very hard metal two side mills used for straddle-milling broke in halves. The four halves were sent to a local autogenous welding shop and welded together. The superfluous metal was then removed on the grinder and the cutter reground.



UNUSUAL AUTOGENOUS WELDING JOB

The size of the holes was not materially changed by the welding. One of the cutters after welding is shown in the illustration.

These mills have been in continual use for nearly a year, and so far they show no signs of weakening, although used for straddle-milling tough forgings. As these cutters were of high-speed steel six inches in diameter, the saving was a considerable item. No heat-treatment was required.

Worcester, Mass. JOHN R. MATTE.

Discussion of Previous Question

Lubricating Lathe Centers

I have been much interested in the discussion pertaining to successful lubrication of lathe centers. My experience coincides very closely with that of Charles C. Steward, as expressed on page 1131, Vol. 43—that is, first, large centers in the work, then the oil grooves. We use three instead of four, having found that this number gives better results. They are made with a punch in the same way as described by Mr. Steward.

For straight work we use the finishing punch described by Mr. Steward, but for work that is turned taper by setting over the tailstock we use a finishing punch that has an angle of 58 deg. at its point, increasing to a 62-deg. angle at its largest diameter. This makes a center in the work that seems to fit the lathe center somewhat better, but is far from perfect. Then to avoid the uneven wear that inevitably takes place in the work centers, we loosen the driving dog at regular intervals, rotate the dog about one-eighth of a turn and clamp again. By carefully following this plan, we get very satisfactory results.

We have not found anything else equal to the mixture of white lead, graphite and oil for a lubricant.

Watervliet, N. Y. MARTIN H. BALL.

Cutting-Off Swage That Did Not Work Well

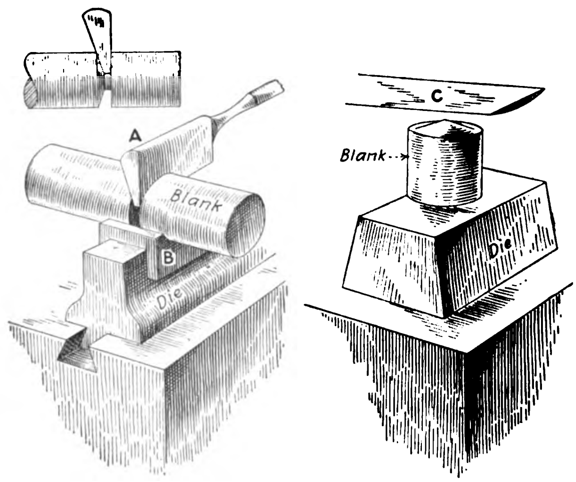
The article on swages, on page 856, Vol. 43, leads me to comment on the subject of cutting off pinions or round pieces under the steam hammer. I ran up against this proposition years ago and have not seen or heard of any tool that would cut a hot billet or shaft in two without leaving one end full in the center.

Under the steam hammer the billet must be cut with a cutter, as shown at *A* in the illustration. The taper of the cutter causes the meal to crowd out on both sides or on one side, depending on how the hammersmith holds his cutter. Holding it upright makes both sides full in the center; holding it slightly on an angle brings the fullness on one side only. The cutter is slightly rounded on the back, so that it can be held upright or at an angle either way.

It is also unnecessary to have such a tool as Mr. Hunter describes, with a plain bottom swage, loose fitting on the bottom die, as at *B*. Keep the blank round, hold the cutter right, and have the helper turn the stock at every blow. It will be soon cut off, but only one end will be square.

As to the weight of the blanks, Mr. Hunter must not expect to get them accurate. I think the hammersmith is doing reasonably well in getting the stock to correct size. By watching his lengths and cutter, the smith can perhaps come within one or two pounds of the estimated weight. But where the measurements are not too close he will forge three pieces to one with close limits. Consequently the cost of a pound or two of steel does not matter much.

The full end on the blank is really of no importance, as the smith can overcome it with a few hammer blows. Stand the blank on the die square end down, and with a piece of half-oval steel, as at *C*, spread the full end with a few light blows, turn it down, round it and it is done.



FLATTENING FULL END OF HOT BLANK

The reason for using the half-oval steel oval side down is to cause the forging to spread at the extreme end, so that the body of the forging is not changed. The blank should be turned round at every blow, and the blows should be light. GEORGE COLES.

Decatur, Ill.

Electric Arc Welding as a Practical Shop Method

The letter by Mr. Miller on p. 694, Vol. 43, is of more than passing interest, because it shows very clearly the importance of judgment when applying modern welding processes. It was therefore with interest that I perused it, particularly regarding the emphasis given to the words "when rightly applied," which undoubtedly apply equally to all methods of welding. It is well known that modern methods of obtaining high temperatures for welding by means of gases and electricity have greatly extended the scope of welding. However, it must be borne in mind that each system has its own particular spheres of applicability to which it should be confined, if maximum technical efficiency and commercial economy are to be secured. Therefore they should be rightly applied, as no system of welding is universally applicable, technical or commercial limitations, or both, being inevitably encountered sooner or later.

In the hands of a skilled welder, and apart from questions of cost, the distinction between oxyacetylene and arc welding lies in volume and degree of heat. For instance, the oxyacetylene flame, owing to its lower tem-

perature, is regarded as better for thin work than the electric arc, because the risk of burning the metal is not so great. In other cases the electric heat is perhaps more effective, because it is produced within the work itself, whereas the heat of the oxyacetylene flame is applied entirely from the outside. Where work is suitable for the electric arc, welds can be made far more quickly than by the oxyacetylene flame.

The special case quoted by the author of the letter referred to, regarding the welding of high physical quality alloy steels, is a concrete example of the absolute necessity for the welding operator to have the needed knowledge of the changes that take place in the structure of the metals under the action of the flame. As these high-quality steels are constitutionally scientific alloys, they demand scientific treatment. In this respect it is customary to find the average welder lacking the required knowledge. It may be of interest to mention that recent investigations have shown that only a few degrees of variation in temperature make considerable difference in the hardness, elastic limit, reduction of area and longevity of these steels, as shown by fatigue tests.

For instance, steel heated 50 deg. F. above the transformation or critical point shows a loss of something like 15 per cent. in these physical properties. Greater variations show correspondingly greater losses, hence the necessity for care when effecting welds on these metals. In minor cases, such as welding tool stub ends to softer bodies, this may be advantageously carried out. Generally speaking, however, it is advisable to abstain from applying welding processes to high-quality steels except where the strength of the welds is not important.

Again, I have known innumerable instances where these welding processes have been incorrectly applied owing to lack of knowledge in designing the work to be welded. It should be thoroughly understood that to weld properly and to make the weld sound throughout, a certain amount of skill and experience is required together with knowledge of how and where to apply the system, as well as how to design and prepare the work being welded, no matter whether electric arc or flame welding be used.

The employment of unskilled labor in operating modern methods of welding is another source of unsatisfactory welds. This is due to a great extent to statements made by salesmen anxious to sell their firms' apparatus, whose remarks are generally to the effect that it is not necessary to employ a skilled man to operate their equipment and that good welds can be obtained with simply a few hours' practice. As a case in point: Some time ago I contemplated the welding of aluminum sheets for arch roofs of cars. Several welding-equipment manufacturers were consulted as to the most suitable equipment, method of effecting the welding of the joints, costs, etc. Sheet aluminum, 0.080 in. thick, was the material used. The roofs were approximately 60 ft. in length and 9 ft. in width. The dimensions of the sheets were 12 ft. in length and 5 ft. in width. The sheets were first formed to the desired curvature, butted together lengthwise, then riveted to steel sections, the pitch of the rivets being about 10 in. The sheets were riveted both to secure them to the steel structure and to keep them in position during the welding operation.

Experienced welders will without doubt readily observe that the welding operation was of a somewhat difficult nature, mainly because the sheets were simply butted together on the cold-steel structure and became restrained members of the structure. Thus internal stresses were rapidly set up in the metal. Nevertheless, the following is a statement which we received from one of the welding firms regarding the operator to work its equipment: "It would be best if you would choose a man who has had no experience in welding, as it is much easier to teach such a man the right way of doing the job than another who has perhaps some idea of welding and thinks himself an experienced welder, but only practices wrong methods."

This suggestion was not entertained and an experienced welder was employed, who welded all the joints, approximately 200 ft. of welding. This was done at the rate of about 12 ft. per hr. Although the work was executed fairly satisfactorily, for various reasons, the design was unsuitable to secure perfect results. The internal strains set up were not only sufficient to crack the metal in the line of welding, but distortion of the sheets was very great. Penetration at the weld was not uniform, and traces of the welding flux on the under side of the weld could not be removed and caused subsequent rapid corrosion of the metal.

Many analogous cases may easily be described where unsatisfactory welding has taken place due solely to lack of knowledge in designing the work prior to welding. Therefore the necessity for judgment to apply modern welding processes only where proper results can be secured.

A. EYLES.

Manchester, England.

Useful Relation Between the Squares of Numbers

Mr. Olds' article, Vol. 43, page 1126, on "Useful Relation Between the Squares of Numbers" calls to my mind a trick which I have long used for squaring a number which is adjacent, or at least near, to a number whose square is known. It is simply that the difference in the squares of any two numbers is equal to the product of their difference and sum, which is expressed by the well-known algebraic formula, $a^2 - b^2 = (a - b)(a + b)$.

Thus it is easy to obtain the square of 28 mentally, as follows: $30^2 - 28^2 = 2 \times 58 = 116$. As the square of 30 is 900, the square of 28 is at once seen to be $900 - 116 = 784$.

The rule is very simple for adjacent numbers. Thus 39^2 is less than 40^2 by $39 + 40$, or 79. As 40^2 is 1,600, 39^2 is 1,521.

WILLIAM O. MILTON.

Franklin, Penn.

Miller Designer and Shop Superintendents

On page 10, Vol. 44, E. P. Armstrong has an article that calls out a piece of history; and as it gives me a chance to blow my own horn—a chance I am looking for—I will proceed. If the editor does not throw this in the waste-basket, he becomes jointly responsible.

Mr. Armstrong calls attention to the common practice of making short the guide in which the table of a miller travels. A maker of millers can say—and if questioned

about it will say—"I have always made them that way; everybody makes them that way. I can sell all I can make, and why change?"

In *Engineering* some time in 1872, or 1873, there was published a cut from a photograph showing a miller with the slide and guide of equal length. While it could not be set at as great an angle as the short guide, it would swing to the angle necessary to flute twist drills made on it. I believe at least a million twist drills were fluted, and yet the slide never wore enough so that the slack was ever taken up. I can prove it, as the machine was built in 1863 and for the first 25 years it was used for making twist drills and regular shop work—and I still have the machine.

This history goes far to confirm the statement that the thing that does not wear out of true does not wear much. No one, so far as I know, has copied this idea, but now after 50 years, Mr. Briggs, the mechanical engineer for the Smith-Premier Typewriter Co., tells me he is designing a machine and is using such a slide.

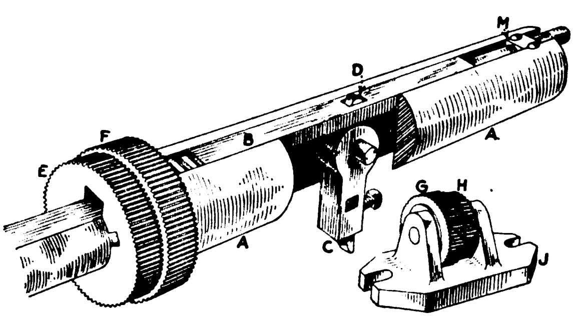
Mr. Armstrong mentions the lack of superintendents, or of men suitably trained for superintendents. Start by instilling into the minds of bright young men the principle that the men who work with their heads get better pay than the men who use only their hands.

Syracuse, N. Y. JOHN E. SWEET.

Machining Spherical Bearings

The shop foreman who is keen must ever be on the lookout for methods of tackling prospective jobs. While spherical bearings may not be part of his work today, they are sufficiently common in present-day design to interest every shopman in methods and tools for their production. For this reason I read with interest the article by J. A. Moffatt, page 816, Vol. 43, on machining spherical bearings.

The boring bar described is ingenious but would be costly to make and has several weak points. Having had several disappointing experiences with bars that use a rack for actuating a tool, I decided not to use the rack again if it were possible to design any other method. The



BAR FOR BORING SPHERICAL BEARINGS

trouble with the rack is that, however well it may be made, backlash between the teeth will sooner or later cause trouble.

In the bar shown by Mr. Moffatt, the method of carrying the star wheel and the gear wheels that actuate the rack seems cumbersome; and as the bar turned they would be apt to catch the operator's clothes. Apart from this, the star feed is not to be recommended on spherical work, as it leaves a small ridge where the feed jumps on.

A simple way of actuating the swinging arm of a bar for boring spherical bearings is shown in the illustration, which shows an existing tool modified to suit Mr. Moffatt's type of bar. Here *A* is the main boring bar and *B* the sliding bar that moves the tool holder *C*. Bar *B* is slotted at *D*, and the tool holder fits this slot, being rounded to work freely without backlash. As both pieces may be hardened, this design is durable and gives a better action than a rack.

The end of bar *A* is turned down to take gear wheels *E* and *F*, which differ in diameter. The wheel *F* has a square thread cut on its inner diameter which engages with a corresponding thread cut on bar *B*. Wheel *E* is slotted to allow bar *B* to work through it and is keyed to boring bar *A*, thus securing wheel *F* in place. The feed is obtained by means of two gear wheels *G* and *H*, shown mounted on a small bracket *J*. Wheels *G* and *H* are fastened together but are free to revolve on the pin.

In action the bracket *J* is fastened to the saddle of the boring machine in such a position that wheels *E* and *F* gear with pinions *G* and *H*. Consequently when the boring bar revolves, wheel *F* will revolve at a different rate from wheel *E*, with the result that the square thread inside wheel *F* will move bar *B* and with it the tool. The feed may be changed for different diameters of work by changing the ratio of the gears.

When a cut has been taken, bracket *J* is drawn back to disengage the wheels, and wheel *F* is turned by hand to return the tool holder to its starting point. Should the number of pieces to be done warrant the extra expense, bracket *J* could be designed as a swinging quadrant.

The bar *B* is held in position in the slot in a small bearing, as shown at *M*, at the end opposite the gear wheels, but could be held equally well by a cover plate.

Having used this method of feed on several occasions, I can recommend it not only for its smoothness in action, but because of its adaptability.

Guildford, England. WALTER G. GROOCOCK.

Machinist Instruction in the Public School System

I agree most heartily with George Heald regarding the time element, as it enters into machine-shop instruction in public or vocational schools, when, on page 122, he says: "Personally I believe that quality should be the foremost consideration, but the time element should always be present. The more a boy does under adequate instruction during the course the more efficient he will be when he graduates."

Time is money, and if left to themselves, almost all boys are millionaires and would soon bankrupt any firm by their spendthrift habits. It then becomes the duty of the trade school to teach the value of time as thoroughly and impressively as it can. Speed, however, is not the first essential. There are many other things to learn first, and on the correctness of the first instruction in manipulation often depends the future rate of the boy as a workman. A correct method, used repeatedly, develops speed of its own accord.

As we get accustomed to doing certain things, they become more and more automatic with us, until we do

them unconsciously and, if the occasion requires, with incredible speed. It follows then that speed is obtained through repeated drill in similar operations, not necessarily performed at a high rate of speed. Accuracy is generally conceded the first place of importance in the beginning of instruction and is usually associated in one's mind with slow, painstaking work. And so it is at the start, but here again familiarity, obtained by more repetition, gradually increases the speed.

In our shop, where the boys put in 7 hr. a day, we expect them to keep busy and stay at their machines just as in a commercial shop, and they do that just so far as we can make them see the necessity for so doing.

Very few people work for any other reason than because they have to, in spite of all the contrary mottoes that they stick up. It is necessity that drives most of us, and we respond according to our various ambitions.

Now, boys are not much different, and they respond to just the same forces. They are concrete-minded creatures, and abstract problems do not appeal very strongly. To tell a boy that he must work faster, because if he was working in a shop and didn't, he would get fired, is not a particularly strong argument. He will listen and agree with you, but as long as he isn't going to get fired right off, he speeds up only a little.

You may try the other tack with him and attempt to demonstrate that his trade is like a bank account and, figuring back from his future salary, show him how much each hour in the shop is worth to him, but remember that you are dealing with a millionaire, and do not be disappointed if he scorns such paltry amounts.

Pride, rivalry and competition will do much to develop rapid workmen out of boys. A desire to beat someone else's record will do more than repeated scoldings and is a bigger appeal to boy nature than the idea of future requirements ever will be.

Any manufacturer who visits your school will invariably tell you that, above all, you must teach your boys to be rapid; that today, owing to the war, high cost of living, heavy taxes, and high cost of labor, employers must get a lot out of a man, if he is to be worth anything to them. True, but he also expects a lot of other things that he doesn't mention, and he gets them as a matter of course. If you bring a certain type of man into a school of this sort and show him your equipment, he will immediately begin to figure how much work you can turn out with it, forgetting that the finished product of this particular shop is not machinery, but machinists. It must not be forgotten either that this training is a natural process and that the speed part comes near the end.

Plant a bulb in a pot and put it in the dark. At the end of six weeks there has apparently no growth taken place; yet if you invert the pot and allow the contents to drop into your hand, you will find that the root growth is remarkable, though where the ordinary observer would look for results, there are none. The same thing applies to the boy. While on the surface he is apparently dormant, in spite of attention and instruction, if you have the faith of your observation and experience you will know that this is not so. The rapidity of his development at a later period will astonish you.

Therefore, knowing this and believing in it, I can say that we do not worry a whole lot about the actual speed as long as the boy keeps busy and does not waste his time or allow his machine to stand idle. I have the utmost faith in the boy and believe that when he goes to work he will respond to the call of necessity with the same alacrity shown by the rest of us, and with the same degree of cheerfulness and success. And this faith is based on the fact that I have seen boy after boy go out and make good. BURTON A. PRINCE.

Westfield, Mass.

A Sharp Deal and What It Cost

On page 1106, Vol. 43, Mr. Godfrey, in his usual interesting manner, sets forth the details of a sharp deal and reminds us that revenge is not always sweet. Sometimes there is a better way of beating a man at his own game than telling him to go to ——.

I am reminded of a case where Mr. Manufacturer sold Mr. Customer a couple hundred of a certain fixture with patented features. This was specified by the engineer in charge as being the best for the purpose. The customer was sore from the start, for he did not like being restricted in his buying. So he tried to get even. The whole transaction amounted to about $500. When the check was received, there accompanied it a letter stating that the articles had been made wrong and a deduction covering labor expended had therefore been made from the invoice.

Inasmuch as the articles were used in the same city in which they were made, Mr. Manufacturer felt aggrieved that he had not been notified and either permitted to make good or prove there was no mistake. Like Mr. Builder, however, he swallowed hard, sat back and awaited his inning.

It came. Mr. Customer had to apply for another lot. He was politely but firmly told that before a single wheel would turn on his order he must come across not only with the balance withheld on the previous sale, but also a check covering the new order. In this case nobody lost. Mr. Customer was not deprived of his needs, and Mr. Manufacturer maintained the respect that one man always gives another for ability to protect his own interests. H. D. MURPHY.

Jersey City, N. J.

Suggestions from Employees

Regarding the unfair manner in which suggestions from employees are treated, I have learned from observation and my own experience that it is not safe to make suggestions unless you are prepared to move or unless you give them to someone to use as his own ideas. Petty officials seem to think that the firm should not be allowed to profit by anything which does not reflect credit in their direction.

Some time ago I was working in a factory which was way out of date. Seeing many chances for improvements, I mentioned them to the assistant foreman, who was also the draftsman. As usual the ideas were ridiculed and apparently killed. Later I learned that they had all been worked out and found O.K., the credit going to the draftsman.

I have just read Charles Gutman's article on page 78 and quite agree with him that the suggester's name should be kept secret from the general foreman and others. I believe that the suggestions should go direct to the office of the manager or president. W. J. WELLS.

Brooklyn, N. Y.

Editorials

A Beneficial Effect of High-Speed Steel Scarcity

High-speed steel is scarce. The general situation caused by its enormous demand, limited supply and high price can only be viewed as a hardship to the machine shop. For there never before has been a time when production was so vital to the American metal-working industries as it is today. Suggestions for relief are many and come from various sources. On page 110 the use of molybdenum in place of tungsten as an alloying agent was advocated. On page 123 of last week's issue and in a following discussion on page 165 of this issue are shown several methods for attaching high-speed steel bits to carbon-steel shanks for the purpose of making the high-speed supply go farther.

Other expedients have been resorted to and changes in practice made in a spirit of what might be termed "sour grapes." As a result some shops are learning a lesson that has been too long overlooked. This lesson is that the speed of many cutting operations can be greatly increased over the ordinary when using regular carbon-steel tools. All that is needed is a little study of the conditions.

This possibility is particularly true of multi-toothed cutters, as mills, counterbores and the like. It does not apply with equal force to drills or single-pointed cutting tools for the lathe, planer and shaper.

Factors that should be studied in order to bring about improvements in output with carbon-steel tools are the type of tool used, its general design, the cutting angles, method of support in the machine, and provision for supplying a generous amount of coolant not only to reduce the temperature of the cutting edges, but to remove chips and thus avoid abrasion with its accompanying heating effect.

It is undoubtedly true that one influence of the introduction of high-speed steel was to check the development of carbon-steel tools. We may reasonably assume that the application of the latter is pretty much where it was some ten years ago, or at the time when high-speed steel began to be generally adopted. A long road of experiment and improvement has been traveled in the newer steels themselves, in both composition, production and application. If the same intense study and effort had been spent on carbon steels for tools and in the design and application of the latter, it is fair to assume that the present-day difference in production between the two kinds would be less than it now is. So under the stress of necessity we may turn once more to our old friends—the carbon-steel tools—and see if their productive capacity cannot be increased.

The possibilities of success seem greater when we consider that the special qualities of high-speed steel are not necessary on some kinds of jobs. For many light cuts, where the amount of metal removed and the heating effect are small, carbon steel is probably just as good as its great competitor. It is well not to forget that for a number of years after the introduction of high-speed steel its place was considered to be on heavy roughing cuts on lathe and planer, and for drills.

These comments do not in any way disparage the remarkable achievements that have come from the development and introduction of high-speed steels. They have brought about in machine-shop practice a revolution that is now history. But these alloyed steels in themselves are not a solution of any problem of cutting metal. Other conditions must be studied as well, and many times when this is done in the hope of the possible use of carbon steel the final results are happy, if not equal in degree to those following from the use of the other.

If you cannot get as much high-speed steel as you need, why not find out for yourself the production capacity of your old friend, carbon steel?

Industrial Preparedness

The first definite plan for the industrial preparedness of the United States for war has just been advanced by Secretary Daniels, following the announcement that President Wilson had taken steps to increase the number of civilian engineers actively engaged in studying this national problem. The President addressed an identical letter to the five engineering societies that previously nominated members to make up the Naval Advisory Board. His request was for the selection of one member from each society for each state of the Union. The five men from each state are to form a local committee charged, under Secretary Daniels' plan, with the work of mobilizing the industries of their state. President Wilson's letter to the American Society of Mechanical Engineers reads:

> The work which the American Society of Mechanical Engineers has done, through its members on the Naval Consulting Board, is a public service which is deeply appreciated. It has been so valuable that I am tempted to ask that you will request the society to enlarge its usefulness to the Government still further by nominating, for the approval of the Secretary of the Navy, a representative from its membership for each state in the Union, to act in conjunction with representatives from the American Institute of Mining Engineers, the American Society of Civil Engineers, the American Institute of Electrical Engineers and the American Chemical Society, for the purpose of assisting the Naval Consulting Board in the work of collecting data for use in organizing the manufacturing resources of the country for the public service in case of emergency.
>
> I am sure that I may count upon your cordial coöperation.

This invitation and the former one that brought about the creation of the present Naval Advisory Board are two of the greatest recognitions of the value of engineering in public life that have ever come to the American engineering fraternity.

Secretary Daniels' plan, in brief, is to collect information with regard to the industrial plants of every state, showing just what each one could do to produce food, clothing, ordnance, munitions or other army supplies. The work of gathering this information and tabulating it for reference and use will be in the hands of the state committees.

It is expected that the Government appropriations for military supplies will be spent through a large number of small contracts placed with manufacturing firms. It is thought that many machine shops will be willing to undertake this work as a semi-patriotic duty, although it is not expected that any shop will lose money in carrying out its contracts. The main thought is to develop a large number of centers, or nuclei, of experience and skill in the manufacture of war material.

For instance, a shop may be given an order for one thousand 3-in. shells with the expectation of repeating this order each year as long as the present policy remains in force. This practice would permit the shop to procure gages, special tools, and stock, and actually to manufacture these shells to meet the Government inspectors' requirements. From the accumulated experience and skill it would be easy to branch out through the shop organization until the entire plant was engaged on munition manufacture in case of a national emergency.

The scheme seems feasible, and if the details are carefully worked out and put into operation with good judgment there seems to be no reason why it should be unsuccessful. However, different industries will have to be handled in various ways. It may be that four classifications will serve: The first would include those where the supplies manufactured for army purposes are identical with whatever is made for general consumption in time of peace. The second might include those where the changes from regular product to army product would be no more than the changes regularly brought about by seasonal demands. The third might include those where the manufacture of war material presents entirely new problems and must be attacked in a different manner from the methods used for regular products. The fourth and smallest class might include industries whose products under no conditions can be manufactured successfully in small quantities, but require a highly specialized equipment and large orders to produce at all.

Without attempting to list the various industries which fall under each class, a few examples in each case will clarify our thinking.

The first class would naturally include the production and manufacture of all kinds of food, hospital supplies, and transportation. A soldier can enjoy the same kind of canned corned beef in the trenches that his wife serves on the home table. He can be transported in the same make of automobile that he used in his native town, or on the same kind of motor truck that was owned by his home shop; and the medical supplies that contributed to his welfare in time of peace can aid him equally well in war.

A good example of product in the second class is shoes. It is evident that it would be no more difficult to change over a shop manufacturing a regular line of men's shoes to make army shoes than to change from summer to winter styles. In like manner, looms used for weaving duck could be changed over for tent cloth or khaki; and hosiery and underwear mills, with slight modifications in material and designs, could go onto army work. In this class would also be all the machine-tool and small-tool industries.

The third class represents a different problem and includes the manufacture of ordnance, ammunition and practically all army supplies made of metals. A shop producing sewing machines can be changed over to make fuses, but the experience of the last eighteen months shows how long a time it takes to do it and make it a success. In a similar way a plant making electrical machinery or steam turbines can turn to shells, and a shop or plant ordinarily engaged on general machine work can make field guns; but these changes take time. They mean the development of a completely new set of methods, small tools, gages, fixtures, cutting tools, etc.

The number of items which enter into the fourth class is much smaller than in any of the others. The most important is the industry of manufacturing rifles and machine guns and their ammunition. Developing a shop organization, collecting the machines and producing the special tools for making a rifle constitute a stupendous task. It has been said that it takes three years to develop a good rifle-barrel driller. It is not feasible to imagine that we can farm out a thousand rifles here and another thousand there and have them produced on the same basis that will prove successful for a thousand shells. Unquestionably the manufacture of rifles, machine guns and a few similar highly organized machine-shop products must be done in large, concentrated plants, especially equipped to do the work and having a sufficient volume of consecutive orders so that they can be operated at practically full capacity year in and year out.

It is evident that the manufacturing methods for classes 1, 2 and 4 can be the very best that we know. In regard to class 3, it is not so possible. If a shop receives a comparatively small order each year, it cannot afford to develop the methods to such a high pitch as if an enormous volume is required. From one viewpoint this is no serious objection, however, for in case of national emergency the general machine-shop equipment of this country would have to produce the greater part of the shells and ordnance that would be required. Thus if the average shop uses its regular equipment and develops methods in keeping with good general machine-shop practice, it is possible that all that can be reasonably expected would be done. At the same time the tools and gages should be planned as closely as possible in keeping with the most highly developed methods and processes used anywhere. For this reason, somewhere in the great Middle West, possibly in southern Illinois, there should be established a huge American arsenal to become the center, the very heart, of the manufacture of munitions in the United States. Here constant experiment and study should be made, both to standardize and develop the types of munitions and to improve the manufacturing processes. This plant should be the example, the great school, the training place for all the other shops of the country. From this center should radiate the lines of influence which would tend to introduce the best possible methods into every one of the nucleus shops.

In spite of the apparent difficulties, the proposed plan possesses many points of practicability, and the *American Machinist* is glad to indorse it heartily in principle. It differs from many of the schemes that have been branded with the word "adequate" in that no large sums of government money are asked for or necessary to put it into effect. This is very much in its favor. A parallel has been drawn between the present and the period just before the Revolutionary War. The colonies prepared for a possible emergency. The "Minute Man" came into being. We are now asked to prepare against possible emergency. The plan is now to train "Minute" shops.

Shop Equipment News

Plain Bench Miller

In the illustrated description of the plain bench miller appearing on page 169, the name of the manufacturer—Miller & Crowningshield, Greenfield, Mass.—was inadvertently omitted.

Heavy-Duty Boring Lathe

In the illustration is shown a heavy-duty boring lathe recently developed by the Giddings & Lewis Mfg. Co., Fond du Lac, Wis.

The boring bar has a single cutting tool, and the boring bar, with its housing, moves across the bed by means of a forming attachment at the rear, which causes the bar to travel exactly to conform to a master contour.

A lever movement throws in the clutch attached to a traverse screw running down through the bed lengthwise. The traverse screw passes through a nut attached to the carriage. The traverse screw starts the carriage to the right and when it has arrived at the end of the bed, a rod, on which are mounted adjustable nuts, comes in contact with a lever throwing out the clutch and stopping the carriage. In this position the forging can be removed from the chuck and another inserted. A lever movement to the right then throws in a reverse clutch on the traverse screw which brings the carriage to within a short distance of the stop attached to the lathe bed, when the adjustable nut on the rod throws the lever to the left, stopping any further movement of the carriage. To avoid the stop being thrown out of position, by the force of the carriage striking it at the instant the clutch is disengaged, nuts are adjusted on the rod so as to throw out the clutch before the carriage strikes the stop.

A crank handle is attached to a shaft that runs through the bed, engaging a pair of miter gears. One miter gear is splined to the traverse screw; therefore, by rotating the crank it slowly brings the carriage up against the stop, in which position the carriage is clamped to the bed by tightening up the hold-down nuts. Another lever movement to the left starts the bar by starting a train of gears and then pushing another lever over toward the boring bar, sliding the gear in mesh. The bar then starts forward and continues in a straight line until it arrives at the point to begin the contour of the forging.

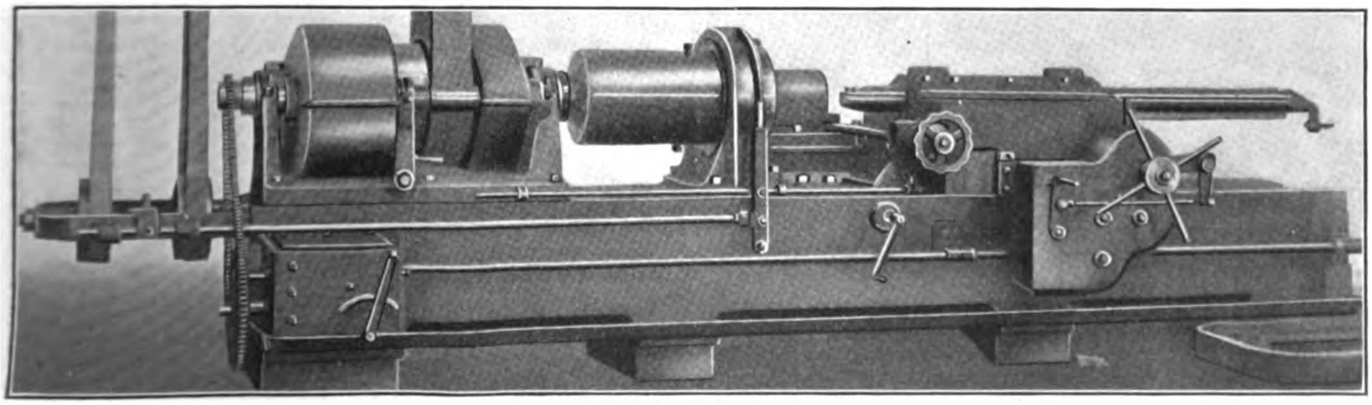
The shaft just above the pilot wheel has a pinion engaging the rack on the boring bar, and also a pinion exactly the same size engaging the rack for moving the forming slide. Either end of this rack is turned down and has two adjusting nuts. To the slide is attached the radius link with 30-in. centers.

It will be realized that by adjusting the nuts on the rack, the instant the tool has arrived at the point to begin the contour the nuts press against the end of the slide, carrying it forward toward the left, drawing the boring bar with it to make a radius of exactly 30 in.

The boring-bar head is gibbed to the forward slide on the carriage. When the boring bar has traversed to a predetermined distance, or the end of the cut, an adjusting screw presses against a lever on the rockshaft, which movement brings another lever over to the right, throwing out the jaw clutch on the bevel feed pinion and stopping any further movement of the bar. In this position the operator can either pull the lever forward, disengaging the feed pinion, permitting him to rotate the pilot wheel and withdraw the bar, or preferably loosen up the hold-down nuts on the carriage, throwing a lever forward, traversing the carriage to the right. This movement of the carriage to the right will, when the nuts on the sliding rack hit the slide, bring the link to exactly right angle of the boring bar.

The machine shown is also built without the former at the back, and making the boring bar fixed. The machine may also be obtained with any gear reduction from $7\frac{1}{2}$ to 1 to 15 to 1 or more. In place of the two-step cone a single pulley for 10- or 12-in. belt can be substituted.

The machine shown is arranged with double back gear and two-step cone receiving power from a 6-in. belt. The back-gear ratios are $7\frac{1}{2}$ to 1 and 5 to 1. The main driving gears are 3-pitch and $3\frac{1}{2}$-in. face. Other driving gears are 4-pitch and $2\frac{1}{2}$-in. face. The carriage or bor-



HEAVY-DUTY SINGLE-PURPOSE BORING LATHE, WITH FORMING ATTACHMENT AT REAR

Swing over bed, 15 in.; hole through spindle, $1\frac{1}{2}$ in.; front bearing, $5\frac{1}{8}$x10 in.; back bearing, $4\frac{1}{2}$x7 in.; length of carriage bearing on bed, 46 in.; pulleys on countershaft, 20x$6\frac{3}{4}$ in., tight and loose; speed of countershaft, 130 r.p.m.; size of boring bar, $4\frac{1}{2}$ in. by 7 ft.

ing-bar head has a bearing on the bed of 46 in. and has quick traverse. The movement of boring bar is by geared feeds, and the rate of feed in thousandths of an inch per revolution of spindle is: 0.020, 0.027, 0.037, 0.048, 0.068, 0.093, 0.123 and 0.163, all obtained by quick-change gear box. The bar is made from crucible hammered steel 4½ in. diameter. It has quick return and adjustable automatic limit stops in both directions, and has No. 7 Morse taper hole. The machine weighs about 16,000 lb.

Self-Centering Shell Chuck

The Jenckes Knitting Machine Co., Pawtucket, R. I., has recently developed a self-centering chuck for holding shells while they are machined.

A view of the assembled chuck is shown in Fig. 1. It is made with a machine-steel body and was designed

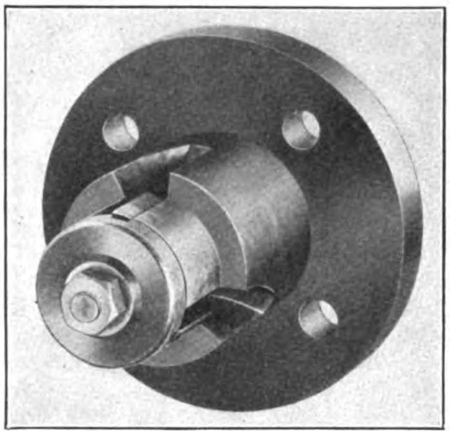


FIG. 1. THE ASSEMBLED CHUCK

for the 3-in. shell. In Fig. 2 are shown details of the chuck. The tool is made with a flange that is attached to the faceplate by four bolts, or screws. The driving action is obtained by three hardened-steel dogs that are kept

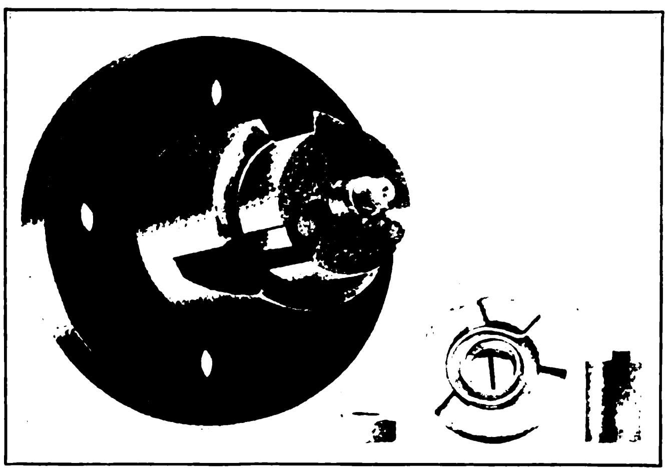


FIG. 2. DETAILS OF THE CHUCK

in tension with a spring in the cap, which is held in position with a nut.

In using the chuck the shell is slid over the shank, and the tool comes in contact with the shell to machine it. The chuck is revolved with the lathe and forces out the driving dogs. Their edges come in contact with the inside of the shell and drive it.

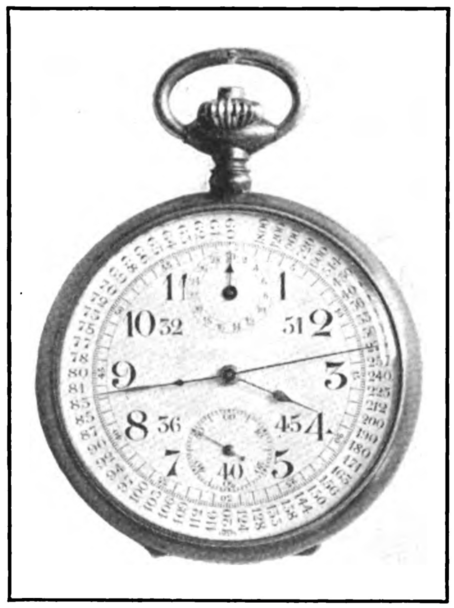
It will be observed that, as the dogs operate in unison, the chuck is self-centering. Another advantage is that the driving effect of the chuck is increased as added demand is made on the action of the dogs.

Master Cronograph

The instrument shown is designed to be useful in making time and motion studies and in obtaining direct results of production per hour or per day, both for mechanical and manual operations.

The cronograph contains a 17-jewel timepiece and divisions in seconds and fifths for the time-study feature. The figures on the extreme outside of the dial designate operations per hour for any operation within one minute, and the figures on the extreme inside of the dial, such as 51, 45, 40, etc., denote operations per hour for any operation running into the second minute. For instance, if the large black hand were stopped on 13 sec., which would denote the completion of an operation, the reading directly under this hand would show 275, the number of operations which could be completed in one hour on a basis of one operation taking 13 sec.

The instrument operates entirely from the crown, being the start, stop and fly-back system. The timepiece



MASTER CRONOGRAPH

feature is the same as any modern watch. The works are impervious to magnetism, to heat and cold, expansion and contraction. The case is of gun-metal. The product is of Swiss manufacture, and the sales rights are controlled by M. J. Silberberg & Associates, Peoples Gas Building, Chicago, Ill.

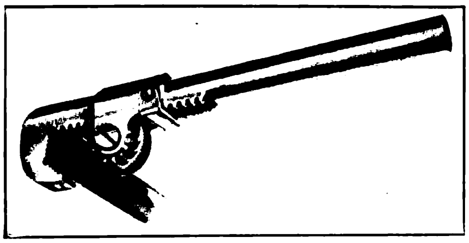
Self-Adjusting Pipe Wrench

The automatic pipe wrench shown derives its automatic feature from a combination of a rotating disk, constituting the under jaw, and a spring hung in the hollow handle. This spring constantly keeps the under jaw pushed forward, thus holding the tool in continuous contact with any size of pipe within the capacity of the various sizes of the wrench.

The head, or upper jaw, is a drop forging made from high-carbon steel and is V-shaped, thus rendering a two-

point contact. The handle is made from flat cold-rolled steel. It is formed, stenciled and milled. The head and handle are joined by a brazed joint having a large bearing. The saddle and saddle cap are blanked from cold-rolled steel and formed.

The disk, or under-jaw, which is really the most vital part of the tool, consists of pinions on each side. This part is made from a special grade of bar steel. The blank for it is central-drilled and cut from the bar, then heated to a high forging temperature and the pinions formed by a special die operation.



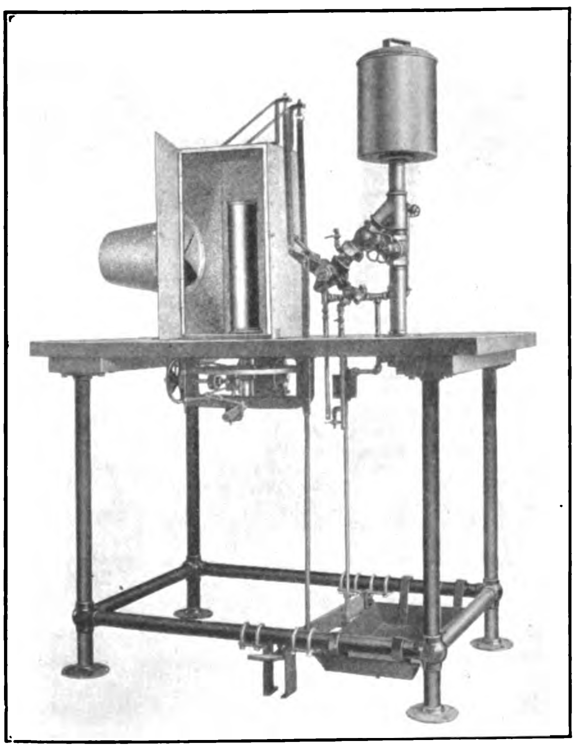
SELF-ADJUSTING PIPE WRENCH

The wrench is a recent product of the Craftsman Tool Co., Conneaut, Ohio.

Shell Coating Machine

The shell-painting machine shown, designed for outside coating, is the latest addition to the line made by the Spray Engineering Co., Boston, Mass.

The machine consists of a table with steel supporting frame, the operating mechanism being mounted beneath the table top. The usual coating material, such as varnish, asphaltum, paint and similar special compounds, is carried in a reservoir supported above the operating table. The liquid coating material passes down the hollow reservoir support to an adjustable measuring device controlling the amount of material sprayed at each operation. A system of levers controls the motion of the device that cuts off the supply from the reservoir and admits the measured quantity of material to a channel leading to the spray nozzle. The last part of this motion admits a compressed-air supply that drives the coating material through the spray nozzle and distributes it evenly over the surface to be coated.



SHELL SPRAYING MACHINE

Drain and priming valves are provided to permit the thorough cleaning of the measuring device and all pipes and passages without taking the mechanism apart.

The machine shown is equipped with a motor-driven rotating shell table and also with an exhaust fan mounted in a sheet-metal hood for protecting the operator from the paint fumes.

Electric Shop Trucks

The storage-battery shop trucks shown represent recent additions to the line made by the Buda Co., Chicago, Ill.

The trucks are worm driven, the transmission mechanism forming a simple unit, of which all wearing parts continually operate in a bath of lubricating oil. The brake and circuit-breaker are operated by a foot pedal, consisting of one-half of the operator's platform. In using the trucks the operator needs only to depress the

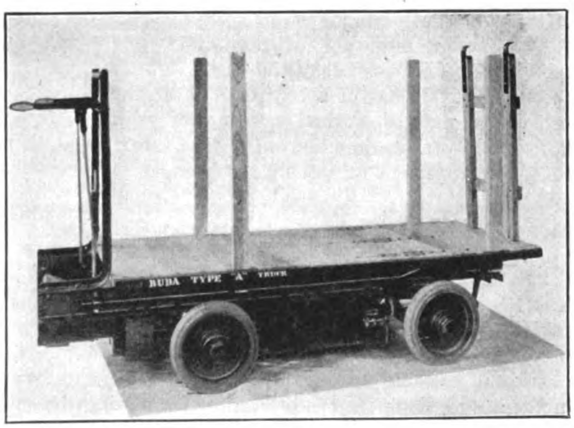


FIG. 1. STORAGE-BATTERY WAREHOUSE TRUCK
Length, 8 ft.; width, 40 in.; capacity, 4,000 lb.; 3 speeds

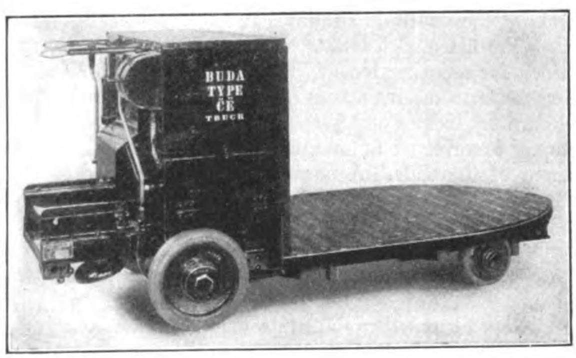


FIG. 2. HANDY TYPE OF ELECTRIC TRUCK
Length, 8 ft.; width, 40 in.; capacity, 4,000 lb.; 3 speeds

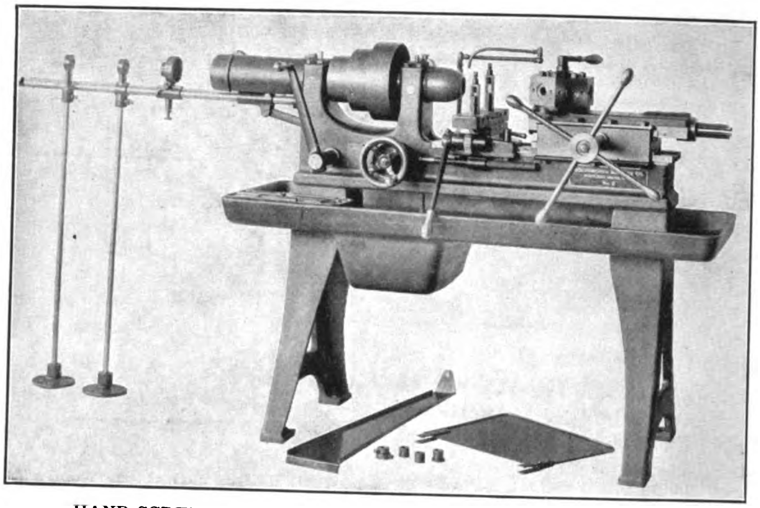
foot pedal, thus completng the circuit and also releasing the brake. Should the operator remove his foot from the foot pedal, it is instantly returned to its normal position by a spring, thus automatically breaking the circuit and also releasing the brake. Likewise the controller lever, which is equipped with a simple set of equalizing springs, is automatically returned at once to its neutral position the instant the operator's hand is taken from it.

The tires are of solid rubber, mounted on metal rims. The wheels have tapered roller bearings. The front axle is a steel casting, and the rear axle is of the full floating type. Both axles are carried on heavy spiral springs within the pedestals; all revolving members are carried on ball bearings and ball thrust bearings. The frames are made of heavy channel iron.

The truck shown in Fig. 1 has a two-wheel steer and is adapted for carrying miscellaneous loads upon its own deck, under which are the batteries. The truck shown in Fig. 2 has a four-wheel steer, with the batteries mounted directly in front of the operator.

The motors used are of the all-enclosed type. The speeds of the trucks are varied by means of a controller lever traveling in a vertical plane, the normal position of which lever is horizontal. In conjunction with this lever there is a simple arrangement for equalizing springs.

Turret Screw Machine



HAND SCREW MACHINE EQUIPPED WITH AUTOMATIC CHUCK

Automatic chuck capacity, 1 in.; hole in automatic chuck plunger, $1\frac{1}{32}$ in.; diameter of turret holes, 1 in.; center of holes to top of slide, $2\frac{3}{8}$ in.; diameter across flats, $7\frac{1}{8}$ in.; swing over bed, 14 in.; swing over cutoff slide, 6 in.; length that can be turned, 6 in.; greatest distance, end of collet to turret, 15 in.; greatest distance, end of spindle to turret, $16\frac{1}{4}$ in.; horsepower required, $1\frac{1}{2}$

The hand screw machine shown is provided with a plain head, automatic chuck, bar feed and hand longitudinal feed to cutoff.

The head and bed are cast integral. The automatic chuck and bar feed are operated by a long lever in front of the head, giving increased leverage for closing the collet. A stepped thimble automatically adjusts the collet for slightly varying diameters.

The hexagonal turret has six tool holes arranged for holding tools with or without shanks. The holes for shank tools are fitted with binder bushings. Bolt holes are provided for securing tools to the faces, the counterbore being made to receive a boss on the back of the tool, which accurately locates and keeps the tool in alignment. The turret is revolved automatically by the backward movement of the slide. A neutral point is provided so that the turret can be revolved in either direction by hand. The locking bolt is at the front end of the slide, directly under the cutting tool, and works into steel taper bushings placed in the bottom of the turret at nearly its full diameter.

Independent adjustable stops operate automatically for each position of the turret. They are readily adjustable for the length of each cut. The turret saddle has a supplementary taper base, by means of which the tool holes in the turret can be adjusted to the exact height of the center of the spindle. Taper gibs, fitted the whole length of the saddle on each side, provide means of adjusting the slide sidewise.

The cutoff saddle is constructed to maintain the alignment by providing a narrow guide and taper adjusting gib. The cutoff saddle has an increased bearing on the bed, with a binder for clamping. The hand longitudinal feed is operated by means of a handwheel in connection with miter gears and a milled screw and is fitted with a graduated dial reading to 0.001 in. Dial indicators are provided to obviate the necessity of making measurements of the longitudinal cuts.

The cutoff slide is provided with four T-slots. The two in front run parallel with the cutoff slide, permitting close adjustment of the tool posts. A geared oil pump delivers lubricant through an adjustable piping system. It operates automatically.

The machine is a recent product of the Southworth Machine Co., Portland, Me., for whom Manning, Maxwell & Moore, New York City, are selling agents.

NEW PUBLICATIONS

SCIENTIFIC MANAGEMENT AND LABOR—By Robert F. Hoxie. New York: D. Appleton & Co. Cloth; $5\frac{1}{2}$x$7\frac{3}{4}$ in.; pp. 302. $1.50.

Reviewed by Dexter S. Kimball*

Professor Hoxie's book is the first of a type of which no doubt we shall see more in the immediate future. Heretofore the greater part of the discussion concerning scientific management has come from engineers, managers and others actively connected with industry. An evaluation of scientific management by a trained economist who has had a rather unusual opportunity to study these new things at close range is therefore of great interest.

The book is based upon an investigation of scientific management in its relation to labor made by Professor Hoxie for the United States Commission on Industrial Relations and is an attempt to test the claims of the late Frederick W. Taylor respecting scientific management as it refers to labor. The book deals therefore with this phase of the problem only and is not a treatise on the theory and practice of so-called scientific management.

The subject matter is divided into three sections, as follows: Part 1. Viewpoint and Method. Part 2. Critical Examination of Scientific Management in Its Relation to

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Labor. Then came the following appendices: (1) Conclusions Resulting from the Investigation. (2) The Labor Claims of Scientific Management According to Mr. Taylor. (3) The Labor Claims of Scientific Management According to Mr. Gantt. (4) The Labor Claims of Scientific Management According to Mr. Emerson. (5) The Trade Union Objections to Scientific Management. (6) Vital Points at Issue Between Scientific Management and Labor Based Upon the Claims of Scientific Management. (7) Vital Points at Issue Between Scientific Management and Labor Based Upon Trade Union Objection to Scientific Management. (8) Questionnaire: Scientific Management and Labor.

In taking up the investigation Mr. Hoxie first made a study of scientific management as presented by its leading advocates. All the important literature bearing on both sides of the question was examined, and representatives on both sides of the controversy were consulted. With these data as a basis, two preliminary statements, entitled respectively "The Labor Claims of Scientific Management" and "Trade Union Objections to Scientific Management," were prepared. The first of these documents was submitted to prominent scientific managers for criticism and revision, while the second was revised and approved by a committee of the American Federation of Labor. From these official statements the vital questions at issue were determined, and they are set forth in appendices 6 and 7. The Questionnaire, appendix 8, was compiled from these documents and used as a means of securing extended information from both employers and employees. The investigating committee also visited a large number of shops where scientific management has been installed in whole or in part and also consulted many individuals concerning the problem. It will be seen therefore that the appendices are important documents, for aside from any conclusions that have been drawn by Mr. Hoxie, appendices 6 and 7 show in a clear and concise form the points at issue, while appendix 8, which is quite voluminous, gives one an idea of the complexity and extent of the controversy.

The conclusions of Mr. Hoxie and his committee, however, are of greater importance. It may be well to quote directly from the report itself, which states:

> Two essential points stand forth. The first point is that scientific management, at its best and adequately applied, exemplifies one of the advanced stages of the industrial revolution which began with the invention and introduction of machinery. Because of its youth and the necessary application of its principles to a competitive state of industry, it is, in many respects, crude, many of its devices are contradictory of its announced principles, and it is inadequately scientific. Nevertheless, it is to date the latest word in the sheer mechanics of production and inherently in line with the march of events.
>
> The second point is that neither organized nor unorganized labor finds in scientific management any adequate protection to its standards of living, any progressive means for industrial education, or any opportunity for industrial democracy by which labor may create for itself a progressively efficient share in efficient management. And, therefore, as unorganized labor is totally unequipped to work for these human rights, it becomes doubly the duty of organized labor to work unceasingly and unswervingly for them, and, if necessary, to combat an industrial development which not only does not contain conditions favorable to their growth, but, in many respects, is hostile soil.

Mr. Hoxie's findings verify what the reviewer has long contended[1], namely, that scientific management at its very best is essentially a means of increasing productive capacity and does not carry with it a single regulative principle that automatically tends to protect the individual worker against certain results that ensue from its introduction exactly like those that follow the introduction of labor-saving machinery. In common with all methods looking to results in productive effort these methods make possible better conditions for the race as a whole. But experience with labor-saving machinery has made it clear that the distribution of the benefits flowing from improved methods cannot be left to chance, since these methods themselves afford no protection to the worker during the period of readjustment following the introduction of more economic methods.

The need of taking advantage of every economic gain is undoubted, and the human race in general never discards any ways or means to that end. The great problem therefore is to develop these methods while at the same time safeguarding human rights, and the reviewer agrees with Mr. Hoxie that this effort cannot be safely left to scientific management, which depends on personal good will to correct abuses that may result because of its introduction.

Mr. Hoxie frankly questions the claims made by exponents of scientific management that time study can be scientifically accurate and states that "far from being the invariable and purely objective matter that they are pictured the methods and results of time and task study in practice are subject to all the possibilities of diversity, inaccuracy and injustice that arise from human ignorance and prejudice." While this statement will be flatly contradicted by some and will be considered overstrong at least by many more, there is no doubt that there is considerable truth in Mr. Hoxie's statement. Time study is not and cannot be an exact science.

Mr. Hoxie makes a similar criticism of the basis of advanced wage systems. Granting that it is possible to measure accurately the task a worker ought to perform, the claim that these advanced wage systems reward the worker in proportion to his effort is, as he points out, begging the question so long as these systems use the rates already determined by competition as a basis for efficiency reward, since these very basic rates are in dispute.

The most interesting and in many respects the most important section of the book is Part 2, which discusses scientific management as the investigator found it to exist in actual practice. This discussion, on the whole, is not over-favorable to scientific management, and one is likely to gain the idea that the author is biased in his opinion.

It should be noted, however, that Mr. Hoxie concedes fully the economic possibilities of the new methods, his criticisms being directed more against false claims and the mistakes and possible injustices arising from the use of these methods in the hands of ignorant practitioners. On the latter he is severe, and justly so.

It may be objected and perhaps with some justice that the report and discussion are based upon collected opinions rather than upon intimate personal knowledge. On the other hand, it should be remembered that Mr. Hoxie was assisted in this investigation by a representative of labor and a representative of employing management, both of whom signed the report.

Whether one agrees or not with all of Mr. Hoxie's conclusions, all who have examined this difficult problem with an unbiased mind will certainly agree with him that we need more thorough study and general publicity concerning the true character and methods of scientific management and concerning the real character, intelligence and spirit of those engaged in its application.

[1]See "American Machinist," Vol. 35, page 263.

PERSONALS

James C. Kelly, for many years with Berry Bros., joined the selling staff of the Moller & Schumann Co., Brooklyn, N. Y.

Frank J. Shay, until recently New England representative of Berry Bros., is now a member of the selling force of the Moller & Schumann Co., Brooklyn, N. Y., operating from headquarters in Boston.

Charles W. Burrage, formerly of the faculty of the Massachusetts Institute of Technology, and associated with the F. W. Dodge Co., has joined the organization of Walter B. Snow and staff, Boston, Mass.

Joseph A. Holland, for many years secretary of the Rhode Island branch of the National Metal Trades Association, has resigned to become supervisor of employment with the General Electric Co., Schenectady, N. Y.

OBITUARY

John Butterworth, one of the proprietors of the New Jersey Agricultural Works, Trenton, N. J., and for many years well known in the farm-implement field, died at his home in that city on Jan. 21. Mr. Butterworth was born in Pawtucket, R. I., in 1833.

Robert Howard Grant, for many years conspicuous in the ball-bearing development in this country, and widely known as a designer of ball-making machinery, died at his home in Ann Arbor, Mich., Jan. 11, after a long illness. Mr. Grant was born in Northampton, Mass., in 1867. After completing a high-school education in Fitchburg, Mass., he entered the shops of Simonds Rolling Machine Co., of that city. Shortly thereafter he became assistant superintendent of the Jones & Lamson Machine Co., which he left in 1888 to become associated with the Cleveland Automatic Machine Screw Co., of which his father, John J. Grant, was then the leading spirit. Later Robert withdrew from his father's concern to start the Grant Auto-Friction Ball Co., Cleveland, Ohio. From then on, until very recent times, Mr. Grant was in turn associated with most of the leading ball-producing plants in this country, founding the Grant-Hoover Ball Co., and the firm of Grant & Wood, Chelsea, Mich. A few years ago Mr. Grant organized the Grant Tool Co., Detroit, Mich., which was later merged into the Detroit Tool Co. He is survived by his wife and two sons.

Prices--Materials and Supplies

Pig Iron—Quotations were current as follows at the points and dates indicated:

	Jan. 28, 1916	Dec. 30, 1915	Jan. 29, 1915
No. 2 Southern foundry, Birmingham	$15.00	$14.50	$9.50
No. 2 X Northern foundry, New York	19.75	10.50	14.25
No. 2 Northern foundry, Chicago	18.50	18.50	13.00
Bessemer, Pittsburgh	21.45	20.45	14.55
Basic, Pittsburgh	18.70	18.95	13.45
No. 2 X, Philadelphia	20.00	19.50	14.25
No. 2, Valley	18.50	18.50	13.00
No. 2 Southern, Cincinnati	17.90	17.40	12.40
Basic, Eastern Pennsylvania	19.50	18.50	13.50
Gray forge, Pittsburgh	18.45	18.20	13.45

Steel Shapes—The following prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger from jobbers' warehouse, New York:

	Jan. 28, 1916	Dec. 30, 1915	Jan. 29, 1915
Steel angles, base	2.60	2.40	1.85
Steel T's, base	2.65	2.45	1.90
Machinery steel (bessemer)	2.60	2.40	1.80

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse, New York:

	Jan. 28, 1916	Dec. 30, 1915	Jan. 29, 1915
No. 28 black	3.50	3.15	2.60
No. 26 black	3.40	3.05	2.50
Nos. 22 and 24 black	3.35	3.00	2.45
Nos. 18 and 20 black	3.30	2.95	2.40
No. 16 black	3.45	2.90	2.35
No. 14 black	3.35	2.80	2.25
No. 12 black	3.30	2.70	2.20
No. 28 galvanized	5.50	5.50	3.50
No. 26 galvanized	5.20	5.20	3.20
No. 24 galvanized	5.05	5.05	3.05

Bar Iron—Prices are as follows in cents per pound at the places named:

Pittsburgh, mill	2.10
New York	2.20@2.25
From storehouse, New York	2.50@2.60

Swedish (Norway) Iron—This material sells at $4.50 base per 100 lb. f.o.b. New York. In coils an advance of 50c. is charged.

Cold Drawn Steel Shafting—From New York warehouse to consumers requiring fair-sized lots the price is 20% off list.

Standard Pipe—On carload lots f.o.b. Pittsburgh, the discounts follow:

	Black		Galvanized	
	Jan. 21, 1916	Jan. 22, 1915	Jan. 21, 1916	Jan. 22, 1915
¾- to 2-in. steel butt welded	76%	81%	60½%	72½%
2½- to 6-in. steel lap welded	75%	80%	59½%	72½%

At these discounts, the net prices in cents per ft. follow:

Diameter, In.				
¾	2.76	2.20	4.54	3.15
1	4.08	3.24	6.72	4.67
1¼	5.44	4.38	9.09	6.30
1½	6.60	5.25	10.86	7.55
2	8.88	7.05	14.62	10.15
2¼	14.63	11.70	23.69	16.70
3	19.13	15.25	30.98	21.80
4	27.25	21.80	44.05	31.00
5	37.00	29.60	59.94	42.20
6	48.00	38.40	77.76	54.60

Seamless Drawn Tubing—The base price per pound from New York warehouse is 38c. for brass and 38.50c. for copper. For immediate stock shipment 3c. is added, which gives the following quotations:

	Copper		Brass	
Diameter, In.	Jan. 28, 1916	Jan. 29, 1915	Jan. 28, 1916	Jan. 29, 1915
¾ to 2½	41.50	21.50	17.00	41.00
3	41.50	22.00	18.00	41.00
3½	42.50	22.50	18.50	42.50
4	43.50	23.00	19.00	43.50
4½	45.50	24.00	20.00	45.50
5	47.50	25.00	21.00	47.50
6	48.50	28.00	24.00	48.50
8	52.60	32.00	28.00	52.60
7	50.50	30.00	26.00	50.50

Wire Rope—On this material the following discounts are for warehouse delivery, New York:

Galvanized	35 and 2½%
Bright	45 and 2½%
Special brands, bright	40 and 2½%

Miscellaneous Metals—The present New York quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	Jan. 28, 1916	Dec. 30, 1915	Jan. 29, 1915
Copper, electrolytic (carload lots)	25.50	22.50	14.50
Tin	41.75	40.00	35.75
Lead	6.10	5.40	3.70
Spelter	19.50	18.00	8.25
Copper sheets, base	31.00	27.00	19.00
Copper wire (carload lots)	31.00	30.25	15.00
Brass rods, base	37.00	32.00	14.50
Brass pipe, base	42.00	36.00	15.50
Brass sheets	37.00	32.00	14.75
Solder ½ and ½ (case lots)	26.12½	24.75	22.50

In St. Louis lead sells at 5.95 and spelter for delivery in February or March at 19.50. For delivery May or June, the quotation is 16.50.

Old Metals—In New York, the following are the dealers' purchasing prices in cents per pound:

	Jan. 28, 1916	Dec. 30, 1915
Copper, heavy and crucible	20.00	17.75
Copper, heavy and wire	19.50	17.25
Copper, light and bottoms	17.00	15.00
Lead, heavy	5.00	4.50
Lead, tea	4.50	4.25
Brass, heavy	12.75	11.50
Brass, light	10.00	9.50
No. 1 yellow rod brass turnings	12.50	14.00
No. 1 red brass or composition turnings	12.00	11.50
Zinc	12.00	11.00

Babbitt Metal—In New York, quotations are as follows in cents per pound:

Best grade	55@60
Commercial grade	25@30

Antimony—For Chinese and Japanese brands the quotation is nominal at 42.50c. per lb., duty paid.

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	31.50	32.00	32.50	33.00	36.00
¼ to 5/16	31.25	31.75	32.25	32.75	35.75
⅜ to 1⅞	31.00	31.50	32.00	32.50	35.50
1 15/16 to 2⅞	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3 7/16	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3½ to 3 15/16	32.25	32.75	33.25	35.75	36.75
Squares					
3 1/16 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4 15/16	33.00	33.50	36.00	36.50	37.50
5 to 6 15/16	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Tin Plates—The following prices are in effect from warehouse, New York:

Coke tin plate, 14x20:

100-lb.	$4.45
I. C. 107-lb.	4.60

Terne plate, 20x28:

Base Weight	Net Weight	Coating	Price	Base Weight	Net Weight	Coating	Price
100-lb.	200	8	$8.30	I. C.	226	20	$13.50
I. C.	214	8	8.60	I. C.	231	25	14.25
I. X.	270	8	10.60	I. C.	236	30	15.50
I. C.	218	12	12.00	I. C.	241	35	17.00
I. C.	221	15	13.00	I. C.	246	40	19.00

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Jan. 8	Jan. 15	Jan. 22	Jan. 29
Prompt furnace	$3.25@3.50	$2.50	$3.00@3.25	$4.00@5.00
Prompt foundry	3.50	3.75@4.00	3.50@4.00	3.50@4.00

Carriage Bolts—On ⅜ by 6 in. and smaller 60 and 5% off list is allowed; for larger and longer sizes 50 and 5% off list is charged. For fair-sized orders from New York warehouse the following net prices at this rate would be charged:

Length, In.	Diameter ¼	5/16	⅜	7/16	½	⅝	¾
1½	$0.38	$0.53	$0.72	$1.05	....	....	....
2	.41	.58	.78	1.14	....	....	....
2½	.46	.62	.84	1.24	$1.54	$2.73	$4.04
3	.49	.67	.90	1.33	1.68	2.91	4.28
3½	.53	.71	.97	1.43	1.81	3.09	4.51

Machine Bolts—From New York warehouse, the base price for fair quantities are as follows: From ⅜ in. by 4 in. and smaller, 60 and 10% off list is discounted; for larger and longer sizes up to 1 in. by 30 in., 50 and 10% is allowed. At this rate prices per 100 are as follows:

Length, In.	Diameter ¼	⅜	⅝	¾	⅞	1 In.
1	$0.61	$0.86	$2.34	$3.47	$4.73	$6.80
2	.64	.92	2.51	3.71	5.04	7.20
2½	.67	.98	2.68	3.96	5.36	7.61
3	.70	1.04	2.85	4.21	5.67	8.01
3½	.73	1.09	3.02	4.46	5.99	8.42

Base prices on other sizes would be as follows: 1⅛ and 1¼ in. by 3 in. and up to 12 in. take 40% off list. On longer lengths a special pound price is quoted. For cold punched square nuts, 40% is discounted from list; for hot pressed hexagon nuts up to 1 in. by 30 in., 50%; up to 1 in. diameter, cold punched nuts, 40%. Buttonhead with hexagon nuts, 40% off list, as do hexagon head with hexagon nuts.

Tap Bolts—The following prices are base per 100 for fair-size orders of tap bolts with hexagon heads, delivered from New York warehouse, the present discount being 25% from list:

Length of Screw	Diameter ¼	5/16	⅜	7/16	½	⅝	¾	⅝	1
1½	$0.73	$0.95	$1.11	$1.32	$1.65	$2.47	$3.47	$4.95	$6.60
1¾	.86	1.03	1.17	1.39	1.73	2.57	3.59	5.12	6.81
2	.91	1.05	1.23	1.47	1.82	2.67	3.71	5.28	7.01
2¼	.95	1.10	1.29	1.54	1.90	2.77	3.84	5.45	7.22
2½	.99	1.15	1.34	1.62	1.98	2.87	3.96	5.61	7.43
2¾	1.03	1.20	1.40	1.69	2.06	2.97	4.08	5.78	7.63
3	1.07	1.25	1.46	1.77	2.15	3.03	4.20	5.94	7.84
3¼	...	1.30	1.52	1.83	2.23	3.17	4.33	6.11	8.04
3½	...	...	1.58	1.91	2.31	2.27	4.46	6.27	8.25
3¾	...	...	...	1.99	2.39	3.37	4.58	6.44	8.46
4	...	...	...	...	2.47	3.47	4.70	6.60	8.66

Bolt Ends with hot pressed nuts sell at the base price of 50 and 10% from list price. This is for fair-sized orders from New York warehouse.

Nuts—On hot pressed nuts $3 off list is allowed and on hexagon $3.20. At this rate the base price per 100 lb. for fair-sized orders from New York warehouse is as follows:

Hot Pressed Square Short Diam.	Blank	Tapped	Hot Pressed Hexagon Short Diam.	Blank	Tapped
½	....	$12.00	½	....	$17.70
9/16	$8.00	9.50	11/16	....	11.30
11/16	6.00	6.90	⅞	$6.40	7.40
¾	5.00	5.70	1¼	5.20	5.80
1⅛	4.50	4.90	1 7/16, 1⅝, 1 13/16, 2	5.10	5.70
1 7/16, 1⅝, 1 11/16, 2	4.40	4.80	2 3/16	5.20	5.90
2¼	4.50	5.00	2⅜	5.50	7.30
2⅜	4.80	5.40			

Semifinished nuts are sold at 70 % from list price.

On cold punched square nuts $3 from list is deducted and on hexagon $3.75. At this rate the base price on fair-sized orders from New York warehouse is as follows in cents per pound:

Bolt	Square Blank	Square Tapped	Hexagon Blank	Hexagon Tapped
¼	17.00	19.00	23.25	25.75
5/16	15.00	16.50	20.25	22.25
⅜	11.50	12.60	14.75	16.35
7/16	11.00	11.90	14.25	15.55
½	8.30	9.00	10.25	11.25
9/16	8.30	8.90	10.25	11.15
⅝	7.00	7.50	8.75	9.45
¾	6.70	7.10	7.65	8.25
⅞	6.60	7.00	7.35	7.95
1	6.60	7.00	7.35	7.95

The base price for fair-sized orders of case-hardened nuts from New York warehouse is 70% from list price.

Rivets—The following are the base quotations for fair quantities from New York warehouse:

	Discount from List
Steel ⅞ and smaller	65 and 10%
Tinned	65 and 10%

	Price per 100 Lb.
Button heads, ¾, ⅞, 1 in. diam. by 2 in. to 5 in.	$4.25
Cone heads, same sizes	4.35

	Extra per 100 Lb.
1¼ to 1¾ in. long, all diameters	$0.25
⅝ in. diameter	0.15
½ in. diameter	0.50
1 in. long and shorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

Wrought Washers—From New York warehouse, the base price on fair-sized orders is $4.50 from list price. At this rate the following prices hold in cents per 100 lb.:

Diameter, In.		Diameter, In.	
⅝	$9.50	1½	$4.80
¾	7.70	1¾	4.70
⅞	6.90	2	4.60
1	6.00	2¼, 2½, 2¾	4.50
1¼	5.30	3¾, 4, 4¼, 4½	5.00
1⅜	4.90	3, 3¼, 3½	4.70

For cast-iron washers, the base price is $2.50 per 100 lb.

Coach or Lag Screws from New York warehouse sell at 65 and 10% from list. This is for fair-sized orders and at this rate the following net prices per 100 hold:

Length, In.	Conical or Gimlet Point ¼ and 5/16	⅜	7/16	½	9/16 and ⅝	¾	⅞	1
1½	$0.69	$0.85	$0.99	$1.18	...	...	...	...
2	.77	.93	1.09	1.29	$1.89	...	...	...
2½	.83	1.01	1.19	1.41	2.05	$2.90	...	...
3	.90	1.10	1.29	1.52	2.21	3.12	$4.73	...
3½	.96	1.18	1.40	1.63	2.36	3.34	5.04	$6.93
4	1.02	1.26	1.50	1.75	2.52	3.56	5.36	7.34
4½	1.09	1.34	1.60	1.86	2.68	3.78	5.67	7.75
5	1.15	1.42	1.70	1.98	2.84	4.00	5.99	8.16
5½	1.21	1.51	1.80	2.09	2.99	4.22	6.30	8.57
6	1.28	1.59	1.90	2.20	3.15	4.44	6.62	8.98

Turnbuckles—From New York warehouse, on sizes smaller than 1¼ in. diameter, 50% off list is charged, and on 1¼ up to 2 in. diameter 40%. At this rate prices follow:

Size		Size		Size	
⅜	$0.20	⅞	$0.38	1½	$0.90
7/16	.21	1	.44	1⅝	1.05
½	.23	1⅛	.50	1¼	1.20
⅝	.25	1¼	.75	1⅞	1.35
¾	.32	1⅜	.83	2	1.59

These prices are for buckles having right and left stub ends and with openings between the heads measuring 5½ in.

Nails—Wire nails f.o.b. Pittsburgh sell at $2.20; galvanized 1 in. and longer, $4.20, and shorter, $4.70. These prices are to regular customers and delivery is made at the mill's convenience.

Copper Rivets from warehouse, New York, sell at 35 and 5% off list and burs at the net list price.

Linseed Oil—Raw, in barrels sells at 77c. per gal. and in 5-gal. cans at 87c. Boiled, it is 1c. per gal. higher.

White Lead, dry and in oil, in cents per pound sells as follows:

100-lb. keg	8.75
25- and 50-lb. kegs	9.00
12½-lb. keg	9.25
1- to 5-lb. cans	10.75

Red Lead, dry, in cents per pound sells as follows:

100-lb. keg	8.75
25- and 50-lb. kegs	9.00
12½-lb. keg	9.25

In oil, the price in cents per pound is as follows:

100-lb. keg	9.25
25- and 50-lb. kegs	9.50
12½-lb. keg	9.75

Sal Soda—These quotations are per 100 lb. at the places designated:

New York	$1.35
Philadelphia	1.10

Roll Sulphur in 360-lb. bbl. sells in New York at $2.15 per 100 lb.

Cotton Waste—In New York, the prices in cents per pound are as follows:

White	8.50@9.50
Colored mixed	6.50@8.00

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire		Cast-Iron Welding Rods	
⅜, 11/32, 5/16, ¼, 7/32, 3/16	8.50	¼ by 19 in. long	22.00
No. 8, 5/32 and No. 10	9.25	3/16 by 12 in. long	26.00
⅛	10.00	⅜ by 19 in. long	20.00
No. 12	11.00	½ by 21 in. long	20.00
3/32, No. 14 and 1/16	12.00	**Vanadium Wire in Coils or Sticks**	
No. 18	14.00	1/16	15.50
No. 20	16.00	3/32	15.00
Special Welding Steel		⅛	14.00
⅛	33.00	5/32	12.00
3/16	30.00	3/16 and larger	11.00
1/16	28.00		

These prices are subject to change according to quantity and shipment desired.

Zinc Sheets—The following prices in cents per pound prevail at New York:

Carload lots, f.o.b. mill	24.00
In casks, New York	24.50
Broken lots, New York	25.00

Copper Sheets—In New York, hot rolled 16 oz. (large lots) base per lb. is 31c.; cold rolled, 14 oz. and heavier, add 1c extra per lb. to the above; polished takes 1c. per sq.ft. extra for 20 in. widths and under; add 2c. per sq.ft. for over 20 in.

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

The Texas Co. has leased the shipyards of Arthur Sewall & Co., Bath, Maine, and will improve the machine shops and install new machinery.

Frank Turner has awarded the contract for the construction of a 2-story, 100x100-ft. garage at Brookline, Mass. Estimated cost, $40,000.

The Colonial Realty Trust Co., Boston, Mass., will build a 2-story, 110x240-ft. garage at Medfield, Mass.

The Springfield Metal Body Co. contemplates the construction of additions to its plant at Springfield, Mass.

H. J. Hartwett will construct a garage at Franklin and Vine St., Worcester, Mass. Estimated cost, $50,000.

The contract has been awarded for the construction of a 1-story, 100x100-ft. garage for George H. Calhoune, Providence, R. I. Estimated cost, $30,000.

The Empire Realty Co. plans to build a 1-story, 50x51-ft. garage on Portland St., Providence, R. I.

The Gong Bell Manufacturing Co. is reconstructing its plant at East Hampton, Conn., which was recently destroyed by fire. Noted Jan. 20.

The contract has been awarded for the construction of a 1-story, 74x113-ft. garage and service station for the Pierce-Arrow Service Station Co., Spruce St., Hartford, Conn. Estimated cost, $15,000.

We have been advised that the contract has been awarded for the reconstruction of the plant for the Winsted Edge Tool Works at Winsted, Conn. Noted Jan. 20.

MIDDLE ATLANTIC STATES

On Jan. 24 an explosion followed by fire wrecked the plant of the Kelker Blower Co., Buffalo, N. Y., manufacturer of plating mill exhausts and ventilators. Loss, $50,000.

The Covert Motor Vehicle Co., Lockport, N. Y., plans to construct an addition to its plant.

W. P. Seaver, Arch., Grand Central Terminal, New York, N. Y. (Borough of Manhattan), is preparing plans for alterations to the garage and shop at 639-49 West 57th St. for the Estate of L. Appleby, 92 Broadway. Estimated cost, $50,000.

The New York Air Brake Co., 165 Broadway, New York, N. Y., plans to construct a 1-story factory at Watertown, N. Y. Estimated cost, $50,000.

Plans have been prepared for a 4-story addition to the plant of the Westinghouse Lamp Works, Bloomfield, N. J. Westinghouse, Church, Kerr & Co., 37 Wall St., New York, N. Y., is Engr.

Plans are being prepared by H. Van Buren Magonigle, Arch., 101 Park Ave., New York, N. Y., for a garage at Butler, N. J., for Morris and Warren Kinney. Estimated cost, $45,000.

The John M. Rogers Works, Inc., Gloucester, N. J., has had plans prepared for the construction of a 1-story, 45x122-ft. machine shop.

The Commercial Welding Co. will establish a new plant on Alling St., Newark, N. J. J. W. Raynor is Gen. Mgr.

The Fulton Garage and Manufacturing Co., Newark, N. J., has acquired a site on Front St. on which it plans to establish a large automobile repair plant and factory for the manufacture of engines for aëroplanes and motor boats.

Plans have been prepared for a 1-story addition to the plant of Kraeuter & Co., Newark, N. J., manufacturer of punches, chisels, etc.

Bids are being received by the Autocar Co., Ardmore, Penn., for the construction of a 3-story, 275x300-ft. addition to its plant. Stearns & Castor, Philadelphia, is Arch.

The Sligo Steel Co., Pittsburgh, Penn., has purchased the plant of the Sligo Iron and Steel Co., Connellsville, Penn. The new company, which was recently organized with $750,000 capital stock, will equip the plant for the manufacture of steel railroad ties. John Robinson and A. L. Allen, Pittsburgh, are interested.

Fire recently destroyed the plant of the Mauch Chunk Foundry and Iron Works, Mauch Chunk, Penn. Loss, $50,000.

The Philadelphia Textile Machinery Co. will build a 250x 260-ft. plant at Philadelphia, Penn. Estimated cost, $20,000.

A 3-story reinforced-concrete garage will be constructed on Senate St., Pittsburgh, Penn., by Golden & Crick.

The Titusville Forge Co. will improve its plant at Titusville, Penn. Estimated cost, $300,000.

The Keystone Talking Machine Co., Williamsport, Penn., has awarded the contract for the construction of a 1-story, 67x200-ft. factory. Estimated cost, $12,000. Noted Jan. 6.

Press reports state that a large tin plate mill is to be constructed near Baltimore, Md., by Baltimore and New York capitalists. J. E. Alfred, Chn. of Bd. of Consolidated Gas Co., Baltimore, is interested.

The contract has been awarded for the construction of a 2-story garage for G. F. Buchholz, 321 West Monument St., Baltimore, Md., at 405-9 McCulloh St.

Plans have been prepared by Stanislaus Russell, Arch., 2900 Clinton Ave., Baltimore, Md., for a 1-story, 100x125-ft. garage for the Northern Garage Co.

We have been informed that Davis & Hemphill, manufacturer of screw-machine products, has awarded the contract for the construction of a new factory at Elkridge, Md.

The contract has been awarded for the construction of a 3-story garage for Joseph J. Leary, 26th and M St., Washington, D. C. Estimated cost, $50,000. Noted Oct. 21 and 28.

SOUTHERN STATES

The Price Electric Devices Corporation, Waynesboro, Va., will establish a plant at Basic, Va., for the manufacturer of lighting and ignition generators, starting motors and other automobile equipment. E. L. Eakle is Gen. Mgr.

The Wilmont Ventilating Co., Roanoke, Va., recently incorporated with $50,000 capital stock, will establish a factory for the manufacture of ventilating fans. G. T. Geer is Pres.

The Barbour Buggy Co., South Boston, Va., will install equipment for the manufacture of automobiles.

Fire recently destroyed the garage and machine shop of E. E. Birch & Sons, Newell, W. Va. Loss, $2,500.

The Forsythe Motor Co., Winston-Salem, N. C., recently incorporated, will build a garage and repair shop. J. H. Grubb and J. A. Walker are interested.

The Bell-Morris Auto Repair Co., recently incorporated, will establish an automobile and machinery-repairing shop at 206-8 Dexter Ave., Montgomery, Ala. C. M. Morris and J. Bell, interested.

William H. Bostwick, Jefferson City, Tenn., plans to construct a 3-story, 50x100-ft. garage on Main St., Morristown, Tenn. Estimated cost, $20,000.

MIDDLE WEST

We have been advised that the Buckeye Twist Drill Co., Alliance, Ohio, is in the market for lathes, milling machines and grinders. Noted Jan. 27.

The Aurora Foundry Co., Aurora, Ohio, will build an addition to its plant.

The contract has been awarded for the construction of a 1-story addition to the plant for the Cincinnati Gear Co., 1825 Reading Rd., Cincinnati, Ohio.

Bids will soon be received by Zettle & Rapp, Arch., 607 Johnston Bldg., Cincinnati, Ohio, for the construction of a 2-story, 78x108-ft. garage and salesroom at Cincinnati for the Sandman Estate. Estimated cost, $25,000. Noted Jan. 27.

The contract will soon be awarded for the construction of additions to the plant of the Champion Machine and Forging Co. at Cleveland, Ohio.

The Chandler Motor Car Co. has awarded the contract for the construction of a 1-story, 60x100-ft. addition to its plant on East 131st St., Cleveland, Ohio. Noted Dec. 23.

The Cleveland Dental Manufacturing Co., manufacturer of dental goods, plans to build an addition to its plant at Cleveland, Ohio.

Plans have been prepared for the construction of a power plant and foundry addition to the plant on Ivanhoe Rd., Cleveland, Ohio, for the Frantz Premier Co., manufacturer of vacuum cleaners. Estimated cost, $100,000.

The Harding Motor Car Co., Cuyahoga Bldg., Cleveland, Ohio, plans to construct a factory in Cleveland. F. I. Harding is interested.

The Loew Manufacturing Co., manufacturer of gas engines, etc., has purchased a site adjoining its plant at 9100 Madison Ave., Cleveland, Ohio, and will construct an addition.

The Ohio Gear and Grinding Co., 2095 East 19th St., Cleveland, Ohio, will establish a factory at Payne and East 17th St., Cleveland.

The Parish & Bingham Co., West 106th St. and Madison Ave., Cleveland, Ohio, is in the market for machinery for the manufacture of pressed metal. Noted Nov. 4.

The Perfection Spring Co., Central and East 66th St., Cleveland, Ohio, will build an addition to its plant. Christian Girl is Pres.

The Lamneck Co., manufacture of heating equipment, plans to construct a 3-story addition to its plant at Columbus, Ohio.

The American Steel and Wire Co. plans to build a rod mill addition to its plant at Cuyhoga Falls, Ohio.

The Dayton Time Lock Co. contemplates constructing an addition to its plant at Dayton, Ohio.

The Recording and Computing Machine Co. plans to construct additions to its plant at Dayton, Ohio.

The Sunray Stove Co. has purchased a site at Sandusky and Railroad St., Delaware, Ohio, and will build a factory.

Fire recently damaged the factory of the Ohio Steel Foundry at Lima, Ohio. Loss, $1,000.

The W. H. Mullens Co. will build a 3-story, 150x200-ft. addition to its plant at Salem, Ohio, for the manufacture of automobile parts.

The John Mertz Manufacturing Co., manufacturer of gasoline tanks and sheet metal products, will build a plant at Sandusky, Ohio.

The Union Chain and Manufacturing Co. has purchased a building opposite its factory at Seville, Ohio, and will install power presses, automatic screw machines, etc. Walter Hay is Gen. Mgr.

Plans are being prepared for a pattern shop for the Modern Pattern Works, Toledo, Ohio.

The Warren Tool and Forge Co., Warren, Ohio, plans to construct several additions to its plant.

The Tower Manufacturing Co., Madison, Ind., will install additional machinery in its plant at Madison for the manufacture of carpet tacks.

The Portland Body Works, manufacturer of vehicle bodies and parts, will build a 48x64-ft. addition to its plant at Portland, Ind.

The Farmers' Auto and Machinery Co. is constructing a 150x200-ft. plant at Bay City, Mich.

The contract has been awarded for the construction of a 5-story reinforced-concrete factory at Detroit, Mich., for the American Auto Trimmings Co. Estimated cost, $45,000.

The Long Manufacturing Co., manufacturer of automobile radiators, plans to construct additions to its plant at Detroit, Mich.

The Standard Motor Truck Co. plans to build a 3-story, 125x150-ft. addition to its plant at Detroit, Mich.

The Timken-Detroit Axle Co. plans to construct a plant at Detroit, Mich.

The Gier Pressed Steel Co., Lansing, Mich., contemplates installing additional equipment for the manufacture of shrouds and panels for automobile bodies, fenders, radiator covers and oil pans. B. S. Gier is Secy. and Gen. Mgr. Noted Jan. 27.

The American Enameled Magnet Wire Co. is constructing a 85x165-ft. factory on Water St., Muskegon, Mich. Estimated cost, $50,000. Noted Dec. 2.

George Helman and Gus Latsch contemplate the construction of a garage at 271 Pine St., Muskegon, Mich.

Plans have been prepared for the construction of an addition to the plant of the Piston Ring Co. at Muskegon, Mich. Noted Jan. 13.

Work has been started on the construction of an addition to the plant of the Romeo Foundry Co. at Romeo, Mich.

The Sheffield Car Co. will construct an addition to its machine shop at Three Rivers, Mich.

The American Ever Ready Co., 1238 South Michigan Ave., Chicago, Ill., manufacturer of electrical novelties, has awarded the contract for the construction of a 4-story factory at Chicago. Noted Jan. 16.

The Cyclone Blow Pipe Co. plans to construct a 1-story factory at 2542-52 West 21st St., Chicago, Ill. Estimated cost, $20,000.

The Kofaro Steel Works, Chicago, Ill., plans to construct a plant at Chicago, and will be in the market for heat-treating furnaces, annealing ovens, tempering tanks and other equipment.

The contract has been awarded for the construction of a 4-story garage at Chicago, Ill., for F. McMahon. Estimated cost, $40,000.

The contract has been awarded for the construction of a 5-story garage at 218 West Monroe St., Chicago, Ill., for the United Garage Co. Estimated cost, $20,000.

Preliminary plans are being prepared for the construction of a 2-story, 90x300-ft. factory at Beloit, Wis., for the Berlin Machine Works. Porter B. Yates is Pres. Noted Jan. 27.

James F. Salmon will establish a garage and repair shop at Glenwood City, Wis.

The contract has been awarded for the construction of a 1- and 2-story, 170x225-ft. plant at Madison, Wis., for the French Battery and Carbon Co. Noted Dec. 23.

The Wisconsin Aluminum Foundry Co. contemplates building a 60x140-ft. addition at 16th and Franklin St., Manitowoc, Wis. Estimated cost, $25,000. Bruno Dalwig is Gen. Mgr.

Paul Pirwitz plans to build a 48x88-ft. garage and machine shop at 4th and Maple St., Marshfield, Wis.

The contract has been awarded for the construction of a plant on Park Ave., Milwaukee, Wis., for the Fitzsimmons Steel and Iron Co. Noted Jan. 27.

It is reported that the Illinois Steel Co., a subsidiary of the United States Steel Corporation, plans to enlarge its plant at Milwaukee, Wis. Estimated cost, $2,000,000. R. P. Charlton is Local Mgr.

Plans are being prepared by Charles E. Malig, Arch., for the construction of a municipal garage on Market St., Milwaukee, Wis. Noted Dec. 9.

We have been advised that the Neacy & Read Investment Co. has rejected all bids received for the construction of a 2- and 3-story, 120x176-ft. garage and machine shop at Milwaukee, Wis. Noted Jan. 20.

The Kimberly, Clark Co., Neenah, Wis., has awarded the contract for the construction of a 1-story machine shop at Niagara, Wis.

E. W. Scheel is preparing plans for the construction of a 56x124-ft. garage and machine shop for the Turtle Lake Auto Co. at Turtle Lake, Wis.

The contract has been awarded for the construction of a 1-story forge shop at West Allis, Wis., for the Allis-Chalmers Co. Otto H. Falk is Pres. Noted Jan. 20.

The contract has been awarded for the construction of a foundry at West Allis, Wis., for the Electric Steel Casting Co. Noted Jan. 27.

WEST OF THE MISSISSIPPI

The City Council, Duluth, Minn., purchased a site at 12th Ave. E., and London Rd. and will construct a municipal garage.

Alexander McDougall, Duluth, Minn., contemplates building a small shipbuilding plant and yard at Duluth.

Press reports state that the Arkansas Valley Interurban Railway Co. contemplates building car shops at Halsted, Kan. Estimated cost, $15,000. Charles D. Bell, Wichita, Ch. Engr.

The McDonald Estate has awarded the contract for the construction of a 2-story garage at Lincoln, Neb. Estimated cost, $15,000.

Plans being prepared by P. Simpson, Arch., Carthage, Mo., for a 1-story garage at Joplin, Mo., for Lanpher Carriage and Auto Co. Estimated cost, $10,000.

The All-Steel Motor Co., La Salle Bldg., St. Louis, Mo., will construct a factory at Macon, Mo.

The Busch-Sulzer Bros. Diesel Engine Co., St. Louis, Mo., has awarded the contract for an addition to its plant. Estimated cost, $40,000. Noted Jan. 27.

The Great Western Smelting and Refining Co. has awarded the contract for a 1-story foundry at 3108-22 North Broadway, St. Louis, Mo. Estimated cost, $50,000.

The Krey Packing Co., St. Louis, Mo., will build a 2-story garage.

The St. Louis Sectional Garage Co., St. Louis, Mo., has been incorporated with a capital stock of $15,000, and will equip a plant to manufacture portable metal garages.

The United States Incandescent Lamp Co., 2901 Clark Ave., St. Louis, Mo., will build an addition to its plant.

The Wagner Electric Manufacturing Co., St. Louis, Mo., has leased an additional building on Maple Ave., and will equip same as an addition to its plant. W. A. Layman is Pres.

The Texas Steel Co., Beaumont, Tex., contemplates building a plant. Estimated cost, $2,500,000.

Plans being prepared by Bert C. Overton, Arch., Joplin, Mo., for a 2-story factory for the United Structural and Sheet Metal Works, Okmulgee, Okla. Estimated cost, $15,000.

The King Mogul Motor Co., Tulsa, Okla., has been incorporated with a capital stock of $10,000, and will build a machine shop and repair plant.

WESTERN STATES

The Anderson Steamboat Co. will enlarge its shipbuilding plant at Seattle, Wash. Estimated cost, $500,000. J. L. Anderson is Pres.

The Rex Metal Works, recently incorporated at Seattle, Wash., with $10,000 capital stock, is having plans prepared for a plant at Seattle. A. K. Goldman is interested.

Fire, Jan. 21, destroyed the plant of the Ornamental Iron Works, Stone St., Spokane, Wash. Loss, $30,000.

Plans are being prepared by Ernest Kroner, Arch., for the construction of a garage and machine shop at Oregon and East 1st St., Portland, Ore., for K. D. Goltra and Louis Kuehn. Estimated cost, $10,000.

Plans are being prepared by J. M. Cooper, 830 McGarry St., Los Angeles, Calif., for the construction of a garage and machine shop for W. Kruse, 400 Towne Ave., Los Angeles, Calif.

Charles P. Kern will construct a garage on Valencia St., San Francisco, Calif.

The Llewellyn Iron Works plan to construct a plant at Torrance, Calif. Estimated cost, $400,000.

CANADA

The Burlington Steel Co. has awarded the contract for the construction of an addition to its plant at Hamilton, Ont. Estimated cost, $5,000. Noted Jan. 27.

The Precision Manufacturing Co. will equip a plant at St. Catherines, Ont., for the manufacture of metal articles.

The Redcliffe Rolling Mills will enlarge its plant at Redcliffe, Alta., and install new machinery.

GENERAL MANUFACTURING

NEW ENGLAND STATES

The Burgess Sulphite Fibre Co. is constructing additions to its plant at Berlin, N. H.

The Stevens Linen Mills has awarded the contract for the construction of a 5-story, 50x100-ft. knitting mill at Dudley, Mass. Noted Jan. 13.

The Wold Woolen Co., Stillwater, R. I., has leased the plant of the Ashway Woolen Co. at Hopkinton, Mass., and will construct a 2-story, 40x80-ft. addition.

We have been advised that the Stoddard Rubber Co., Milbury, Mass., is in the market for heater presses and general machinery. Noted Jan. 20.

The contract has been awarded for the construction of a 4-story spinning mill at New Bedford, Mass., for the Sharp Manufacturing Co. Noted Dec. 23.

The Keith Shoe Co. plans to construct an addition to its plant at North Adams, Mass.

The Otis Manufacturing Co. has awarded the contract for the construction of a 3-story, 100x250-ft. spinning mill at Ware, Mass. Noted Jan. 13.

The Mysto Manufacturing Co., manufacturer of novelties, plans to construct an addition to its plant in the Cedar Hill District, New Haven, Conn.

The James J. Regan Manufacturing Co., manufacturer of cotton goods, will construct a two-story, 32x48-ft. addition to its plant at Rockville, Conn.

The Stafford Worsted Co., Stafford Springs, Conn., recently incorporated with $150,000 capital stock, will construct a 2-story, 115x200-ft. mill.

The contract has been awarded for the construction of a 90x300-ft. addition to the plant of Baer Bros., manufacturer of bronze powder, at Stamford, Conn. Noted Dec. 2.

MIDDLE ATLANTIC STATES

Plans are being prepared for the construction of a plant at Liverpool Rd. and Spring St., Syracuse, N. Y., for the Will & Baumer Co., manufacturer of beeswax. Estimated cost, $300,000.

A 1-story addition will be built to the plant of the Beaver Leather Co., Frelinghuysen Ave., Newark, N. J.

An addition will be built to the plant of the Dye Products and Chemical Co., Poinier St., Newark, N. J.

Marden, Orth & Hastings, Boston, Mass., manufacturer of oils and acids, has acquired a site on Newark Meadows, Newark, N. J., and will construct a plant. Estimated cost, $75,000.

The Seaboard Chemical Co., Newark, N. J., recently incorporated with $285,000 capital stock, will construct a plant on the Newark Meadows near Point-No-Point. Charles M. Mason is Pres.

Fire, Jan. 21, damaged the plant of the I. T. Straus Leather Manufacturing Co., Newark, N. J. Loss unknown.

A company is being organized at Paterson, N. J., to be known as the Silk Dye Stuffs Manufacturing Co., with a capital stock of $1,000,000. The new company plans to construct a plant at Paterson for the manufacture of aniline dyes. James C. Mackey is interested.

Plans have been prepared for the construction of a 1-story addition to the plant of the Griswold Worsted Co., Darby, Penn.

The Manhattan Woolen Mills Co., Greensburg, Penn., recently incorporated with $100,000 capital stock, will construct a factory. Robert F. Evans, Greensburg, is interested.

The Air Reduction Co., Philadelphia, Penn., is having plans prepared by William Steele & Sons for a 1-story, 70x100-ft. plant at Germantown and Sedgley Ave.

The L. H. Gilmer Co., manufacturer of webbing, belting and tape, will construct a 50x200-ft. addition to its plant at Tacony, Philadelphia, Penn.

SOUTHERN STATES

The Fields Manufacturing Co., Mouth of Wilson, Va., recently incorporated with $50,000 capital stock, will build a factory at Mouth of Wilson for the manufacture of cotton goods. J. C. Fields, Mgr.

A bottling plant will be constructed by H. S. Cushwa and George Buxton, Martinsburg, W. Va.

The Essex Glass Co., Parkersburg, W. Va., plans to build an addition to its plant.

An addition will be constructed to the picker room of the Florence Cotton Mills, Forest City, N. C.

The Linn Mills Co., manufacturer of cotton yarn, Landis, N. C., will enlarge its mills.

The Thread Mills Co., Spray, N. C., will construct a mill at Leakesville, N. C.

The Longisland Cotton Mill Co., Longisland, N. C., plans to construct another mill. G. H. Brown, Statesville, N. C., is Pres.

C. E. Hutchison and associates, Mt. Holly, N. C., plan to construct a cotton-yarn mill.

MIDDLE WEST

A permit has been granted to the National Lead Co. for the construction of an addition to its plant on Freeman Ave., Cincinnati, Ohio.

Fire, Jan. 22, damaged the plant of the American Box Co. at Stones Levee and Central Ave., Cleveland, Ohio. Loss, $8,000.

The Euclid Glass Co., a subsidiary of the General Electric Co., plans to construct a 50x65-ft. and 35x50-ft. addition to its plant on Ivanhoe Rd., Cleveland, Ohio. Izant & Frink, Illuminating Bldg., Cleveland, is Arch.

The Sheriff Street Market and Storage Co., East 4th St., Cleveland, Ohio, contemplates the construction of a cold storage plant along the line of the new Cleveland & Youngstown Ry. Homer McDaniel is Mgr.

The Excelsior Seat Co., Columbus, Ohio, will be in the market for machinery for the manufacture of automobile bodies.

The Akron Repair and Tire Co., 340 Erie St., Toledo, Ohio, plans to enlarge its plant at Toledo.

The Central Ohio Paper Co., 124 Ontario St., Toledo, Ohio, plans to construct a factory at Toledo. Estimated cost, $50,000.

The Bockstege Furniture Co. plans to construct an addition to its plant at Evansville, Ind. Estimated cost, $40,000.

Ward Bros., manufacturer of maple flooring, is constructing an addition to its plant at Big Rapids, Mich.

The contract has been awarded for the construction of a 1-story addition to the plant of the Michigan Lithographing Co. at Fulton St. and Carleton Ave., Grand Rapids, Mich. Estimated cost, $4,000.

The Cappon-Bertsch Leather Co. has awarded the contract for the construction of a 3-story addition to its plant at Holland, Mich. Noted Jan. 13.

The contract has been awarded by the De Pree Chemical Co. for the construction of a 4-story, 60x130-ft. addition to its plant at Holland, Mich. Noted Jan. 6.

The contract has been awarded for the construction of a factory at Ionia, Mich., for the Ypsilanti Reed Furniture Co. Noted Dec. 2

WEST OF THE MISSISSIPPI

The Continental Serum Laboratory Co., Muscatine, Iowa, contemplates the construction of a plant. Estimated cost, $50,000.

The Duluth Gas and Welding Co., 2112 West Michigan St., Duluth, Minn., will enlarge its plant. Estimated cost, $7,000.

The Price Cereal Co., Minneapolis, Minn., has awarded the contract for a new mill at 13th Ave. and Jackson St., Minneapolis. Estimated cost, $60,000. Noted Oct. 21.

The C. F. Massey Co., Chicago, Ill., will build a factory in St. Paul, Minn., for the manufacture of concrete products. Estimated cost, $100,000.

The Ralston Furniture Factory Co., Omaha, Neb., will enlarge its factory. Estimated cost, $60,000.

The Northern Alcohol Manufacturing Co., Great Falls, Mont., has acquired a site at 35th St. and 6th Ave., S., Billings, Mont., and will construct an alcohol plant.

Adolph Item, Livingston, Mont., contemplates the construction of a fruit-packing plant at Livingston.

The Kansas City Chemical Co., Kansas City, Mo., has leased floor space and will equip same for the manufacture of magnesite products.

WESTERN STATES

Fire recently destroyed the plant of the Crescent Box Co. at Bonners Ferry, Idaho.

The contract has been awarded for the construction of a plant at Delta, Utah, for the Southern Utah Sugar Co. Estimated cost, $500,000.

Herman Ahlers is interested in the construction of a canning plant in the Necanicu District, Astoria, Ore.

Plans are being prepared by the Geijsbeek Engineering Co., Blake-McFall Bldg., Portland, Ore., for the construction of a plant near Astoria, for the Warrenton Clay Co. Estimated cost, $85,000. George W. Warren is Pres.

Steusloff Bros. contemplates building a packing plant at Salem, Ore. Estimated cost, $30,000.

R. B. Taylor and S. A. Graves, Escondido, Calif., are interested in the construction of a plant in a cañon near Escondido for the manufacture of powder.

The Smythe-Jay Music Co. plans to construct a plant at Los Gatos, Calif., for the manufacture of music rolls. Estimated cost, $12,000.

CANADA

Fire, Jan. 15, damaged the plant of the Standard Boot and Shoe Co., Middle Sackville, N. B.

Wallace, Chapman & Marshall plans to build a factory at Oakville, Ont., for the manufacture of boxes, baskets, etc.

The Western Sugar Refining Co., Ltd., will construct a refining plant at Petrolia, Ont. Estimated cost, $46,000. Ralph D. Mitchell, Cleveland, Ohio, is interested.

Lockwood, Green & Co., Boston, Mass., plans to construct a factory at Sarnia, Ont., for the manufacture of cotton goods. Estimated cost, $500,000.

Work will soon be started on the construction of a 30-ton sulphite mill at Thorold, Ont., for the Ontario Paper Co., Ltd.

Plans are being prepared by William R. Gordon for the construction of a refinery at Wallaceburg, Ont., for the Dominion Sugar Co. Estimated cost, $300,000.

The Dominion Glass Co. will build an addition to its plant at Redcliffe, Alta.

Classified Advertising

The Classified Advertising section appears on pages 217, 218, 219, of this issue and will in future appear in the same relative position in the paper.

The Classified Advertising section appears on pages 217, 218, 219

American Machinist

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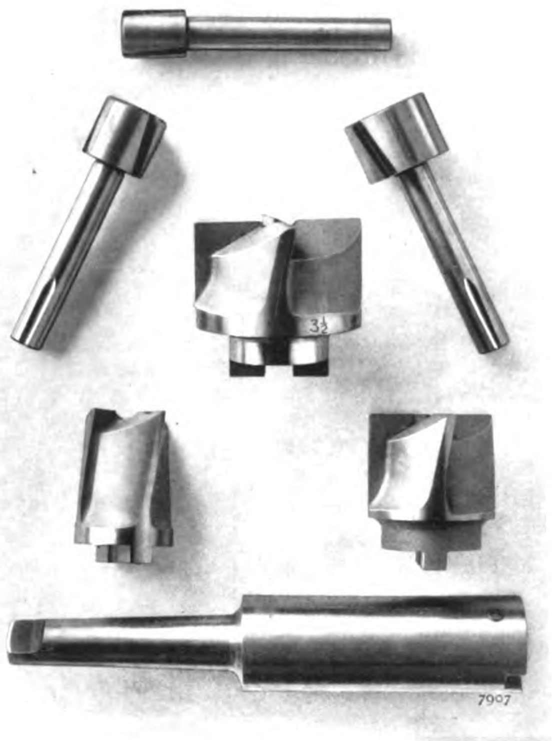
The Right Combination At Once



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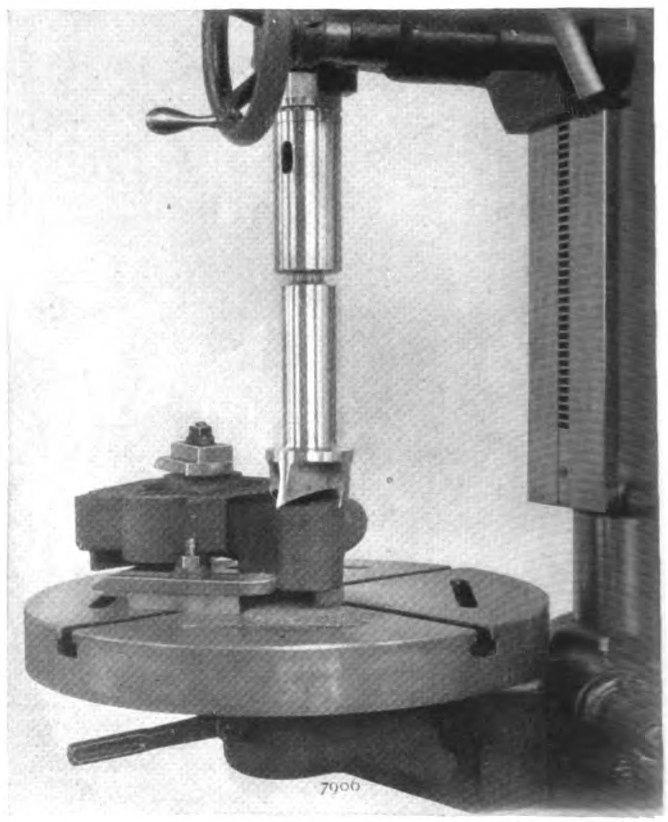

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WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormay processes, protected by United States patent issued June 22, 1915, and another pending

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Talks · With · Our · Readers

By the Publisher

Nineteen hundred years ago an attempt was made to kill personality with hammer and nails.

The attempt was so unsuccessful that we are surer today than ever before, that personality, through uniqueness and integrity, cannot be killed, does not die—but LIVES.

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In the minds of men he counseled, and in the hearts of those he inspired to hard, useful, honest work, he lives.

You are asking: "What will happen to the American Machinist now?"

For a long time Mr. Hill had referred to himself as "The Umpire." It was his policy to share responsibility. It was his pride, expressed in his last written statement, that the death of no one of those among whom the responsibilities of this institution were divided, would alter the policies or lessen the efficiency of the organization he made.

This confidence is to be justified.

No standard will be lowered. No proved policy changed.

If it is humanly possible to do better work, to produce larger results, to be of greater help to the industries we serve, we will do it—

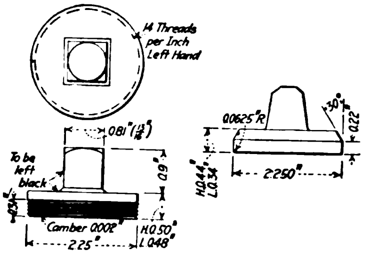
Because we know that is what John A. Hill would expect us to do.

Manufacturing British 18-Pounder High-Explosive Shells--IV*

By E. A. Suverkrop

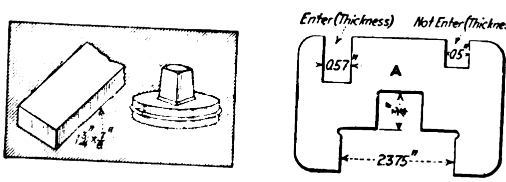
SYNOPSIS—The body of the high-explosive shell is merely a container for a quantity of high explosive that, as a matter of prime importance, must be protected from premature detonation. In all steel bars there is a possibility of piping. Should a pipe be present in the base of a high-explosive shell and should no precautions be taken to seal it, the flame from the propulsive charge in the gun might communicate with the explosive charge in the shell, resulting in wrecking the gun and killing or maiming all the men in the vicinity.

The bases of all high-explosive shells are sealed with steel base plates. In order to make the sealing more positive the base plates are made from flat steel bars worked



FIGS. 38 AND 39. TWO TYPES OF BASE PLATES
Fig. 38—Threaded base plate for 18-pounder high-explosive shell. Fig. 39—Plain riveted base plate

so that the grain of the metal in the finished base plate, when it is in place in the shell, runs at right angles to the grain of the metal in the shell itself. With the base plate made in this manner, even should there be pipes in both the base plate and the shell, they will run at right angles to each other and in different planes when the shell and plate are assembled. There will consequently be no possibility of connection between them and therefore no means of communication between the propulsive and explosive charges.



OPERATION 23. DROP-FORGING BASE PLATES
Machines Used—Billings & Spencer and Bliss drop hammers.
Special Fixtures and Tools—Oil furnaces, trimming press and dies.
Gages—Diameter and thickness gages A and B.
Production—One man, one furnace and one hammer, 110 pieces per hour.
References—See Figs. 38, 39, 40, 41 and 42.

As previously stated, two types of base plates are now permitted by the Government authorities—one, threaded as shown in Fig. 38; and the other, a riveted base plate, shown in Fig. 39, which is now used at the Dominion Bridge Works. The blanks for both types are made under Billings & Spencer and Bliss drop hammers in the drop-forge shop, shown in Fig. 40.

In Fig. 41 is shown the drop-forging die for both types of base plates. In Fig. 42 is shown the die for the larger base plate used in the 4.5-in. shells. It will be noticed that the large base-plate forging is of the shape required for threading. Experiments have been made with plain riveted base plates for the larger sizes of shells, but so far no particular type of riveted base plate for the larger sizes of shells has been adopted as a standard.

The steel used for these dies—one that has given entire satisfaction—is Jessop's, containing 0.75 per cent. carbon. With the equipment found in the average toolroom a die like this should be made in about 75 hours. This time could probably be cut considerably by a drop-forge-die maker. When finished, the dies are heated to about 1,450 deg. F. and quenched in water. Before they are quite cold, they are removed from the water and immersed in fish oil, where they are allowed to cool off gradually. It is well to remember that the exact quenching temperature depends on the size and shape of the piece, as well as on the carbon content.

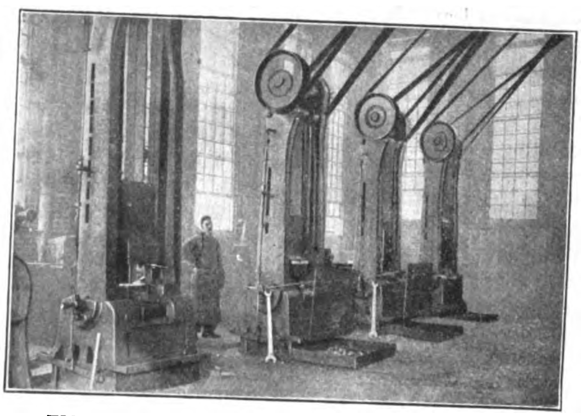


FIG. 40. DROP HAMMERS IN THE FORGE SHOP

The average life of the dies on this work is about 20,000 forgings for the small dies and 18,000 for the large size before the impression wears so that resinking becomes necessary.

The steel used for forging the base plates is 0.50 carbon, but satisfactory tests have been made with 0.20 carbon steel for this purpose, although none of this is used. For the small plates the stock used is 1¾x⅞ in., and for the large plates 2½x⅞ in.

The drop-hammer operator can on an average make 110 small plates an hour, or 85 large ones. The trimming die is an ordinary round die with a punch to match. An operator can trim about 550 of either size of forgings per hour. While not actually an operation on the shell itself, this making of the base plate will be considered as the twenty-third operation in this series.

*Previous installments appeared on pages 1, 45 and 145.

After forging, the base plates are subjected to a rigid visual inspection. Test pieces are also taken from a certain percentage of the forgings and pulled to destruction. The base plates that pass inspection are trucked from the forge shop to the rough-turning lathes in the No. 2 shell shop. One of these lathes is shown in Fig. 43. In these machines the forging undergoes the twenty-fourth operation, in which it is merely reduced in diameter, no stock being removed from the face of the base-plate blank. The rough forging is shown at *A*, and the rough-turned work at *B*. The lathes are equipped with sockets *D* having a tapered square hole that fits over the shank of the rough forging. The sockets are provided with tapered tangs that are driven in the taper in the nose of the lathe spindle. Fitted in the tail spindle is a flat disk center *E*, which abuts against the face of the rough forging and holds it in the tapered socket while the cut is running. In the tool post of the lathe is an ordinary roughing tool *F*.

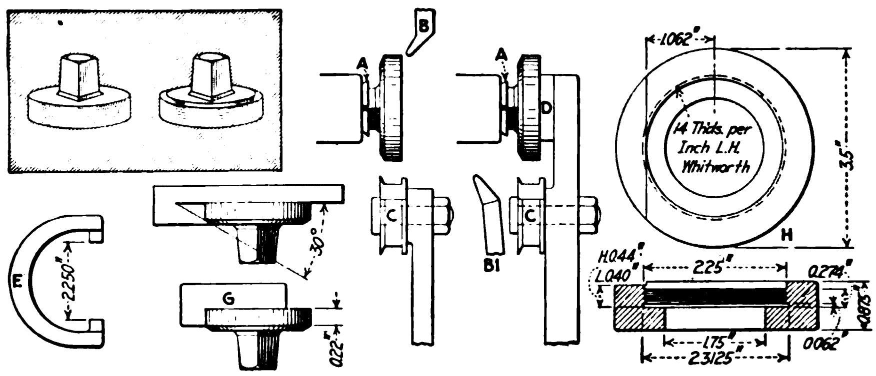
The operation of rough-turning is as follows: The rough forging is entered in the socket *D*, as shown at *G*, in Fig. 43. The disk center in the tail spindle is run up against the flat base of the forging, and the tail spindle is clamped. The travel of the tool is toward the headstock. Enough metal is removed to leave about $\frac{1}{32}$ in. for the finish-turning operation. A man can rough-turn from 175 to 200 small base plates per hour. One cut only is taken, and the setting of the tool is altered only after grinding and when, through wear, slight adjustment becomes necessary.

The twenty-fifth operation, which consists of finishing the base plates, is done both on engine lathes and on Bridgeport special base-plate threading machines that have been modified to do this work. The method of turning and threading base plates with the Bridgeport machines is fully described and illustrated in the fourteenth operation in the series of articles covering the manufacture of the 4.5-in. high-explosive shell and therefore need not be repeated here. Its output on the small base plate is of course higher than on the large one. On this work it is capable of turning from 12 to 15 threaded base plates per hour.

The method of holding the rough-turned base-plate forging is in both types of machines the same. The entire arrangement is to be seen in Fig. 44. Here is shown one of the Bridgeport automatic machines that has been changed over to take care of this particular class of work.

The spindles of the machines are hollow and provided with draw-in collets to hold the work *A*. The draw-in collet is operated by the large handwheel *B*. The rear tool block *C* is controlled by the ball handle *D*, which is mounted on a screw that passes through a hole in the screw operating the front tool block *E*. The front tool block is operated by the handwheel *F*. It carries a circular formed tool *G* of the same shape as the finished base plate.

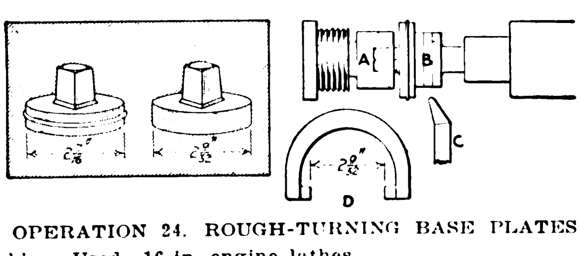
The operation of finish-turning a base plate is as follows: The rough-turned base plate *A* is chucked in the collet chuck. The facing tool in the rear tool block *C* is then brought forward by operating the ball handle *D*. When the bottom of the base plate is faced, the tool is returned clear of the work. The operator then feeds the circular forming tool *G* into the work until the stop *H* brings up against the member *I*. This determines the diameter of the work and finishes the operation.



OPERATION 25. FINISH-TURNING BASE PLATES

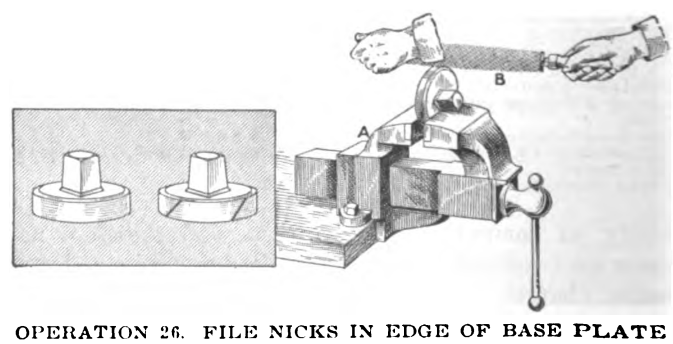
Machines Used—Converted Bridgeport automatics and engine lathes.
Special Tools and Fixtures—Draw-in collet A; facing tool B; formed tool C; for the engine lathes the special stop D and turning tool B1.
Gages—Snap gage E; angle gage F; height gage G; gage H for threaded base plate.
Production—One man and one machine, 75 per hour.
References—See Figs. 44 and 45.

The tools used in the engine lathes are shown in Fig. 45. They differ slightly from those used in the converted automatics. The draw-in chucks are arranged in precisely the same manner as those in the converted automatics. Owing to the fact that the lathe was close to a window, it was necessary to swing the compound slide around so that the photograph for Fig. 45 could be taken. The reader should remember, therefore, when looking at the illustration, that the compound rest is swung counter-clockwise about 90 deg. from its operating position; that is to say, the face of *C* should be at right angles to the axis of the lathe spindle and not in line with it, as is illustrated.



OPERATION 24. ROUGH-TURNING BASE PLATES

Machines Used—16-in. engine lathes.
Special Tools and Fixtures—Socket driver A; disk center B; turning tool C.
Gages—Snap gage D.
Production—One man and one lathe, 175 to 200 per hour.
Reference—See Fig. 43.



OPERATION 26. FILE NICKS IN EDGE OF BASE PLATE

Machines Used—None.
Special Tools and Fixtures—Machinist's vise A; half-round file B. Hand operation.
Gages—None.
Production—One man, vise and file, 60 per hour.
References—None.

At A is shown one of the collets with a jaw broken out, thus permitting a view of the teeth in the inner faces of the jaws. The taper on the inner faces of the jaws is 7 deg., the same as that on the shanks of the base plates. The facing tool B, which is the first tool used, is set in advance of the forming tool. At C is a stop so located that when it is against the faced bottom of the base plate the forming tool D is correctly located to finish the perimeter.

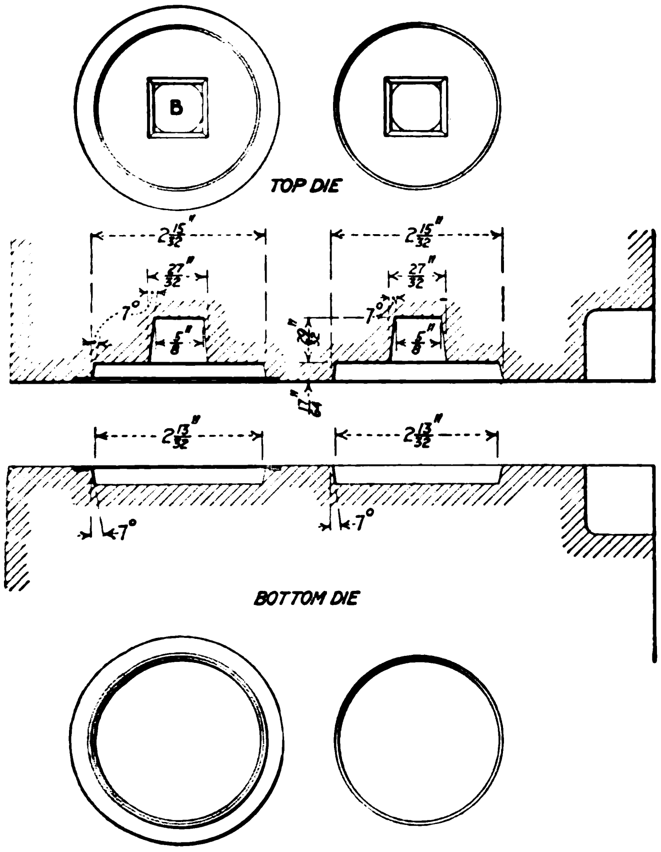


FIG. 41. DIES AND FORGING FOR RIVETED BASE PLATE FOR 18-LB. HIGH-EXPLOSIVE SHELL

The operation of finish-turning a base plate with the engine lathe is as follows: The rough-turned blank is chucked in the same manner as in the converted Bridgeport automatic machine, shown in Fig. 44. The facing tool B is run across the base of the plate. It is then run back and the carriage racked toward the headstock until the stop C encounters the faced base of the work. With the carriage held in this position the formed tool D is fed in until the stop on the cross-slide is reached. This finishes the work.

For inspection three gages are used—a 2.250-in. snap gage for the diameter; a 30-deg. angular gage for the angular part of the work and a 0.22-in. height gage for the height of the cylindrical part. The scheduled time on the finish-turning is about 75 pieces per hour. This is about five times as fast as the highest possible production on the threaded base plate. The tools used are much more rugged than those used for threaded base plates and consequently give less trouble. After inspection the work is credited to the operator and trucked to the benches, where the edges are nicked.

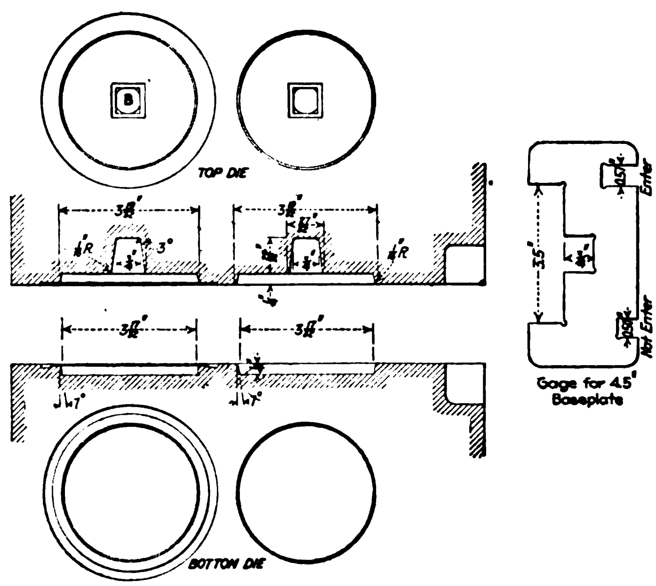
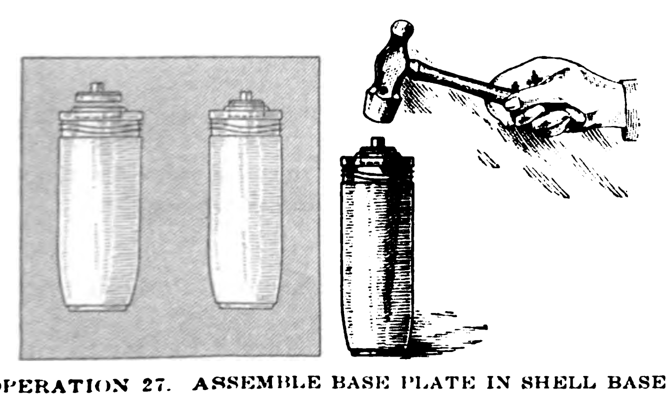


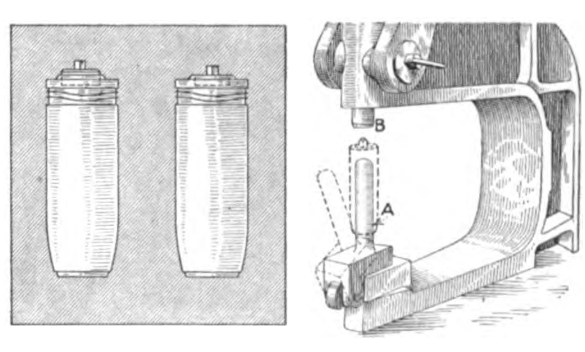
FIG. 42. DIES FOR BASE PLATE, 4.5-IN. HOWITZER HIGH-EXPLOSIVE SHELL

To preclude the possibility of trapping the air in the base-plate recess when the base plate is forced home, the Government requires that the base plates have three grooves cut in the periphery of the cylindrical part. These act as vents for the release of the air. The requirement is that the nicks be cut out; that is to say, the metal must be removed, not merely wedged to the sides with a cold chisel, as is the method when the wave ribs are nicked for the same purpose in the copper driving-band groove.



OPERATION 27. ASSEMBLE BASE PLATE IN SHELL BASE

Machines Used—None.
Special Fixtures and Tools—None; hand hammer only used to enter the plates in the shell.
Gages—None.
Production—One man, about 200 per hour.
Note—No Pettman cement used with this type of base plate.
References—None.



OPERATION 28. DRIVE IN THE BASE PLATES

Machines Used—Murphy pneumatic riveters.
Special Tools and Fixtures—Tilting post A; hollow punch B to clear the shank of the base plate.
Gages—None; the hand hammer is used to test the work.
Production—Two men and one machine, 200 per hour
Note—For method of assembling threaded base plate see operation 15 in manufacture of the 4.5-in. high-explosive shell.
References—See Figs. 47 and 48.

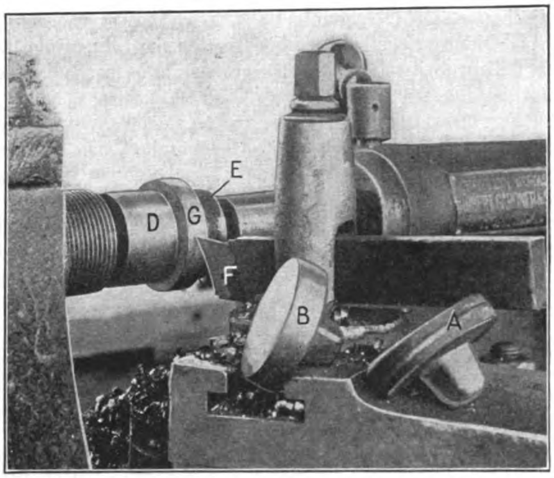
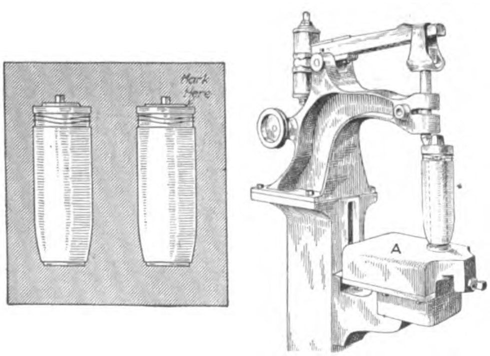


FIG. 43. ROUGH-TURNING BASE-PLATE FORGINGS

A special machine was constructed for this work, but it was found that using a file was quicker. The base plates are held in a vise, and the operator takes three strokes with the edge of a half-round file. He makes three nicks at an angle of 45 deg. with the base and approximately 120 deg. apart. This finishes the twenty-sixth operation, as there is no inspection. When done, the base plates are trucked to the bench, where they and the shell bodies are assembled preparatory to forcing in the base plate. Assembling, which is the twenty-seventh operation, consists merely of entering the base plate in the recess in the base of the shell body.

It will be remembered by those who read the series of articles covering the manufacture of the 4.5-in. high-explosive shell that the threaded base plate is smeared with Pettman cement before it is screwed in. The new type of base plate is put in dry without any Pettman cement. It may be well at this time to correct an error which occurred in the articles on the 4.5-in. shells as to the composition of Pettman cement. The composition is as follows:

	Lb.	Oz.
Gum shellac	7	8
Spirits, methylated	8	4
Tar, stockholm	5	0
Venetian red	20	12



OPERATION 29. RIVET BASE PLATE

Machines Used—High-speed hammers.
Special Tools and Fixtures—Slide and post A.
Gages—None; the hand hammer is used to test the work.
Production—One man and one machine, 30 per hour on new-type base plate; on threaded base plate, 100 per hour.
Reference—See Fig. 49.

The amount of Venetian red seems so large in comparison with the quantities of the other ingredients that one might think it an error. It merely represents, however, a quantity equal to the combined weights of all the other ingredients. Pettman cement is still used with the threaded base plates.

The screwing in of the threaded base plate is fully covered in the fifteenth operation in the series of articles describing the manufacture of the 4.5-in. high-explosive shell

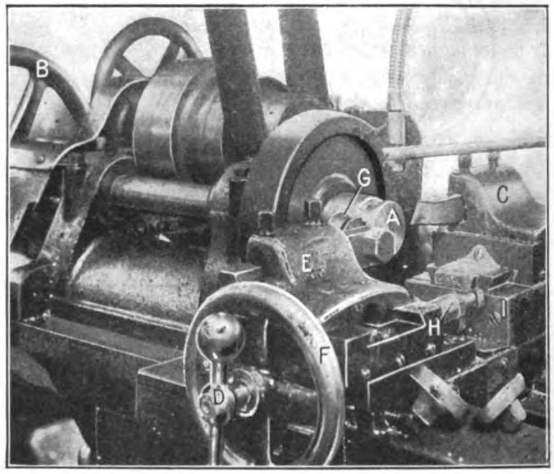
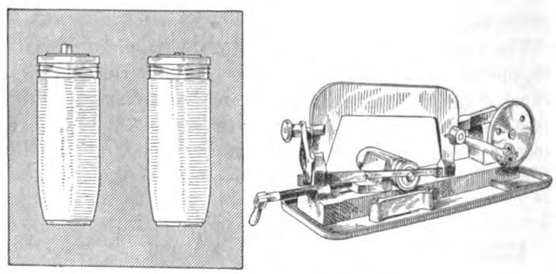


FIG. 44. FINISH-TURNING THE FORGING IN CONVERTED BRIDGEPORT AUTOMATIC MACHINES

and therefore need not be repeated here. This operation is at the Dominion Bridge Co.'s plant, done in a slightly different manner. The threaded base plate is first screwed down with a hand-operated machine, shown in Fig. 46. The gearing was designed to give a pull equivalent to a lever 8 ft. long, but it was found in practice that the final tightening was better done with the old-fashioned lever. In the illustration the machine is shown while being used



OPERATION 30. SAW OFF SQUARE STEMS

Machines Used—Racine power hacksawing machines.
Special Fixtures and Tools—None.
Gages—None; the boy operator works as close to the shell base as he can.
Production—One boy and two machines, 120 per hour.
Note—Cutting lubricant used.
Reference—See Fig. 51.

to size threaded base plates. The base plate is shown at *A* and the sizing die at *B*.

In Fig. 47 is shown a 40-ton Murphy pneumatic riveter used for the twenty-eighth operation, which is pressing in the new type of base plate. The assemblers enter the base plates in the recess in the bottom of the shell body. The shells are then placed on a bench convenient to the operator of the riveter. The post *A*, Figs. 47 and 48, is

hinged so that it can be tilted forward for placing and removing the shell.

The operation of forcing a base plate into the shell base is as follows: The operator slips a shell over the post *A*, which is tilted toward him, as shown by dotted lines in Fig. 48. The post and shell are then pushed back until the heel of *A* rests on the plate *B*. When in this position the post *A* is vertical and its axis is in line with the axis of the plunger *C*. The air valve is then opened, and the

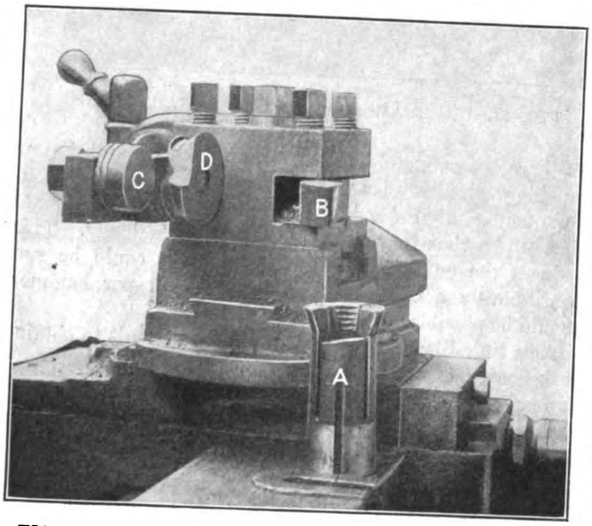


FIG. 45. BASE-PLATE TURNING TOOLS AND COLLET FOR THE ENGINE LATHE

piston of the air cylinder comes forward, forcing the plunger *C* downward. One or two strokes of the plunger are sufficient to force the base plate firmly to its seat in the recess in the shell base. Details showing how the Murphy riveter is arranged are given in Fig. 48.

The speed of handling depends on the men and not on the machine. Two men handle the job, and they can

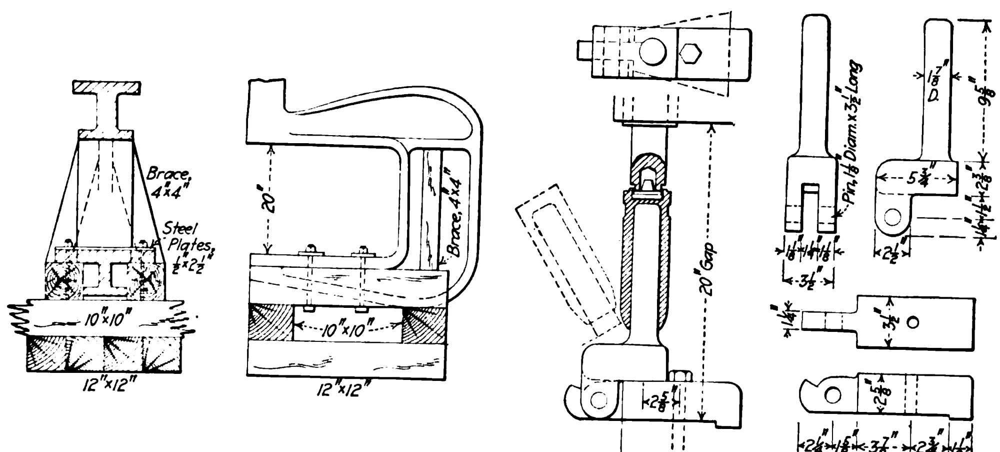


FIG. 48. DETAILS OF MURPHY PNEUMATIC RIVETER FOR FORCING IN BASE PLATES

press in 200 base plates per hour. After being pressed in, a Government inspector tests each base plate with a hammer blow. Any that sound hollow are removed, and slightly larger ones are fitted and driven in. From the Murphy riveter the shells are trucked to the riveting

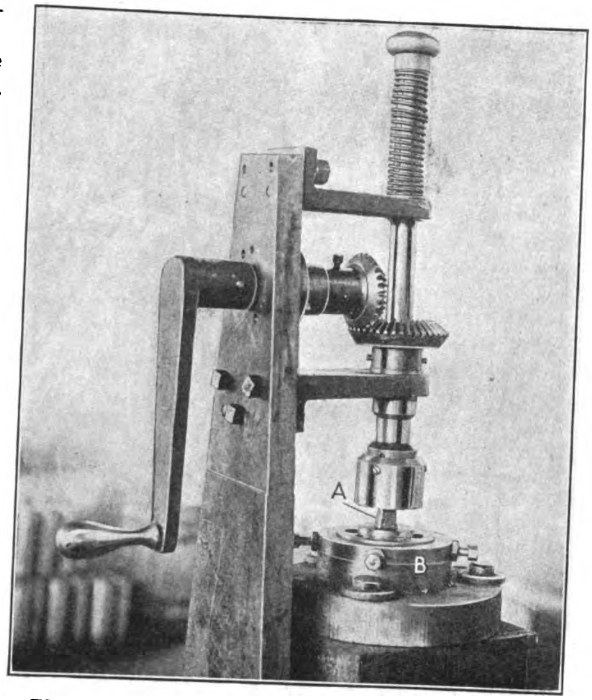


FIG. 46. MACHINE FOR SCREWING IN THREADED BASE PLATES

hammers, shown in Fig. 49, where they undergo the twenty-ninth operation. The helve hammers used are of the type built by the High Speed Hammer Co., Rochester, N. Y.

At *A* is shown a shell as it comes from the previous operation, and at *B* as it appears after the base plate is riveted in. The machine is provided with a vertical post *C* on the sliding table *D*. The alignment of the riveting flange of the shell, with relation to the riveting punch *G* when in riveting position, is determined by the stop *E*. When this is in contact with the knee of the machine, the riveting flange on the shell is correctly located. The speed of the hammer is controlled by a foot lever so that many or few blows, depending on the foot pressure, can be given in a certain space of time.

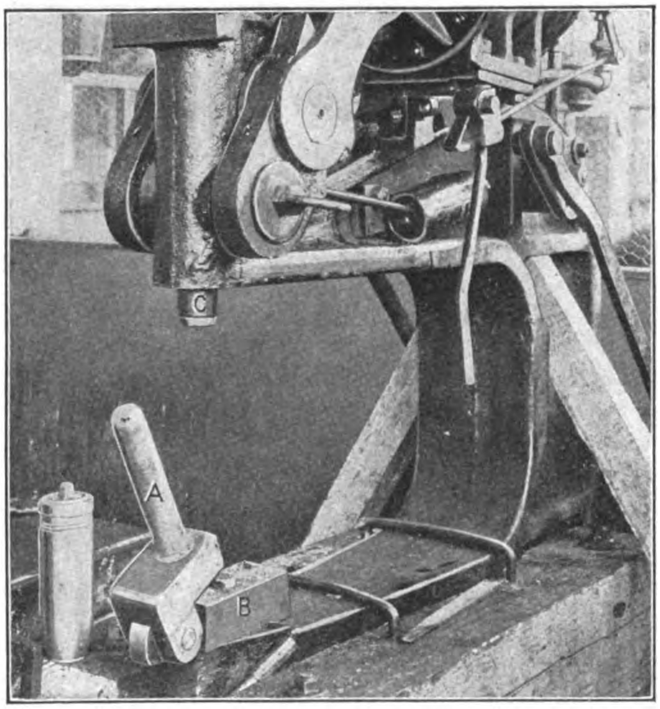


FIG. 47. MURPHY PNEUMATIC RIVETER FORCING IN BASE PLATES

The operation of riveting is as follows: The operator slides the table *D* toward him and places a shell from the previous operation, as shown at *A*, over the post *C*. The table is then pushed away from him until the stop *E* brings up against the front of the knee *F*. The operator then depresses the foot lever, and the hammer is started. With both hands embracing it, the shell is slowly revolved on the post until practically all the metal in the riveting flange is driven down onto the angular part of the base plate. Riveting the new type of base plate can be done at the rate of about 30 base plates per hour. Riveting the threaded type of base plate is done much more rapidly,

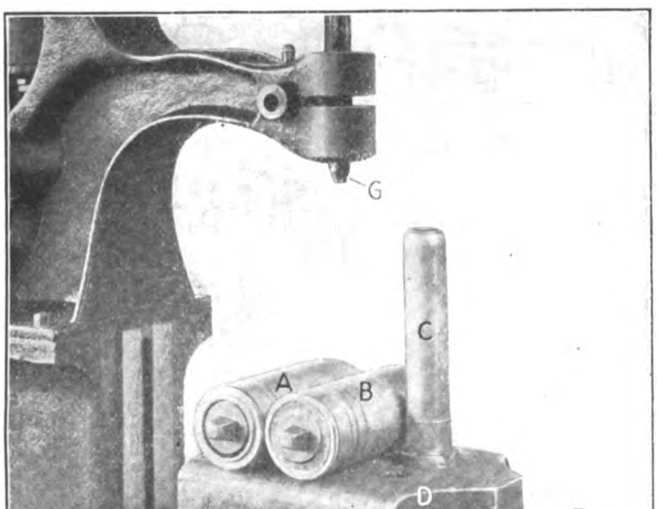


FIG. 49. HIGH-SPEED RIVETER FOR BASE PLATES

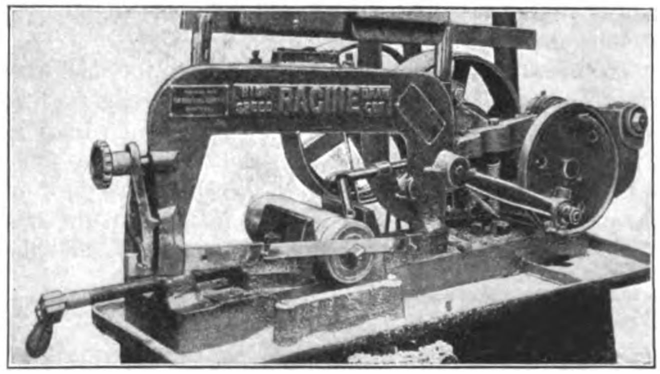


FIG. 51. HACKSAW SAWING OFF SQUARE SHANKS

as there is less metal to displace, and the scheduled time on this work is 100 base plates per hour. When run continuously at high speed, the riveting hammers are apt to heat up so that they cannot be run satisfactorily. This reduces the output. With hammers that could be run continuously a considerably higher output per hammer should be possible.

At a time like this, when tools are so difficult to obtain, it behooves every man who is responsible for results to make use of every possible expedient by which he can keep up production while waiting for special or other machines. In Fig. 50 is shown a simple arrangement of an ordinary pneumatic riveting hammer for handling this work. The hammer *A* is supported on the rolled-steel frame *B*. The thrust of riveting is taken by the yoke and springs *C*. The hammer is supported by the yoke lever and weight *D*. It would seem that a spring instead of a weight would make a better and more elastic support as the inertia of the weight is apt to give trouble. The shell *E* is placed over the post *F*, which forms a part of the swinging member *G* pivoted at *H*. When inserting or removing the work, the member *G* is swung to one side, as shown by the dotted lines in the detail. A stop *I* on the table determines the position of the member *G* when it is in operating position. After riveting, the work is visually inspected and also given the hammer test. The shells are then credited to the operator and trucked to a bank of Racine hacksaws, where they undergo the thirtieth operation. In Fig. 51 one of the

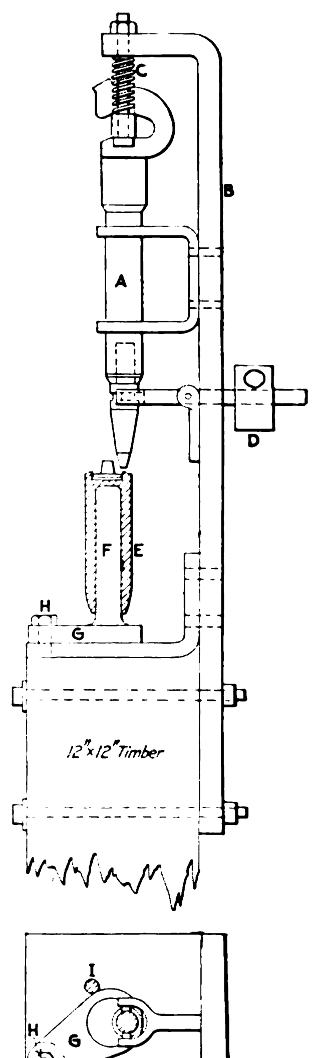


FIG. 50. PNEUMATIC HAMMER ARRANGED FOR RIVETING

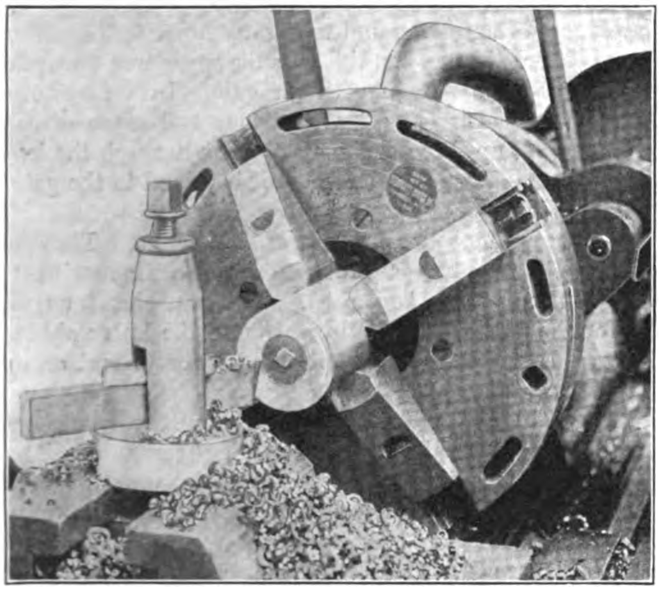
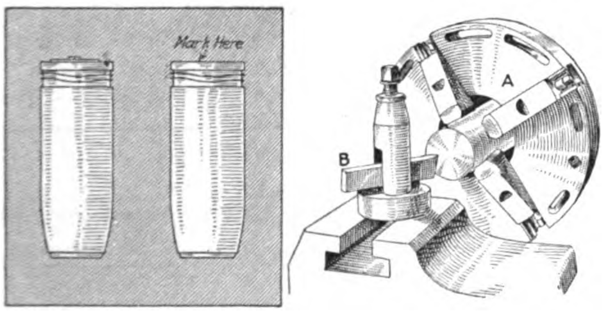


FIG. 52. FACING BASE PLATE AND BASE IN ENGINE LATHE EQUIPPED WITH COMBINATION CHUCK

saws is shown with a cut part way through the square shank of a base plate. One boy runs two machines, and they are never stopped except to renew saw blades. The time for sawing is one minute from floor to floor, so the boy's output should be nearly 120 shells per hour.



OPERATION 31. FACE THE BASE PLATE AND BASE

Machines Used—Engine lathes 20 in. by 6 ft.
Special Tools and Fixtures—Combination chuck A; facing tool B.
Gages—None.
Production—One man and one machine, 30 per hour.
Reference—See Fig. 52.

After the stems are sawed off, the shells are trucked to 20-in. engine lathes, one of which is shown in Fig. 52, where the base plate and the base of the shells are faced off. This constitutes the thirty-first operation. The lathes are equipped similarly to those used in operation 12. From three to four cuts are necessary to face the bases correctly.

Making Tools for a Die Casting

By W. Eastman

In this article will be described the operations performed when making the dies for forming the die casting, Fig. 1.

The first thing to do is to square up the two blocks of steel that comprise the die, Fig. 2. The die maker then lays out the four $\frac{1}{2}$-in. dowel-pin holes. These are drilled and reamed all the way through while clamped together in a drill press. The dowel pins are hardened and drawn to a straw color and then driven into position in either block. This block is then known as the bottom die.

The dowel holes in the upper die block are now reamed with an expansion reamer, so that the dowels will slide easily. Then both blocks are put in the shaper together and the sides planed off. Care must be taken to have the two sides perfectly square and square with the face, from which all layouts are made. Both faces of the die blocks are coppered and the center lines scratched in with a height gage.

Construction of Lower Die

The two parts of the die are now bored. The upper die contains the two smaller diameters of the article. Extreme care must be taken to bore these sizes to a smooth surface, leaving a little clearance. In this case 0.007 in. was allowed for shrinkage. A spring tool holder is used for the finishing operation. All holes in a die are bored straight, since the metal will shrink away from the hole; but all cores are tapered about 0.010 in. and draw-filed.

Since the lower die contains the core *A*, it is obvious that it must be provided with a core seat. This is done by counterboring the bottom of the die hole to a depth of

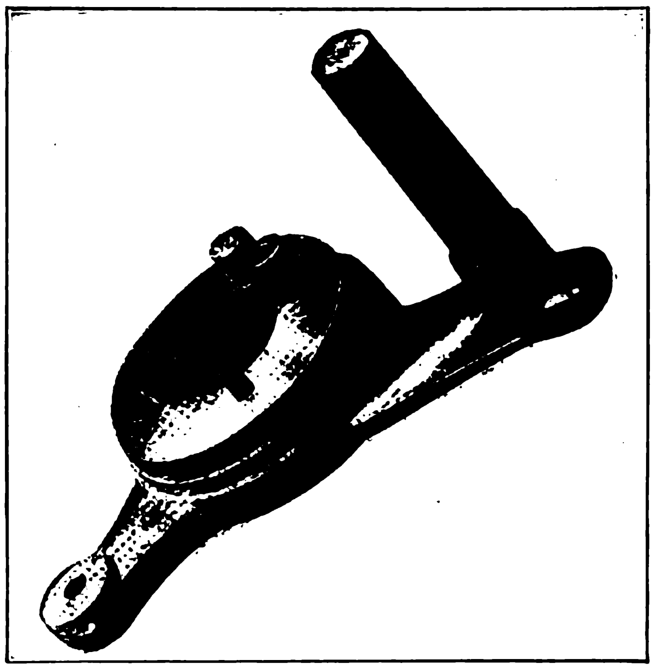


FIG. 1. THE DIE-CASTING MADE

about $\frac{3}{16}$ in., into which the core fits snugly. The core *A* is draw-filed all over after fitting into it the key *B*, which is held in position by means of small screws reaching in from the bottom.

The boss *C* is $\frac{3}{32}$ in. high. This must be remembered when the lathe operation is being performed. The die is set up on a miller having a vertical attachment. The surface of this boss is the dividing line of the crank *D*, which has a $\frac{3}{16}$-in. hole cored through the knob *E*. A stationary core *F* is fixed in the upper die for this purpose.

The boss *C* has sides at an angle of 45 deg., so that there will be room for the side cores *G* and yet reinforcement for that section of the boss where the crank is joined to the cylinders of the casting. Such reinforcement is necessary on dies for aluminum; otherwise, after several hundred castings are made the slim section would oxidize and disappear, compelling early repairs.

The section of the core hole shown at *G* must not be longer than about $\frac{5}{16}$ or $\frac{3}{8}$ in., because these sections are

drilled and reamed from the finished core block *H*, which is accurately made by first drilling and reaming, then turning on an arbor, making a sliding fit into the lower die block. The die blocks are held in position by means of flat-head screws reaching up from the bottom. The cores are made a sliding fit into the core blocks and extend out to be secured to the adapter *I*. That section of the core marked *G* is made 0.010 in. larger than the end that enters the casting, because, after a number of castings are made, particles of aluminum become attached to the core and tend to scratch the core hole in the die block.

Referring again to the core blocks *H*, the reader might ask why blocks are provided. The answer is that it is almost impossible to bore small core holes all the way in from the sides and have them come out exactly central. Therefore, large holes to be filled with blocks are bored first, and after the blocks are inserted the small hole is transferred from the blocks.

In order to set the dies up properly so as to get the holes at accurate angles, the lower die was set up first by means of clamps which entered 3/8-in. holes 3/8 in. deep, drilled into the sides of the lower die blocks for the purpose. The upper die was laid in its proper position on the lower one and the whole securely clamped to the miller table. The knob *F* was next milled, the position being obtained by a bevel protractor to set up each die block so that 1/2-in. feeler pin projecting out of the milling-machine spindle could be measured so many thousandths away from the die hole. The next operation was milling the crank space, which in cross-section is shaped something like a cross-file. A special cutter is necessary for this purpose. It is easily made, being nothing more than a drill rod of the size required. It is turned in a bench lathe to the needed shape to a templet, and then milled or shaped like the tang of a taper-shank twist drill. The cutting edges are then backed off, and the tool is hardened.

In order to mill the arcs of the crank it was necessary to set up the dies on an auxiliary revolving table, graduated in degrees and operated by a worm. The center of an arc is located concentric to the revolving table. This revolving table being graduated in degrees, it is an easy matter to locate the positions of the lugs and small core holes in the cylindrical section.

Water jackets *J* are provided in most dies for aluminum castings. They are not needed in dies for soft-metal castings, since most soft metals melt at 700 to 800 deg. F., while aluminum requires a much greater heat, depending on the alloy used. Water pipes are connected by means of rubber hose and nipples screwed into seats *K*. The hole *L* is drilled from the side in order to complete the jacket and is plugged up by the plug *M*.

The sprue hole is placed in the upper die about 1 1/4 in. away from the casting and is slightly tapering toward the dead side of the die. In this case the sprue was twisted off and allowed to remain with the gate. In various other dies the sprue is cut off with a long rod made of cold-roll passing up through the ejector box through the lower die and striking the sprue where it is joined to the gate—a sort of punch-and-die operation.

The ejector box is made of cast iron. The view shows the front legs broken off on a line with the top surface of the box at *O*, which contains four pins *P* for the ejector plate *Q* to rest on. The latter also has four pins *R* for the core bracket plates *S* to rest on and operates the levers *T*. The operations follow:

The handle *U* and pinion *V* are a unit to operate the rack *W*, which raises the plates *S*. The joints *X* are joined to the links *T* by means of 3/8-in. pins. The upward movement of the studs causes the adapter *Y* to pull out the side cores *G*. Safety pins *Z* are provided so that the casting may not be ejected before the cores are pulled out. The pin *Z* cannot rise until a hole is partly made in the core above it, which is done when the core is pulled all the way out.

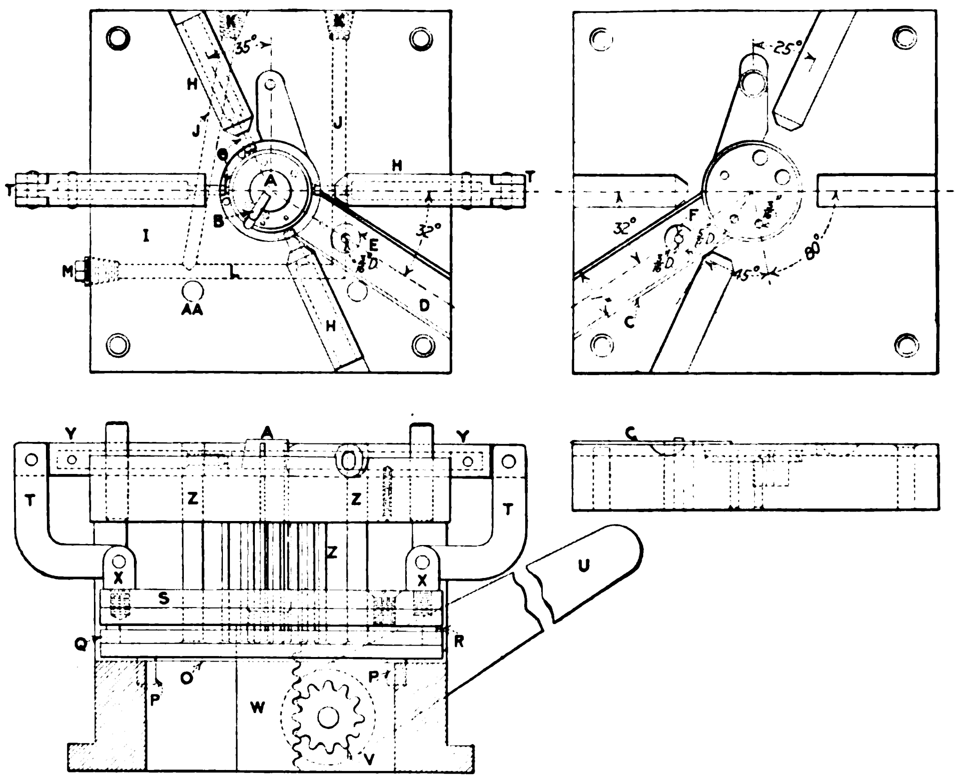


FIG. 2. DETAILS OF TOOLS USED FOR A DIE CASTING

The safety pin is a member of the gang of ejector pins surrounding it. They are all operated by a handle *T* actuating a rack. The handles move in opposite directions. All the ejector and safety pins pass through clearance holes in the plate and through the die block to within 1/4 in. of the surface, when they must fit snugly. *AA* is another safety pin, two of which are generally provided and laid out just about where they are shown. These are furnished to make sure the ejector pins do not butt against the casting before the upper die block is removed. Should the workman operate the ejector-plate handle before he separates the die blocks, then these safety pins will separate and the casting will be ejected, as the safety pins and ejector pins are secured to the same plate.

Painting Small-Shop Products--II

By John H. Van Deventer

SYNOPSIS—Brush painting and air drying of the painted articles comprise the process most common in the small shop. This article describes various methods of applying filler, flat finish, semigloss and full gloss. It also gives practical points in caring for brushes and securing freedom from dust.

There is an unfortunate and very general tendency to use paint as a means of covering up defects instead of regarding it as a means of emphasizing high-quality workmanship. A manufacturer of small hardware, for example, will tolerate sandy castings, with the expectation that Old Doctor Paint will apply his universal remedy for rough surfaces and make a healthy specimen out of each decrepit invalid. Wrinkled and scratched products of the drawing press get by, in the hope that they will become respectable and presentable beneath a few coats of black japan. Certain products of the woodturner's art (or, rather, lack of it) go into the dipping tanks fringed with wooden whiskers that must be rubbed off by the painter, who is thus forced to add the profession of barber to his other accomplishments. This policy has made machinery painting much more expensive than it needs to be, because both painter and paint must do work that has been left undone by someone else. They are the ultimate correctors of all the sloppy jobs that go through the shop.

How much more does it cost to produce a smooth casting in the foundry than to make it smooth in the paint department? Balance the cost of good facing and a few moments' slicking of the mold against the cost of knifing on two coats of filler and currying them with sandpaper and rubbing bricks. How much longer does it take to get smooth products from the drawing press than scratched and wrinkled ones? How much longer does it take to sandpaper wood turnings in a tumbling barrel before they are painted than to rub down the irregularities after the first coat? Getting these things right in the first place costs less in money, but more in care—which is a scarce article in a good many shops.

What Constitutes a Painting Department

A small-shop painting department may be a simple or an elaborate affair, according to its needs. But to be a success, it must be regarded as a real department, even if the equipment consists only of a putty knife, two brushes and a few cans of paint. It must be regarded as an institution worthy of existing for what it does, and not as a necessary but unpleasant evil. And for the same reason, the work of painting should be done by the same man, even if there is not enough of it to keep one man continually busy. This is the only way that real interest in the work can be created and maintained, and interest is as essential a part as is the paint can or the brush.

One of the greatest handicaps to a good painted finish is dust. A machine shop is sure to have plenty of it on hand at all times, no matter what other commodity is short. Fresh paint and varnish seem to attract it as a magnet draws iron filings, with the difference that the filings can be removed, but the dust cannot. It sticks, and spoils the finish.

There are two ways of overcoming the dust disadvantage, both of them based on not letting it get on. The easiest and most common way, and quite naturally the one with lesser merit, is to shorten the drying time by the addition of drier, so that the period in which dust can settle and stick is decreased.

The second and better way is to have a separate room for painting, at least for the final coats. Don't throw up your hands at this point, Mr. Small-Shop Man—there are more ways than one of killing a cat or of making a paintroom. I have known small-shop owners with offices that were more ornamental than useful who moved their desks out into the shop, and their pails and brushes into the office, with beneficial results both ways. Sitting in an office chair does not buy the small-shop baby new shoes, and dust works less injury to bills payable than to painted products.

Compromising on a Canvas Curtain

In one shop, where it was felt that a separate room for painting could not be provided and yet the necessity for it was known, a satisfactory compromise was made by providing a canvas curtain that partitioned off the assembling floor from the rest of the shop. The curtain was kept rolled up until required; when dropped down while painting a machine, it had a noticeable effect in decreasing the amount of dust.

Dust works its way through shop ceilings; and when this condition must be avoided, the ceiling may be either filled and painted, thus stopping the cracks and the dust leakage, or it may be covered with sheet iron, provided the fire-inspection regulations will permit.

The dust which settles on a coat of paint that has dried sufficiently to lose the quality of stickiness should be removed before the next coat is applied. It would seem that this is so self-evident as to be hardly worth mentioning, but it is a precaution that is overlooked in many shops. Compressed air is the best dust remover, and a hand bellows will act as an air compressor and hose combined in the shops that do not have compressor installations.

Much could be said on the subject of the proper size and kind of paint brush to use for a given purpose and a given paint; but you will find that experienced painters have different views in the matter, and even among them there is little agreement. No scientific study of this subject seems to have been made, and little, except opinions, can be offered. There is one thing, however, that is beyond contradiction—the size of the brush should be in proportion to the size of the work. By size is meant paint-carrying capacity. An oval brush will carry more paint or varnish than a thin flat brush that is wider in dimension. A brush is really a paint conveyor working back and forth between the pail and the painted surface, and the fewer round trips that it must make to cover the job the higher will be its conveying efficiency. As far as helping to produce a smooth finish, the brush itself is of little importance, properly dipped work being as excellent in this respect as the most skillfully applied brushwork.

The matter of caring for brushes has been much more definitely worked out. It was my privilege recently to hear the views of Carl J. Schumann, of the Moller & Schumann Co., Brooklyn, on this and other points relating to metal finishing. In the matter of caring for brushes this firm has evolved what it calls a "brush keeper," which is a closed metal can in which brushes are held suspended in a solution of linseed oil and turpentine. The brushes are placed in this can after being properly cleaned in clear turpentine. Thus they are kept in first-class condition, ready for use. The instructions for using this device are as follows:

When through using your brushes, rinse them thoroughly in turpentine, then put into the brush keeper.

In the brush keeper use a mixture of about four-fifths raw linseed oil and one-fifth turpentine. As the oil shows signs of thickening, which practically means that the turpentine has evaporated, add more turpentine.

Empty and clean out the keeper at least once a month. Strain the contents through two thicknesses of cheese cloth and make good any deficiency with a mixture in the same proportions as the original.

When brushes hang in the keeper, make sure that they are at least 1 in. clear of the bottom and also clear of the sides and of each other.

Rinse the brush in turpentine after taking it from the brush keeper; and before putting it into the varnish cup, discharge the turpentine from the brush by drawing it once or twice across the wire, then shaking briskly.

Fill the brush with the varnish in the cup, draw over the wire once or twice, immerse again in the varnish and let it stand for a short time. The brush is then ready for use.

Keep the varnish cup at all times protected from dust.

Closed Paint Cans Economize on Material

Waste and evaporation take a greater percentage of paint in the small shop than in the large one. A can of paint may be used one day and then set away for a week, often without being tightly covered. This is especially true of those cans which are opened by cutting the top. A simple cure for this waste is at hand in all shops and costs nothing. If you are up against a case of this kind, put a sheet of paper over the top of the can, fold it down over the sides and tie a string around it. It will look like an old-fashioned can of mother's marmalade, but the contents will keep indefinitely, so appearances may be overlooked.

The customary method of applying filler by knifing it on the casting requires a fair degree of skill to produce a smooth job. A better way in the small shop is to use the "benzine" process, which is as follows: The filler is first reduced with turpentine to a stiff paste, using a round brush. A second and a third coat are applied in the same way, before the first coat has had time to dry. Three or four hours are then allowed for the filler to take hold, after which it is rubbed down with a piece of heavy felt soaked in benzine.

It is quite a common belief that priming, filling and rubbing are essential to a high-grade finish. Some machinery builders proclaim in their catalogs that their machines are given so many coats of filler and rubbed down after each coat, as if the application of filler and the elbow grease necessary to rub it were things that no self-respecting high-grade machine could do without.

If the notion that finish is a covering of imperfections, as mentioned in the first paragraph, did not exist, you would hear less about the primer and filler. Defective and rough surfaces necessitate filler, and this in turn calls for primer to make it stick. If you attempt to fill a porous surface that has not first been primed, the result will be disastrous, as the binding element in the filler will be absorbed, leaving it without adhesive power and likely to flake off, carrying with it whatever paint and varnish have been applied. Neither primer nor filler is a necessary part of a good finish—neither of them adds one bit to its quality. Both are substitutes for a suitable surface on which to apply color and varnish. If you have the smooth surface to start with, no amount of these substitutes will better the finish; in fact, they will make it worse, for two coats will very often stick better than six. We cannot do away with filler and primer on many kinds of work, but at least we can give them their proper value as defect and roughness coverers.

Three Classes of Brush Finish for Machines

There are, omitting black asphaltum and other more or less temporary coatings, three classes of brush finishes for machine shop products. These are the flat, the eggshell, or semigloss, and the full-gloss finish. The suitability of each of these for certain classes of work was mentioned on page 183, in the preceding article. Priming and filling, when necessary, are the same, no matter which of these final finishes is to be used—which is another argument for regarding priming and filling as restricted to the preparation of the surface for finishing and not as a part of the finishing itself. In describing these three finishes I will assume that this preparatory work has been completed and that the surface is ready for color.

A flat finish may be obtained in one coat of color, but it will not be anything to brag about. Two coats, however, will produce a first-class flat-finished job, providing the materials used are of good quality. Give the first coat 24 hr. to dry, whenever possible, even if it means holding back the shipment one day—the customer won't kick if you come that close to keeping your promised date. In this connection beware of paint bargains.

The semigloss finish requires more skill to apply and get right than either of the others. The coat underneath the eggshell or semigloss must be impervious, as otherwise the soluble matter in the semigloss is absorbed in spots and the result is crude. A coat of full-gloss enamel will provide the necessary surface on which to put the eggshell finish, but it must be allowed to dry thoroughly before this finish is applied.

Full gloss can be obtained in two coats of enamel. Usually, a "first-coat enamel" and a "finishing enamel" are applied, the supposition being that these two must be of different composition to produce the best results. This is another of those wrong guesses, for equally good results can be obtained by using finishing enamel for the first coat, thinning or reducing it with turpentine. It does not pay the small shop to stock first- and second-coat enamels, the wastage and extra investment more than making up for the slightly greater cost of the finishing material.

The expense of applying brush finish and the length of time required to air dry put a limit to the number of coats that can be applied under these conditions. A first and a finishing coat of good quality enamel will produce a full-gloss finish that will reflect credit on the small-shop product, unless it is a machine of such high grade as to require a number of coats, with each one rubbed. When that is the case, however, one must look to dipping and oven drying for means of shortening the time and labor, as otherwise the shipment of small-shop products would be sadly delayed.

Power-Press Accidents

By C. B. Hayward

Many serious accidents occur on power presses; and although much has been done to prevent a great many of them through the installation of safety devices, there seems to be no remedy that will eliminate them all. The market is flooded with safety devices for this type of machine, all supposed to be "sure cures"; but still there are fingers lost and hands mangled, and no satisfactory reason is given. Injuries received while working on a guarded press bring forth the ever ready statement that the guard failed to work properly. This is not so in many cases. The guard is not necessarily at fault, neither is the operator. It is the press-clutch mechanism that needs attention.

When an injury is attributed to the punch press, an examination following as the result of the accident generally renders the following verdict: "The operator must have been out of time in feeding the work into the die of the press, and the punch came down, catching his fingers, directly due to his putting his foot down on the treadle at the wrong time." This deduction may be correct in some instances, but not so in a great many; especially is it wrong in cases where a standard guard is used. Safety devices that are attached to presses and place a bar or partition between the operator and the punch or make necessary the using of both hands to operate the press will prevent the old "out of time" accident.

The workman, when he states that the gate fell a second time, is speaking the truth in most instances. Why? Because that is just what happens. It is possible for the gate to descend twice in succession, even though the treadle has been released and the cam allowed to spring back in position in order to pull the clutch pin out of the yoke collar and flywheel driving the eccentric shaft and ram. The failure can be definitely located at this one point. The pin sticks in the flywheel or collar and does not respond to any cam action, but simply forces the cam out of place and goes by, resulting in the sending of the punch down a second time without the assistance, and to the surprise, of the operator.

Safety stops placed on the cam mechanism are a necessity on presses that are operated only after the placing of each separate piece of work. They serve their purpose, but they are nothing more than automatic treadle releases making certain the placing of the cam in position for working the pin from its position in the collar. If the pin fails to work out on the cam, it jumps the cam, the same as in the case of a press without such a stop.

In some shops positive locks have been attached to the cam levers, causing the cam to remain in positive position after being released by the treadle or the safety automatic mechanism. The intention here is to keep the cam in place and make it force the pin out of the collar and flywheel, where perchance it might stick. This plan has never proved successful. The pin, refusing to be moved and not being able to jump the cam, is broken off, and the gate is sent downward on its second stroke. This sort of accident not only results in the punch descending twice in succession, but breaks part of the machine in accomplishing the act.

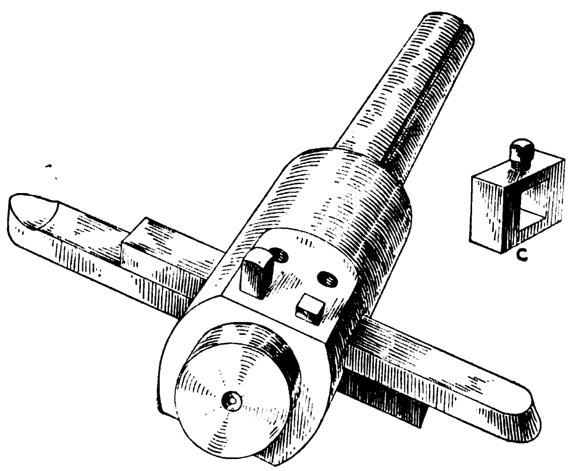
Therefore, as there seems to be no feasible and practical way of preventing the "falling gate," it is up to the man running the press to keep his hands out from under the punch as much of the time as possible. He must keep the clutch pin well oiled. He must be careful to wait long enough between taking the finished work out of the die plate and feeding in the next piece to ascertain if the gate is up to stay. This latter practice is a difficult proposition indeed and requires the watchfulness of a careful man. But that is exactly what safety stands for, and it is through carefulness that we hope totally to obliterate many of the present serious injuries received in power-press accidents.

Old Cutters in Boring Bars

By Ralph G. Noble

Having quite a lot of old boring-bar cutters which were not always of the size desired, I devised the boring bar shown in the illustration as a means of utilizing these cutters and avoiding the necessity of buying high-speed steel at the present prices.

As will be seen, I make the slot of double thickness and use two cutters. This has the advantage of reaming each cutting line at the center line, and it also makes it easy to set the cutters central and to size. By making the bars of a standard diameter it is only necessary to



OLD CUTTERS IN BORING BARS

measure the distance from the bar to the edge of each cutter. The only disadvantage is in the slot of double width, which prevents its use in a very small bar. But on work of 6 in. in diameter and upward there is no difficulty whatever.

Two keys must be used, one to hold each cutter, in order to secure best results. When long cutters are used, clamps should be put over them, as shown at *C*, in order to prevent vibration and help to stiffen the cutting edges. If no pilot is to be used, I would put the two setscrews in the end instead of keys and use a block in front of the cutters for the screws to bear against.

We use two 4-in. cutters in a 6-in. bar and can bore from 6 to 7 in. with the same cutters. We recently used this type of bar to bore an $8\frac{1}{4}$-in. hole in hard bronze, taking a $\frac{1}{2}$-in. cut.

Machining the Inking-Mechanism Details for a Press

By Robert Mawson

SYNOPSIS—In this article are shown the jigs used in machining some of the details used on a printing press. On these tools it will be seen that the object aimed at has been to make them simple and quick in operation. This effect has been attained by using fastening screws fitted with pins so that the operator can place the casting in position and hold it without the use of a wrench. Where setscrews have been used, sufficient pressure can be obtained by the fingers.

The two-sheet rotary printing press manufactured by the United Printing Machinery Co., Woonsocket, R. I., was illustrated and described on page 58. Some of the tools used—examples of modern high-grade small-tool construction—were shown on page 138. In this article other jigs of equally high-class design for machining four other details used on the inking mechanism are considered.

The parts include the vibrator-wormwheel casing—Fig. 1 of facing page; vibrator-wormwheel, Fig. 4; inking-mechanism gear guard, Fig. 6, and vibrator frame-lifting shaft cap, Fig. 8. The operations are all drilling and reaming. The tools include two jigs for the first-mentioned piece and one for each of the others. The drilled holes range in size from $^{25}/_{64}$ in. to $2^{7}/_{64}$ in. The reamed holes range from $3/8$ in. to $2\frac{1}{8}$ in.

Attention is called to the production times given in connection with each one of the jigs shown on the facing page. These are 15 min. each per piece for the two jigs used for the part shown in Fig. 1 and 30 min. each for each one of the tools used on the three other parts.

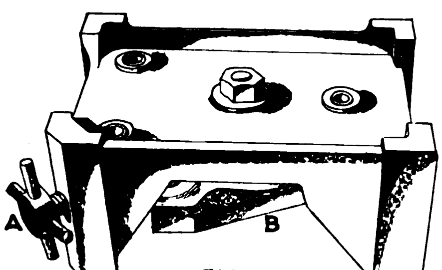


FIG. 2

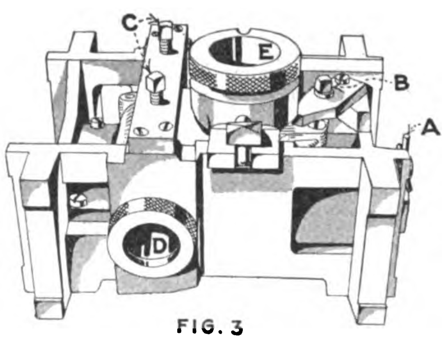


FIG. 3

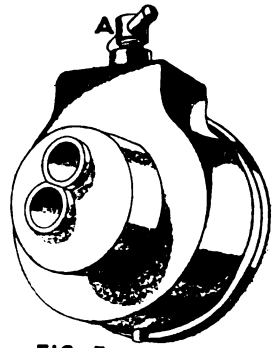


FIG. 5

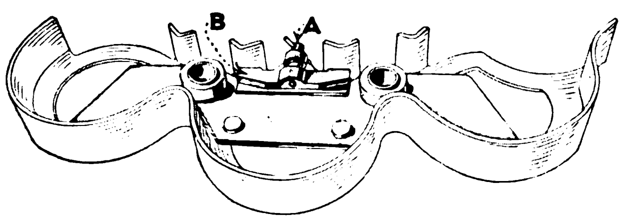


FIG. 7

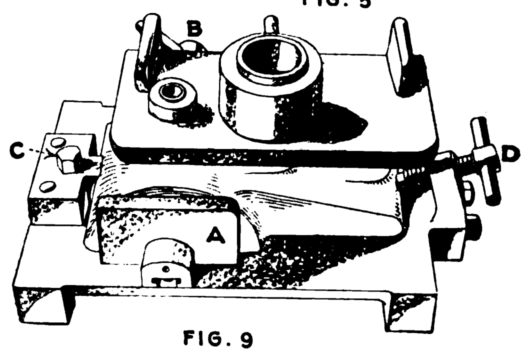


FIG. 9

DRILLING JIGS FOR MACHINING INKING-MECHANISM DETAILS, WITH WORK IN POSITION

FIGS. 2 AND 2-A

Operations—Drilling and reaming holes in vibrator wormwheel casing, Fig. 1. The casting, which has been previously milled on the parting line, is forced against an adjustable setscrew and located by a steel V-block by the pin-headed screw A. The plate B, tightened up by a nut, holds the casting in position.

Holes Machined—Two $^{25}/_{64}$-in. drilled and one $\frac{3}{8}$-in. reamed in one hand, and three $\frac{11}{32}$-in. in the other hand. On the latter casting the holes are then tapped with $\frac{3}{8}$-in. United States standard threads; on the former casting they are counterbored $\frac{9}{16}$ in. in diameter and $\frac{3}{8}$ in. deep.

FIGS. 3 AND 3-A

Operation—Machining gear, driving and driven shaft, and holes in vibrator wormwheel casing, Fig. 1. The castings—one left- and one right-hand element—are fastened together with three $\frac{3}{8}$-in. fillister-head setscrews. The part is located in the jig by two adjustable screws placed to form a vee, the casting being forced against them with the pin-headed screw A. Strap B and screws C hold the part in position.

Holes Machined—A $1^{23}/_{64}$-in. drilled and a $1\frac{3}{8}$-in. reamed at D, and one $2^{7}/_{64}$-in. drilled and one $2\frac{1}{8}$-in. reamed at E.

FIGS. 5 AND 5-A

Operation—Drilling holes in vibrator wormwheel, Fig. 4. The machined gear is placed in the jig and forced back into position with a brass shoe operated by the pin-headed screw A. A shouldered cover is then dropped into the open end of the jig and held with the headless setscrew B. The purpose of the cover is to hold the piece from sliding out of the jig during the drilling operation.

Holes Machined—Two $^{39}/_{64}$-in. drilled.

FIGS. 7 AND 7-A

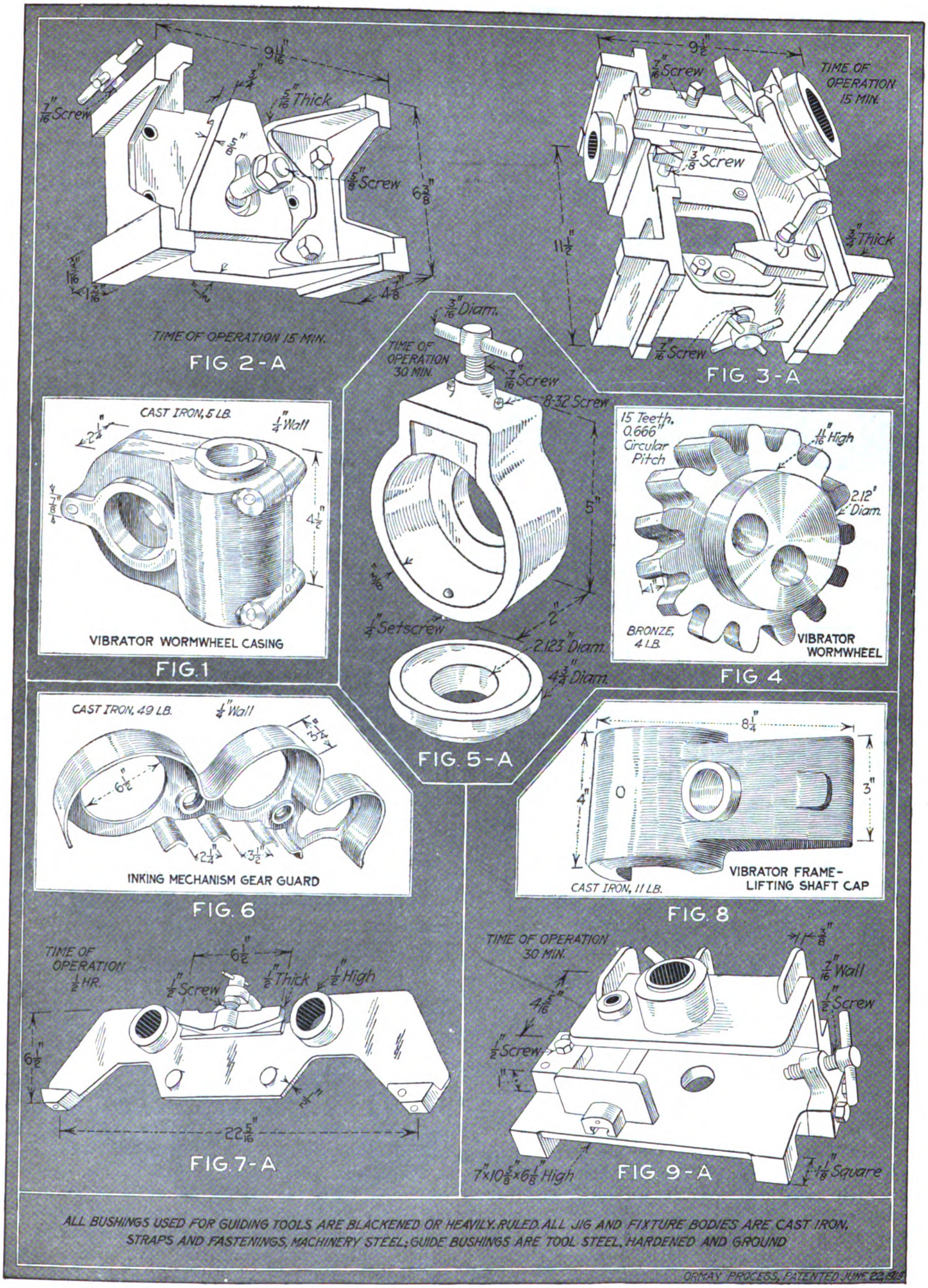
Operations—Drilling and reaming holes in inking-mechanism gear guard, Fig. 6. The jig is placed in the rough casting and the pin-headed screw A tightened. It comes in contact with the equalizing clamp B and forces the lower arms of the jig and ends of the clamp against the casting, thus holding it.

Holes Machined—Two $1\frac{1}{4}$-in. drilled and reamed.

FIGS. 9 AND 9-A

Operation—Drilling holes in vibrator-frame lifting-shaft cap, Fig. 8. The milled cap is slid into the jig and the open plate A dropped down as shown. The casting is then forced against this plate with the pin-headed screw B and against the stop C with the screw D.

Holes Machined—One $1\frac{9}{32}$-in. drilled and one $\frac{5}{8}$-in. drilled.



DETAILS OF DRILLING JIGS USED IN MACHINING THE ELEMENTS OF PRINTING-PRESS INKING MECHANISM

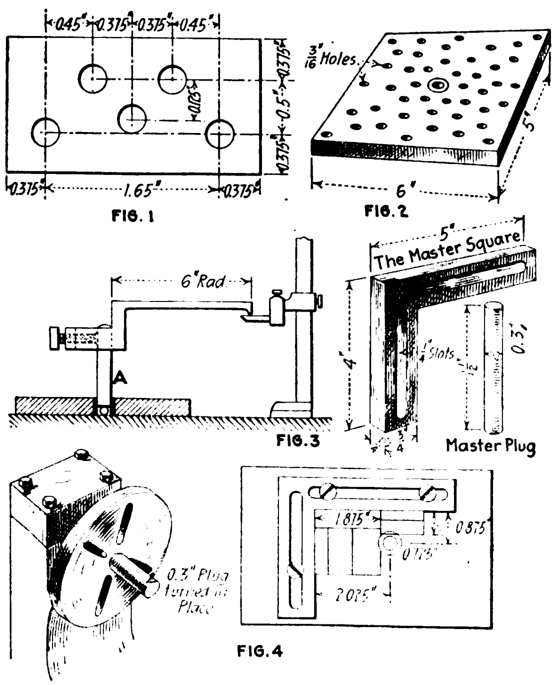
Boring Jigs and Fixtures

By J. J. McHenry

The demand for gages and precision jigs is getting more insistent every day, owing to the necessity of such tools in small- and special-tool manufacture. Some locating methods are much slower than others, and the amount of time spent on the diffierent schemes does not always give a corresponding degree of accuracy.

As an instance, let us take a locating plate or precision jig with holes 0.250 in. in diameter and located as indicated in Fig. 1. A great majority of machinists would probably button this jig. Whether they would button all five holes before boring, or whether they would button one or two and locate the remaining buttons from plugs inserted in the finished holes, is largely a matter of choice. With a limit possibly of 0.0002 to 0.0003 in. the final completion would be doubtful.

In the first instance a great deal of time and patience would be required to set the buttons, and the location depends entirely upon the tool maker's ability with micrometers, the accuracy of the micrometers, and his patience in checking and resetting until convinced of their



BORING JIG AND FIXTURE

proper location. When it comes to setting up the work in the lathe, we have the second chance for error—in faulty indicators and in the amount of the tool maker's patience in trying to get his indicator to zero.

Third, there are the chances of the piece shifting, possibly 0.0001 in., possibly 0.001 in., maybe more; and it is likely to be finished without checking. In any case the necessary time for checking is nonproductive but essential.

The disk and button method of locating these holes could be used, but this requires a great deal of time and added expense in making hardened and ground disks, which must be absolutely accurate. The chance for error in indicating, and the probability that the work will shift, still exist.

The best, simplest and most accurate method, which is advised in preference to the others mentioned, uses a master plate, a master square, a master plug and size blocks. With these we are equipped to bore any jig or gage and require no other special tools, as they are equally adapted for any manner of spacing.

The master plate, Fig. 2, made of cast iron, is planed, scraped square and parallel with a hardened, ground and lapped bushing.

It might be well to show the manner of trammeling from the bushing, which is necessary on precision jigs. This is shown in Fig. 3.

Insert the master plug *A* in the master plate. Assume that the greatest distances from the edges of the jig are found to be 2.025 in. on one side and 0.875 on the other, as shown in Fig. 4. Allowing half the diameter of the master plug gives 1.875 and 0.725 in.

Set in the size blocks of these dimensions and add a piece of thin paper to use as proof. Then bring the master square up against the size blocks and tighten in place. Take out the master plug and the size blocks, and set in the plate to be bored. This brings the piece in the correct location to the hardened and lapped bushing for boring. Slip the plate on the turned plug in the faceplate, and bore.

For each of the succeeding holes take the plate off the lathe, but do not move the square again. Insert the size blocks. Between the master square and the piece to be bored, test as before. After tightening to see that the paper is firmly held, slip on the lathe faceplate plug and bore each succeeding hole.

This method is fast and accurate, and work can be bored within limits of 0.0002 in. to 0.0003 in. It is equally suitable for any desired location and can be found useful in many cases of accurate machining as well as for the boring of holes.

Suggestions for All Shops

By F. D. Mair

Small spring or half-spring brass wire should always be kept in the dark and wrapped up in paper; otherwise it will soon become brittle. The reason for this has not been given, but it is a fact nevertheless.

In hardening pointed instruments made of steel, such as are used by draftsmen and machinists, the heat should be applied away from the point. As soon as the heat runs down to the point, the instrument should be instantly jabbed into a piece of soap. This treatment will result in a good hard end, and it obviates the danger of burning the steel. Common yellow bar soap is best.

If a job has been chucked and is running true when the whistle blows to quit, the tool should be withdrawn from the work. When starting up next morning, the lathe should be allowed to run a few minutes before work is again begun. Otherwise the cut will be eccentric, because the oil film in the bearings will have been forced out by the weight of the spindle and work during the night. Of course this is of moment on a fine job only.

In a well-designed boring mill fitted with a proper tool and running at right speed, the cut through a cylinder should be made in the time represented by the length multiplied by the diameter divided by ten.

Manufacturing Operations on Automobile Lamps

By Ethan Viall

SYNOPSIS—Although the making of the present-day lamps is a comparatively simple proposition, it presents a number of problems that can only be solved by actual manufacturing experience. The methods of handling the shell and door parts are especially interesting. Several unusual machines for polishing reflectors are shown.

Only a few years ago practically everything formed of thin sheet metal in the way of reflectors, lamp bodies, lamp shells, lamp doors, basins, heat bells and the like was spun over forms. Now most of this work is done much faster and better in punch presses, and the use of the spinning process is an exception. The first oil or gas lamps used on automobiles were cumbersome and complicated affairs and expensive things to make. With the passing of the large-sized oil lamps and the simplification of the gas type went much of the difficulty of manufacture, but the purely electric type used so extensively now is the least complicated of all. To be sure, a large number of the smaller sizes of oil lamps are still used for supplementary side or tail lights, but even these have been greatly simplified.

The Indiana Lamp Co., Connersville, Ind., makes automobile, carriage and boat lamps of almost every size and style, though its principal run is on the various sizes of electric automobile lamps.

The ordinary style of electric automobile lamp consists of very few metal parts. The body or shell also forms the

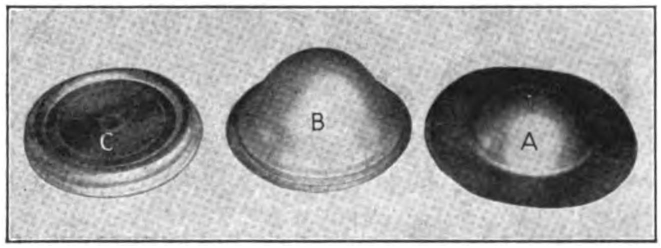


FIG. 1. DRAWN SHELL AND DOOR PARTS

reflector. Along with this are the door, hinges, holding brackets and a few minor parts. The shell may be of various sizes and forms, according to the use to which

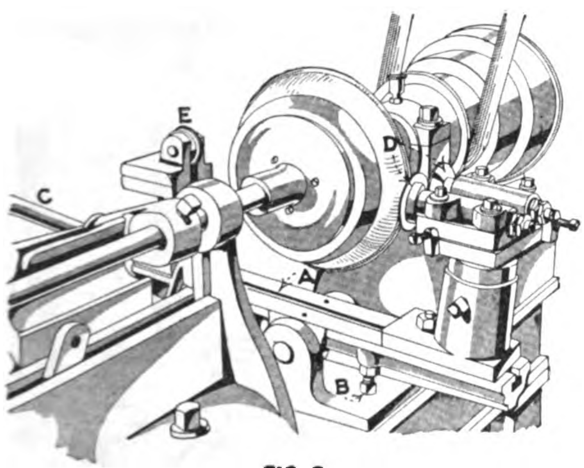


FIG. 2

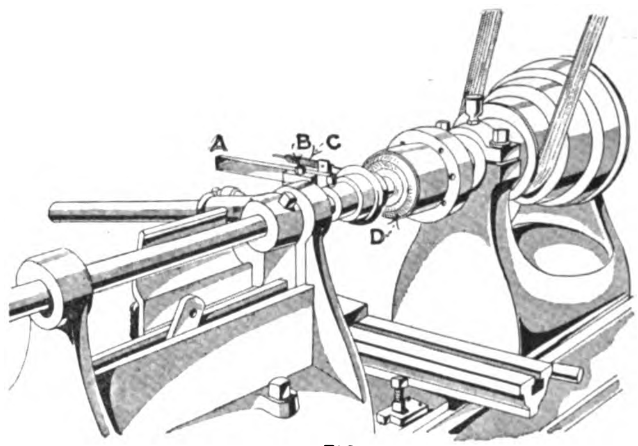


FIG. 3

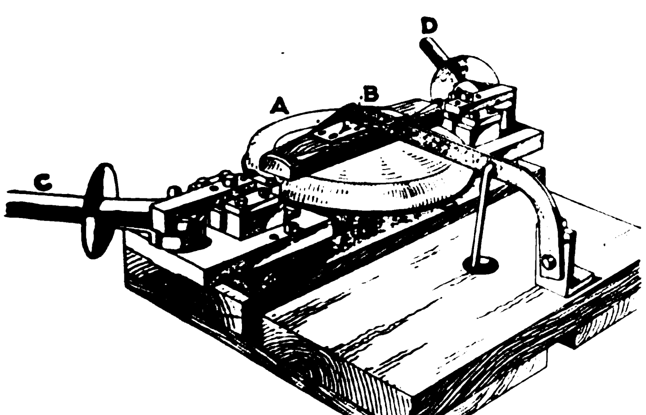


FIG. 4

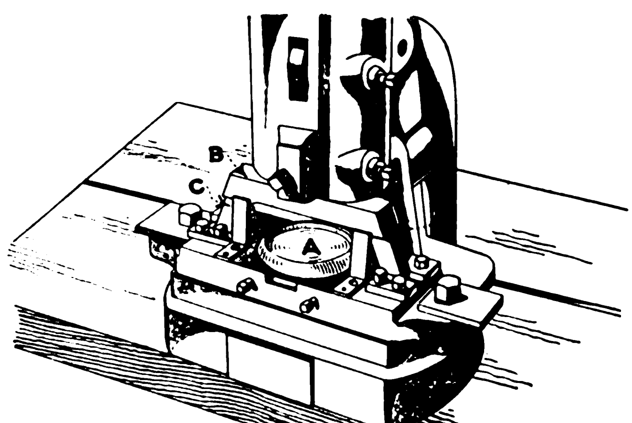


FIG. 5

FIGS. 2 TO 5. SPECIAL DEVICES FOR MANUFACTURING AUTOMOBILE LAMPS

Fig. 2—Trimming and rolling door edges. Fig. 3—Rolling in the wire groove. Fig. 4—Piercing hinge and latch rivet holes
Fig. 5—Kick press fitted for piercing rivet holes

the lamp is to be put, but the type so made as to form a parabolic reflector inside is probably the more common. These shells are made in drawing dies, those made from cold-rolled steel being formed in two draws. These two draws are illustrated in Fig. 1. The pieces are for a 12-in. shell. The original blank is 16 in. in diameter and 0.036 in. thick, cold-rolled steel. The first draw is 3 in. deep and the second one 6 in. deep. At C is shown a door drawing. The pieces are made either from XXX tin or from No. 22 gage brass; according to the finish they are to have, and one draw is sufficient in either case. These examples may be taken as typical of the other sizes,

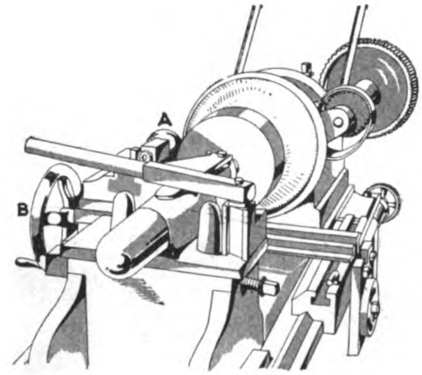


FIG. 6

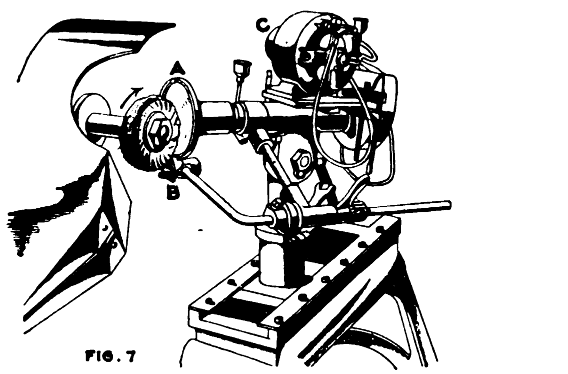


FIG. 7

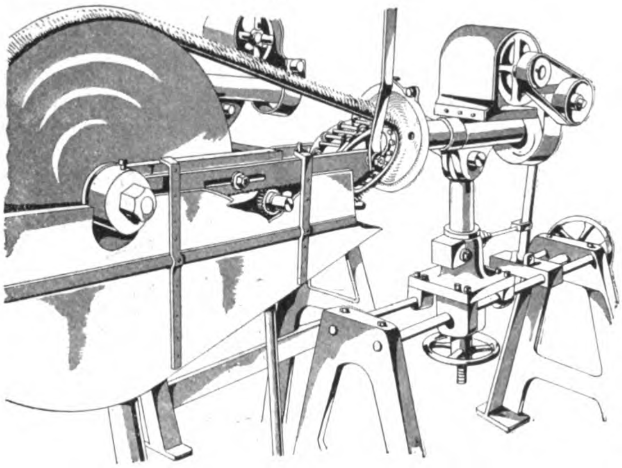


FIG. 8

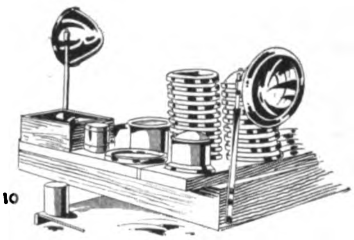


FIG. 10

FIG. 11

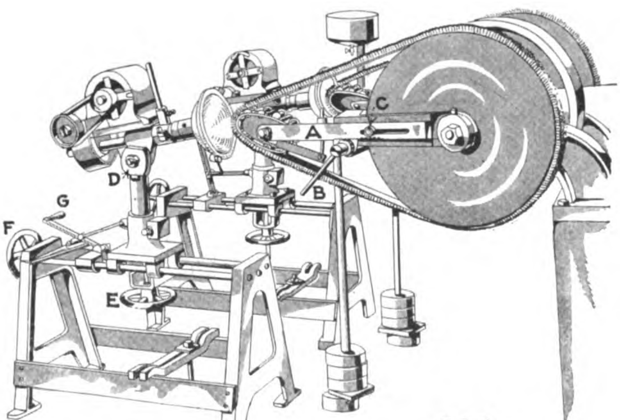


FIG. 9

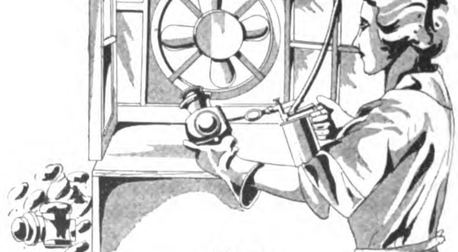


FIG. 12

FIGS. 6 TO 12. A VARIETY OF SPECIAL DEVICES USED IN MANUFACTURING AUTOMOBILE LAMPS

Fig. 6—Trimming edge of a lamp shell. Fig. 7—Simple polishing and buffing machine. Fig. 8—Belt type of automatic polishing machine. Fig. 9—A more detailed view of the belt machine. Fig. 10—Electric lamp assembling stands. Fig. 11—Riveting small lamp parts. Fig. 12—Enamel spraying outfit

the principal differences being in the depth of the draws, thickness of the metal or slight variation in shape.

The doors are formed as shown, after which a number of operations are performed on them, such as edge trimming, rolling, beading and rivet-hole piercing. Then the door is polished, and the center is blanked out. The leaving in of the center until after the polishing operation makes a stiffer piece and one in which the wheel is not so apt to catch.

The edges of the doors are trimmed and rolled in a lathe, fitted as shown in Fig. 2. The door is placed over a form screwed to the spindle nose and is held in place by means of a revolving tailstock clamp, like that used for spinning work. The trimming and rolling tools are carried on a tilting carriage *A*. This carriage has stops like *B* under each end, which may be adjusted so as to feed the

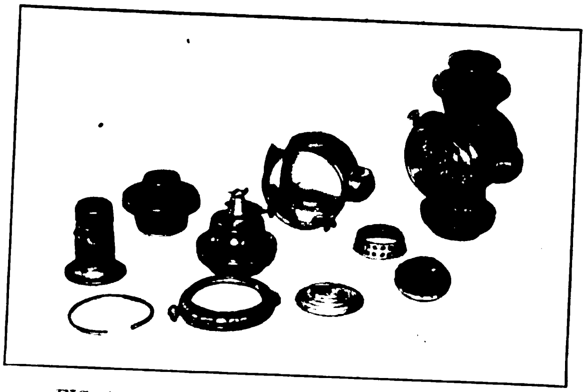


FIG. 13. AN OIL-BURNING LAMP AND PARTS

tools in just the right amount for the job in hand. By pressing down on the handle *C* the trimming rolls *D* are fed on to the edge of the door and trim it off even all around, leaving just enough to curl right when the roll *E* is pressed on to the work by lifting on the handle *C*. This method forms a much quicker way of using the tools than is possible when they are mounted on a slide.

After the edge has been trimmed and curled over, a groove is rolled in to hold the wire by which the glass is retained. This work is done as shown in Fig. 3. Here the piece is held in a way similar to that in the previous operation. The groove is put in by means of a small roller carried on the front end of the tool *A*. This tool is made to turn on the screw *B*, so that the roll may be swung to or from the work. When in working position, it is held in place by means of the latch *C*. With the roll in working position the carriage is tilted toward the operator and the groove formed, as shown at *D*. After this is done the latch is released, the tool swung back far enough to be out of the way and the door removed.

There are two ways employed for piercing the rivet holes for hinges and catches. One is by the use of a hand-operated device, and the other is by the use of a specially fitted kick press. The hand-operated device is shown in Fig. 4. It will take in large sizes, and various-sized centering forms may be placed in it to hold the doors. The work to be pierced is placed over the centering form, as shown at *A*, and is held securely by means of the foot-operated clamp *B*. The operator then pulls on the two levers *C* and *D*, and the punches carried in the slides are forced through the metal, dies being placed in the centering form for the purpose.

The kick press is shown in Fig. 5 The work is placed as shown at *A*. The punches are carried in slides which are forced in by the descent of the ram-yoke *B*, which carries the two angular arms *C* and *D* on the ends.

The final drawing of lamp shell leaves a narrow flange that must be trimmed off. This is done in a lathe, fitted as shown in Fig. 6. It is held in practically the same way as the doors, but the trimming tool is different. It is a round sharp-edged tool *A*, and it is fed against a steel cutting edge on the holding form, so that a shearing cut is taken all around. The tool is carried in a block on the cross-slide and is fed in by means of the handwheel *B*.

An odd proposition came up in the course of time on trimming shells of different sizes. An operator could trim 1,700 of the 11-in. shells but only about 1,100 of the 10-in. size. It seemed that the workman should trim a larger number of the smaller sizes, and several different men were tried, with practically the same results. The final conclusion was that the different shape of the two sizes made the difference in handling, as the larger size had a more conical bulge that could be easily grasped, while the smaller size was rounded and difficult to get a grip on in order to put it in or take it out of the lathe.

To give a good reflecting surface on the inside of the shells or on separate reflectors, the rough surface is first polished, then plated and finish buffed. The wheels do not differ from those usually employed for this work, nor do the polishing belts that are used in the machines, except in form. In other words the polishing work on reflectors is no different from similar work done elsewhere, except that automatic machines are used to do the work correctly and evenly.

One of the simpler forms of polishing machines used is shown in Fig. 7. It is used in connection with a regular polishing stand. The shell to be polished is placed in the cast-iron holder *A* and is kept from being brushed out by means of the adjustable stop *B*, the wheel revolving as indicated by the arrow. The shell holder revolves at about 36 turns a minute, being driven through a train of reduction gears from the motor *C*. The polishing wheel runs at about 2,500 r.p.m. The whole apparatus is mounted on a stand in such a way that it may be fed to or from the wheel. Both buffing and polishing wheels are used in connection with this device, according to the class of work being done.

A more complicated type of machine, used on parabolic reflectors, is shown in Figs. 8 and 9. Polishing, scratch brush and buffing belts are used in these machines. The belt is driven by means of a large wheel belted to a countershaft overhead. The working part of the belt runs over a cage of rollers, so made as to be adjusted to change the curve to suit the work in hand. By referring to Fig. 9, the arrangement for adjusting the belt and roller cage will be plainly seen. A rack arrangement *A*, operated by means of pinions and the lever *B*, moves the cage out or in to obtain the required tension on the belt. It is locked by means of the screw *C* in a slot in the sliding member. The roller cage itself has a screw adjustment of its own for holding it in any required position. The work head is driven by a small motor belted to a worm and worm gear on the work shaft. The whole head is carried on a bracket hinged to the column at *D* so as to be tilted at any angle. The column may be elevated as

required, by the handwheel *E*. The entire head and column mechanism may also be run in or out by means of handwheel *F*. A special link motion operated by the hand lever *G* makes it possible to run the work in or out quickly after the head has once been properly set.

Some of the shells are held on stands by means of their mounting brackets, as shown in Fig. 10, while the parts are being placed in them. The illustration represents the final assembly of this type of lamp.

On parts of various lamps that need to be riveted, hand work is employed exclusively. As a rule only a stroke or two of a hammer is needed in any case to fasten the parts securely together. Special anvils are used to give an easy hold for riveting. In most cases these anvils have a cupped-out place for the rivet head. One of the outfits is shown in Fig. 11.

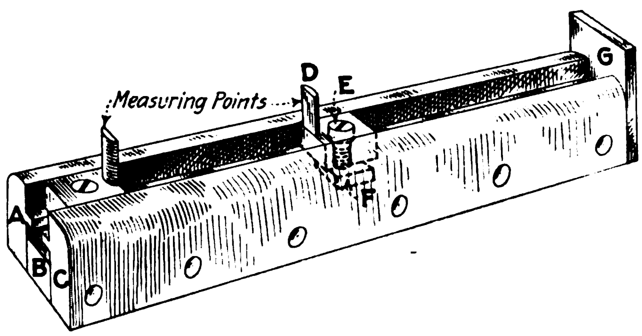
Many small-sized oil-burning tail lights are made. They are manufactured on a sort of unit system, and are so planned as to be easily put together separately and then assembled. In order to give an idea of the method, a complete and a disassembled lamp are shown in Fig. 13.

Lacquering or enameling, where this finish is required, is done as shown in Fig. 12. A De Vilbiss vaporizer is used, and the work is done inside a hood at the back of which is placed a fan to carry off all the fumes, or vapors.

Convenient Adjustable Gage

By D. Baker

The device shown is handy for the tool and gage maker's kit. It was first designed as a ready means of measuring small snap gages without the necessity of turning up plugs for each one, but it has since been found to be very useful in many other ways, taking the place of,



A CONVENIENT ADJUSTABLE GAGE

and being more rigid and accurate than, the vernier, on account of its shorter measuring points.

The three pieces *A*, *B* and *C* are riveted to form the body of the tool. They are hardened and ground all over. *D* is one of the hardened, ground and lapped measuring points which slide in the groove in the body of the tool. It is held in position by the screw *E* and the nut *F*.

To use the tool, the points are adjusted to the work in about the same manner as with an ordinary caliper; that is, by tapping the points until the proper "feel" is obtained, when with the screws tight, an ordinary inside or outside micrometer is used to find the exact measurement.

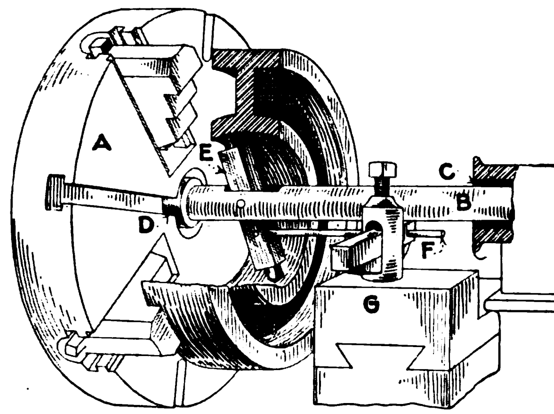
On the end will be noticed a piece *G*. This is also hardened, ground and lapped and will allow measurements being taken close up to the end of the tool as frequently is necessary on account of a shoulder or other projection on a piece of work.

One advantage of this tool is that more than one form of point can be made up and used with it as the work may require.

Spherical Boring on a Lathe

By W. C. Makley

In the illustration is shown a handwheel the bore of which is to be machined out spherically. The work is done on a turret lathe with power cross-slide. The piece is held in the scroll chuck *A* mounted on the turret-lathe spindle. The bar *B* is held in a bushing *C* inserted in the



SPHERICAL BORING ON HORIZONTAL TURRET LATHE

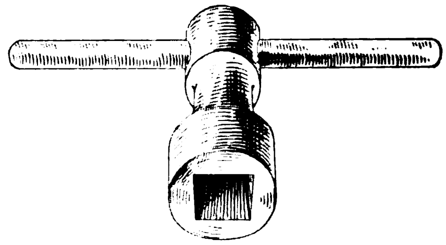
turret and in a bushing *D* mounted on the spindle. This bar is slotted at one end to permit the part *E*, which is pivoted at its center to the bar, to oscillate back and forth in a direction parallel with the center line of the bar. Two boring tools are inserted in the ends of *E* and held by a setscrew. A small rod *F* is fastened to the part *E* at one end, and to the cross-slide *G* at the other end, there being sufficient clearance between the work and the bar to permit the rod to pass through.

In order to bore the center of the work spherically, the cross-slide is moved along the bed by hand or power, while the work is revolved, causing the part *E* to oscillate about its center, where it is pivoted to the bar, thus causing the boring tools to move in the arc of a circle and generate the required form in the work

Improved Type of Wrench

By J. H. Davis

When a chuck is being used on the lathe, it takes quite a few seconds to enter the chuck key in the square hole. I have found that by making the wrench as shown in


IMPROVED TYPE OF WRENCH

the illustration, with the handle going across the square, the key may be inserted more quickly. As usually supplied, the handle goes across the corners of the square.

Making Adapters for British Detonating Fuse

By Fred H. Colvin

SYNOPSIS—A comparatively simple job and yet one which requires splitting into several operations to increase production and secure accurate work. Here again the threading is done in separate operations, although hard threading is avoided in this instance.

The adapter, shown in Fig. 1, is used in connection with the British detonating Mark-100 fuse, as illustrated on page 749, Vol. 43. It is made of machine steel $1\frac{1}{16}$ in.

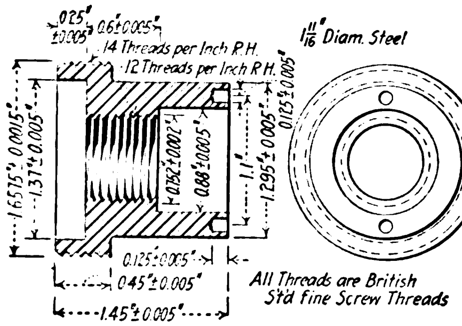


FIG. 1. ADAPTER FOR BRITISH NO. 100 DETONATING FUSE USED ON VARIOUS SHELLS

in diameter and screwed inside the fuse body, making a connection for the gaine, which is screwed inside the adapter.

These pieces are made from bar stock on National Acme automatics No. 56, the first operation being shown in Fig. 2. The adapter blanks then go to the Cleveland automatic, shown in Fig. 3, utilizing the tilting magazine for this purpose. This machine simply counterbores the large end, as shown in Fig. 4.

The chip-draining pans, shown in Fig. 5, are used in connection with both the first and second operations and are found to be very convenient for any work of this

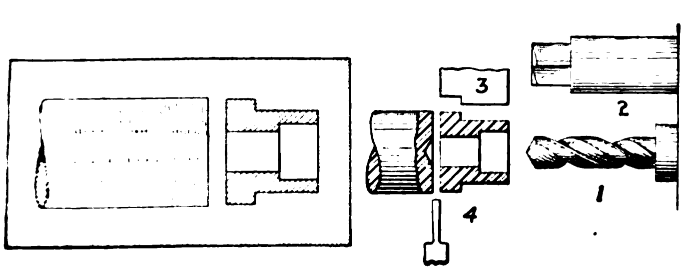


FIG. 2. THE FIRST OPERATION

Machine Used—National Acme No. 56.
Special Fixture—None.
Gages—See Fig. 10.
Production—60 per hour per machine.

kind. They are simply large, widely flared funnels with the lower end somewhat smaller than the top of an ordinary galvanized-iron bucket. They are placed near the machine, and the chips are shoveled into them from the machine pan. They allow a larger proportion of the oil to drain into the bucket, making it immediately available for further use. The chips then go to a centrifugal separator, where the remainder of the oil is extracted. Although these funnels are generally used singly, they are occasionally stacked up as shown, to save floor space.

The adapters are now ready for threading, none of this being done on either of the automatics. The third operation is the tapping of the thread for receiving the gaine,

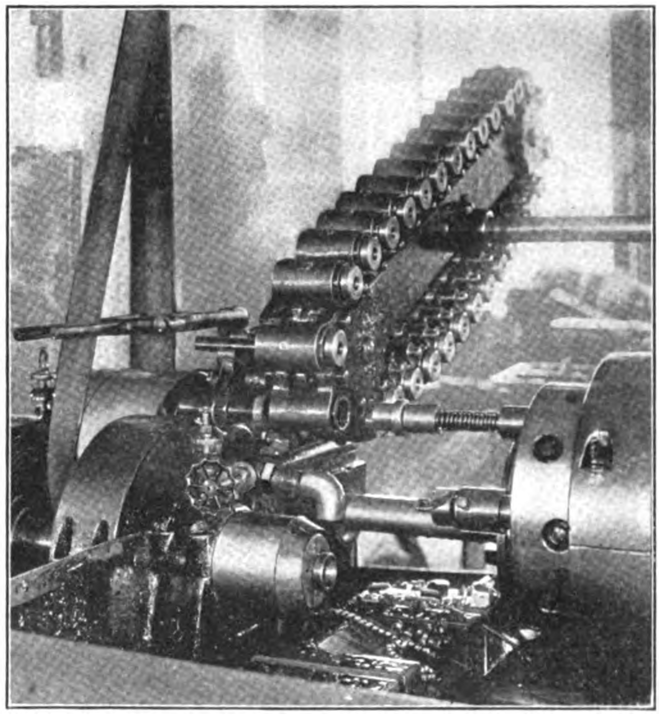


FIG. 3. SECOND OPERATION ON CLEVELAND AUTOMATIC

this being done in almost any kind of lathe, although a hand turret is preferable. A tapper tap is held in a suitable chuck on the lathe spindle, and the adapter is held in the turret while it is being fed over the tap. When the shank of the tapper tap is full, it is removed from

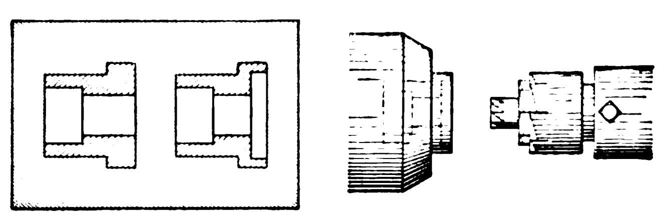


FIG. 4. SECOND OPERATION—COUNTERBORING

Machine Used—Cleveland automatic.
Special Fixture—Tilting magazine.
Gages—See Fig. 10.
Production—90 per hour per machine.

the chuck, the pieces are slid off and the operation is repeated. It is illustrated in Fig. 6.

The next operation is cutting the threads on the outside of the adapter, this also being done in a plain turret. The work is held in a spring chuck, and a self-opening die is used for the threading. Dies of the Geometric, Modern, and Warner & Swasey types are all used for this work.

FIG. 5. FUNNELS FOR DRAINING OIL FROM CHIPS PRIOR TO CENTRIFUGAL SEPARATION

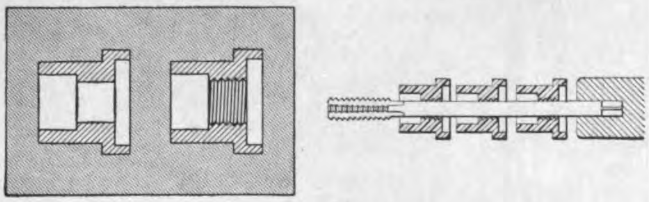


FIG. 6. THE THIRD OPERATION—TAPPING

Machine Used—Hand turret, Smur & Kammen.
Special Fixtures—Chuck-in turret and tapper tap.
Gages—See Fig. 10.
Production—150 per hour per machine.

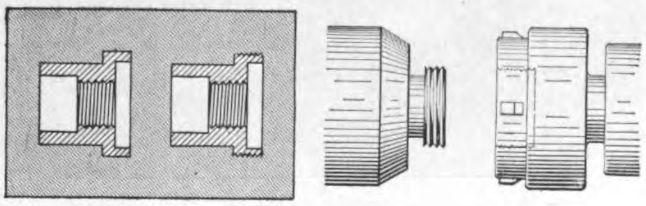


FIG. 7. THE FOURTH OPERATION—THREADING

Machine used—Hand turret.
Special Fixture—Self-opening die head.
Gages—See Fig. 10.
Production—300 per hour per machine.

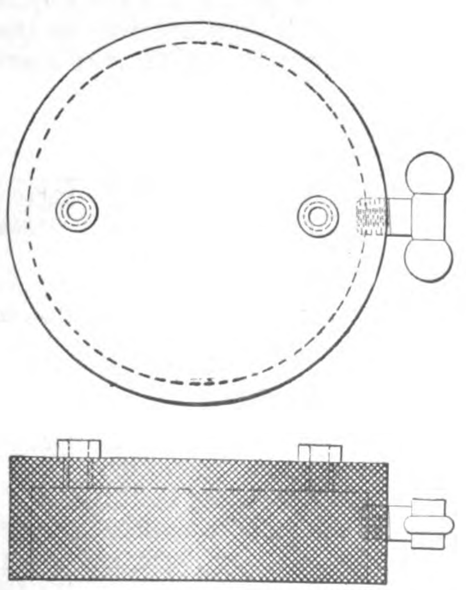


FIG. 9. SIMPLE DRILL JIG ESPECIALLY DESIGNED FOR ADAPTER WORK

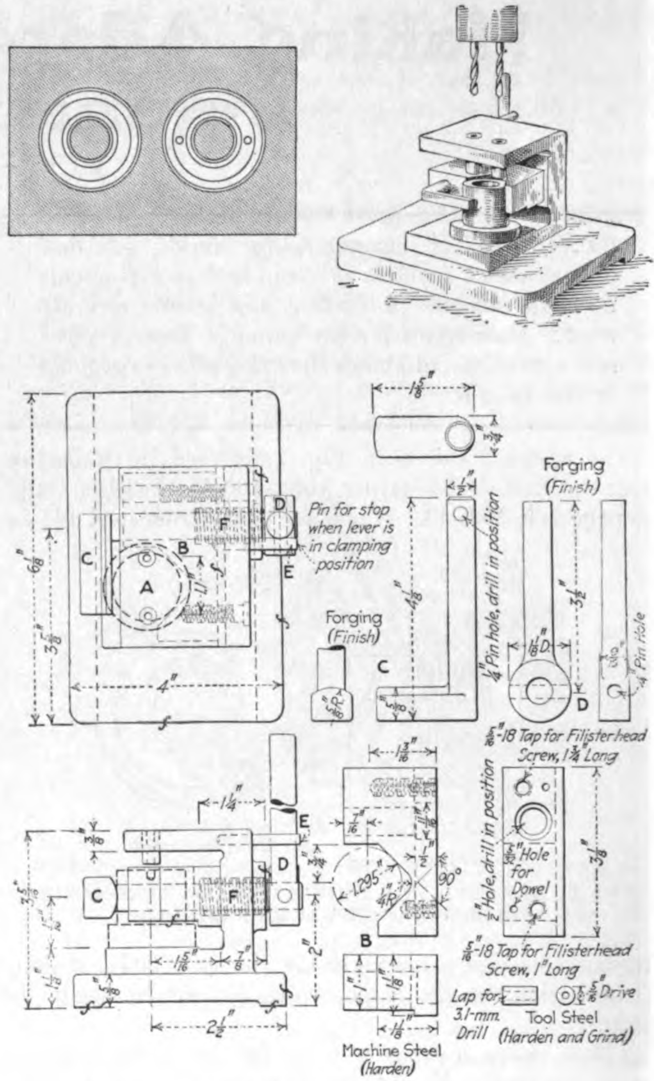


FIG. 8. THE FIFTH OPERATION—DRILLING

Machine Used—Leland-Gifford drilling machine.
Special Fixtures—Sellew two-spindle drilling head.
Gages—See Fig. 10.
Production—400 per hour per machine.

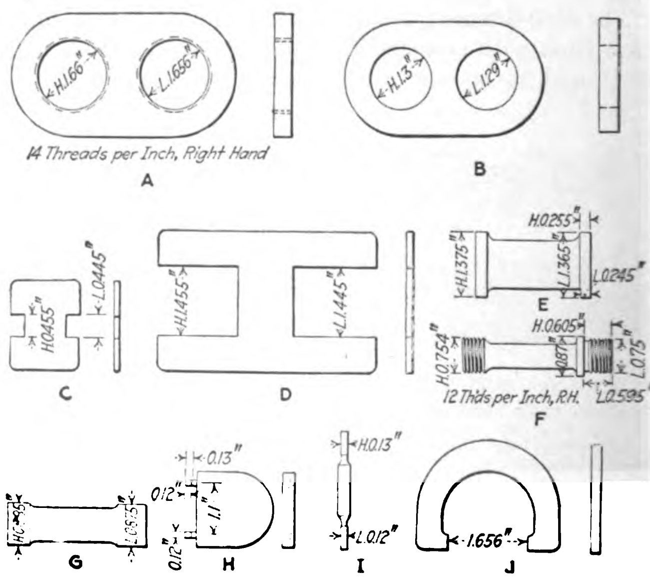


FIG. 10. GAGES USED FOR THE ADAPTERS

A—Diameter of outside screw thread. B—Diameter of plain part. C—Length of screw. D—Total length. E—Diameter and depth of recess at top. F—Diameter and length of internal thread. G—Diameter of small bore. H—Depth and distance of keyholes. I—Diameter of keyholes. J—Low or "not go" diameter of screw threads.

A fifth and last operation is drilling the two holes for the side spanner wrench, as shown in Fig. 8. This is done in a simple drilling jig. The adapter *A* fits into the block *B* and is held in place by the hook bolt *C*, which has a rounded surface on the inside of the hook and a pin handle *D* at the other end. It is held closed by the spring *F*. This hook bolt is swung to an angle of about 90 deg. to release and to lock the adapter. The pin *E* affords a stop for the handle *D* when in a locked position.

A two-spindle Sellew drilling head has been used on a Leland-Gifford high-speed drilling machine.

Fig. 9 shows a very simple type of jig for this work. It has been used by another contractor making adapters.

The gages used are shown in Fig. 10.

Increasing the Usefulness of a Radial Drilling Machine

By R. W. Grace

The standard pattern of radial drilling machine is equipped with a drill table having three or four slots and large enough for one job at a time. By providing a second table at right angles to the standard table a considerable increase may be made in the output.

In a machine shop drilling automobile cylinders this arrangement was possible, as two jigs were used, one for each table.

When one table with casting and jig is ready for setting the second table is loaded with part and jig, as before. The drill hand has by this time completed the drilling of the first casting. The machine arm is then swung around to the second table, where the jig is all ready. This method of handling the work makes it almost continuous.

Drilling Long, Small Holes

By A. R. Robertson

Not infrequently it becomes necessary to drill in steel small holes of considerable length; that is, holes as small as a No. 30 drill and from 4 to 6 in. in length. In work of this kind the drill clogs, breaks or does not run straight, resulting in spoiled work. I have found a way to overcome this difficulty.

The drill should be ground so that one cutting lip is slightly longer than the other. This, of course, will produce a hole slightly larger than the diameter of the drill, but by selecting a somewhat smaller drill the hole can be made fairly close to the desired size. The action of this drill seems to be to break up the chips and prevent the drill from sticking.

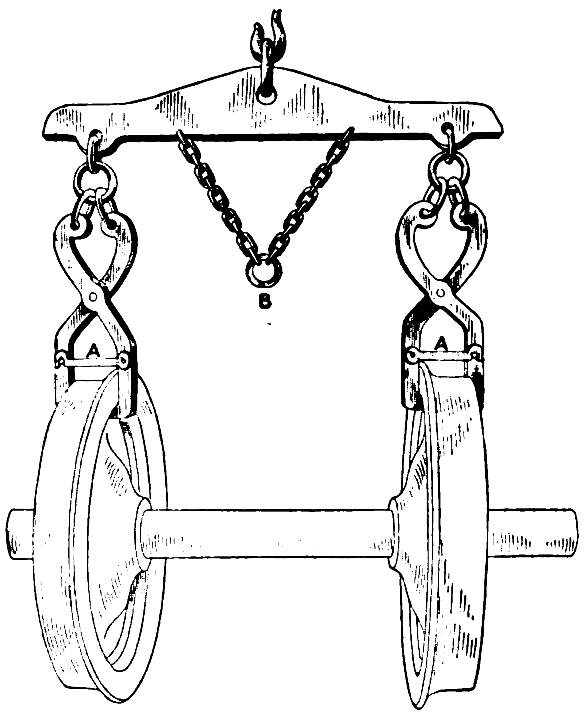
In holes of these small diameters only about 1/8 in. can be drilled before withdrawing the drill for cleaning and oiling. A great deal depends upon getting the drill started true, and it will be found advantageous to start the hole with a short tool, the work being revolved in a chuck. It is well to have the small drill fitted nicely into a tube that can be made quite stout. The drill shifts forward in the tube as the hole deepens, being held by a setscrew in the tube.

If these suggestions are followed, quite satisfactory results can be obtained, but the work is slow, requiring about 25 min. to drill 6 in. in soft steel. A great deal of care must be taken to get the oil into the hole during the operation of drilling, and pure lard oil thinned with kerosene is about the best lubricant to use. The speed should be considerably higher than is usually employed by machinists, and the feed should be very delicate and sensitive.

Car-Wheel Lifting Device

By J. A. Lucas

The illustration shows a wheel-lifting clamp that has been devised especially to handle wheels having a plate or web in the center. Most of the lifting clamps illustrated depend on the hooks going between the spokes, which is



CAR-WHEEL LIFTING DEVICE

obviously impossible in this case. The lifter shown can be used on wheels of either kind.

In order to make this appliance doubly secure, we put the hook at *A* to prevent the possibility of the hooks dropping the load under any conditions. The chain *B* was added so that the lifter could handle other work.

Smoke Nuisance Investigation

A recent investigation of the smoke nuisance in Chicago, under the able guidance of Dean Goss of the College of Engineering, University of Illinois, shows some interesting facts. Instead of the railroads being the worst offenders, as usually supposed, they are responsible for but 22 per cent. of the visible smoke and but 7.47 per cent. of the solid particles discharged into the atmosphere.

About 65 per cent. is due to stationary steam plants for power and heat, making the manufacturing plants of various kinds the greatest offenders. This of course pleases the railroads; but as the main question is the abatement of smoke, regardless of who is responsible for it, there is no room for self-congratulation in any quarter. Citizens have a right to demand that all business shall be conducted with as little nuisance as possible.

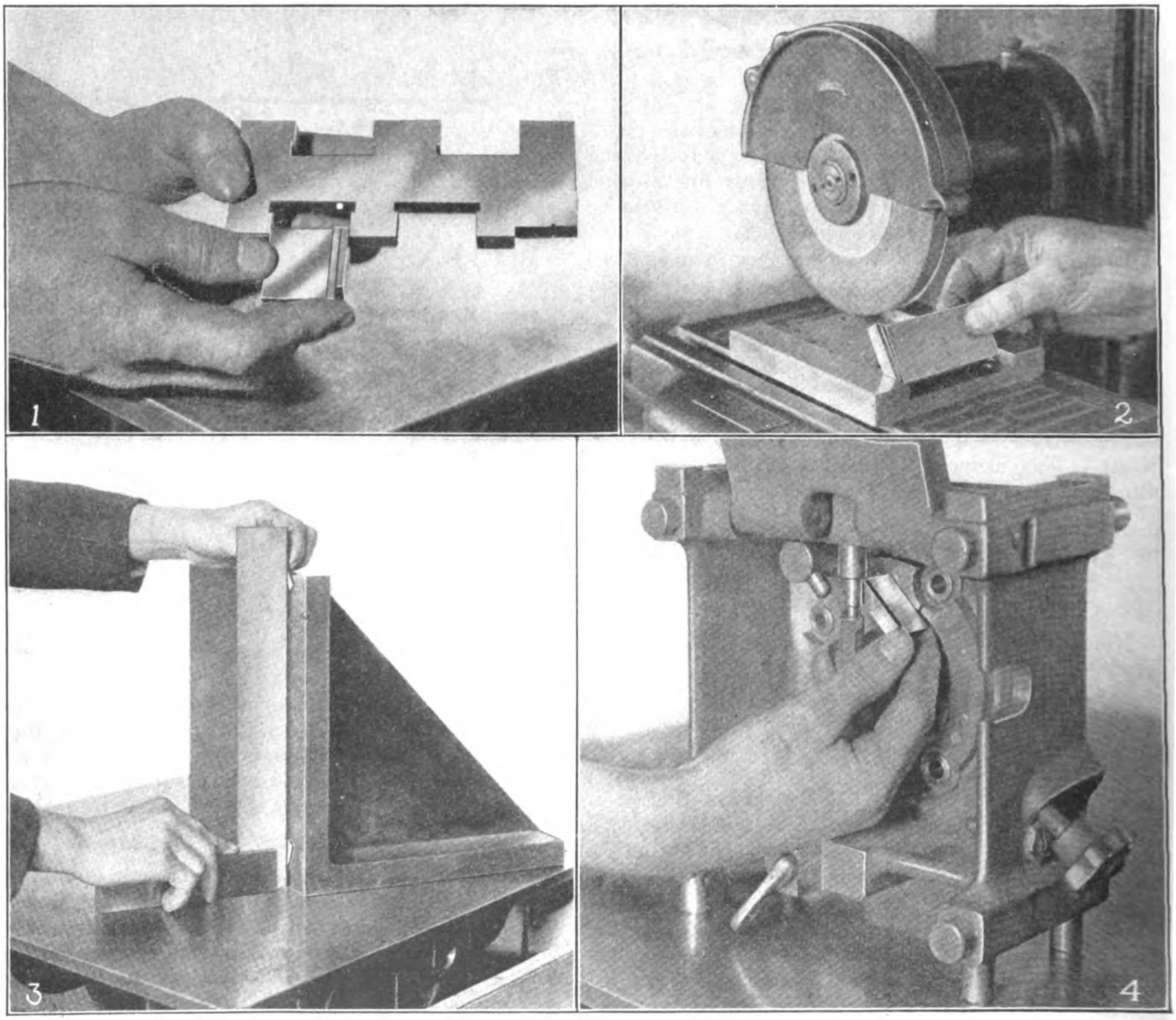
Johansson Gages in Tool Making

By Louis Ruthenburg*

SYNOPSIS—New tools bring new methods. Several of those developed in tool making to secure effective use of Johansson, or Swedish, gages have been gathered together into this article. Their use brings ease and certainty in making accurate measurements.

"One good turn deserves another." Every major invention has a following of innovations to adapt it to its various fields of usefulness. Likewise, new machines bring novel processes, and new tools bring new methods. The most recent aid in doing work in the machine-shop toolroom. It is therefore but natural that, as these gages came into use, methods were brought out or discovered to gain the greatest possible benefit from their accuracy and ease of application. A few of these applications that are now used daily have been gathered together into this article.

As a rule, all such set-ups, or methods, are simple and need only to be shown to a mechanic to have him see how they are done and to be able to do the same things himself. So it seems to me that only a small amount of description is needed by *American Machinist* readers, as



FIGS. 1 TO 4. APPLICATIONS OF SWEDISH GAGES IN THE TOOLROOM

Fig. 1—Direct measurement of snap-gage opening. Fig. 2—Direct measurement of fixture slot. Fig. 3—Measuring accuracy of right-angle fixture. Fig. 4—Measuring distance from pad to bushing in a jig

ingenuity, skill and effort of both inventor and user are necessary to get the most and best out of any departure from the usual, whether it be a device or a discovery. Only a few years ago Johansson, or Swedish, gages were the the illustrations show how the Swedish gages are actually used for measuring or checking other gages, jigs and fixtures, for laying out, and for setting indicators for inspecting. The benefit that comes from using methods such as these is the greater ease and certainty with which

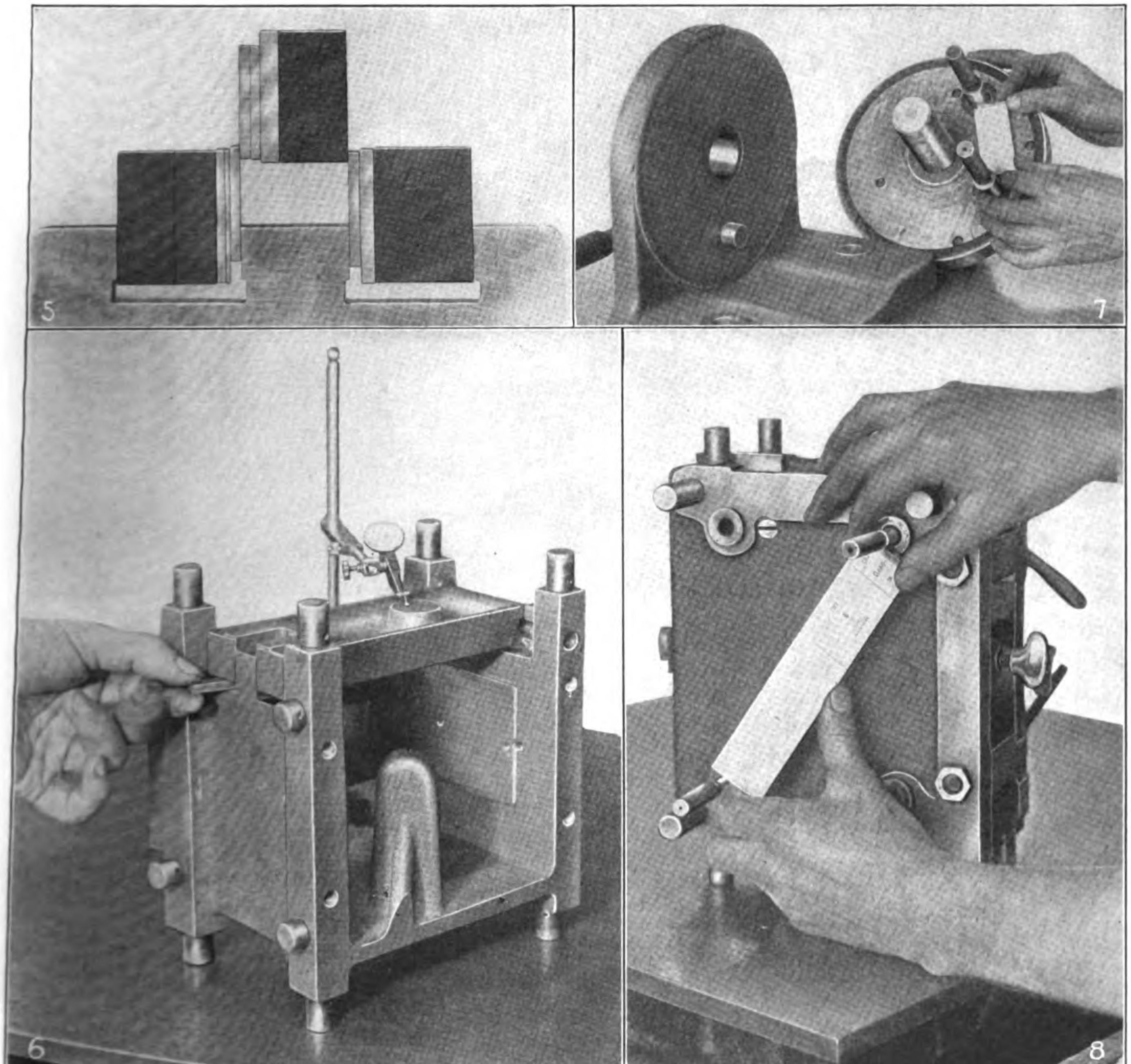
*Chief Inspector, Dayton Engineering Laboratories Co.

measurements can be made. The gages should be thought of as tools to be used by the tool maker to save him time and worry, instead of as mere references to be consulted only when it is necessary to settle some dispute.

The first application that I show, in Figs. 1 and 2, saves time and secures a high degree of accuracy by the direct measurement of snap gages and fixture slots. It is hard to conceive of a simpler scheme than that of fitting together the necessary gage blocks and then trying them into the opening or slot that is to be measured.

Gages wear rapidly, particularly when used for shop inspecting on grinding and lapping operations. A difference of a few ten-thousandths between the gages used by operators and inspectors often causes disputes. Thus, facilities that aid in the making and inspecting of the gages used in production earn real dividends.

If a right-angle fixture is made so that it is out of square only 0.0001 in. at a point 6 in. above the base, the job is considered pretty accurate. The tissue and feeler tests for such a fixture, using a standard square, are familiar to every tool maker. Fig. 3 shows how to measure—not merely test—an angle plate under such conditions. The one shown happened to be a little wide at the top. A Johansson block, size 0.1001 in., was held against the bottom of the angle plate by the square. The next largest block in the case, size 0.1002 in., was then tried at the top of the plate. As both gage blocks were held in place with the same amount of pressure, there was obviously a difference in dimensions between top and bottom equal to the difference in the sizes of the two blocks. In the case shown, this difference was 0.0001 in., which was readily eliminated.

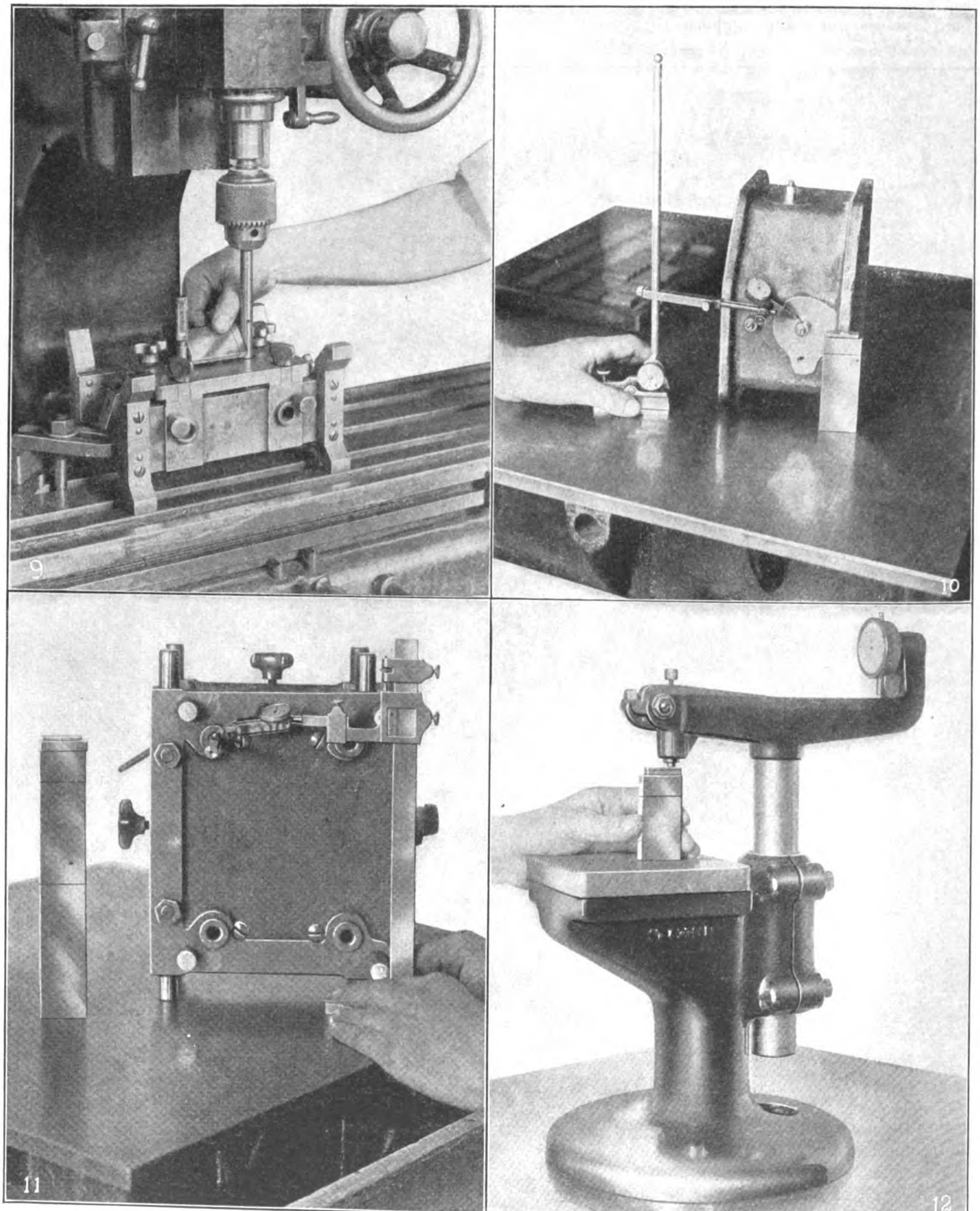


FIGS. 5 TO 8. OTHER APPLICATIONS OF THE JOHANSSON SWEDISH GAGES

Fig. 5—Measuring distance between gage openings. Fig. 6—Determining thickness for a striking block. Fig. 7—Spacing holes in an indexing fixture. Fig. 8—Spacing holes in a drilling jig

The most common cause of head-scratching in the toolroom is a job having points between which accurate measurements must be made, but which are so situated that they are difficult of access. This condition often causes the mechanic to use inaccurate, makeshift methods. A job of this kind is shown in Fig. 4, where it was necessary to measure in the drill jig from the rest pad to the bushing. The method illustrated is wonderfully simple, quick and accurate.

Fig. 1 shows how to measure the opening in a snap gage. The adaptability of the Johansson system of gaging to the problem of measuring the distance between two



FIGS. 9 TO 12. APPLYING THE SWEDISH GAGES TO LOCATING AND GAGE-SETTING WORK
Fig. 9—Locating boring bar from a bored hole. Fig. 10—A simple method for setting buttons. Fig. 11—A simple method for inspecting jigs. Fig. 12—Setting a dial indicator for inspecting

slots—in Fig. 5 the distance between the two gage openings—gives another idea of its usefulness among the varied requirements of tool making and inspecting. The illustration is self-explanatory. Incidentally, not only is an accurate measurement made of the distance between the openings, but the parallelism of the slots, both vertically and horizontally, can also be noted accurately.

When box jigs must be so designed that they will maintain their accuracy, they are usually fitted with striking blocks between the lid and the frame. The time-consuming, comparatively inaccurate method of cut-and-try is the one usually employed for fitting these blocks. Fig. 6 shows something vastly different. Swedish gage blocks are slipped under the lid. When the correct combination is found, the indicator shows parallelism between lid and base. The combined thickness of the gage blocks is then noted and the striking blocks ground to correspond.

A job that taxes the skill of the most painstaking mechanic is the proper spacing of holes in highly accurate indexing fixtures. On work of this kind, disputes sometimes arise between the tool maker and the tool inspector about "the way the vernier was read." A simplified method that is beyond dispute is illustrated in Fig. 7. Swedish gages built up to the proper length feel between standard plugs in the holes, whose spacing must be accurate.

This same method is applied equally well to the measurement of hole spacing in drill jigs, Fig. 8, and in locating work for boring, Fig. 9. In the latter view a transfer bar held in the miller chuck is the starting point for the measurement. From this the dimension is checked with reference to a standard plug in a hole. A similar measurement might be made to some reference surface on the work.

In many tool rooms the setting of buttons for locating boring operations is a slow, tedious process. At the same time it is a method that frequently provokes much profanity, especially when a finished tool is rejected because someone slipped in reading his height gage. When you substitute Johansson's gage blocks for the usual measuring tools, the method of setting buttons simplifies to the following:

A combination of blocks is selected, corresponding to the distance from the bottom of the jig to the top of the button. This dimension is the distance given on the drawing to the center of the hole to be bored, plus one-half the button diameter. Now set up the jig and blocks on the surface plate and adjust the indicator to read zero when it is drawn across the top of the stack of gage blocks. The indicator is then moved to button No. 1, which is adjusted until the pointer registers zero. Without disturbing the original combination of the gage blocks, select a second combination corresponding to the location of button No. 1 from the side of the jig. Turn the jig over on its side and adjust the button in this second direction. This finishes the location of button No. 1.

Now leave the top block of the original combination projecting slightly over its mate, add other blocks as needed and proceed to locate button No. 2 in the same manner. If two buttons are so located, we will have two stacks of gage blocks, each having a projecting block to indicate the location of one button, while the tops of the stacks indicate the location of the second. It is now a very easy job to check all dimensions in "jig time."

This method and the underlying principle are shown in Fig. 10, where the first step is set up. A simple jig was selected for this example and only a few blocks stacked in combination, to avoid any possible confusion in understanding it.

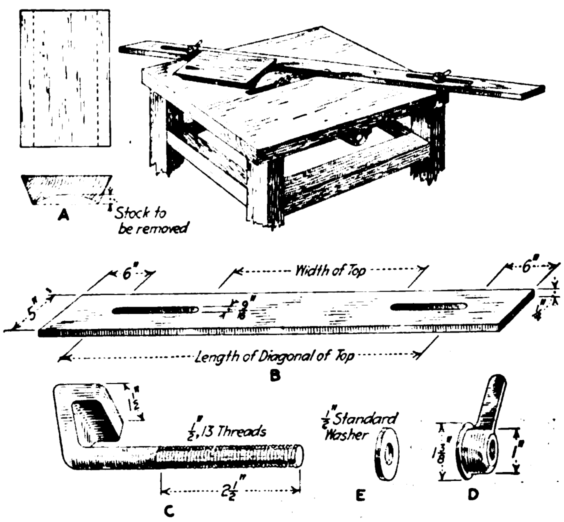
Of course, the same process is applied by the inspector in checking the jig when finished. Fig. 11 shows this operation. The height gage that appears in this view is used only as a convenient means for holding and adjusting the dial indicator, which feels the top of the standard plug and the top of the stack of gage blocks.

The highly sensitive indicating gage is coming into more and more use for inspecting, because of the time it saves and the means it provides for obtaining accuracy in production. It is a tool that lends itself to fast, accurate results in gaging a wide variety of work. Such a gage is shown in Fig. 12. Each graduation of the dial is equivalent to a variation of 0.0001 in. in the work. The illustration was prepared to show the method of using Swedish gage blocks to adjust the dial zero at the middle of the tolerance range of the work to be inspected. For example, let us suppose that the work to be gaged is a ½-in. straight-ground shaft with limits of 0.4995 and 0.5005 in. The dimension midway of these limits is 0.5000 in. A gage block of this size is used to adjust the dial to read zero. All work that is within the limits set will not move the indicator pointer more than five graduations either side of the zero point.

Cutting Lags To Fit Around a Curved Surface

By S. L. Cook

The device described, while not intended to revolutionize pattern-shop practice, will be found to be extremely handy, and in a shop where there is a great deal of "lagging up" or stave work it will prove almost indispensable, as it will quickly take the place of the usual straight-edge and hand screws.



ATTACHMENT FOR A CIRCULAR SAW

At *A* is shown an assembly of the rig on the saw table. On some saw tables it will be necessary to remove the fence, but this operation requires but a very few seconds.

The straight-edge shown at *B* should be made of maple planed on both sides and carefully straightened on

both edges. There should be a small hole bored near one end about ½ in. in diameter, to hang the rig up by when not in use.

The hook and the wing-nut, shown at *C* and *D*, are given in detail, and no difficulty will be experienced in making these two patterns. The castings should be made of bronze, and what little machine work is required may be easily done with the pattern-shop drill press and a hand tap and die borrowed from the machine shop. Two castings of each are required.

The standard ½-in. washer, shown at *E*, will be easily found. Obtain two ½-in. washers. The use of this device will be apparent to any pattern maker. If a little time is spent in constructing it, the saving will easily pay for it many times over. It will add to the efficiency of the pattern makers' old standby, the circular saw.

Indexing Work Tables for the Drilling Machine

Two indexing work tables that are extremely handy for various shop jobs, or for holding jigs and fixtures, are shown in Fig. 1. They are made by the Mueller Machine Tool Co., Cincinnati, Ohio, and all the radial drilling machines in its shop are equipped with them.

The slotted tables, 16x26 in., are 3½ in. thick. The circular part is 18 in. in diameter. Most of the tables are bushed quartering for the index pin *A*, but as many holes can be made and bushed as the conditions require. The feature of this type of table is that a jig may be bolted to it; by using a radial drilling machine, all the holes may be drilled in the piece before removal and with the minimum labor on the part of the operator.

Fig. 2 shows one of these tables with a lathe-apron drilling jig bolted to it. Fig. 3 shows a similar table with a lathe saddle clamped to it. The size of the tables makes them strong and rigid enough for any ordinary shop use. Besides the heavy center pin on which they revolve, there are two heavy locking bolts, working in a circular slot, to clamp the table solid after locating.

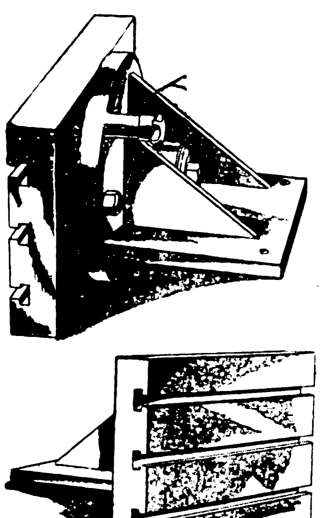


FIG. 1. INDEXING WORK TABLES

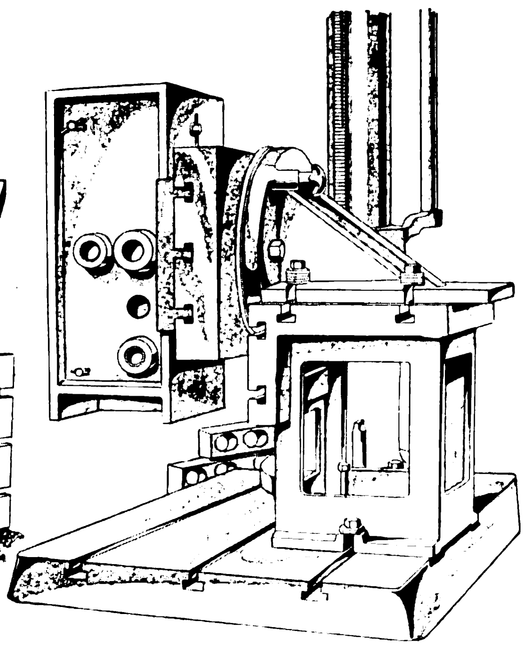


FIG. 2. APRON JIG BOLTED TO TABLE

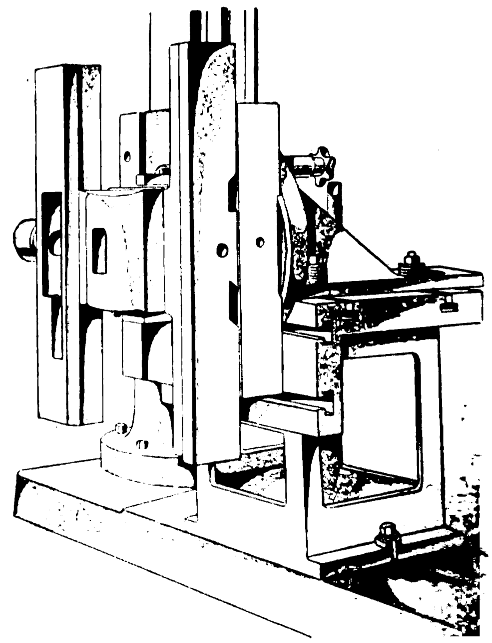


FIG. 3. LATHE SADDLE IN PLACE

Annual Manganese Production

The manganese ore and metal industries continue to undergo readjustment, but the impetus given the domestic industry on account of the shortage of foreign ore has not brought forth the production that had been expected. Important exploratory work and preparations for milling have been carried out at several mines in Virginia, Tennessee, Colorado and California, but except in the case of one mine this has not yet resulted in production. A close estimate of the production in the United States for 1915 cannot be made, but it is very doubtful that it exceeded 6,000 tons, as compared with 2,635 tons produced in 1914, according to the United States Geological Survey.

The shortage in high-grade ores for use in the manufacture of flint glass and dry batteries has been keenly felt, and several dry-battery plants have been forced to close down.

The shortage of imports forced two important steel producers—Jones & Laughlin Steel Co., of Pittsburgh, Penn., and Maryland Steel Co., Sparrows Point, Md.—to devote furnaces to the manufacture of ferromanganese. This is noteworthy because most of the domestic ferromanganese has heretofore been made by two subsidiaries of the United States Steel Corporation, although several more firms have occasionally contributed.

Efforts are being made to conserve during refining the manganese contained in raw pig iron, thereby reducing the amount of ferromanganese that must be added to make steel. If these efforts are successful, they will mark an important advance in steel metallurgy.

During the first 10 months of 1915 Brazil supplied a very large proportion of the manganese oxide and ore that was imported into this country. The total from the South American country was more than twice the average for the preceding three years and partly made up for the failure of supplies from Russia and India. The receipts from India were about one-twelfth normal and from Russia negligible.

Tools Used in Machining Small Connecting-Rods

By E. P. Gleason*

SYNOPSIS—In this article are described the tools used when machining connecting-rods used on a motor-operated boat. The forging is straddle-milled for the first operation, and in the next operation the larger end is rough and finish bored. A locating plug is then used to center the rod for the subsequent operations. A neat open-side latch, which is tightened against a turned shoulder or the locating rod, is noteworthy.

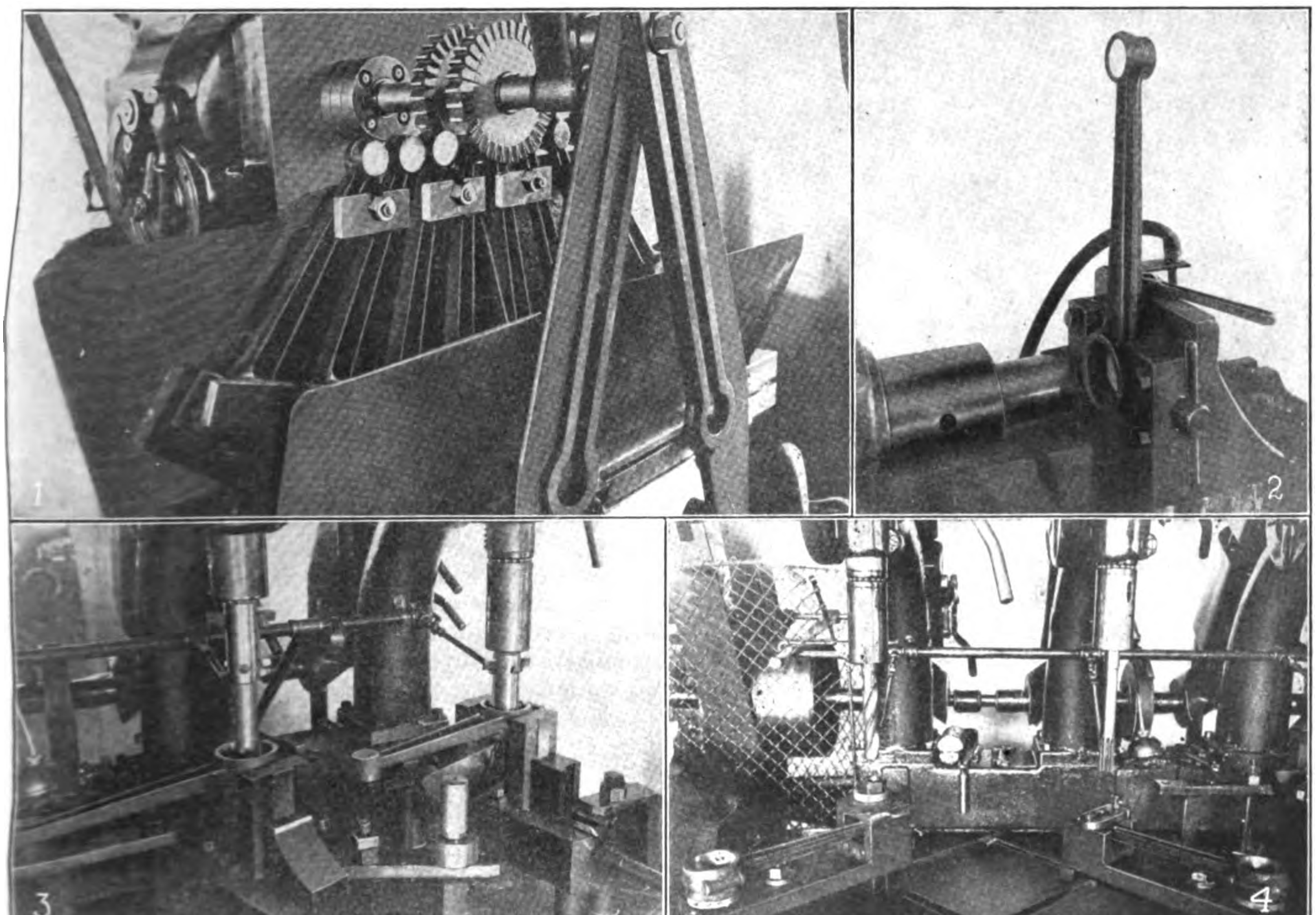
The operations observed when machining a small connecting-rod are of interest, and here are shown the tools and methods used, also the times and productions for each operation.

Operation 1 is straddle-milling the small end or piston-pin end. Eight rods are machined at one setting, clamped at each end in the usual manner and lined up by the face of the large end and the web at the small end. This operation could be improved upon by lining up the small end by the clamp screw lug against a V-block, as in operations 2 and 3. The machine output for one man in 10 hr. is 600 rods. The set-up is shown in Fig. 1.

Operation 2 refers to rough-boring the large, or crank-pin, end. This operation is done on two lathes which are tooled up by turning up a tool holder for a lathe spindle and inserting a high-speed cutter, as shown. The rod is lined up by V-slots clamping onto the bolt lugs and is securely held by the clamp. This method insures alignment and evens up the stock around the edges of the bolt holes.

One man puts out 500 per 10-hr. day on two lathes, removing ¾ in. of steel at the center of the forging. The method of tooling is shown in Fig. 2.

Operation 3 is finish-boring the large end. The jigs are made from two jaw chucks with V-jaws, as shown, thus following the same lining up as in operation 2. The cutter bar is piloted by a bushing bolted between the jaws to the face of the chuck. Two tools are used for boring and one for facing. The facing of the side is gaged by measuring from the center of the V-blocks. One man puts out 250 per 10-hr. day on two jigs. The manner in which this operation is performed is shown in Fig. 3.



FIGS. 1 TO 4. MILLING AND BORING TOOLS FOR CONNECTING-ROD ENDS

Fig. 1—Straddle-milling the rods. Fig. 2—Rough-boring large end. Fig. 3—Finish-boring large end. Fig. 4—Drilling and reaming small end

*Superintendent, Evinrude Motor Co., Milwaukee, Wis.

Operations 4 and 5 refer to drilling and reaming the piston-pin hole in the small end. The rod is fastened with the faced side down, bringing both holes at right angles with the web and parallel with it.

In placing the rod in the jig the small end is centered by a V-slot in a crosshead held by spring tension at the back. The large end is supported on the bottom by an adjustable pilot perfectly fitting the large end. When in place, a bushing is screwed down onto the rod to hold it during the operation. The reaming operation may be easily followed. One man puts out 300 per day for the two operations.

Operation 6, facing the opposite sides of the large end, is done on the drill press with a facing mill. The output for one man is 1,000 per day.

Operations 7 and 8, broaching both ends, give an output for one man of 300 per day.

Operation 9 is drilling the two holes in the bolt lugs. A four-spindle auxiliary head is fitted to a 20-in. power-feed drill press. The jig is made to hold two rods. It is held at the drilled end by washers, by eccentric clamps at the lower end and is supported by a pin. One man runs two spindles, with an output of 300 rods per day. The jig as used is shown in Fig. 5.

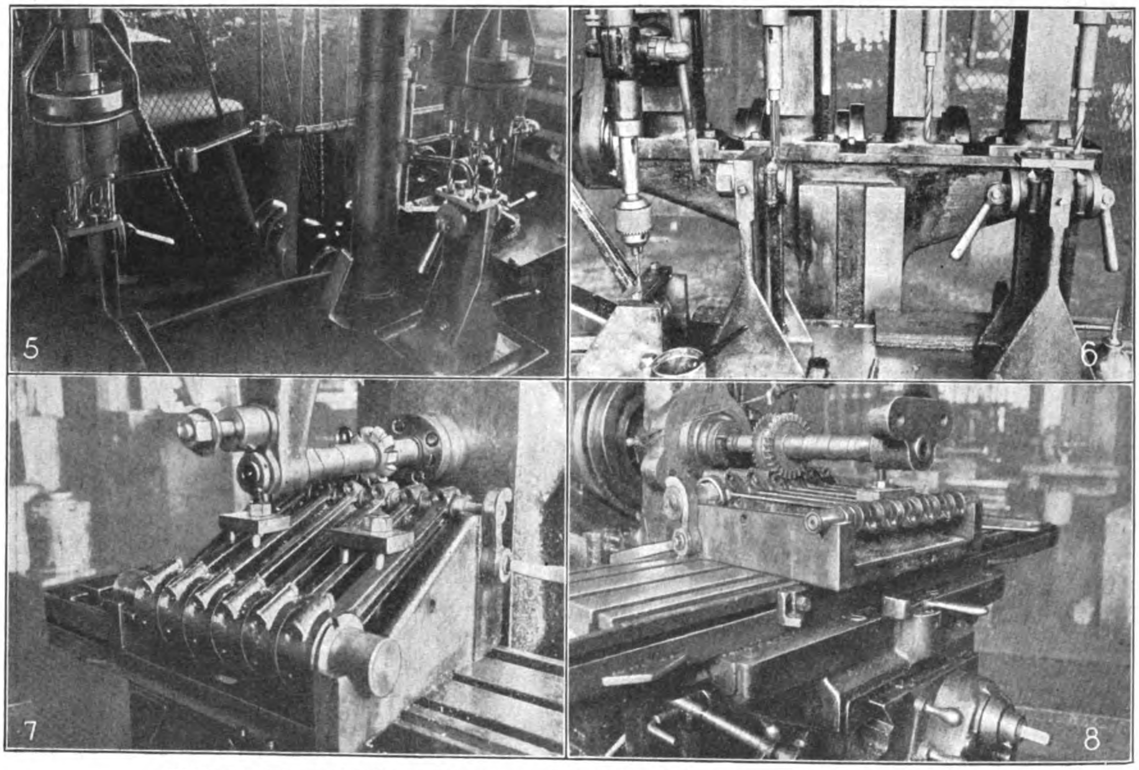
Operations 10 and 11, drilling, tapping and facing the clamp screws at the small end, are performed by one man on a three-spindle press and tapping machine. He completes 300 per day.

Operations 12 and 13 refer to drilling and reaming the pilot hole for the bushing and drilling the oil holes. The jig for drilling the oil hole is simple. A pin that fits into the reamed hole is fastened in the center of the shaft at right angles with the end terminating directly under the drill bushing. In operation the rod is held up against the bushing, as shown, until drilled on one side, then released. The rod is turned over, and the operation is performed on the opposite side. One man completes 300 per day. The jig as used is shown in Fig. 6.

Operations 14 and 15 are milling the radii, facing the lugs and splitting. Four sets of mandrels are in service. While one set is being used, as shown in Fig. 7, the operator is setting up another. After milling the radii this set is placed in the next fixture, Fig. 8, where the lugs are milled and split. One man completes 250 rods on two milling machines.

Operation 16 is milling the clamp slot in the small end. It is a simple operation. One boy does 1,000 in 10 hr.

The time required for 100 connecting-rods is 35 hr.. including trucking and inspecting which represents a creditable rate of production.



FIGS. 5 TO 8. DRILLING, MILLING AND FACING AUTOMOBILE CONNECTING-RODS
Fig. 5—Drilling holes for bolt in lugs. Fig. 6—Drilling and reaming pilot holes. Fig. 7—Milling radii on lugs
Fig. 8—Facing lugs of rods

The Production of Gold in the United States in 1880 was \$36,000,000, while in 1914 the total domestic yield was \$94,-500,000. The world's output of gold is approximately \$460,-000,000, of which the United States produces 20 per cent. It is not possible to give an accurate estimate of the total reserves of gold ore in the United States, but it is safe to assume that they are sufficient for a long period of years. Advances are being made in the mining and treatment of low-grade placer gravels by the introduction of larger and more efficient dredges that recover practically all of the gold in the gravel. As in years past, the supply of gold will continue to come from California, Alaska, Colorado, South Dakota, Nevada and Montana.

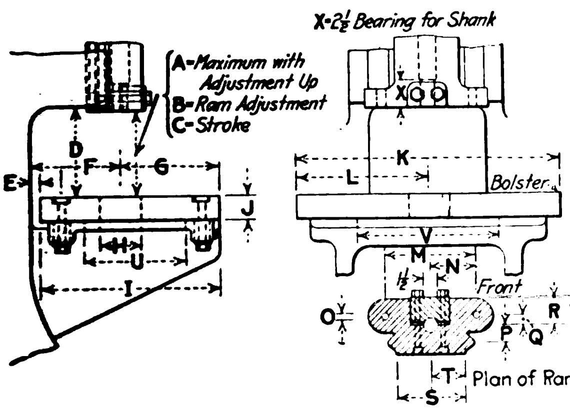
Letters from Practical Men

Data for Punch Presses

In the illustration are shown data on punch presses that may be found useful by designers in making punch and die tools to be used on No. 4 and No. 5 Adriance

No. of Press	Speed	A	B	C	D	E	F	G	H	I	J	K	L
4	100 / 150	$8\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{1}{2}$	$7\frac{3}{4}$	$\frac{1}{4}$	7	$7\frac{5}{8}$	$4\frac{3}{4}$	$14\frac{5}{8}$	$1\frac{1}{2}$	$22\frac{5}{8}$	$11\frac{3}{16}$
5	75 / 125	9	$3\frac{1}{2}$	3	9	$\frac{1}{16}$	$8\frac{3}{4}$	10	5	$18\frac{1}{16}$	$2\frac{1}{2}$	$27\frac{1}{2}$	$13\frac{3}{4}$

No. of Press	Speed	M	N	O	P	Q	R	S	T	U	V	W
4	100 / 150	$7\frac{1}{2}$	$3\frac{3}{4}$	$\frac{11}{16}$	2	$\frac{5}{8}$	2	$5\frac{1}{4}$	$2\frac{3}{4}$	$10\frac{1}{2}$	$10\frac{3}{4}$	$2\frac{1}{8}$
5	75 / 125	10	5	$\frac{3}{4}$	$2\frac{1}{4}$	$\frac{1}{2}$	$2\frac{3}{16}$	7	$3\frac{1}{2}$	12	16	$2\frac{5}{8}$



PUNCH AND DIE DESIGNING DATA

presses. There are also supplied data required by the designer regarding the minimum and maximum sizes of tools which can be used in operating.

Hartford, Conn. W. F. O'Conner.

A Home-Made Paint Sprayer

The paint sprayer illustrated requires very little description, as all essential dimensions and the method of construction are shown. It is connected to the air line at *A*, the air pressure being controlled by the handle *H*. Pressing this opens the air passage by forcing the valve *C* downward. The passage of air through the T at *D* forms a vacuum in the suction pipe *E* and draws paint from the bottom of the can through the pipe *F*. The amount of paint is regulated by the thumb-screw valve *G*.

This sprayer is primarily intended for painting coal or box cars, either wooden or steel, but can also be used in painting shop walls with oil or water paint, or even whitewash. It will be found extremely convenient in any shop having air available. Joseph K. Long.

Renovo, Penn.

Two Forms of Wire Benders

In another article are shown a few simple types of benders. In this article are illustrated two of a more complicated type, both using the brake bend. Both have been made exactly as shown and are capable of an

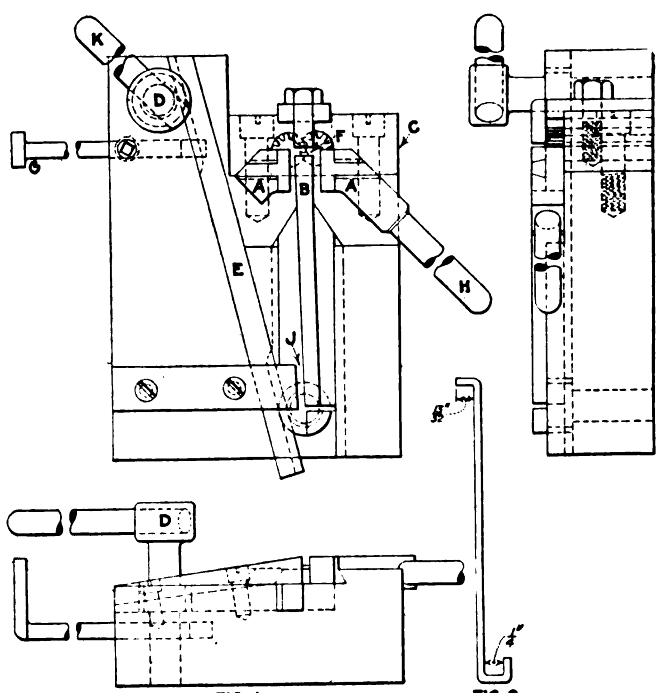
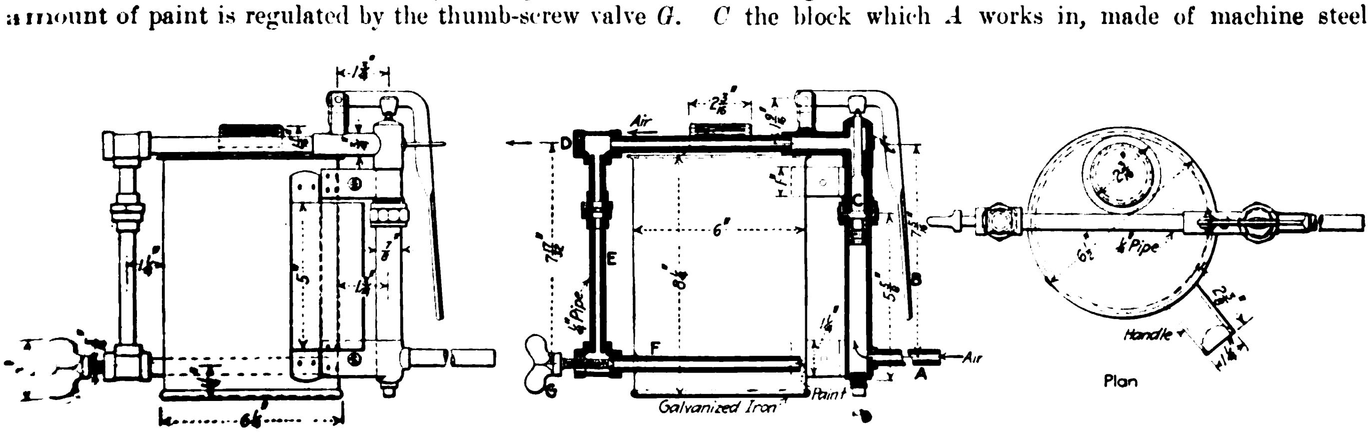


FIG. 1 FIG. 2

BENDING FIXTURE FOR SINGLE BEND

output of from 1,000 to 1,500 per hr. of No. 12 spring wire. Fig. 1 shows views of a machine that produces a bend as shown in Fig. 2.

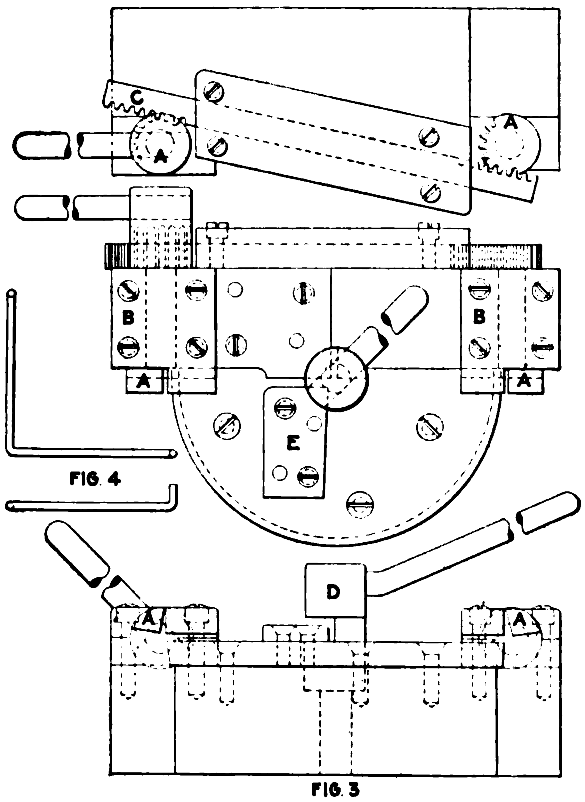
In Fig. 1 *A* are the double-brake benders, *B* the form, *C* the block which *A* works in, made of machine steel



HOME-MADE PAINT SPRAYER ADAPTED FOR SHOP WALLS AND OTHER GENERAL WORK

case hardened, *D* is a geared handle which actuates the rack *E* which makes the final bend.

In action both handles are thrown back. Place the wire in the slot *F* and against the stop *G* and pull the handle *H* the full stroke. This makes the double right-angle bend and introduces the extended length of wire



BENDING FIXTURE FOR RIGHT-ANGLE BEND

to the slot *J* or in position to make the final bend. Then pull the handle *K* to make this bend.

Fig. 3 shows another bender making one right-angle bend and two other right-angle bends in the opposite plane of the first bend, as shown in Fig. 4.

This machine works on exactly the same principle as the first shown. The first motion makes two right-angle bends, but farther apart. The second operation makes the single bend. *A* are the double-acting brakes or benders, which work in the bearing *B*. These benders have pinions at the rear which engage the rack *C*. *D* is a single-acting brake which bends around the block *E*.

Grand Rapids, Mich. F. C. MASON.

Small Parallels for Shop Use

There is no difficulty whatever in producing machine-shop parallels, provided the size is ½ in. or more, but there is considerable difficulty in making small accurate parallels. And when made, they will usually be found to have cost far more than is generally supposed, if anything like an accurate record is kept of the work. There are, however, a considerable number of commercial articles that can be used for parallels, and their cost is insignificant.

The first of these is the Woodruff key, which is known to all machinists. While the faces of these keys look somewhat rough, they will be found extremely close to any given measurement and they have the advantage of being nicely graded in general size in relation to their thickness.

The common one-cent pieces, if new, will be found to run almost to measurements of precision, and they are most convenient for even quite large work. The only trouble connected with their use is the general desire of the human race to appropriate them.

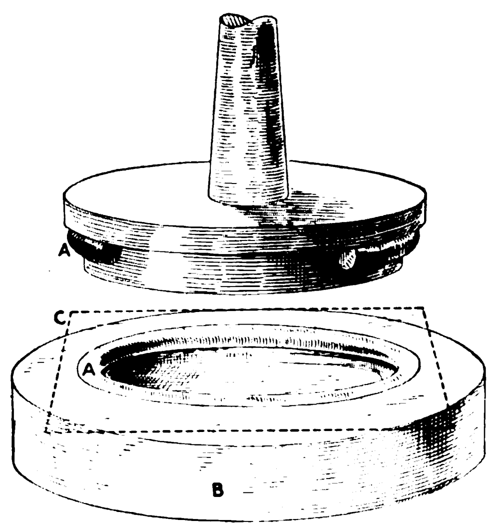
Perhaps the most precise work, when quantity is considered, will be found in printers' type. Ordinary type of a given size will, in one direction, show practically no difference, and for a good deal of machine-shop work no better parallels can be obtained. Since the introduction of cold-drawn squares and flats, there is at hand for parallels for general use a material that is very inexpensive, as it costs but a few cents per pound and only requires cutting off to be ready for use. When the price of these parallels is compared with the cost of those made of cast iron and planed up in the shop, it will be found that the cold-drawn material will be nearly 90 per cent. cheaper and just about as accurate. A. R. NEMOUR.

New London, Conn.

Attaching Emery Cloth to Disk

In the illustration is shown a method for attaching emery cloth to a disk. A ring *A*, ¼ in. in diameter, is made to fit into the recess of the disk.

This ring is then laid in the recess of the iron form *B*, and the emery cloth *C* is placed on the top of the ring.



ATTACHING EMERY CLOTH TO DISK

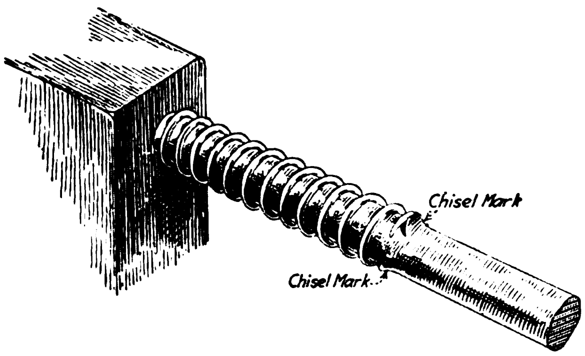
The disk is then forced down onto the emery cloth and into the ring. When the disk is raised from the form, the emery cloth is held to the face of the disk by the ring. The edges of the emery cloth are then trimmed off.

Naugatuck, Conn. A. E. HOLADAY.

Holding a Spring Without a Pin

The illustration shows a method of holding a spring on a spring pin, such as is used for backing up lock bolts and lock pins of various sorts, especially those seldom requiring removal. It will be noticed that by this method no pin is required.

It takes time to scribe, prick-punch and drill for a pin, especially if it is done on the assembly floor. By the method shown, two chisel marks serve the purpose



HOLDING A SPRING WITHOUT A PIN

equally well, and the work can be done much more quickly than by inserting a pin. H. B. McCRAY.

Charles City, Iowa.

Tools for a Strap Holder

Simple tools that are perfectly satisfactory—under the conditions that govern both their design and use—give the greatest return for the thought and money spent on them.

A set of tools of this kind is illustrated herewith. The article to be made was a strap holder, or bracket, that was riveted to a loading tray. These loading trays are used in the navy for teaching the men rapidity in loading the guns. The appearance of the strap holders when riveted in place is shown at *A*, Fig. 1. Here it is

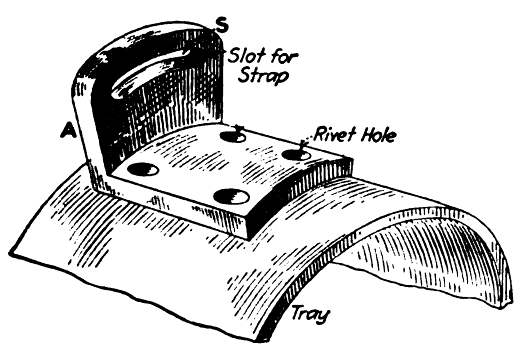


FIG. 1. THE STRAP HOLDER TO BE MADE

shown in the final shape after bending, showing the position of strap slot and rivet holes.

The operation to be performed for producing this piece was as follows: Blank from strip brass; bend to shape, including curve to fit tray; punch slot and drill holes for rivets.

There may be a division of opinion as to whether rivet holes and slot should not have been punched with a follow-on tool that would in one stroke also have punched the blank. This idea was dismissed for two reasons: The number of pieces to be produced did not appear to warrant the expense of such a complicated tool, and secondly it was thought that there was a very great probability that the slot *S* would be distorted in the subsequent bending operation. While this was merely an assumption, it was based on the very best of data, that is, previous experience with similar pieces.

The tools finally adopted were very simple and are shown in Figs. 2 to 5.

In the blanking tool, shown in Fig. 2, the cast-steel bolster *A* was turned to fit into a standard adapter on the press; it was slotted out to suit the punch *B*, the contour of which corresponded to the blank to be produced. The stripping plate *C*, which also acted as a guide for the strip at *G*, was secured to the press adapter by means of screws through holes *SS*, while the bolster was secured in the adapter by means of three cheese (fillister) headed screws as shown.

After blanking, the pieces of brass were bent to shape with the tool shown in Fig. 3, where *A*, the bottom tool, was turned to fit into the machine adapter and shaped at *C* to the contour desired. The upper tool *B* was of course shaped to coincide with *C*, allowing for the thickness of material.

The blank was located in position on the bottom tool by means of the two locating plates *P*, which were slotted so that they could be adjusted endways to give the best position for bending.

The slot was punched with the tool shown in Fig. 4. Here *A* is the bolster, *B* the punch and *C* a combined locating and stripping plate. When punching the slot, the strap holder was pushed under the stripping plate until the curved part met the curved edge of the stripper; then the punch was tripped and the work was withdrawn.

The four rivet holes were drilled in the two-part drilling jig, shown in Fig. 5. In this figure, *B* is the base and *P* the jig plate carrying the four bushes. Both

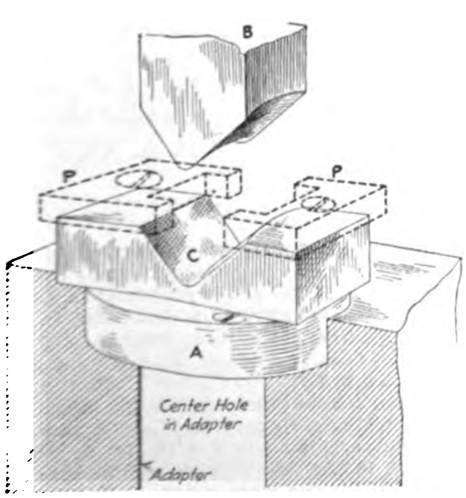


FIG. 2. THE BLANKING DIE

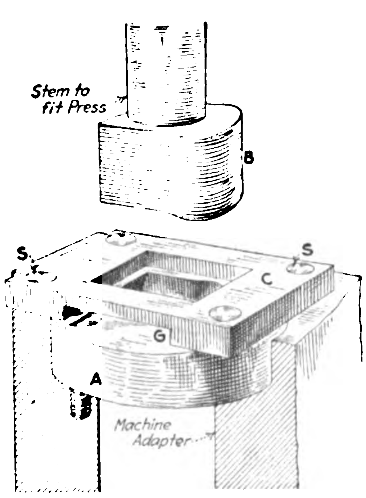


FIG. 3. BENDING THE STRAP

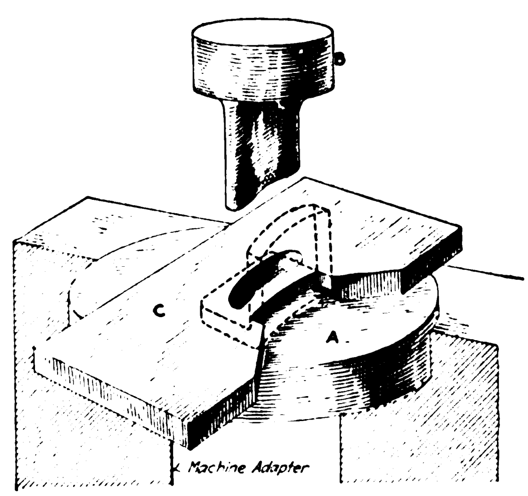


FIG. 4. PUNCHING THE SLOT

are machined to the curvature of the piece to be drilled, as shown by end view and part section at *XY*. Plate *P* is retained in position on the base by means of screw *S* and stops *M*, and the work is located in the jig by ridges at the side of the curve on base *B* and endways by the end of plate *P* and the stop pin *L*. It is secured in position by means of a wing nut and screw.

The slot *K* in plate *P* was to clear the web of a small casting—of the same curvature as the strap holder—that

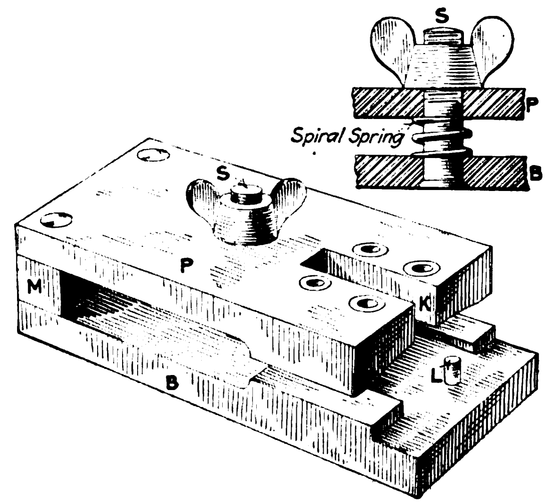


FIG. 5. THE DRILLING JIG

also had to be drilled. It is quite possible that the knowledge that a drilling jig would be required for this casting had some weight in the decision to drill the rivet holes in the strap holder instead of punching them.

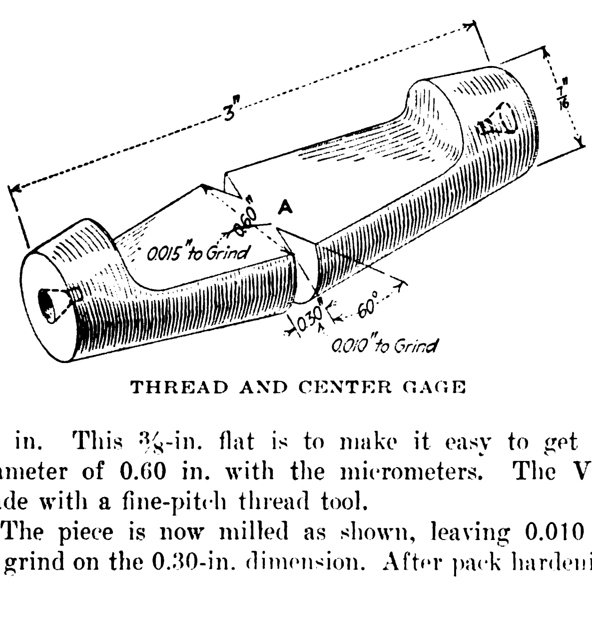
The whole set of tools as described worked particularly well, and though simple and cheap they were thoroughly efficient in action. WALTER G. GROOCOCK.

Guildford, England.

Thread and Center Gage

The illustration shows a handy tool for those who have to cut accurate threads. It is for setting the threading tool at right angles to the axis of the piece to be chased and also to set the tool on dead center.

A piece of 11/16-in. machine steel is turned as shown, leaving 0.015 in. to grind on the center dimension of



THREAD AND CENTER GAGE

3/8 in. This 3/8-in. flat is to make it easy to get the diameter of 0.60 in. with the micrometers. The V is made with a fine-pitch thread tool.

The piece is now milled as shown, leaving 0.010 in. to grind on the 0.30-in. dimension. After pack hardening, a piece is soldered in the center so that the 0.60-in. dimension can be calipered or measured. This done, the soldered piece is removed and the face *A* ground for the dimension of 0.30 in. The V is ground in a bench lathe and lapped.

The tool is now completed, it being understood that all grinding has been done on centers, as the tool itself is always used on centers.

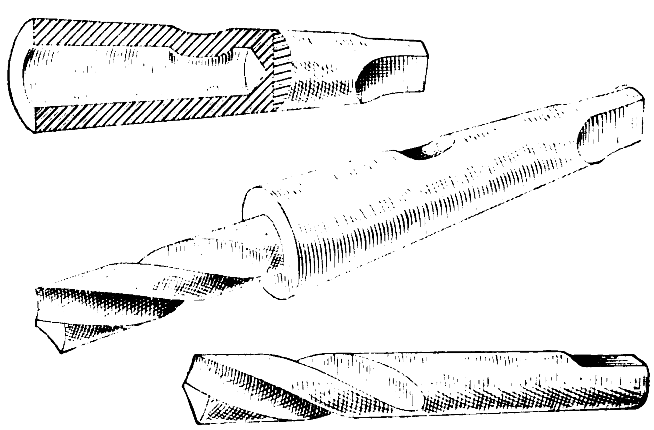
When this tool is placed on the lathe centers the thread tool is set into the V, and the center height is shown by the surface *A*, the gage being turned one-half a revolution so as to bring the surface *A* on top of the thread tool. The thread tool is raised until there is no movement felt in the gage. On taper thread work this will help to set the tool at right angles to the axis of the piece.

Bridgeport, Conn. JAMES MCINTYRE.

Economy in Utilizing Broken Taper-Shank Drills

We use a large number of taper-shank drills, mostly in sizes below 13/32 in. The breakage was heavy and the difference in price between taper-shank and straight-shank drills was considerable. Owing to the requirements of our work, it was impossible to use a chuck for holding these small drills, as the holes were close to parts interfering with the body of the chuck.

In order to use a straight-shank drill, we gathered up the broken taper shanks and drilled them out to exactly



USING TAPER SHANK OF DRILL TO HOLD STRAIGHT SHANK DRILLS

the size of the drill to be used. We flattened the back end of the sleeve and made a corresponding flat on the end of the drill, thereby giving us a taper-shank drill. One taper shank answers for any number of broken straight-shank drills, and we have a taper-shank drill for service.

This may not be a new idea, but it has saved us a lot of money. E. A. CLARK.

Joliet, Ill.

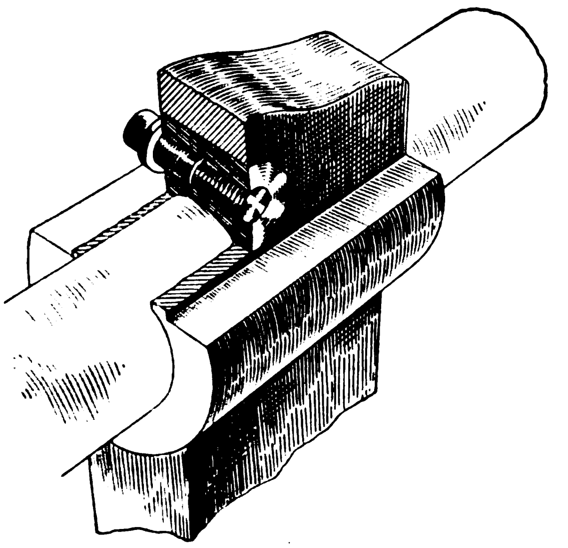
The Production of Silver in the United States has gradually increased, until in 1914 the total amount produced—the largest ever recorded—was 72,400,000 oz. The silver production of the world is about 225,000,000 oz. annually, of which the United States produces one-third. Practically three-fourths of the world's silver production is derived from North America. There is every reason to believe that the United States will continue to retain its position as the largest producer of silver and have a large surplus for exports. Vast quantities of low-grade complex ores carrying silver with lead, copper or zinc are now unworked in the Western states because of the lack of processes by which the metals can be recovered at a profit.

Discussion of Previous Question

Best Way To Do Certain Things--Rocker-Arm Fastenings

On page 1177, Vol. 43, M. V. Terry, in connection with Professor Sweet's article on page 936 on securing a rocker arm to a shaft, shows the split rocker arm. This often introduces an element of weakness at the binding point.

To avoid this defect I have adopted a common form of binder used for holding the shanks of tools in the turret of hand screw machines and turret lathes. I have usually seen rocker arms made with a slight hub on each side of the web. This method consists in drilling the rocker-



CLAMPING A HUB WITHOUT SPLITTING IT

arm hub at a right angle to the center of the shaft hole, which is laid out so that the binding screw will just clear its circumference.

This screw hole is then counterbored about 1/4 in. larger, cutting into the circumference of the shaft hole before the latter is bored and going completely through the hub. A plug of the same length as the hole is fitted to drive in it, then chucked and tapped for a collar-head capscrew and counterbored to body size a little more than half its length. The plug is driven in and the shaft hole bored in the rocker arm. Then the plug is driven out and eased to a good sliding fit in its hole. A small segment of a circle, which represents part of the circumference of the shaft hole, is now cut in the plug, which is divided by a thin saw into two pieces at the deepest part of this cut. The plug then represents the jaws of a vise drawn together with the collar-head capscrew. It is placed in its hole in the rocker arm with the screw in place, turned until the cuts in the two parts match with the shaft hole, when it is ready to be slipped on the shaft and to be set in position.

This fastening is a very old and a very good one and can be used in a great variety of ways. It holds so well that in many instances I have found a key unnecessary. It never mars the shaft. If it sticks, a slight rap on the head of the screw after it has been slacked loosens it. If the piece it is used upon has no key and requires adjustment, it can be moved either much or very little and will stay exactly in the position in which it is set, without moving when it is clamped again. The boss on the hub for binding need not project so far from the hub; and in case the boss is in the way or is not wanted, it can be omitted, the hub made slightly larger and the shaft hole bored enough out of center with the hub to allow room for the binding plug and screw in the proper place. The accompanying illustration shows this method of securing a rocker arm to a shaft. J. P. POLAND.

Springfield, Mass.

Adjustable Stop for Automatic Screw Machine

The adjustable stop described by Mr. Hoffman on page 80 is a part of the regular equipment of the Cleveland automatic screw machine. In fact, it is about the only style of stop that can be used on the Cleveland turret type of machine, on account of the shoulder, which prevents the stop from being forced back into the turret when feeding stock at high speed. I have known of several disastrous accidents that happened to the No. 0 Brown & Sharpe automatic screw machine through the use of this style of stop.

One case I have in mind was where a long piece was being made on the machine. In feeding out stock, the end of the rod fell between the front end of the feed tube and the stop, which was a shouldered one such as Mr. Hoffman's shows. The result was that three teeth were sheared off on the lead camshaft gear. This probably would not have happened, if a plain stop without a shoulder on it had been used, as the stop would then have pushed back in the turret without injury to the machine. I would also suggest that a clever operator would cut off stock without having a teat on the end of the piece.

New York City. FRANK H. SAGE.

Helping the Standard-Price Man Get Off

Frank C. Hudson need not worry about the short memory of the buyer. The conditions to which he refers on page 1121, Vol. 43, are too aggravating to be soon forgotten. Not only that, but the effrontery of some of the manufacturers of machine and small tools gives every indication of continuing right up to the very day when the bottom is going to drop out of the market—and it is surely going to drop, for arrogance brings its own reward.

It is not all a matter of price, however. Orders for special attachments for machines already in use, for example, are treated with scant courtesy. That great word "Service" seems to have been put on the shelf for the present.

But then, as Mr. Hudson states, it is not a case of "everybody's doing it." The courtesy and coöperation of those who have not lost their sense of proportion are made more evident by contrast. They may rest assured that the buyers are appreciative and will reciprocate.

Jersey City, N. J. H. D. MURPHY.

Empirical Design of Gas-Engine Piston Pins

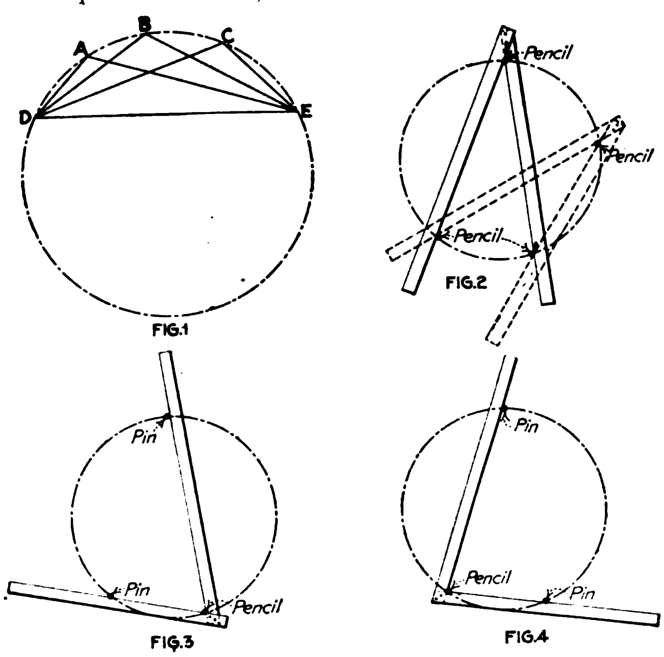
Messrs. Lewis and Kessler, on page 111, give formulas for making piston pins for gas engines. I do not know whether there is much relation between a gas-engine piston pin and a steam-engine crosshead pin, but the work would seem to be nearly enough alike so that what would be good for one would be good for the other.

In about thirty years in the steam-engine business we did not learn much, but did find out some things; and one was that a cast-iron crosshead pin was a lot better than a hardened tool-steel one. To get the most bearing surface possible, we gripped the crosshead pin in the connecting-rod and gave the rod 1/4-in. clearance, so as to give the bearings end play. When I say the cast-iron pins were a lot better, that is just what I mean. The professor may want to know what kind of cast iron we used. I do not know and never wanted to know, but I can say that they were never hard, unless by accident, as we never made hard iron if we could help it. We made the pins large enough to get generous measuring surface, and hollow to make them light. JOHN E. SWEET.

Syracuse, N. Y.

Beam Compass for Large Arcs

On page 953, Vol. 43, H. O. Smith describes a beam compass for drawing large circles. If he will investigate a little closer he will find that, while the instrument draws parts of a circle, it is not of the chord he thinks but



BEAM COMPASS FOR LARGE ARCS

a part of a circle whose chord extends from one of his pin points to the other.

Some years ago I contrived a beam compass that worked on this principle. It was suggested by the fact that you can always draw a circle through three points if they are not in a straight line. Geometry tells us that all angles formed by drawing lines from the ends of any chord to points in the circle are the same for any particular chord. The angles *A, B* and *C* in Fig. 1, no matter where they are located on that part of the circle on the same side of the chord and standing on the chord ends *DE,* are all the same. This being true, any one of the three points can be the pencil point of our trammel, and with the other two pin points to guide the straight edges of the trammel, we get the same circle.

Figs. 2, 3 and 4 show circles of the same size, with the three pins located in the same position in each, and with the trammels in place and the pencil occupying a different one of the three points in each.

Fig. 2 shows the trammel, or beam compass, in two positions. Large-angled trammels slide more freely over the pins without springing the trammel.

Stockton, Calif. M. JACKER.

New Design for Reducing Gears for Aero Propellers

The article by Mr. Balkachine, entitled "A New Design for Reducing Gears for Aëro Propellers," on page 78, Vol. 44, calls for some comment.

He makes the following statement: "Epicyclic gearing was tried, but it could not be made small enough. I finally came to the idea of a stationary pinion as a means of reduction, and the whole device took the shape shown herewith."

Apparently Mr. Balkachine believes himself to have discovered a new form of mechanism. He has not. His mechanism is an epicyclic train, pure and simple, in which one of the gears of the train is locked and the arm is free to revolve. His stationary pinion is the locked gear; and his spider, or cage, as he calls it, is the arm of the gear train.

One inherent fault of epicyclic trains lies in the power consumed in friction. Given the same materials, workmanship and finish, Mr. Balkachine's mechanism will have a lower mechanical efficiency than the mechanism patterned after the back gears of an engine lathe and designed to give the same reduction ratio—1,200: 533.

But this is not all. The ball bearings on which his planetary gears are mounted actually run at 1,200 r.p.m. while being subject to pressure resulting from transmission of power at 533 r.p.m. This necessitates the use of larger and heavier ball bearings, as the size of the latter is a direct function both of pressure and speed.

While I am not sufficiently acquainted with aëronautics either to condemn or recommend Mr. Balkachine's mechanism for aviation purposes, it appears to me that the unfortunate combination of lower mechanical efficiency and greater weight would constitute a rather serious obstacle in the way of its general adoption in a field where weight and maximum power are of prime importance.

Flint, Mich. M. V. TERRY.

The World's Production of Copper is approximately 2,211,000,000 lb., of which the United States produces 60 per cent. and consumes about 41 per cent. of the world's output of copper, or 65 per cent. of our own production. One of the most remarkable advances in mining in this country has been in cheapening the cost of handling copper ore.

Editorials

The New President of the Hill Publishing Company

Arthur J. Baldwin has been elected President of the Hill Publishing Co., to succeed the late John A. Hill.

Mr. Baldwin is a lawyer and a member of the firm of Griggs, Baldwin & Baldwin. For the past ten years Mr. Baldwin has devoted himself almost exclusively to business problems and has been identified with large business enterprises.

At the present time he is treasurer of the Rogers Silver Plate Co.; treasurer of the Borough Development Co., which has a contract with New York City for the removal of ashes from Brooklyn; treasurer of the Boston Development and Sanitary Co., which handles all the garbage and ashes for the City of Boston; vice-president of the Automatic Fire Protection Co. and secretary of the Mississippi Wire Glass Co.

Mr. Baldwin has been for the past ten years Mr. Hill's intimate friend and business adviser and brings to the company an intimate knowledge of Mr. Hill's policies and plans.

Mr. Baldwin has arranged his business affairs to take active charge of the interests of this company. The organization will remain intact, the plans and policies so ably devised by the founder of the business will be carried forward, and the standards of practice will be upheld.

Scientific Method of Attack

A man named Newton, while lying under an apple tree one day, saw an apple fall. The occurrence was remarkable in that it led to the enunciation of the laws of gravitation. No doubt a great many men had noticed apples falling long before Newton's time; the difference between those other men and Newton was that Newton thought about it. Why did the apple fall? Why down? Why so fast? How fast?

Such studies are in the realm of "pure" science, so called—that is, abstract science. The method of research is to observe a phenomenon, think about it, pick it to pieces, study the parts and finally put them together. This procedure is called the scientific method.

This method of attack is useful in other places than in scientific laboratories. Its principal feature is the requirement of thought, which is of universal application. A homely case in which this attack was finally successful is set forth in the story about a loom in a cotton mill.

The loom had the habit of throwing out the shuttle every once in so often—out through the window, down three stories to the ground. It became tiresome to the weaver to make so frequently the round trip downstairs to retrieve his shuttle, so he complained to the loom fixer, who nailed a piece of tin over the window pane favored by the shuttle. After that, the shuttle would strike the tin and fall to the floor, and its replacement was simple. All went well until the overseer saw the piece of tin; his mind cerebrated and caused him to have the loom fixed so that it would not throw out the shuttle.

Every day's work in the plant is filled with cases just like this one in principle. If the scientific method—the thoughtful, reasoning method—is used in attacking a problem, the answer is usually correct and satisfying, whether the problem is one of finding out why a pump won't pump or what is the best way to bore high-explosive shells.

The trouble usually is that those in charge have not the time to sit and think out the right answer. As a rule, the supervisory force is so busy getting the work done that there is no time to spend in meditation. Meditation looks too much like loafing.

It begins to appear, however, that there is a profit to be had from so arranging the work among the members of the supervisory force as to permit some of them to spend their time thinking for the benefit of the firm, bringing to bear on production problems their previous experience combined with their present thought in the same way that an engineer or a draftsman solves an engineering problem. In a nutshell this is all there is to modern management.

Cutting Downward in the Lathe

A visitor in Continental machine shops has undoubtedly seen instances where engine lathes were "running backward," or "cutting downward." If he inquired the reason, he was probably told that the lathe chattered less on this backward cut and was run in that way to get a smooth finish on the work. To this explanation the American probably replied mentally, if not aloud, "Why not tighten up the spindle boxes, or grind the tools properly, and get rid of the chatter in a workmanlike fashion?"

On rare occasions this same practice is seen in American shops, where foreign-trained workmen, particularly French and Swiss, are employed. While the imagined comment of the American observer is natural and applies here with the same force that it does abroad, it is worth while considering just a little further to make sure that the European practice is unjustified even from the American viewpoint. It probably is justified from European practice.

At the outset of such a consideration, we must recognize one general difference in design between foreign- and American-built lathes. With the flat ways of the European-made machine, it is customary to gib the carriage both front and back. American-made lathes are commonly gibbed at the back, but not at the front; and further, American lathe builders do not arrange spindles so that the lathe can be run backward without the danger of unscrewing the chuck or faceplate. The only exceptions are probably in the field of toolroom or precision lathes. That there might be some advantage in changing this last detail is shown by the fact that we occasionally find chucks or faceplates that have been setscrewed to clamp them to the spindle nose. The end of

the setscrew is of course provided with a brass plug, or "mouse," threaded the same as the spindle, so as not to mar it.

The construction of the foreign lathe is such that the lifting effect on the tool when the lathe is run backward is taken by the front gib. The lifting effect on the tool in the case of American lathes similarly run would be resisted by the weight of the carriage and apron.

Turning now to the forces acting on the tool and the work, in forward running we have the upward thrust of the cut resisted by the weight of the spindle and the work, and the pressure of the spindle bearings. The pull of the belt is upward. The relative amount of these resisting pressures and this weight varies with the size of piece, size of lathe, cut taken and kind of tool used. In small lathes the pull of the belt is undoubtedly sufficient to overcome all the others. With large lathes we can imagine a situation where the spindle is floating in its bearings—a condition that may easily lead to chattering unless the boxes are very tight.

With backward running, however, or "downward cutting," we have the pressure on the cut acting in the same direction as the weight of the piece and the weight of the spindle. In a belted lathe the belt pull is the only upward force. Thus all the forces except belt pull act in a way to press the spindle down into the lower halves of its bearing instead of trying to lift it out of them. Thus there can be no tendency to float.

An identical relationship of the forces exists if the cutting tool is transferred to the back and the lathe run forward as normally. This is a condition of "downward cutting."

Many older British lathes were arranged so that downward cutting with a tool on the back of the rest was possible. The slide rest was an independent part in many cases and was bolted to the saddle, which had a number of T-slots so that the former could be secured at almost any angle with relation to the work. With these rests it was an easy matter to invert a tool and use it at the back.

The ordinary hand-screw machine is an example of a machine so designed that cross-slide tools can be used both front and back, those on the back cutting downward.

These facts, which tend to show that downward cutting may lead to the practical result of less chatter, suggest the question, "May there not be very good reasons why the Continental machinist sometimes runs his lathe backward, odd as it looks to American eyes?" And another immediately follows, "Why should not lathes—at least small ones for accurate work—be so designed that they can be run in either direction, depending upon the kind of work to be done?" Or if not in either direction, why should they not be designed to carry a tool post on the back of the slide rest to permit downward cutting with the lathe running forward?

How do we know but that there are some kinds of work, particularly small, light pieces, that can be machined better with a lathe running for downward cutting? It would surely be a simple thing so to construct lathes that they could be thus operated and still have the tools rigidly supported at the proper height. Is not this suggestion of sufficient importance to warrant consideration and perhaps experiment.

Our Industrial Mobilization

There is a difference of opinion as to the kind of men who should be selected to plan our industrial mobilization. Preliminary meetings have been held by the governing bodies of some of the five national engineering societies invited by President Wilson to nominate men for this work, but at this writing no society has announced its selection.

These men, when appointed, will be charged with grave responsibility. The success or failure of the present attempt to organize the manufacturing resources of this country into a unit that will be instantly available for the support of our armed forces in a national emergency will be in the hands of these engineers. The patriotism of the manufacturer will be insufficient to meet such a crisis when it comes. In preparing for that time someone must have spent many anxious weeks and months of planning. Under the proposed plan the state committees selected from the ranks of the engineering societies in coöperation with the present Naval Advisory Board are charged with this far-reaching duty. In a great measure the final outcome of the project is in the hands of the men yet to be appointed.

The first qualification that they must possess is a record that will win the support of manufacturers and the American people. They must command respect and confidence. They must have a wide technical experience in manufacturing. They must be men of matured judgment and possessed of a far-seeing grasp of present and approaching industrial conditions. The amount of work to be accomplished is tremendous. Thus each one must be so situated that he can divert a large amount of time from his regular business, as well as assume the accompanying expenses. The present plan provides that these engineers shall work without compensation of any kind, and they will not even be allowed traveling expenses by the Federal Government.

This brief analysis of some of the principal qualifications of these representative engineers shows that men with certain connections must be at once eliminated from consideration. Men who are today actively engaged in the manufacture of munitions and men who are connected with financial interests that have been handling European or American munition contracts will never have the confidence of the American people. The public will, expressed through Congress, will not permit American manufacturers to make large profits out of their work for national preparedness. Thus any man who is directly or even remotely connected with the manufacture of munitions today will be looked upon with suspicion; and justly or unjustly, his motives would be questioned if he should attempt to serve upon any one of these committees for the mobilization of our industrial resources. The only men who will be acceptable are those who have excellent records as organizers or manufacturers, whose patriotism is unquestioned and who are entirely free from any direct or indirect connection with munition manufacture.

Upon the national engineering societies is placed a grave responsibility in the selection of their candidates. Unwise nomination might seriously jeopardize the entire plan.

If you suspect a man, don't employ him; if you employ him, don't suspect him.—Chinese Proverb.

Shop Equipment News

Portable Floor Crane

This crane is known as the Brownhoist portable floor crane and is made by the Brown Hoisting Machinery Co., Cleveland, Ohio. It is intended for all-round shop use where overhead construction, belting, shafting or the like

PORTABLE FLOOR CRANE

Made in three styles: No. 1—capacity, 1½ tons; maximum lift with tackle, 5 ft. 5 in.; overhang, 2 ft. 3 in.; width clear between front wheels, 1 ft. 11¼ in. No. 2, or garage type—Capacity, 1½ tons; maximum lift, 6 ft. 8¾ in.; overhang, 3 ft. 1 in.; width clear between wheels, 3 ft.; wheel base, 4 ft. 2½ in. No. 3—Capacity, 3 tons; maximum lift with tackle, 7 ft. 6 in.; overhang, 3 ft. 1 in.; height over all, 9 ft.; clearance between front wheels, 3 ft.; diameter of front wheels, 10 in.; swivel wheels, 7 in.; height of truck bed, 11 in.

prevents the use of other types or where infrequent use would not justify installing an overhead system.

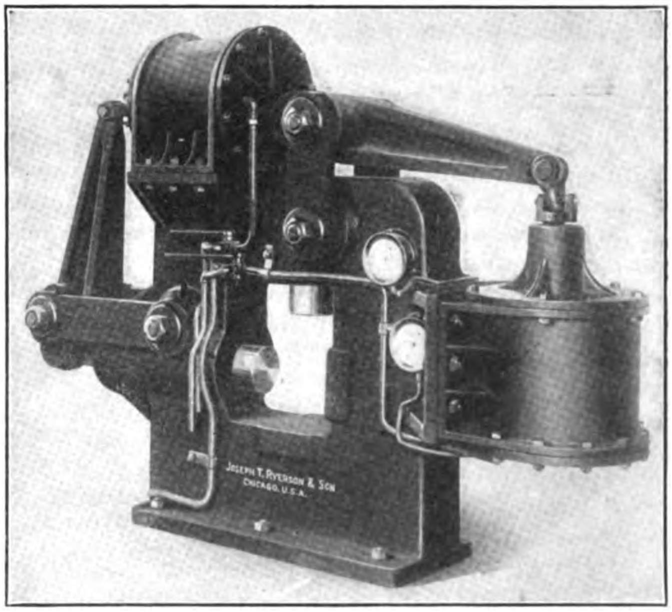
The crane frame and truck are steel castings. The supporting wheels are large and set well apart, so that the crane will not upset by side pulls on the load. A narrow-gage swivel truck is provided at the front, fitted with a handle for hauling and steering the device. By placing the handle in an upright position a wheel brake is automatically applied, keeping the crane stationary while hoisting or lowering a load. The hoisting is done either with a self-contained compact winch or by means of a triplex chain block.

On the winch type, which is illustrated, the operating handle is so placed as to be turned without interfering with any load. The winch has wire-rope drum, large cast-steel main gear, cast-steel pinion, all-steel shafts and is fitted with substantial ratchet and pawl hoist-check and with steel hand cranks. The bottom tackle block is of steel plate, side type, with one large sheave and drop-forged swivel hook. The tackle is arranged for either two-part or three-part rope, and the top sheaves are supported directly on the frame and housed in one-piece rope guards.

A Heavy Pneumatic Spring-Banding Press

The machine shown is especially designed for railroad and commercial spring-manufacturing and repair shops that are not equipped with hydraulic power.

It is operated by compressed air, the cylinders being of such size that with air pressure of 100 lb. a pressure of 60 tons is exerted on the rams. By means of both horizontal and vertical rams a positive and known pressure is exerted on the spring band, which insures uniform and



PNEUMATIC SPRING-BANDING MACHINE
Capacity, 60 tons; diameter of cylinders, 16 in.

rapid work. Each machine is furnished complete with three-way hand-operated valves and the necessary pressure gages.

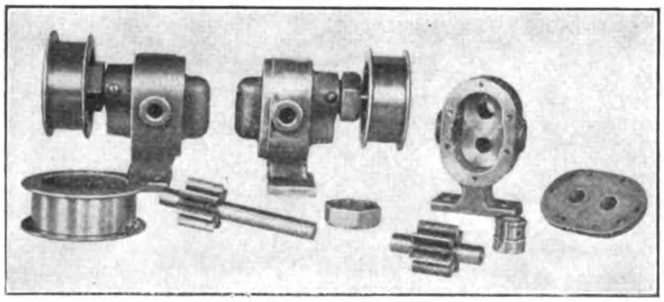
The machine is a recent product of Joseph T. Ryerson & Son, Chicago, Ill.

Gear Pump for Lubricants

At first sight the gear pump shown assembled and in detail differs but little from similar types on the market. This pump, however, has been designed and made with unusual care. All parts are interchangeable.

The cast-iron body is accurately bored in a special fixture. The pulley shaft runs through a bronze packing gland machined true with the adjusting nut. This nut is large and so placed as to be easily reached with an ordinary wrench at any time without the necessity of disturbing the pulley. The gears are made of steel, pack hardened, and then the shafts and ends of the gear teeth are carefully ground to size.

The outside diameters of the teeth are ground to fit the pump bores. The grinding is all done true with the gear pitch, so that the meshing is as perfect as possible when assembled in the pump. Screw oil holes are placed



GEAR PUMP FOR LUBRICANTS

Gears, 1½ in. in diameter by 1⅛ in. long; shafts, $\frac{9}{16}$ in. in diameter; body, 4¾ in. high, tapped for ⅜-in. pipe; pulley, 3 in. in diameter for 1-in. belt

on each side of the drive shaft, so that it can be properly oiled no matter what the position in which it is placed or what liquid is pumped. Various-sized bases or bolting flanges are furnished to suit conditions.

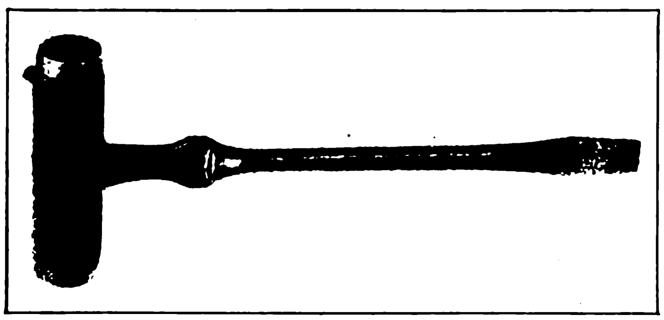
These pumps are manufactured by the Stevens Manufacturing Co., Dayton, Ohio.

Handy Combination Tool

The tool shown is designed to meet the requirements of both a screwdriver and hammer.

In the position shown, with the handle turned to form a T, the tool can be used as a hammer, and the T-handle provides increased leverage for use as a screwdriver.

The handle is slotted so that when use as a straight screwdriver is preferred, the knurled handle may be



COMBINATION SCREWDRIVER AND HAMMER

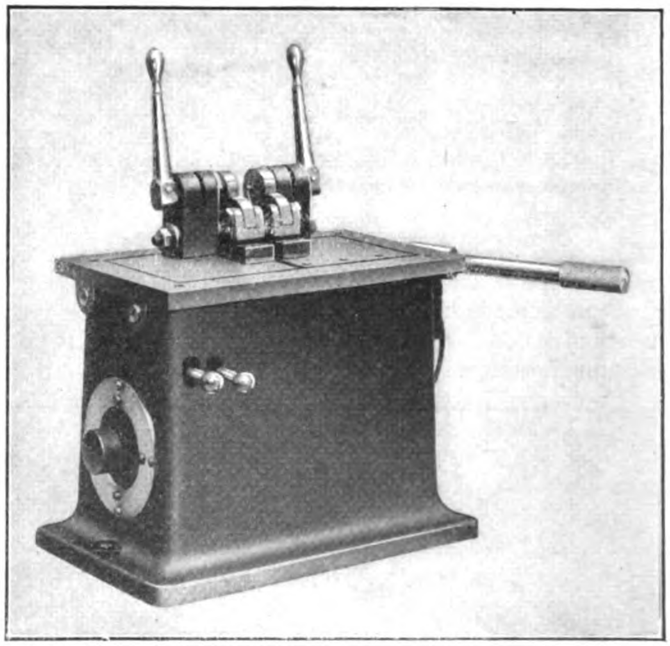
sprung over the flat shank to furnish a well-fitting straight handle.

This tool is made in a number of sizes by the Crescent Tool Co., Jamestown, N. Y.

Portable Electric Butt Welder

The electric butt welder here shown has about the proportions of an ordinary typewriter and is intended for welding iron, steel, copper, brass, or semiprecious metals. Its small size and weight make it easily portable.

The two levers shown upright at the top operate eccentric bushings and are for adjusting the jaws, or clamping devices, used to hold the work to be welded. The lever at the right is for upsetting the material, and at the same time the current is switched on by simply twisting the handle. The two knobs projecting from the front, toward the left, are for adjusting the table. By moving them in



PORTABLE ELECTRIC BUTT WELDER

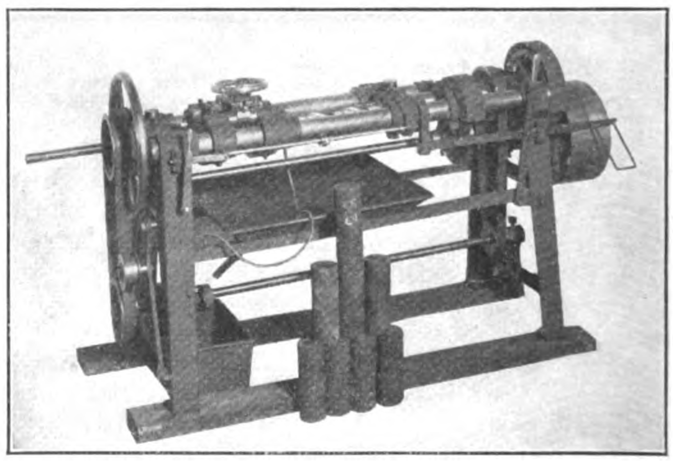
Largest diameter of stock that the machine will weld, $\frac{3}{16}$ in. round, or equivalent in other shapes; maximum amperage, 15; size of base, 14x16¾ in.; height of base, 10 in.; height over all, 18 in.

or out, the table is raised or lowered, or moved back and forth in a horizontal plane. This permits a very accurate adjustment for welding the finest material.

The machine is made by the Detroit Electric Welder Co., Detroit, Mich.

Horizontal Drilling Machine

The machine shown was designed for drilling 18-pounder high-explosive billets. On this class of work the chief advantage claimed for the horizontal type of



HORIZONTAL SHELL-DRILLING MACHINE

Tight and loose pulleys, 16x3½ in.; power required, approximately 5 hp.; speed, 600 r.p.m.

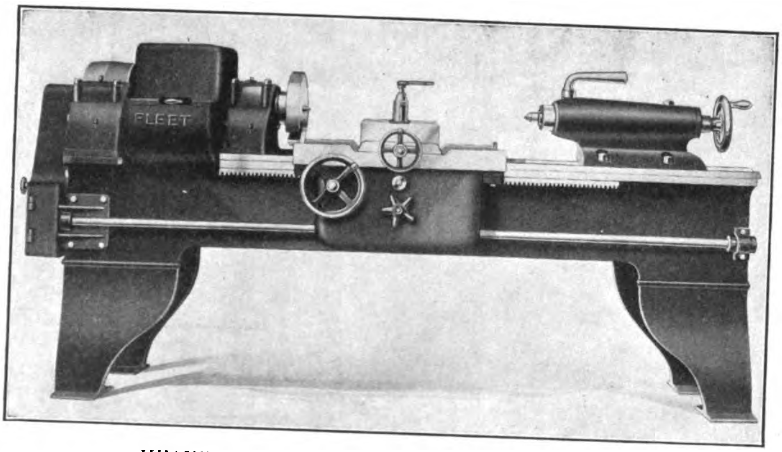
machine is the ready manner in which the chips free themselves from the hole, thus avoiding a binding action on the drill.

A quick-return shell vise is operated by means of a foot treadle and belt drive. The feed is automatically cut out by means of a trip-rod on the side of the machine. A movable stop operates to cut out the feed when the required depth is reached. This machine is made by the A. R. Williams Machinery Co., Toronto, Canada.

Heavy-Pattern Engine Lathe

In the design and construction of the lathe illustrated the aim was to provide capacity for the utilization of high-speed tools.

The bed has one large V in the front and one flat way in the rear for the carriage. The geared headstock, with single-pulley drive, affords two speeds in the head, which with two speeds on the countershaft furnish a four-speed machine.



HEAVY-DUTY SINGLE-PULLEY ENGINE LATHE

Swing over bed, 18 in.; swing over cross-slide, 9¼ in.; distance between centers, 36 in.; drive pulley, 12x6½ in.; length of carriage bearing on bed, 30 in.

The spindle bearings are self-oiling by means of rings from a reservoir beneath. The apron is made in a complete double-wall or box section, giving all studs and shafts an outboard bearing. The feed drive consists of two steel sprockets and chain. The feeds, per revolution of spindle, are 0.020, 0.040, 0.060, 0.080 and 0.100 in.

The machine is built with any length of bed, from 8 ft. up, by the Standard Lathe and Tool Co., Cleveland, Ohio.

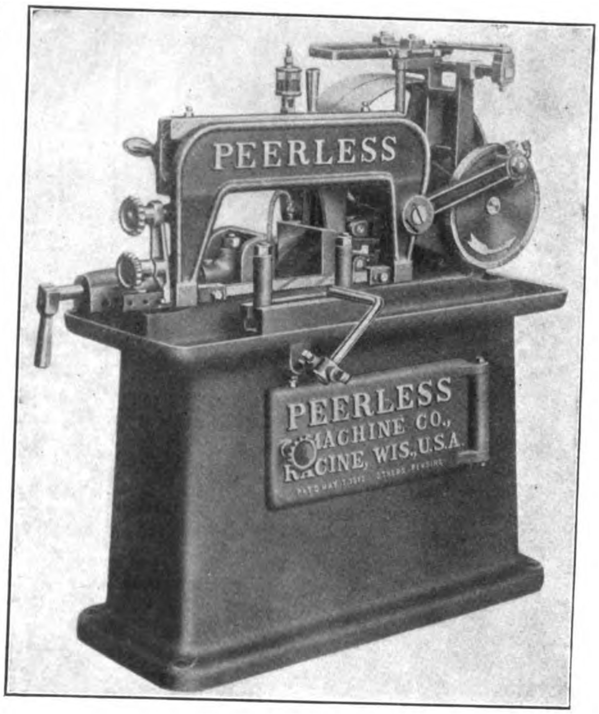
High-Speed Power Hacksaw

It will be observed that full cabinet construction is provided in the high-speed hacksaw machine shown. At the bottom of the cabinet is formed a tank for the cutting compound, the pump for circulating which is located inside the rear end of the cabinet. The cutting compound, after flowing on the blade and the work to be cut, is collected, together with the chips, in a separate pan located inside of the door in the cabinet, shown on the right-hand side of the machine. In this pan the compound is separated from the chips, is turned back into the bottom of the cabinet and again circulated.

The saw blade, which travels in a center line of the saw guide and connecting-rod, thus eliminating any tendency toward side pull, is clamped solidly in a special clamping device and secured at each end with straight steel hardened pins. The saw table has T-slots on each side of the vise used for clamping down any work of irregular shape. This vise is quick acting, having 1 in. of screw adjustment. The screw is inclosed, to protect it from damage. A special quick-acting attachment that prevents the jaws from tilting is also provided for cutting short pieces.

The feeding mechanism is by a spring so arranged that it has the same effect as if a weight were used, giving a uniform pressure on the blade throughout the entire cut, the pressure being instantly changed and controlled by a lever on the left-hand side of the machine. When the lever is down, there is no pressure on the blade; when at the top notch, a pressure of 125 lb. is provided. The automatic lifting mechanism is also by spring, the saw frame being overbalanced by this spring. On the main shaft is a cam that allows the feeding spring to act only on the cutting stroke, at the end of which the cam releases the feed. As the saw frame is overbalanced, it automatically raises and clears the blade from the cut until the end of the return stroke, at which point the cam again allows the feeding spring to come into action. It will be noticed that both the feeding mechanism and the automatic lift have the same action as by gravity, or if a weight were used, and are therefore positive in their action.

The feeding mechanism is controlled by the belt shifting lever. When the belt starts to shift, the machine begins operation. The feed does not come into action until the belt has been shifted three-quarters of its movement, at which point the feed mechanism is thrown into action. This allows the cutting compound to get on the blade and the work to be cut, before any feed pressure is applied. It also allows the operator to apply a little pressure on the blade by pressing down the handle, shown



HIGH-SPEED POWER HACKSAW MACHINE

Capacity, 6x6 in.; tight and loose pulleys, 3x16 in.; main shaft, 1$\frac{7}{16}$ in.

on the saw guide, until the machine has made a few strokes, thus avoiding the likelihood of stripping the teeth. If preferable, the feed can be entirely released by dropping down the feed lever on the left-hand side of the machine. By gradually raising the lever the pressure is also gradually applied on the blade, so that it has a chance to start without being forced sidewise. This provides an extremely sensitive feed.

The dropping of the saw frame, in case of blade breakage, is eliminated in this machine. In case of such accident the feeding is increased until the saw has finished its cut, when the machine is automatically shut off in the regular manner. As the feeding mechanism is controlled by the belt shifter, the feed is always released before the machine stops, allowing the saw frame to rise automatically. Both height and depth gages are provided. The bearing on the saw frame, which travels in V-shape slides, is 11½ in. long.

This machine is the latest model of the Peerless Machine Co., Racine, Wis.

Sand Blasting Helmet

The sand-blasting helmet shown was designed to afford complete protection to the operator and at the same time avoid any inconvenience owing to weight, impaired vision or difficult breathing.

SAND-BLASTING HOOD

The free admission of air is permitted by finely screened openings, while a glass partition of the front opening provides clear vision.

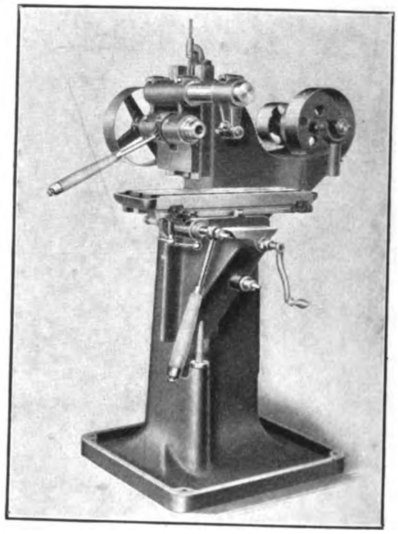
The helmet is a recent product of the Multi-Metal Separating Screen Co., 77 East 131st St., New York City.

Hand Miller with Weight Feed

In the hand miller shown the knee is of the box type, designed to provide rigidity and to afford protection to the vertical adjusting screw, thrust bearings and bevel gears. The lower end of the vertical adjusting screw is protected by the hollow upright part, which supports the vertical adjusting-screw nut.

Feed weights are provided to be hung on the handles shown.

The general design and construction of the machine are apparent from the illustration. The top of the table can be brought up on a level with the center of the spindle. The cone pulleys, 7 and 10 in. in diameter, provide four spindle speeds. The hand lever provides a table feed of 6 in., while the crank furnishes a 14-in. feed.



HAND MILLER WITH WEIGHT FEED

Dimension of table inside of oil pocket, 4x20 in.; dimension of table outside, 7x24 in.; adjustment of table under spindle, 15 in.; hole in spindle, No. 9 B. & S. taper.

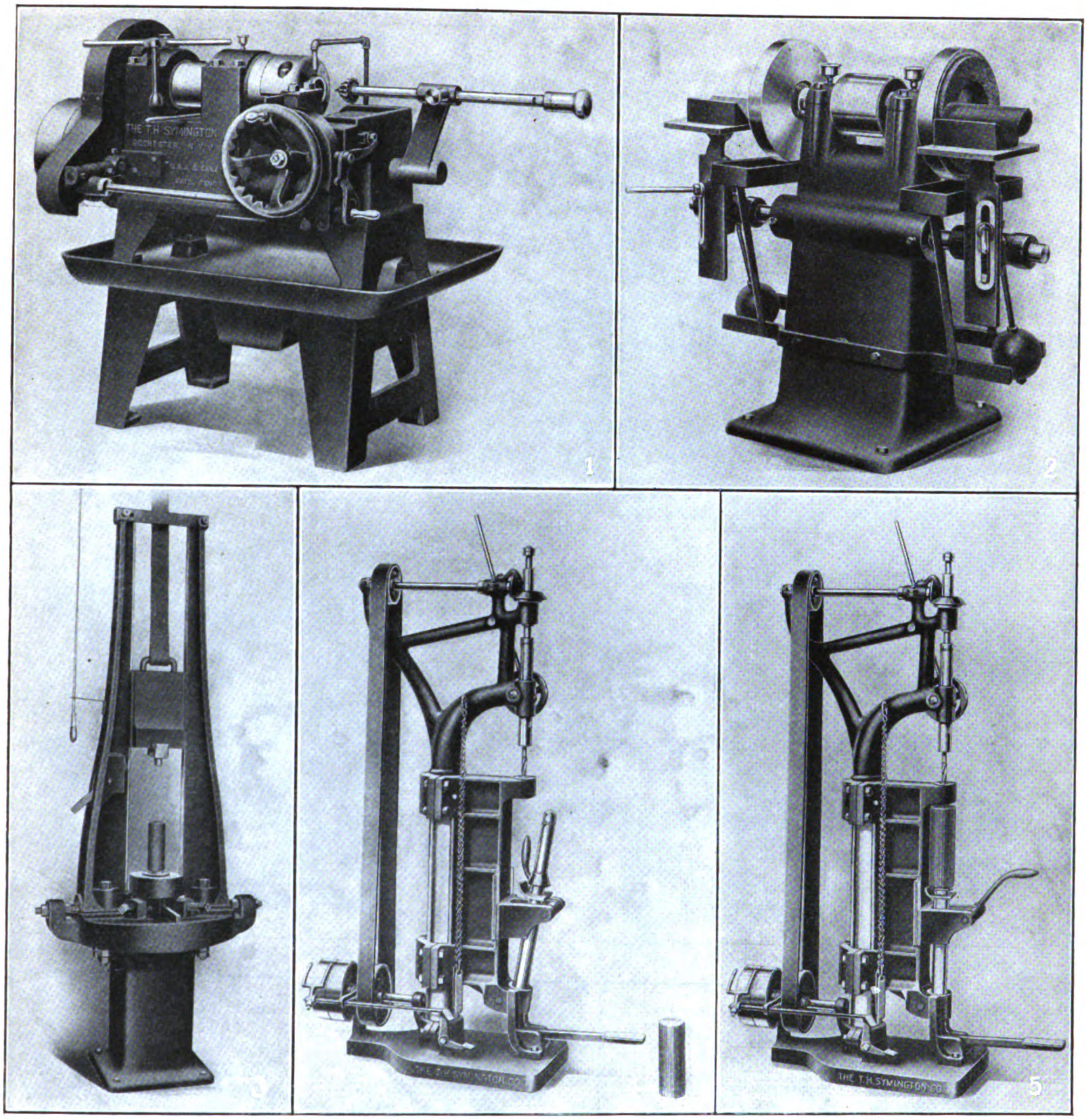
The machine is a late product of the Standard Engineering Works, Pawtucket, R. I.

Machinery for Shell Work

Among the interesting machinery developed for the manufacture of shrapnel and high-explosive shells is the line of special machines brought out by the T. H. Symington Co., Rochester, N. Y., who occupy a unique position on account of including a machine planned especially for each operation. This line of machines has been designed of well-known mechanical elements, with the sole purpose of having each machine perform its separate operation in the shortest possible time.

They are designed to carry through the operations on forged shells in the following sequence: Cut off the open end and take out the burrs caused by the cutting-off tool; grind the closed end square; nick the open end for driving center; center the closed end; first rough-turn; second rough-turn; bore and finish the inside of shell; rough-face the closed end or base; face the closed end; finish the base and rough out the band groove; put the undercut and wave in the band groove; bore, ream and tap the nose; finish-turn the outside of shell; turn the copper band.

As will be seen, the construction of the machines is simple, using large bearings, rigid holding chucks and well-supported cutting tools. Nothing has been spared to make the machine rigid, and nothing has been wasted in unnecessary finish.

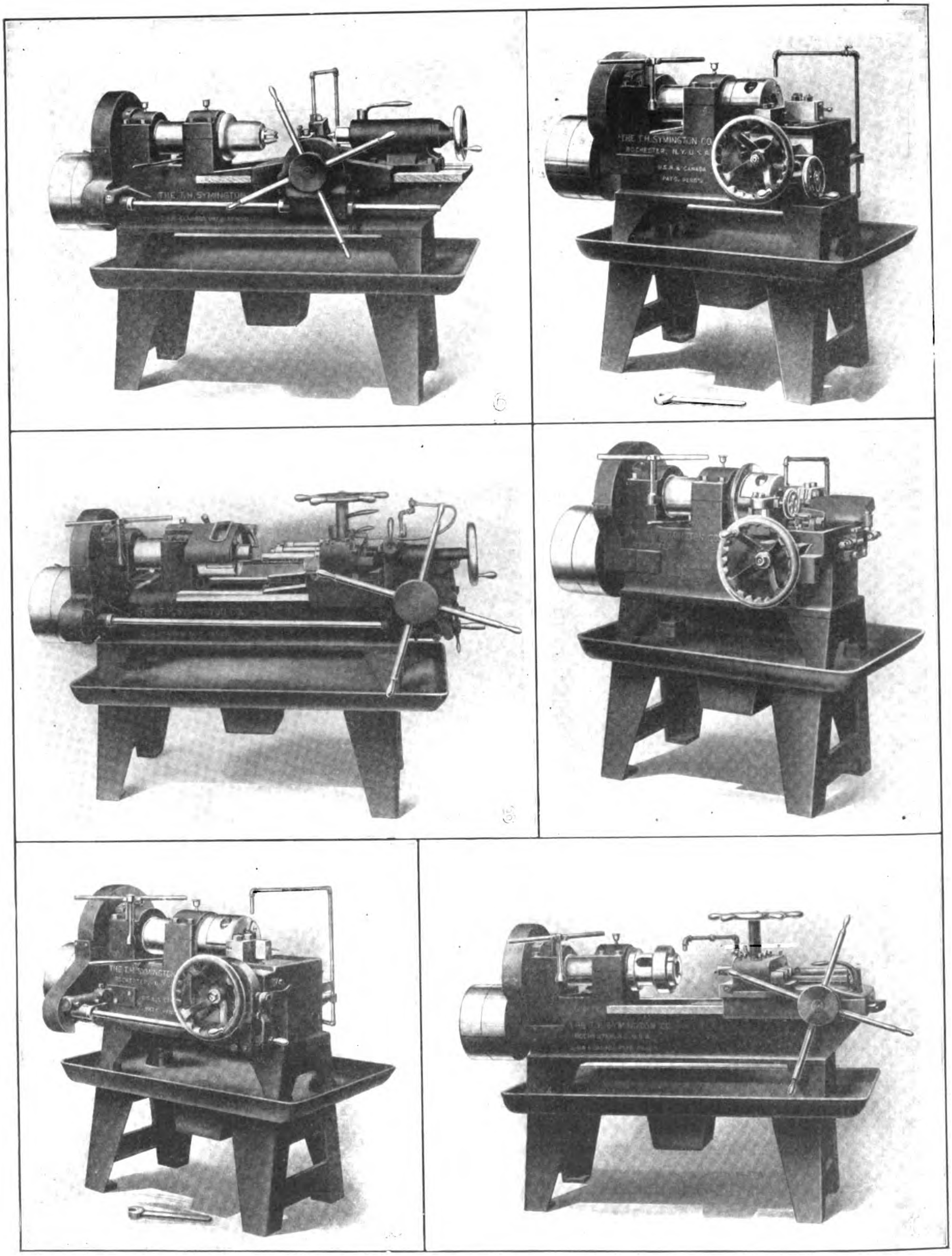


FIGS. 1 TO 5. SPECIAL SINGLE-PURPOSE MACHINES FOR SHELL OPERATIONS
Fig. 1—Chucking machine. Fig. 2—Ring-wheel grinder. Fig. 3—Drop-hammer. Figs. 4 and 5—Centering machine

The spindles of the lathe are of cast iron 6 in. in diameter, and both the front and rear bearings are 6 in. long. The spindles are ground so as to lay the iron in the direction it is to run in the bearing, and high-grade babbitt bearings are provided in all cases. The chucks form an integral part of the spindle, some being of the hinge or flap variety, while other are split and drawn together by a collar or sleeve. The machines are heavy, ranging in weight from 1,500 lb. for No. 1 to 2,100 lb. for No. 7. One interesting and time-saving fixture seen on all the machines is a wrench-holding bracket so placed that the operator need lose no time. It also eliminates excuses for mislaying the wrench.

Machine No. 1 grips the drop forging in the hinged chuck, which has three hardened jaws and holds the work easily in spite of inequalities of the forging. The cutting-off tool is 1/4 in. wide by 2 in. deep and solidly supported, as can be seen. The cutting-off point is gaged from the bottom of the inside of the shell, the gage rod also supporting the burring tool, shown. This removes the burr left in cutting off. The closed end is next ground on a ring wheel, No. 2, so as to be square with the bore. The shells then go to the drop hammer, shown by No. 3, and the open end is placed over a burr containing chisels. A stroke of the hammer on the closed end produces ratchet-shaped nicks in the end of the shell. These nicks center the shell very accurately and afford a powerful drive for the outside turning operations, which follow.

The shell next goes to the centering machine, shown by Nos. 4 and 5, the tilting mandrel allowing it to be



FIGS. 6 TO 11. SPECIALIZED EQUIPMENT FOR SHELL-MACHINING OPERATIONS

Fig. 6—Rough-turning body machine. Fig. 7—Boring machine. Fig. 8—Rough-facing machine. Fig. 9—Base-forming and finishing machine. Fig. 10—Waving and undercutting machine. Fig. 11—Nose-forming and reaming machine

easily slipped into place. The mandrel has expanding jaws at the end, to center the closed end of the shell, while the cone lines up the open end. The tilting of this mandrel is controlled by the foot treadle, the handle just below the shell locking the mandrel into drilling position.

Turning comes next, the shell blanks being driven by the special spur on No. 6, which permits the tool to pass over the entire length of the shell. Two ¾-in. square turning tools are used, one at the front and the other behind. They are held in adjustable steel holders that are bolted to the lathe carriage. The front tool leads, and takes the heaviest cut, the second tool following about ⅛ in. behind. This makes it possible to hold the turning size within close limits.

Boring is done on machine No. 7, the boring tools being held in a very substantial cross-slide instead of the usual turret. The shell blank is gaged from the open end by a stop on the chuck guard and a spring plunger at the bottom of the hinged three-jawed chuck. The cross-slide carries three tools, the first for boring and the others for rough- and finish-reaming. One tool bar may be used for form boring, and in this case the cross-slide is guided by a hardened roll held against the steel cam, or form, by a heavy spring at the back of the machine. The heavy pressure required for finishing the bottom of the shell is accomplished by a powerful handwheel provided especially for this purpose.

The shell is then reversed in the three-jaw hinged chuck shown on No. 8, closed and rough-faced. The facing point is gaged from the bottom of the inside of the shell by a stop rod, which is fastened in the bottom of the chuck. As will be seen, the tool holder and cross-slide are rigid, a ¾-in. square turning tool being used.

Machine No. 9 is very similar, but has a different tool arrangement for finishing the base and also forming it. The blank is gaged as before, a ½-in. square tool being used for finishing and a small tool for roughing the band groove and finish-turning the base of the shell. A two-speed counter is used on this machine to give a slower speed for the form turning tool and a fast speed for facing the smaller diameter.

Waving and undercutting are done on machine No. 10, the waving tool being controlled by a cam direct on the lathe spindle, just behind the chuck. The undercut is secured by the form shown at the end of the bed, which gives a side movement as the tool is moved into the cut. The waving tool is supported at the back of the machine.

For forming and reaming the nose, machine No. 11, which closely resembles No. 7, is used. The shell is held in a four-jawed spring chuck, and provision is made for four bars in the cross-slide. It is rough- and finish-bored, tapped and undercut.

The finish-turning is done in the lathe shown in Fig. 12. The shell is held and faced by a four-jawed spring chuck, and at the nose by a quick-acting tail center, a centering plug being used in the shell. The tool is guided by a hardened pin that is held by a heavy spring against the steel cam, or form, at the back of the machine. An automatic quick-change speed device is provided to give a fine feed over the nose and bourrelet, and a passage over the body of the shell as far as the band groove.

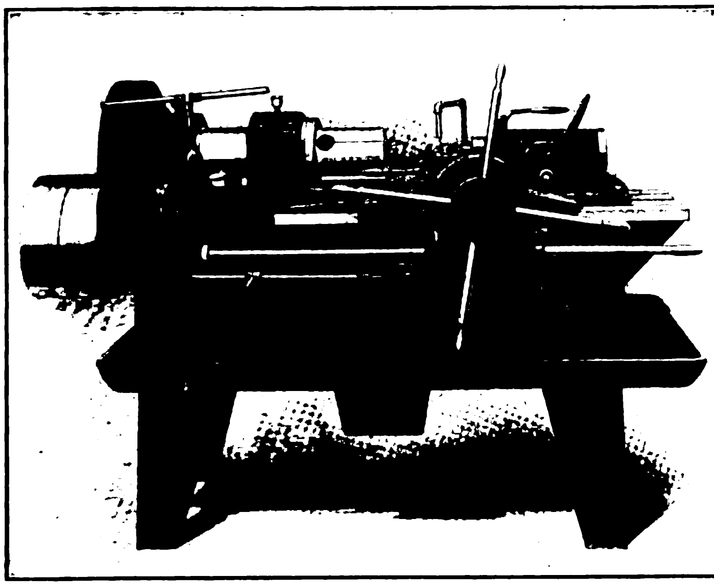


FIG. 12. FINISH-TURNING LATHE

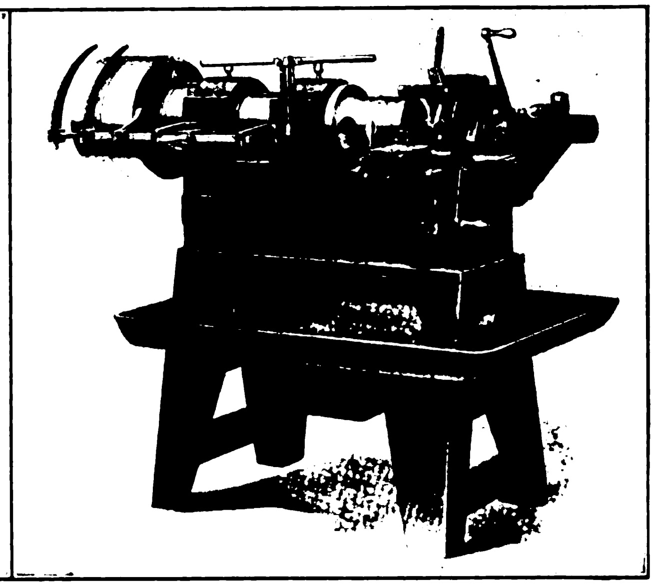


FIG. 13. BAND-TURNING MACHINE

After the copper band has been swaged in place, the shell goes to machine No. 13, where it is held by the base in a spring chuck and again supported as for finish-turning. A form tool is used at the front for rough-turning, and there is a shaving tool on the inclined slide at the back for the finish. A burring tool is also provided for scraping away the small fringe or sharp edge left by the finish tool.

On shells with curved noses a lathe with a split chuck is provided, the cross-slide carrying two tools of the desired form. Taken altogether, this group of machines makes a very complete set for handling all the various operations on the 3-in. shell. These machines are also made for larger projectiles, the spindles and other parts being proportionately heavier.

Personals

Leslie B. Stauffer, for many years associated with the Warner & Swasey Co., Cleveland, Ohio, has become secretary, succeeding Frank A. Scott, who was recently elected vice-president and treasurer.

Charles F. Scribner, a frequent contributor to the columns of the "American Machinist," until recently production engineer with the Colt's Patent Fire Arms Manufacturing Co., has become assistant superintendent of the Cleveland Twist Drill Co., Cleveland, Ohio.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	Feb. 4, 1916	Jan. 7, 1915	Feb. 5, 1915
No. 2 Southern foundry, Birmingham	$15.00	$15.00	$9.50
No. 2 X Northern foundry, New York	19.75	19.50	14.25
No. 2 Northern foundry, Chicago	18.50	18.50	13.00
Bessemer, Pittsburgh	21.45	21.95	14.55
Basic, Pittsburgh	18.70	18.95	13.45
No. 2 X, Philadelphia	20.00	19.75	14.25
No. 2, Valley	18.50	18.50	13.00
No. 2 Southern, Cincinnati	17.90	17.90	12.40
Basic, Eastern Pennsylvania	19.50	19.50	13.50
Gray forge, Pittsburgh	18.45	18.45	13.45

Steel Shapes—The following prices in cents per pound are for angles 3 in. by 1/4 in. and larger and tees 3 in. and larger from jobbers' warehouse, New York:

	Feb.4, 1916	Jan. 7, 1915	Feb. 5, 1915
Steel angles, base	2.60	2.50	1.85
Steel T's, base	2.65	2.55	1.90
Machinery steel (bessemer)	2.60	2.50	1.80

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse, New York:

	Feb. 4, 1916	Jan. 7, 1916	Feb. 5, 1915
No. 28 black	3.50	3.35	2.60
No. 26 black	3.40	3.25	2.50
Nos. 22 and 24 black	3.35	3.20	2.45
Nos. 18 and 20 block	3.30	3.15	2.40
No. 16 black	3.45	3.10	2.35
No. 14 black	3.35	3.00	2.25
No. 12 black	3.30	2.90	2.20
No. 28 galvanized	5.50	5.50	3.50
No. 26 galvanized	5.20	5.20	3.20
No. 24 galvanized	5.05	5.05	3.05

Swedish (Norway) Iron—This material sells at $4.50 base per 100 lb. f.o.b. New York. In coils an advance of 50c. is charged.

Cold Drawn Steel Shafting—From New York warehouse to consumers requiring fair-sized lots the price is 15% off list.

Bar Iron—Prices are as follows in cents per pound at the places named:

	Feb. 5, 1916	Jan. 6, 1916
Pittsburgh, mill	2.10	1.80@1.85
New York	2.20	2.00@2.07
From storehouse, New York	2.50	2.40@2.50

Standard Pipe—On carload lots f.o.b. Pittsburgh, the discounts follow:

	Black		Galvanized	
	Feb. 5, 1916	Feb. 5, 1915	Feb. 5, 1916	Feb. 5, 1915
3/4- to 2-in. steel butt welded	76%	81%	60½%	72½%
2½- to 6-in. steel lap welded	75%	80%	59½%	72½%

At these discounts, the net prices in cents per ft. follow:

Diameter, In.				
3/4	2.76	2.20	4.54	3.15
1	4.08	3.24	6.72	4.67
1¼	5.44	4.38	9.09	6.30
1½	6.60	5.25	10.86	7.55
2	8.88	7.05	14.62	10.15
2¼	14.63	11.70	23.69	16.70
3	19.13	15.25	30.98	21.80
4	27.25	21.80	44.05	31.00
5	37.00	29.60	59.94	42.20
6	48.00	38.40	77.76	54.60

METALS

Old Metals—In New York, the following are the dealers' purchasing prices in cents per pound:

	Feb. 4, 1916	Feb. 5, 1915
Copper, heavy and crucible	21.00	12.10
Copper, heavy and wire	20.50	11.75
Copper, light and bottoms	17.50	10.50
Lead, heavy	5.00	3.20
Lead, tea	4.50	...
Brass, heavy	13.25	8.25
Brass, light	10.50	6.75
No. 1 yellow rod brass turnings	12.50	...
Zinc	12.00	4.50

Antimony—For spot delivery on Chinese and Japanese brands the quotation is at 42.50c. per lb., duty paid.

Miscellaneous Metals—The present New York quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	Feb. 4, 1916	Jan. 7, 1916	Feb. 5, 1915
Copper, electrolytic (carload lots)	26.00*	24.00	14.75
Tin	41.75	41.00	37.00
Lead	6.10	5.90	3.70
Spelter	19.50	18.00	8.25
Copper sheets, base	32.00	30.00	19.25
Copper wire (carload lots)	32.00	30.00	15.25
Brass rods, base	38.00	35.00	14.75
Brass pipe, base	43.00	38.00	15.75
Brass sheets	38.00	35.00	15.50
Solder ½ and ½ (case lots)	26.00	26.50	24.50

ST. LOUIS

Lead .... 5.95 Spelter 19.50

*This quotation is for delivery in June or later. For earlier delivery 27.50c. is asked.

Babbitt Metal—In New York, quotations are as follows in cents per pound:

Best grade	55@60
Commercial grade	25@30

Monel Metal—The following are the prices 'n cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	31.50	32.00	32.50	33.00	36.00
1/4 to 5/16	31.25	31.75	32.25	32.75	35.75
3/8 to 1 7/8	31.00	31.50	32.00	32.50	35.50
1 15/16 to 2 7/8	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3 7/16	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3½ to 3 15/16	32.25	32.75	33.25	35.75	36.75
Squares					
3 1/16 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4 15/16	33.00	33.50	36.00	36.50	37.50
5 to 6 15/16	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than 1/8 in. thick.

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

SHOP ACCESSORIES

Carriage Bolts—On 3/8 by 6 in. and smaller 60 and 5% off list is allowed; for larger and longer sizes 50 and 5% off list is charged. For fair-sized orders from New York warehouse the following net prices at this rate would be charged:

Length, In.	Diameter 1/4	5/16	3/8	7/16	1/2	5/8	3/4
1½	$0.38	$0.53	$0.72	$1.05	....	....	....
2	.41	.58	.78	1.14	....	....	....
2½	.46	.62	.84	1.24	$1.54	$2.73	$4.04
3	.49	.67	.90	1.33	1.68	2.91	4.28
3½	.53	.71	.97	1.43	1.81	3.09	4.51

Machine Bolts—From New York warehouse, the base price for fair quantities are as follows: From 3/8 in. by 4 in. and smaller, 60 and 10% off list is discounted; for larger and longer sizes up to 1 in. by 30 in., 50 and 10% is allowed. At this rate prices per 100 are as follows:

Length, In.	Diameter 1/4	3/8	5/8	3/4	7/8	1 In.
1	$0.61	$0.86	$2.34	$3.47	$4.73	$6.80
2	.64	.92	2.51	3.71	5.04	7.20
2½	.67	.98	2.68	3.96	5.36	7.61
3	.70	1.04	2.85	4.21	5.67	8.01
3½	.73	1.09	3.02	4.46	5.99	8.42

Base prices on other sizes would be as follows: 1¼ and 1¼ in. by 3 in. and up to 12 in. take 40% off list. On longer lengths a special pound price is quoted. For cold punched square nuts, 40% is discounted from list; for hot pressed hexagon nuts up to 1 in. by 30 in., 50%; up to 1 in. diameter, cold punched nuts, 40%. Buttonhead with hexagon nuts, 40% off list, as do hexagon head with hexagon nuts.

Bolt Ends with hot pressed nuts sell at the base price of 50 and 10% from list price. This is for fair-sized orders from New York warehouse.

Nuts—On hot pressed nuts $3 off list is allowed and on hexagon $3.20. At this rate the base price per 100 lb. for fair-sized orders from New York warehouse is as follows:

Hot Pressed Square Short Diam.	Blank	Tapped	Hot Pressed Hexagon Short Diam.	Blank	Tapped
½	....	$12.00	½	....	$17.70
9/16	$8.00	9.50	11/16	....	11.30
11/16	6.00	6.90	⅞	$6.40	7.40
⅞	5.00	5.70	1¼	5.20	5.80
1¼	4.50	4.90	1 7/16, 1⅝, 1 13/16, 2	5.10	5.70
1 7/16, 1⅝, 1 13/16, 2	4.40	4.80	2 3/16	5.20	5.90
2 3/16	4.50	5.00	2⅝	5.50	7.30
2⅝	4.80	5.40			

Semifinished nuts are sold at 70 % from list price.

On cold punched square nuts $3 from list is deducted and on hexagon $3.75. At this rate the base price on fair-sized orders from New York warehouse is as follows in cents per pound:

Bolt	Square Blank	Square Tapped	Hexagon Blank	Hexagon Tapped
¼	17.00	19.00	23.25	25.75
5/16	15.00	16.50	20.25	22.25
⅜	11.50	12.60	14.75	16.35
7/16	11.00	11.90	14.25	15.55
½	8.30	9.00	10.25	11.25
9/16	8.30	8.90	10.25	11.15
⅝	7.00	7.50	8.75	9.45
¾	6.70	7.10	7.65	8.25
⅞	6.60	7.00	7.35	7.95
1	6.60	7.00	7.35	7.95

The base price for fair-sized orders of case-hardened nuts from New York warehouse is 70% from list price.

Rivets—The following are the base quotations for fair quantities from New York warehouse:

	Discount from List
Steel 7/16 and smaller	65 and 10%
Tinned	65 and 10%

	Price per 100 Lb.
Button heads, ¾, ⅞, 1 in. diam. by 2 in. to 5 in.	$4.25
Cone heads, same sizes	4.35

	Extra per 100 Lb.
1⅛ to 1⅞ in. long, all diameters	$0.25
⅝ in. diameter	0.15
½ in. diameter	0.50
1 in. long and shorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

Wrought Washers—From New York warehouse, the base price on fair-sized orders is $4.50 from list price. At this rate the following prices per 100 lb. hold:

Diameter, In.		Diameter, In.	
9/16	$9.50	1½	$4.80
¾	7.70	1¾	4.70
⅞	6.90	2	4.60
1	6.00	2¼, 2½, 2¾	4.50
1¼	5.30	3¾, 4, 4¼, 4½	5.00
1⅜	4.90	3, 3¼, 3½	4.70

For cast-iron washers, the base price is $2.50 per 100 lb.

Coach or Lag Screws from New York warehouse sell at 65 and 10% from list. This is for fair-sized orders and at this rate the following net prices per 100 hold:

Length, In.	Conical or Gimlet Point: ¼ and 5/16	⅜	7/16	½	9/16 and ⅝	¾	⅞	1
1½	$0.69	$0.85	$0.99	$1.18	...	...	...	...
2	.77	.93	1.09	1.29	$1.89	...	...	...
2½	.83	1.01	1.19	1.41	2.05	$2.90	...	...
3	.90	1.10	1.29	1.52	2.21	3.12	$4.73	...
3½	.96	1.18	1.40	1.63	2.36	3.34	5.04	$6.93
4	1.02	1.26	1.50	1.75	2.52	3.56	5.36	7.34
4½	1.09	1.34	1.60	1.86	2.68	3.78	5.67	7.75
5	1.15	1.42	1.70	1.98	2.84	4.00	5.99	8.16
5½	1.21	1.51	1.80	2.09	2.99	4.22	6.30	8.57
6	1.28	1.59	1.90	2.20	3.15	4.44	6.62	8.98

Tap Bolts—The following prices are base per 100 for fair-size orders of tap bolts with hexagon heads, delivered from New York warehouse, the present discount being 25% from list:

Length of Screw	Diameter: ¼	5/16	⅜	7/16	½	⅝	¾	⅝	1
1½	$0.73	$0.95	$1.11	$1.32	$1.65	$2.47	$3.47	$4.95	$6.60
1¾	.86	1.03	1.17	1.39	1.73	2.57	3.59	5.12	6.81
2	.91	1.05	1.23	1.47	1.82	2.67	3.71	5.28	7.01
2¼	.95	1.10	1.29	1.54	1.90	2.77	3.84	5.45	7.22
2½	.99	1.15	1.34	1.62	1.98	2.87	3.96	5.61	7.43
2¾	1.03	1.20	1.40	1.69	2.06	2.97	4.08	5.78	7.63
3	1.07	1.25	1.46	1.77	2.15	3.03	4.20	5.94	7.84
3¼	...	1.30	1.52	1.83	2.23	3.17	4.33	6.11	8.04
3½	...	...	1.58	1.91	2.31	2.27	4.46	6.27	8.25
3¾	...	...	...	1.99	2.39	3.37	4.58	6.44	8.46
4	...	...	...	...	2.47	3.47	4.70	6.60	8.66

Copper Rivets from warehouse, New York, sell at 25 and 5% off list and burs at 2½% the net list price.

Nails—Wire nails f.o.b. Pittsburgh sell at $2.20; galvanized 1 in. and longer, $4.20, and shorter, $4.70. These prices are to regular customers and delivery is made at the mill's convenience.

Turnbuckles—From New York warehouse, on sizes smaller than 1¼ in. diameter, 50% off list is charged, and on 1¼ up to 2 in. diameter 40%. At this rate prices follow:

Size		Size		Size	
⅜	$0.20	⅞	$0.38	1½	$0.90
7/16	.21	1	.44	1⅝	1.05
½	.23	1⅛	.50	1¾	1.20
⅝	.25	1¼	.75	1⅞	1.35
¾	.32	1⅜	.83	2	1.59

These prices are for buckles having right and left stub ends and with openings between the heads measuring 5½ in.

MISCELLANEOUS

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire	
⅜, 11/32, 5/16, ¼, 7/32, 3/16	8.50
No. 8, 5/32 and No. 10	9.25
⅛	10.00
No. 12	11.00
3/32, No. 14 and 1/16	12.00
No. 18	14.00
No. 20	16.00

Special Welding Steel	
⅛	33.00
5/32	30.00
3/16	28.00

Cast-Iron Welding Rods	
¼ by 19 in. long	22.00
3/16 by 12 in. long	26.00
⅜ by 19 in. long	20.00
½ by 21 in. long	20.00

Vanadium Wire in Coils or Sticks	
1/16	15.50
3/32	15.00
⅛	14.00
5/32	12.00
3/16 and larger	11.00

These prices are subject to change according to quantity and shipment desired.

Seamless Drawn Tubing—The base price per pound from New York warehouse is 39c. for brass and 39.50c. for copper. For immediate stock shipment 3c. is added, which gives the following quotations:

Diameter, In.	Copper Feb. 4, 1916	Copper Feb. 5, 1915	Brass Feb. 4, 1916	Brass Feb. 5, 1915
¾ to 2½	42.50	21.50	18.00	41.00
3	42.50	22.00	19.00	41.00
3½	43.50	22.50	19.50	42.50
4	44.50	23.00	20.00	43.50
4½	46.50	24.00	31.00	45.50
5	48.50	25.00	22.00	47.50
6	49.50	28.00	25.00	48.50
8	53.60	32.00	29.00	52.60
7	51.50	30.00	27.00	50.50

Tin Plates—The following prices are in effect from warehouse, New York:

Coke tin plate, 14x20:

100-lb.	$4.45
I. C. 107-lb.	4.60

Terne plate, 20x28:

Base Weight	Net Weight	Coating	Price	Base Weight	Net Weight	Coating	Price
100-lb.	200	8	$8.30	I. C.	226	20	$13.50
I. C.	214	8	8.60	I. C.	231	25	14.25
I. X.	270	8	10.60	I. C.	236	30	15.50
I. C.	218	12	12.00	I. C.	241	35	17.00
I. C.	221	15	13.00	I. C.	246	40	19.00

Zinc Sheets—The following prices in cents per pound prevail at New York:

Carload lots, f.o.b. mill	24.00
In casks, New York	24.50
Broken lots, New York	25.00

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Jan. 15	Jan. 22	Jan. 29	Feb. 5
Prompt furnace	$2.50	$3.00@3.25	$4.00@5.00	$3.00@3.25
Prompt foundry	3.75@4.00	3.50@4.00	3.50@4.00	4.00@4.50

Sal Soda—These quotations are per 100 lb. at the places designated:

New York	$1.35
Philadelphia	1.10

Roll Sulphur in 360-lb. bbl. sells in New York at $2.15 per 100 lb.

Cotton Waste—In New York, the prices in cents per pound are as follows:

White	9.50@11.50
Colored mixed	6.50@ 9.00

Linseed Oil—Raw, in barrels sells at 77c. per gal. and in 5-gal. cans at 87c. Boiled, it is 1c. per gal. higher.

White Lead, dry and in oil, in cents per pound sells as follows:

100-lb. keg	8.75
25- and 50-lb. kegs	9.00
12½-lb. keg	9.25
1- to 5-lb. cans	10.75

Red Lead, dry, in cents per pound sells as follows:

100-lb. keg	8.75
25- and 50-lb. kegs	9.00
12½-lb. keg	9.25

In oil, the price in cents per pound is as follows:

100-lb. keg	9.25
25- and 50-lb. kegs	9.50
12½-lb. keg	9.75

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

The William J. Hyland Manufacturing Co., manufacturer of plumbers' supplies, 151 Dwight St., Springfield, Mass., plans to construct a 68x203-ft. factory on Liberty St., Springfield. H. L. Sprague is Arch.

The Brown & Sharpe Manufacturing Co., manufacturer of machinery and tools, will construct an addition to its factory No. 5 at Providence, R. I.

The Connecticut Alloyed Metals Co. will build a 90x100-ft. factory at Bridgeport, Conn.

The Colt's Patent Fire Arms Manufacturing Co. is constructing a 4-story, 60x175-ft. addition to its plant at Hartford, Conn. Noted Nov. 4.

Plans have been prepared for the construction of a 1-story, 50x64-ft. addition to the plant of the Risdon Tool Co. on Andrew Ave., Naugatuck, Conn.

Hopkins & Allen Arms Co. has awarded the contract for the construction of a 4-story addition to its plant at Norwich, Conn., to be used as a gun factory. Noted Jan. 27.

Plans are being prepared by C. H. Preston, Arch., 47 Broadway, Norwich, Conn., for the construction of a 2-story, 68x74-ft. garage at Norwich for M. B. Ring, 21 Chestnut St. Estimated cost, $20,000.

The contract has been awarded for the construction of a 1-story, 100x130-ft. factory at Plainville, Conn., for the Rockwell Drake Co., manufacturer of ball bearings. Noted Jan. 13.

MIDDLE ATLANTIC STATES

Bids will soon be received by Fuller & Robinson, Arch., 95 State St., Albany, N. Y., for a 1-story, 25x100-ft. garage for William H. Pabst, 781 Madison Ave. Estimated cost, $10,000.

The Ford Motor Co., New York, N. Y. (Borough of Queens), will construct a 3-story service building at Bedford Ave. and Eastern Parkway, New York (Borough of Brooklyn). Estimated cost, $20,000. Albert Kahn and Ernest Wilby, 58 Lafayette Ave., Detroit, Mich., are Archs.

William Kahl is having plans prepared by James A. Boyle, 367 Fulton St., New York, N. Y. (Borough of Brooklyn), for the construction of a 1-story garage at 1084-86 Decatur St. Estimated cost, $12,000.

William H. Ludwig, Arch., 16 Court St., New York, N. Y. (Borough of Brooklyn), is preparing plans for a 1-story, 50x143-ft. garage on Putnam Ave. for Charles Strickland. Estimated cost, $12,000.

Plans prepared by William H. Ludwig, Arch., 16 Court St., New York, N. Y. (Borough of Brooklyn), for a 1- and 2-story, 50x230-ft. garage on 3d Ave. for Richard Von Lehn's Sons, 2791 Ave. G. Estimated cost, $30,000.

Bids will soon be received for the construction of a 5-story, 40x100-ft. garage at 208-10 East 75th St., New York, N. Y. (Borough of Manhattan), for Harry Fischel, World Bldg. Estimated cost, $40,000. M. J. Harrison, 63 Park Row, Arch.

Engelbert and Catherine Neus, 703 West 171st St., New York, N. Y. (Borough of Manhattan), will construct a 4-story, 25x100-ft. garage at 703 West 171st St.

Plans will be prepared by Francisco & Jacobus, Arch. and Engr., 200 5th Ave., New York, N. Y., for a ball-bearing manufacturing plant for the Norma Co. of America, 1790 Broadway, New York, N. Y. (Borough of Manhattan). Estimated cost, $300,000.

The plant of the Pierce-Arrow Auto Co., New York, N. Y. (Borough of Queens), will be enlarged.

The Seaboard Foundry and Machine Co., Montclair, N. J., will establish a foundry and machine shop. H. J. Redfield is interested.

The Gamon Meter Co., Newark, N. J., manufacturer of water meters, will improve its plant on South St.

The Wilson-Ward Motor Co., Inc., Newark, N. J., will build a new garage and service station on William St.

The contract has been awarded for the construction of a 2-story, 200x300-ft. addition to the plant of the Autocar Co., Ardmore, Penn. Estimated cost, $100,000. Noted Feb. 3.

The Peters Packing Co., McKeesport, Penn., has awarded the contract for the construction of a garage and power house. Estimated cost, $40,000.

The plant of the Mauch Chunk Iron Works at Mauch Chunk, Penn., will be rebuilt.

The contract has been awarded for repairing the foundry of the William Adams Foundry Co., 916 North 9th St., Philadelphia, Penn. Estimated cost, $1,000.

The contract has been awarded for the construction of a factory at Tacony and Lewis St., Philadelphia, Pnen., for the John Illingwork Steel Co.

A. Raymond Raff will construct a garage on Sydenham St., Philadelphia, Penn.

Schaum & Uhlinger, Inc., Glenwood and 2nd Ave., Philadelphia, Penn., will build a 3-story, 126x175-ft. machine shop at its Fletcher Works, Philadelphia.

The Textile Machinery Co., Hancock and Somerset St., Philadelphia, Penn., is having plans prepared for a plant. Estimated cost, $150,000. Day & Zimmerman, 611 Chestnut St., Philadelphia, Engr.

The contract has been awarded for the construction of a 1-story, 28x42-ft. addition to the machine shop of Frank Toomey, Inc., 127 North 3rd St., Philadelphia, Penn. Estimated cost, $3,100.

The Nicola Land Co., Farmers' Bank Bldg., Pittsburgh, Penn., has awarded the contract for the construction of a 3-story commercial garage. Estimated cost, $50,000.

Bids will soon be received for a 3-story, 100x170-ft. service building at Scranton, Penn., for the Ford Motor Co., Detroit, Mich. Estimated cost, $25,000. Albert Kahn and Ernest Wilby, 58 Lafayette St., Detroit, Mich., are Archs. Noted Jan. 20.

The Titusville Forge Co., Titusville, Penn., has awarded the contract for the construction of an addition to its plant. This company was recently acquired by the Bethlehem Steel Co. Estimated cost, $300,000. Ntoed Feb. 3.

R. P. Anderson, 56 South George St., York, Penn., will construct a 3-story, 60x85-ft. garage. Estimated cost, $15,000. Noted Jan. 27.

The Baltimore Sheet and Tin Plate Co. plans to establish a plant at Baltimore, Md.

The contract has been awarded for the construction of additions to the metal-working plant of the Baltimore Copper Smelting and Rolling Co., 4th Ave. and 5th St., Baltimore, Md. William H. Peirce is Vice-Pres.

Plans are being prepared by Archer & Allen, Arch., 3 East Lexington St., Baltimore, Md., for a 1-story garage for E. Culbreath. Estimated cost, $25,000.

The Northern Garage Co., Baltimore, Md., has awarded the contract for the construction of a 1-story, 100x125-ft. garage. Estimated cost, $10,000. Stanislaus Russell, 2900 Clinton Ave., Baltimore, Arch. Noted Feb. 3.

A building is being constructed at 24th and M St., N. W., Washington, D. C., by Joseph J. Leary which will be occupied by the Pathfinder and Auburn Automobile companies as a garage, service station and salesroom. H. W. Soper and H. W. Robertson are interested.

SOUTHERN STATES

The Noreck Broiler Co., Richmond, Va., plans to construct a plant for the manufacture of broilers at Hopewell, Va. H. Noreck is Pres.

The Freed Heater Co., Collegeville, Penn., has purchased a plant at Phoebus, Va., and is in the market for radial drilling and tapping machines, sand-blast equipment and reaming machines.

The Whitaker-Glessner Co., Wheeling, W. Va., plans to construct a new steel mill at Beech Bottom, W. Va. (Wellsburg post office).

The Baltimore & Ohio Railroad Co. will construct a 2-story factory at Fairmont, W. Va., for the manufacture of car wheels.

Scott Bros., Main St., New Cumberland, W. Va., will construct a garage. C. M. Metsch, First National Bank Bldg., East Liverpool, Ohio, is Arch.

George H. Dieringer, 106 North Huron St., Wheeling, W. Va., is preparing revised plans for a garage for Louis Storch, 224 16th St. Bids will soon be received.

The Union Manufacturing Co., manufacturer of dinner pails, etc., is constructing a 1-story, reinforced-concrete factory at Canton, N. C., and is in the market for gasoline or kerosene engines, stamping machines, presses, small tools and sheet-metal shop supplies. T. J. Wooldridge is Gen. Mgr.

The North Carolina Steel and Iron Co., Salisbury, N. C., recently incorporated with $50,000 capital stock, plans to establish a plant for the manufacture of steel and malleable castings. P. H. Thompson and John S. Henderson are interested.

The Reo Motor Car Co., Lansing, Mich., plans to establish an assembling plant at Atlanta, Ga.

The Hardie Manufacturing Co., Hudson, Mich., manufacturer of spraying machinery, will establish a plant at Tampa, Fla.

The Southern Ry. will construct repair shops at Knoxville, Tenn.

The Hull Pump and Tank Co., Owensboro, Ky., is in the market for a variety of machine tools.

MIDDLE WEST

The Bryan Motor Service Co. will construct a 2-story addition to its garage and repair plant at Bryan, Ohio.

The Tower Manufacturing Co., Cincinnati, Ohio, is in the market for automobile wire straighteners, either new or second-hand.

The Duriron Castings Co. will construct an addition to its foundry on South Ludlow St., Dayton, Ohio. Estimated cost, $5,000.

Plans are being prepared for the construction of a plant at East Liverpool, Ohio, for the Columbia Sheet and Steel Co. Estimated cost, $500,000 Noted Dec. 16.

The Columbia Steel Co. has awarded the contract for the construction of additions to its plant at Elyria, Ohio. Estimated cost, $40,000.

The East Iron and Machine Co., manufacturer of cartridge-making machinery, will construct an addition to its plant on Market St., Lima, Ohio. Estimated cost, $2,000.

Fire recently damaged the machine shop of John Mills, 641 Broadway, Lorain, Ohio.

The Medina Foundry Co. will build a 120x140-ft. addition to its foundry at Medina, Ohio.

The Matthews Boat Co., manufacturer of power boats and farm-lighting machines, will build a factory at Port Clinton, Ohio.

The W. H. Mullins Co. has awarded the contract for the construction of an addition to its plant at Salem, Ohio, for the manufacture of automobile parts. Estimated cost, $50,000. Noted Feb. 3.

The contract has been awarded for the construction of a 1-story, 72x72-ft. addition to the plant of the Miller Improved Gas Engine Co. at Fair and Plum St., Springfield, Ohio.

The Champion Spark Plug Co. has awarded the contract for the construction of 6 factory buildings and a 1-story addition to its plant at Toledo, Ohio.

The Toledo Speed Wrench and Tool Co., recently incorporated, will establish a plant at Toledo, Ohio. J. S. O'Connell is Pres. and Gen. Mgr.

The Edwards Valve Manufacturing Co., 1200 145th St., East Chicago, Ind., is building a 1-story factory. Estimated cost, $4,200.

The Sterling Metal Co. has purchased a site at Huntington, Ind., and will construct a plant.

The Stutz Motor Car Co. has awarded the contract for the construction of a 4-story, 80x205-ft. factory at Indianapolis, Ind. Estimated cost, $80,000.

Bids are being received by Freyermuth & Maurer, Arch., 9 Warner Bldg., South Bend, Ind., for the construction of a 1-story, 56x192-ft. garage for James A. Judie, 112 South Main St. Estimated cost, $20,000.

The contract has been awarded for the construction of additions to the plant at Ann Arbor, Mich., for the Hoover Ball Co., manufacturer of steel balls and bearings.

The Grand Rapids Brass Co., Grand Rapids, Mich., will establish a brass foundry at Belding, Mich.

The A. T. Harrow Tractor Co. plans to establish an assembling plant at Detroit, Mich. A. Sweet, 27 East Jefferson St., is Vice-Pres.

The A. C. Knapp Co., manufacturer of automobile tops, has awarded the contract for the construction of a 1-story addition to its factory at Detroit, Mich.

We have been advised that L. Rinkel, 3511 Jefferson Ave., E., Detroit, Mich., desires circulars and catalogs on machine tools and small tools.

The Turner & Moore Manufacturing Co., manufacturer of large parts for automobiles, is constructing a factory on Addison St., Detroit, Mich.

The Brownwall Gas Engine Co. will construct a 2-story, 150x200-ft. addition to its plant at Holland, Mich.

The Harrow Spring Co. has awarded the contract for the construction of a 50x165-ft. addition to its plant at Kalamazoo, Mich. Estimated cost, $80,000. Noted Jan. 27.

Gallagher, Hutchinson & Campbell Bros., Muskegon Heights, Mich., has secured a factory at Marshall, Mich., and will remodel it for the manufacture of iron, brass and aluminum castings for automobiles.

Bids are being received by Joseph Zidek, Arch., 4021 West North Ave., Chicago, Ill., for the construction of a garage. Estimated cost, $12,000.

J. J. Berkenfield, State Bank Bldg., Chicago, Ill., will build a 100x150-ft. garage at 2724 North Halsted St., Chicago. Estimated cost, $13,000. A. L. Levy, 28 North Clark St., Chicago, Arch.

Plans are being prepared by Albert S. Hecht, Arch., 154 West Randolph St., Chicago, Ill., for the construction of a garage at Rockford, Ill., for Letts & Bennett.

Plans have been prepared by Robert S. Chase, Arch., for the construction of a 2-story manufacturing building and garage for J. C. Harlow, Janesville, Wis.

William Van Lieshout will construct a machine shop at Kaukana, Wis.

The Hub City Auto Co. has purchased a building on West 2nd St., Marshfield, Wis., and will remodel it as a garage and repair shop. J. P. O'Connell is Mgr.

Plans are being prepared by Stanley F. Kadow, Arch., 988 Kinnickinnic Ave., Milwaukee, Wis., for the construction of a 65x80-ft. foundry on Clinton St., Milwaukee. Estimated cost, $10,000.

The Milwaukee Dairy Supply Co., 934 13th St., Milwaukee, Wis., will construct a 2-story, 60x120-ft. machine shop at 13th and Burleigh St., Milwaukee. Estimated cost, $18,000. The company is in the market for lathes, milling, planing and shaping machines, etc., with individual electric motor drive.

WEST OF THE MISSISSIPPI

The Louden Machinery Co., Fairfield, Iowa, will build a 2-story factory.

Plans are being prepared by F. E. Colby, Arch., 510 Davidson Bldg., Sioux City, Iowa, for a 2-story garage for E. J. Preszler, 2514 Pierce St., Sioux City. Estimated cost, $20,000.

The Chicago, Burlington & Quincy Railway Co., West Burlington, Iowa, contemplates constructing a machine shop and power plant.

Mueller Bros., Gaylord, Minn., will build a garage and machine shop. Estimated cost, $12,000. W. D. MacLeith, Summit and Wabash St., St. Paul, is Arch.

The Standard Oil Co., Minneapolis, Minn., will build a 2-story garage and machine shop at Oak and 4th St., Minneapolis. Estimated cost, $23,000.

The Martin Metal Co., Wichita, Kan., contemplates building a 1-story factory. Estimated cost, $20,000. H. S. Conrow, Beacon Bldg., Wichita, Arch.

The Western Iron and Foundry Co., Wichita, Kan., will construct a 1-story reinforced-concrete plant. Estimated cost, $4,000.

The Johnson Heating Co., First National Bank Bldg., Fargo, N. D., will build a factory for the manufacture of vacuum furnaces.

The Chicago Iron and Metal Co., Chicago, Ill., plans to construct 2 iron furnaces at Poplar Bluff, Mo.

The Continental Auto Top Co., St. Louis, Mo., has leased a building at 818 North Leffingwell Ave., St. Louis, and will remodel same for the manufacture of automobile tops.

The Hudson-Phillips Motor Car Co., St. Louis, Mo., will construct a new service and repair plant at Locust and Leonard St., St. Louis. John H. Phillips is Pres.

The Kardell Motor Car Co., 4156 Olive St., St. Louis, Mo., has awarded the contract for a 2-story garage. Estimated cost, $35,000. William P. McMahon, Wainwright Bldg., St. Louis, Arch.

The Liberty Foundry Co., St. Louis, Mo., has awarded the contract for an addition to its plant at 314-20 East Stein St., St. Louis. Estimated cost, $25,000. Noted Jan. 27.

The Heine Manufacturing Co., Amarilla, Tex., is in the market for radial drills, milling machines, lathes, turret lathes, emery grinders and furnaces.

The Texas Steel Co., Beaumont, Tex., will build a plant for the manufacture of pig iron and c.-i. pipe. Estimated cost, $2,500,000. Noted Feb. 3.

The Cuero Auto Sales Co., Cuero, Tex., will install a machine shop.

The Studebaker Corporation, New York, N. Y., will build an automobile asembling plant at Dallas, Tex. Estimated cost, $300,000.

The Lucey Manufacturing Co., Houston, Tex., will build a plant for the manufacture of oil-well machinery and equipment.

C. C. Morgan, Colorado Springs, Colo., will build a 1-story garage on Huerfano Ave. Estimated cost, $10,000.

Thomas Botterill, Denver, Colo., will construct a 1-story garage at 1275 Lincoln St., Denver. Estimated cost, $10,000.

WESTERN STATES

The Colfax Iron Works will construct a plant at Colfax, Wash.

The shipbuilding plant of Nilson & Kelez at Seattle, Wash., will be enlarged.

Fire, Jan. 18, damaged the plant at First and Stark St., Portland, Ore., of Fairbanks, Morse & Co., manufacturer of scales and trucks. Loss, $50,000.

The Union Iron Works, San Francisco, Calif., has taken over the shipbuilding plant of the United Engineering Works, Alameda, Calif., and will construct additions to the plant. Estimated cost, $250,000.

C. A. Muller, 2023 Bancroft Way, Berkeley, Calif., is constructing a garage, machine shop and vulcanizing plant.

The Burnett Iron Works will enlarge its plant at Burnett, Calif. Estimated cost, $25,000.

Kleiber & Co. has purchased a site at 11th and Folsom St., San Francisco, and will construct an addition to its factory for the manufacture of automobile trucks.

John Lee, Jr., will construct a 2-story, reinforced-concrete garage on Sutter St., San Francisco, Calif. Estimated cost, $27,500.

The Pacific Coast Steel Co. plans to improve and construct additions to its plant at San Francisco, Calif. Estimated cost, $500,000.

The Sperry Flour Co., 332 Sansome St., San Francisco, Calif., will build a 1-story, 97x120-ft. garage at Greenwich and Sansome St., San Francisco.

CANADA

The International Nickel Co., Sudbury, Ont., will build a refinery at Cape Breton, N. B. Ambrose Monell is Pres.

MacFarlane-Pratt-Hanley, Ltd., Port Robinson, Ont., is in the market for 8x10-in. or 7x12-in. double hoist, double drum with ratchet, pall and brake straps with swinger attached.

Bids are being received for the construction of a 4-story, 125x130-ft. addition to the plant of the American Can Co. at Vancouver, B. C. Estimated cost, between $60,000 and $70,000. B. C. M. Bigger is Mgr. Noted Dec. 9.

Black Bros., Ltd., manufacturer of automobile tops and bodies, 1115 Homer St., Vancouver, B. C., is in the market for a metal swedge or beader and carriage hub borer.

GENERAL MANUFACTURING

NEW ENGLAND STATES

G. M. Seidel has purchased the mill of the Elastic Web Co. at East Hampton, Mass., and will equip same as a knitting mill.

The contract has been awarded for the construction of 8 factory buildings at East Walpole, Mass., for S. W. Bird & Son, manufacturer of paper. Estimated cost, $125,000.

The Hood Rubber Co. plans to construct a 1-story, 100x120-ft. factory at Watertown, Mass. Estimated cost, $20,000.

The contract has been awarded for the construction of an addition to the plant of the American Silk Spinning Co., Providence, R. I.

The River Weaving Co., Danielson, Conn., plans to establish a factory at Danielson. F. E. Cunneen is interested.

The contract has been awarded for the construction of a 2-story, 115x200-ft. mill at Stafford Springs, Conn., for the Stafford Worsted Co. Noted Jan. 20.

MIDDLE ATLANTIC STATES

Edward E. Kochkeller is interested in a project to establish a canning plant at Amityville, N. Y., to be a branch of the Brown Snapper Canning Co., Springfield, Ill.

The Contact Process Co., manufacturer of chemicals, Buffalo, N. Y., will construct a plant for the manufacture of nitric acid. Estimated cost, $32,190.

Plans are being prepared by E. M. Adelsohn, Arch., 1776 Pitkin Ave., New York, N. Y. (Borough of Brooklyn), for a 4-story, 50x100-ft. factory for the Chester Knitting Mills, 88 Junius St. Estimated cost, $25,000.

The Firestone Tire and Rubber Co., Akron, Ohio, has purchased a site at South State and East Genesee St., Syracuse, N. Y., on which it will build a plant.

The Avalon Knitwear Co. plans to construct a 4-story addition to its plant on Broad St., Utica, N. Y.

The Linde Air Products Co., manufacturer of oxygen, acetylene, etc., 42d St. Bldg., New York, N. Y., has awarded the contract for the construction of a plant at Utica, N. Y. Estimated cost, $35,000.

The contract has been awarded for the reconstruction of the factory of the Fords Porcelain Works, Fords, N. J., recently destroyed by fire. Estimated cost, $25,000. Noted Jan. 20.

The contract has been awarded for the construction of a 3-story factory at Freehold, N. J., for A. & M. Karagensian, manufacturer of rugs.

The contract has been awarded for the construction of a 2-story factory at Kearney, N. J., for the Frank Skriwanek Button Works, 397 Market St., Newark, N. J.

Bids are being received by the Ammo Phos Corporation, 200 5th Ave., New York, N. Y. (Borough of Manhattan), for the construction of a chemical plant, consisting of 12 buildings, at Linden, N. J.

The Butler Chemical Co., Paterson, N. J., recently incorporated with $500,000 capital stock, will establish a plant for the manufacture of dyes.

SOUTHERN STATES

W. W. Jenks plans to construct a cold-storage plant at Alta Vista, Va.

According to press reports Swift & Co. and the American Leather Co., Chicago, Ill., plan to construct a plant at St. Paul, Va., for the manufacture of wood extracts.

The Sanitary Manufacturing Co., manufacturer of sanitary fixtures, has acquired the plant of the Independent Steel Co. at Kenova, W. Va., and will remove its plant from Hamilton, Ohio, to Kenova. The company will equip the recently acquired plant for the manufacture of its specialty. J. H. Davis is Gen. Mgr.

The Brookford Mills Manufacturing Co., Brookford, N. C. (Hickory post office), will build an addition to its plant.

The plant of the Hickory Manufacturing Co., manufacturer of building supplies, Hickory, N. C., destroyed by fire in November, will be rebuilt. Noted Nov. 18.

Fire, Jan. 29, destroyed the plant of the Orangeburg Fertilizer Co., Orangeburg, S. C. Loss, $100,000.

A cotton mill will be constructed at Alston, Ga., by F. Dees.

MIDDLE WEST

Fire recently damaged the factory of the Valley Tanning Co. at 1014 Berlin St., Cincinnati, Ohio. Loss, $3,000.

The Great Lakes Refining Co., 409 Superior Ave., N. W., Cleveland, Ohio, has awarded the contract for the construction of a 1-story, 60x200-ft. factory.

The contract has been awarded for the construction of a packing plant at Newark, Ohio, for the Miller Packing Co. Estimated cost, $70,000.

The Grasselli Chemical Co., Arcade Bldg., Cleveland, Ohio, has purchased a site at Niles, Ohio, and contemplates the construction of a factory.

The contract has been awarded for the construction of a plant at Anderson, Ind., for the Patent Vulcanite Refining Co. Estimated cost, $25,000.

The Cayuga Packing and Manufacturing Co. will rebuild its canning plant at Cayuga, Ind.

The Milner Provision Co. plans to build a packing plant at Frankfort, Ind. Estimated cost, $100,000.

The Indiana Refrigerating Co., 232 South Pennsylvania St., Indianapolis, Ind., plans to construct several cold-storage plants throughout the United States. William J. Hogan is Pres.

The contract has been awarded for the construction of a 3-story, 80x110-ft. cold-storage plant at Muncie, Ind., for the Kuhner Packing Co.

Plans are being prepared for the construction of a plant at Kalamazoo, Mich., for the Kalamazoo Paper Co. F. M. Hodge is Pres. Noted Dec. 23.

The E. I. Du Pont de Nemours Powder Co. is constructing additions to its plant at Barkdale, Wis. F. T. Beers is Supt. Noted Jan. 27.

The Ladysmith Manufacturing Co., recently incorporated, will establish a lath and veneer factory at Ladysmith, Wis. J. C. Young and F. Kinyon are interested.

The contract has been awarded for the construction of a 4-story addition to the plant of the Harsh & Edmonds Shoe Co. at Milwaukee, Wis.

Plans are being prepared by Leenhouts & Guthrie, Arch., 424 Jefferson St., Milwaukee, Wis., for the construction of a chair factory as another unit of the Milwaukee County House of Correction.

WEST OF THE MISSISSIPPI

The L. Eisenmenger Co., St. Paul, Minn., contemplates constructing a packing plant. Estimated cost, $100,000.

Maendler Bros., 42 East 3d St., St. Paul, Minn., contemplates building a factory on 9th St. for the manufacture of brushes. Estimated cost, $50,000.

We have been advised that the Great Western Sugar Co., Denver, Colo., will not construct a sugar factory at Burlington, Wyo., as noted in the Jan. 13 issue.

The Samuel Cupples Woodenware Co., St. Louis, Mo., contemplates an addition to its plant for the manufacture of automobile tires.

R. Piper, San Angelo, Tex., contemplates building a tannery.

The Oklahoma Stock Yards Serum Co. will build a plant at 1838 West Hickory St., Oklahoma, Okla. Estimated cost, $10,000.

Plans are being prepared for the construction of a paraffin plant in connection with the refinery of the Pierce Oil Corporation, Sand Springs, Okla. Estimated cost, $800,000. Noted Jan. 20.

The Bartless & Collins Glass Works, Sapulpa, Okla., will consolidate with the Premium Glass Manufacturing Co. and will double the capacity of its plant. Estimated cost, $30,000.

The holdings of the Western Sugar and Land Co., Grand Junction, Colo., will be purchased by A. E. Carlton, who will build a factory at Delta, Colo.

WESTERN STATES

James Campbell contemplates the construction of a knitting mill at Bovill, Idaho.

F. J. Mahoney is interested in the construction of a fruit-canning plant at Tekoa, Wash.

The Rogue River Canning Co. will build an addition to its plant at Medford, Ore.

H. S. Hadsall, 884 West 47th St., Los Angeles, Calif., is interested in the construction of a sugar refinery at Chula Vista, Calif. Estimated cost, $600,000.

John S. Ackerman, Pres. of Chamber of Commerce, is interested in the construction of a sugar plant at San Diego, Calif. Estimated cost, $200,000.

The California Canneries Co. is constructing additions to its plant at 18th and Minnesota St., San Francisco, Calif. New machinery will be installed.

The Sierra Madre Citrus Association will construct a packing plant at Sierra Madre, Calif. Estimated cost, $25,000. W. W. Hamilton is Pres.

H. W. Sprague, Astoria, Ore., is interested in a movement to build a canning plant at Cordova, Alaska.

CANADA

Cardiff & Dames, Brussels, Ont., will be in the market for 1 rock crusher, pulverizer, 20-hp. steam or gasoline engine, wagon scale and platform scale.

The National Portland Cement Co., Durham, Ont., will be in the market for new machinery.

The Bonner-Worth Co., Ltd., manufacturer of worsted yarns, etc., will construct an addition to its plant at Peterboro, Ont.

The Ruddick Novelty Co., Vancouver, B. C., has leased the Slocum Bldg. at 3rd and Main St., Vancouver, and will remodel it for the manufacture of furniture. J. S. Ruddick is interested.

Classified Advertising

The Classified Advertising section appears on pages 155, 156, 157, of this issue and will in future appear in the same relative position in the paper.

American Machinist

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CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

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The Value of Publicity

By Geo. W. Perkins

Extracted from an address before the Advertising Club of New York

FOR many years I have been a firm believer in the value of publicity as, in a sense, a cure-all for many of the ills in our business and political life.

My first experience with publicity and its great value as a business asset was when I was connected with the New York Life Insurance Company. During my young manhood, while with the field force of the agency department of that company, the practice of all life insurance companies was to give their policyholders, their agents and the public generally just as little information as they possibly could. The idea was to conceal everything as nearly as possible, on the theory that their competitors would find out something that would be to the competitors' advantage. This practice, as a matter of fact, often led the management of life insurance companies to cover up mistakes in their internal management and accounts, and transactions that were often worse than mistakes. This practice naturally caused them to drift into the habit of doing this because under their secret practices and lack of publicity the chances were that no one would find out the mistakes and wrongdoing.

The adoption of a policy of complete publicity was not only beneficial in securing new business, but it showed results at once in the financial management and every other branch of the company's affairs; for every man, in every department, realized every day that his transactions were bound to become public; that the company's investments, whatever their character, must be scheduled item by item at the end of each year and exposed to the scrutiny of the entire world.

I have never forgotten this experience of mine with publicity in the New York Life, and I have tried in every corporation with which I have been connected to bring about, so far as one man's influence can, the same sort of public accounting. Indeed, wherever situated, whether in business or public affairs, I have endeavored to introduce and use publicity, both as a medium of strength and protection and to advance the practical success of the undertaking.

The more I have studied, worked with and seen the results of full, frank and complete publicity the more I have come to believe that it is almost a cure-all for many of our modern business ills. The subject is a very big one; but, to put it as concisely as I can, I believe that the reason why publicity in our day and generation can accomplish so much is primarily because of the intelligence and fair mindedness of our people. I firmly believe that all that our people as a whole want or ask is a fair, square deal. They do not expect managers of business concerns or leaders of political parties to be infallible; they know they are human and liable to make mistakes; but the people want to know how their business managers and political leaders handle the affairs intrusted to them.

We Americans are not afraid of things simply because they are big, provided that they are big in the open, aboveboard; but we are afraid of secretive, blind pool methods. And it is largely because of secretive, blind pool methods that our people have been afraid of large aggregates of capital under what is known as corporate control. That is why they have been afraid of legislation conducted by a small group of men in star chamber councils.

From my observation I firmly believe that in another very important respect publicity is a great cure-all, viz., in the relations between capital and labor. Secrecy, concealment, lack of information, have done more than anything else to arouse suspicion on the part of labor that all was not as fair and equitable as it should be between capital and labor. I am perfectly satisfied that labor is more than willing that capital should have a handsome return in the way of interest or dividends, but when it does not know whether that return is fair, handsome or exorbitant you cannot expect labor to be contented and free from suspicion.

I believe that when a business concern becomes so large that the capital it uses is represented by more than a few people living in the same neighborhood it should be required to furish at least annually a complete statement of its affairs; that it should do this for the benefit alike of its stockholders, its consumers, its employees and the public generally. If this were required by law of all corporations, in place of being done as at the present time by a few corporations as a favor and because certain managers believe in it as a policy, we would be surprised at the rapidity with which many of the evils of which we complain would disappear.

Publicity would accomplish what the Sherman law does not, viz., abolish false prospectuses, overcapitalization and stock watering. Full and complete publicity would practically do away with these and kindred bad practices and crimes which are constantly recurring and for which the public has no redress at present.

I stand for and believe in publicity full, frank, complete.

Three-Inch Russian Shrapnel--IV*

BY JOHN H. VAN DEVENTER

SYNOPSIS—The eight steps described in this article, which concludes the work on the 3-in. Russian shrapnel shell, are a combination of hand and machining operations. Of the latter the more important are the forming of the copper drive band, which is done without lubrication, and the file finishing of the nose of the shell. An unique and ingenious mechanical device used in revolving the shells while lacquering their exterior surfaces is described.

Anyone who has observed the combination of 4-ft. wrench and husky man power shown in operation 19, in which the fuse socket is screwed home into the shell, would consider that no force short of that exerted by the explosion of the shell itself would be sufficient to loosen the fuse socket. This fact does not influence the Russian ordnance officials, however, who insist on additional precaution in the shape of two 3/8-in. screws that extend through the steel shell into the metal of the fuse socket. The drilling and tapping for these screws, as well as for the "grub" screw that is to hold the zinc fuse-hole screw plug, is done on multi-spindle high-speed sensitive drills and is shown in operation sheet 23. The fixtures used in this operation consist of a stationary angle plate screwed to the drill table, represented at *A*, and a number of square index blocks, shown at *B*. These blocks are for the purpose of properly spacing the holes at 90 deg. of the shell circumference. They are clamped to the bases fixture, each located centrally with one of the three drill spindles. A detail of one of these shell positions is shown at the lower left-hand corner of the operation sheet. It consists of the central plug *H*, which enters and fits the

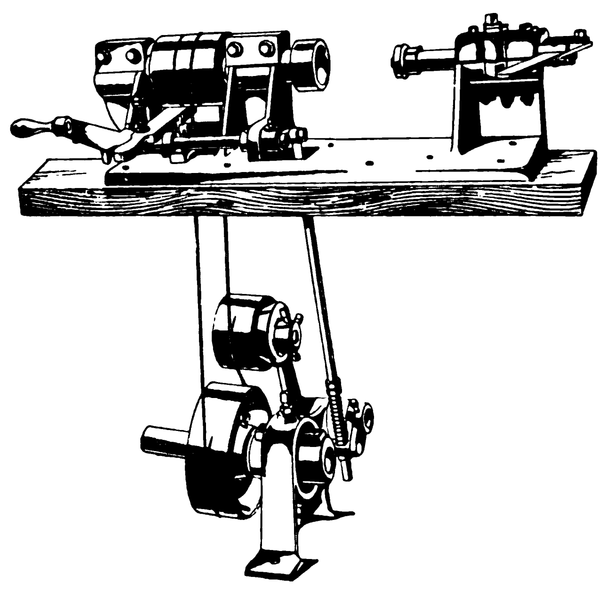


FIG. 1. BELT-DRIVEN SHELL FILING AND POLISHING MACHINE OF SIMPLE CONSTRUCTION

hole in the fuse socket, and the distance plugs *J*, which butt up against the outside edge of the shell and maintain it at the proper distance from the face of the fixture.

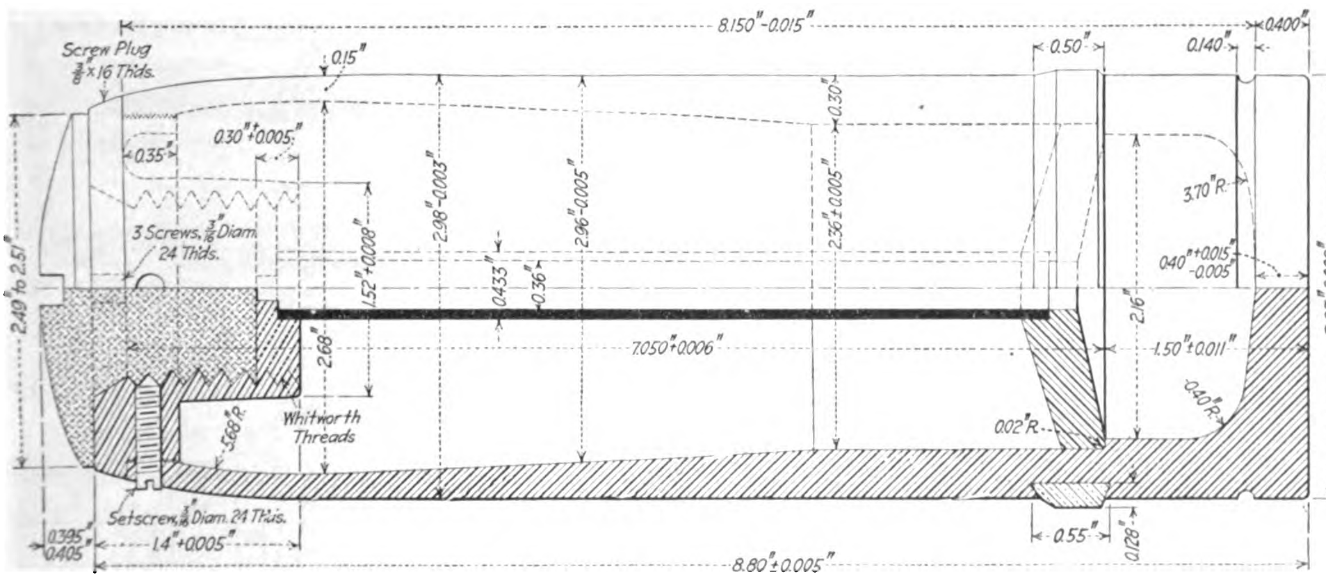


FIG. 2. SECTION THROUGH 3-IN. RUSSIAN SHRAPNEL, SHOWING DISK, POWDER-TUBE, FUSE SOCKET, COPPER PLUG AND ZINC FUSE-HOLE PLUG

of the shells by means of the clamping screws, shown at *C*, which are tightened by means of a special socket wrench and which hold the split portion of the index block upon the base of the shell.

The stationary fixture *A*, while simple, is well adapted to fast production. There are three shell positions on this

*Previous installments appeared on pages 89, 155 and 177.

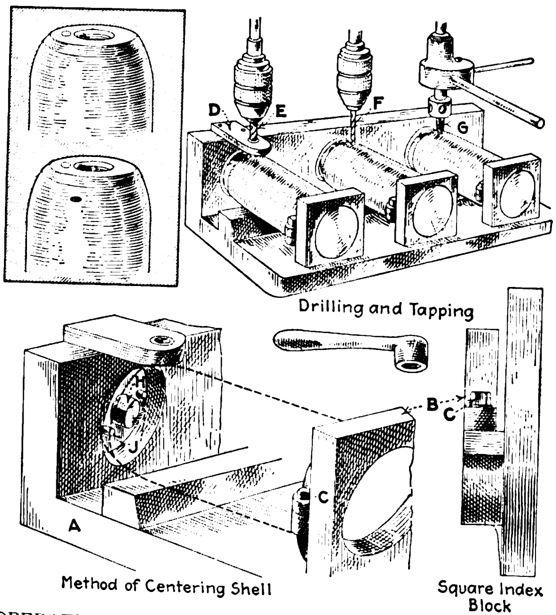
The thrust of the drill is not taken altogether by plug *H*, but upon a strip that runs across the jig and upon one of the faces of the square index blocks.

The procedure in this operation is to spot a center with a countersinking drill, shown at *E*, through the bushing *D*. Then the shell is moved to the second position, in which the hole for the tap is drilled at *F*. Finally, the shell goes to the third position, in which these

holes are tapped by the tap *G* in an automatic reversing tapping chuck. Three holes are drilled and tapped in each shell, with an average output of 30 shells per hr. This production is not at its maximum, since the capacity of the drills at this plant has exceeded that of the other machines.

The simple wooden vise shown at *A* in operation sheet 24 may well be applied to other examples of cylindrical work that it is desired to hold, and yet release quickly. It consists of a series of tapered wooden blocks forming spaces into which shells are dropped and where they are effectively held against rotation and other movement. While here, the 3/8-in. screws are driven home with a Yankee screwdriver, the heads are snipped off with a pair of hand shears and what is left of them is riveted over with a machinists' hammer.

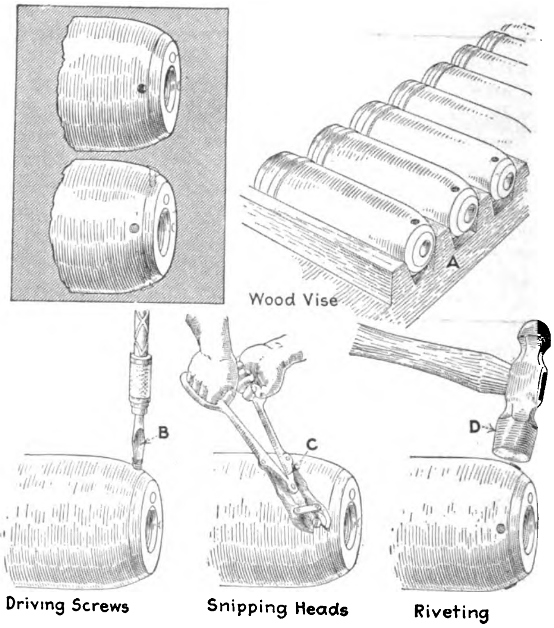
A converted engine lathe furnishes the means of performing the double operation shown in operation sheet 25, in which the copper band is formed to size and shape,



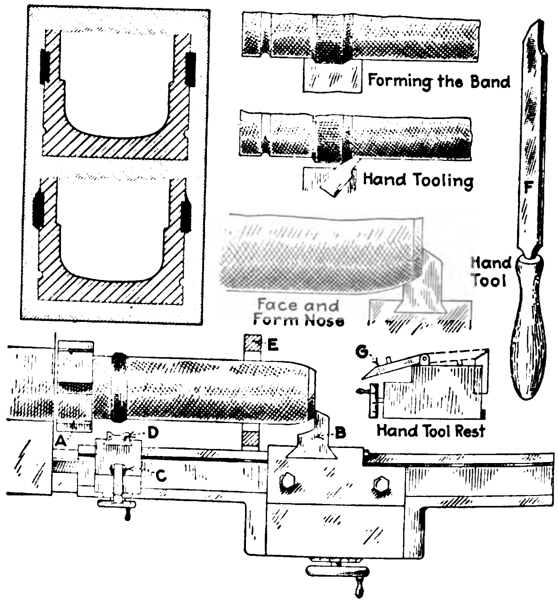
OPERATION 23: DRILL AND TAP FOR HOLDING SCREWS
Machines Used—Three-spindle sensitive drills.
Special Fixtures and Tools—Stationary centering fixture A; square index block B.
Gages—None.
Production—From one operator and one machine, 30 shells per hr.
Note—Speed for drilling and tapping, 1,200 r.p.m.; reversing tapping chuck used. Countersink with No. 11 and drill 5/16 in. for tapping; turpentine and white lead used as tap lubricant. Drills are run dry.

and the nose end of the shell is formed and faced. The shell is held in a simple split collet chuck, shown at *A*, and runs in the steadyrest *E*, with its outer end projecting beyond this so that the combination forming tool *B* may be advanced to face off the end of the fuse socket and also to remove the projecting ends of the riveted screwheads that remain from the preceding operation. An auxiliary tool slide is used for the copper-band forming. It is mounted on the lathe carriage at the proper distance away from the facing and forming tool *B* and is provided with a micrometer feed dial by means of which the size is determined.

A hand operation is necessary after the forming tool *B* completes its work, in order to remove the rough edges of the band. This tool is simply a flat file that has been dressed up on a grinding wheel to the shape shown at *F*. It is used in connection with the hinged hand-tool



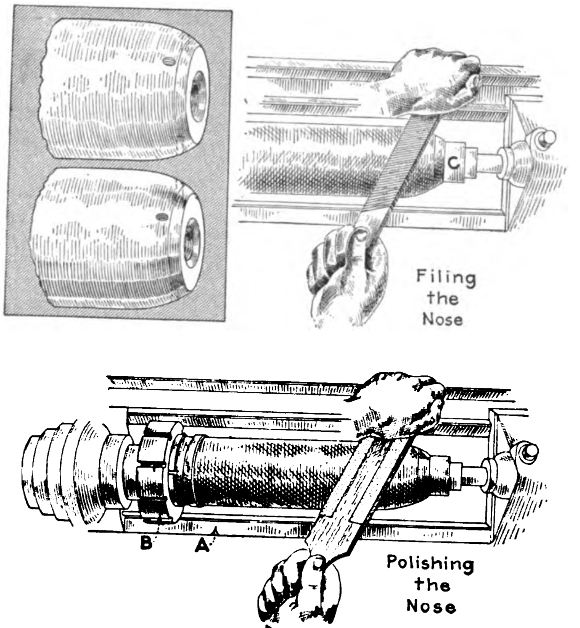
OPERATION 24: INSERT HOLDING SCREWS, SNIP AND RIVET
Machines Used—Hand operations.
Special Fixtures and Tools—Special wood-block bench vise A; Yankee screwdriver B; hand shears C; hammer D.
Gages—None.
Production—From three men, 2,500 shells in 10 hr.



OPERATION 25: FORM DRIVE BAND, AND FACE AND FORM FUSE END OF SHELL
Machines Used—Converted engine lathes.
Special Fixtures and Tools—Split collet chuck A; nose-forming and end-facing tool B; auxiliary tool slide C, with band-forming tool D; steadyrest E; hand turning tool F.
Gages—Limit snap gages for diameter of copper band; templet gage for drive band; templet gage for nose profile.
Production—From one man and one machine, 30 to 40 shells per hr.
Note—No tool lubrication used in forming the copper drive band; cutting speed, 65 ft. per min.; sequence of operations—(1) form band, (2) hand-tool band, (3) face nose end and form.

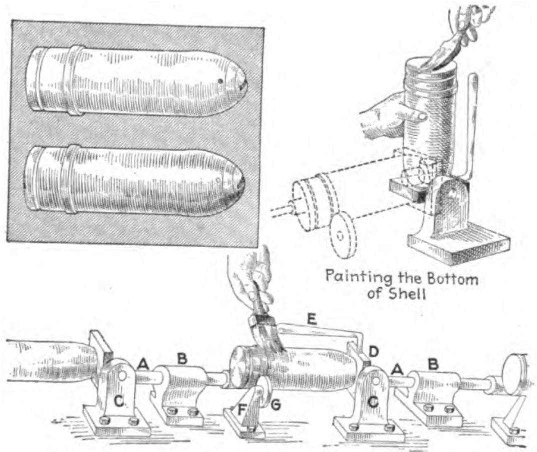
rest, shown at *G*, which is ordinarily flapped back out of the way except when hand-tooling, at which time it is brought into the position shown in the dotted lines and forms a tool rest. No lubricant is used in this operation, which is performed at a cutting speed of 65 ft. per min. with an output ranging between 30 and 40 shells per hr.

The same type of simple speed lathe that was used in the twelfth operation, shown on page 158, in filing and polishing the body and bourrelet of the shell is brought into use again in operation 26 for filing and polishing the nose. One of these lathes is placed back to back with each of the band-turning lathes, and the operators of each keep pace together, so that the two operations can really be looked upon as forming one unit. The chuck used, which is shown at *B*, is a simple cup chuck that grips the shell by friction and requires no tightening. The tailstock spindle is spring actuated and has a ball thrust bearing at *C*, similar to that shown in detail on the body-finishing lathe in operation 11 on page 158. These machines are run at a speed of 150 r.p.m. They are driven from below by means of a floor shaft and started and stopped by means of an idler pulley and an automatic brake, which is brought into action as soon as the belt tension is decreased. Lathes of this type are mounted upon a wooden base and are quite simple in construction, as shown by the one illustrated in Fig. 1.



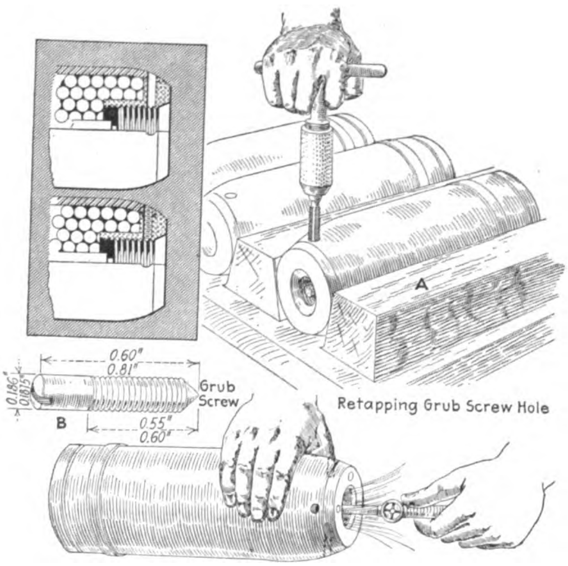
OPERATION 26: FILE AND POLISH NOSE OF SHELL

Machines Used—Special polishing lathes, with cup chucks and ball-bearing, spring-actuated tail centers.
Special Fixtures and Tools—None.
Gages—Templet gage for nose profile.
Production—From one operator and one machine, 30 to 40 shells per hr.
Note—The polishing lathes used on this operation work in step with a like number of band-turning lathes, one of each, back to back, forming a unit.
Reference—Special polishing lathe, shown in **Fig. 1.**



OPERATION 28: LACQUER OUTSIDE OF SHELL

Machines Used—Special driving device mounted on bench and driven from floor shaft.
Special Fixtures and Tools—None.
Gages—None.
Production—Three men lacquer 2,500 shells in 10 hr.
Note—Shell is placed vertically on tipping block D, rotated by hand while the base is lacquered, then tipped horizontally and power driven by a leather friction wheel running on the copper driving band, while the cylindrical surface is lacquered.



Blowing out the Fuse Socket

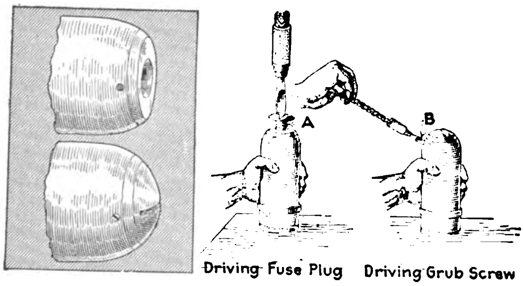
OPERATION 27: RETAP FOR FUSE-HOLE PLUG GRUB SCREW

Machines Used—None.
Special Fixtures and Tools—Wooden taper-wedge block vises A; hand tap.
Gages—None.
Production—Two men can handle 2,500 shells in 10 hr. on this operation.
Note—Compressed air used to blow out the fuse socket; the cork inserted in powder tube prior to operation 20 is now removed.

It may have been noticed that but two of the three holes drilled and tapped in operation 23 were used for fuse-socket holding screws. In preparing the third hole for the fuse-hole socket grub screw that keeps the zinc plug from coming loose a retapping operation is necessary. It is shown in operation sheet 27. The shell is held in the tapered wood-block chuck, shown at *A*, while a hand tap is run through the threads to remove any burrs that may have been put on by the forming of the nose. At this time, also, the fuse socket is cleaned out with compressed air, and the cork that has remained in the powder tube since the twentieth operation is removed and returned to be used over again.

The final Government inspection and the stamping of the official marks upon the base of the shell have not been shown as operations, since they are really interruptions in the process of manufacture and not to be

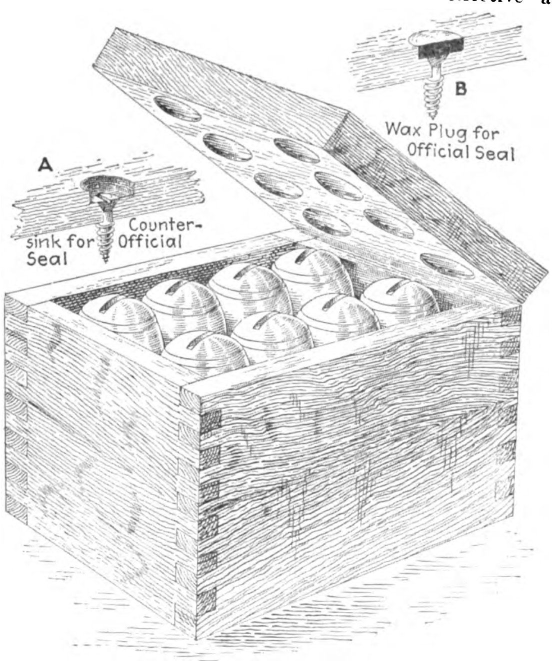
considered as operations. If a shell manufacturer had his way about it, he would probably do away with both of them! Incidentally it may be said that the Russian final inspection is by no means a mere formality. By the time the shell has got past the two Government shop



OPERATION 29: INSERT FUSE-HOLE PLUG AND GRUB SCREW
Machines Used—None.
Special Fixtures and Tools—None.
Gages—None.
Production—Two men produce 2,500 in 10 hr. on this operation.

inspections and the proving-ground test, if there is anything the matter with men, methods or machines at the factory, it has small chance of getting by without discovery.

An ingenious arrangement for painting shells is shown in operation sheet 28. It is about as effective an



OPERATION 30: PACK FOR SHIPMENT
Machines Used—None.
Special Fixtures and Tools—None.
Gages—None.
Production—Four men, 2,500 shells in 10 hr.
Note—After boxing, the cover is sealed by means of a countersunk wax plug, shown at A and B.

arrangement has has yet been developed by the shell manufacturers. The device is mounted on top of a work bench and consists of a drive shaft *A* running in bearing *B* and provided with leather friction drivers at various points in its length. The shells are held on swivel stands, consisting of brackets, shown at *C*, and tipping blocks *D*, which are manipulated by means of the handle *E*. The bottom of the shell is first painted while in a vertical position, the shell being rotated by hand, after which it is tipped over against the leather friction driver and the idler *G*, which runs upon the copper band, and the painting of the outside is completed. The shell is held at its nose, or fuse, end upon the tipping block by means of a plug that fits within the hole in the fuse socket and permits the shell to rotate.

Zinc is getting to be rather an expensive metal, and those who have subcontracts for Russian shrapnel are glad that they do not have to pay for the zinc fuse-hole screw plugs that are used to close the shell for shipment. One of these is shown being screwed home at *A* in operation sheet 29. There is quite a contrast between the zinc plug and the wooden fuse-hole screw plug, which was described and illustrated in *American Machinist*, Vol. 43, page 1057. This difference is multiplied enormously by the quantities in which they are used, and the total must represent an amount that would be well worth saving by the use of cheaper material.

After the fuse-hole screw plug has been driven home, it is held by means of the setscrew inserted in the small $\frac{5}{32}$-in. hole, the pointed end of which bears against the thread of the screw. Russian shells of this size are shipped eight in a box in substantial wooden packing cases made with locked corners. One of these is shown in operation sheet 30.

An interesting point is the manner of sealing these boxes so that when received on the other side there will be assurance that they have not been tampered with. At *A* is shown a counterbore through which one of the cover screws is drilled and countersunk. There are two of these counterbored holes in each cover in addition to the other screws, which are flush with the top surface. Wax plugs are inserted in these counterbores after the screws have been driven home. The plugs are heated by means of a gasoline blow torch and then sealed by the official receiver of the goods after the case has been packed.

Plan for Industrial Research

Following a personal study of industrial conditions in Germany and other foreign countries by Dean Frederick A. Goetze and several members of the faculty of the Graduate Engineering School of Columbia University, Dean Goetze elaborates in his annual report, which has just been issued, the proposed plans for the foundation of a large industrial-engineering research laboratory under the auspices of the university. Such a move, he sets forth, would be a boon to the industries of this country, bringing to their aid, as is done in Germany, keen university research study to solve the many engineering problems which confront them and saving them millions of dollars.

The plan outlined by Dean Goetze and his colleagues calls for the immediate erection of a building easily accessible to the university, with water and railroad facilities, which with the equipment necessary would cost $500,000. This would be but an initial step, however, as it is ultimately proposed that a research foundation of from $2,000,000 to $5,000,000 be secured, the income to be used exclusively for engineering research.

Painting Small-Shop Products--III

By John H. Van Deventer

SYNOPSIS—While brush painting is the most common process of finishing small-shop products, dip-tank finishing should be studied. It is within the reach of the average small shop and saves labor. The use of dip tanks is described in this article, which also touches on oven drying, spraying, and tumbling.

Dip-tank finishing is a subject that the small-shop man needs to know more about. Paint, primer, filler, enamel, japan and varnish can be dipped, although there are limitations coming from a design of the piece; but where this process can be employed, it not only saves labor, but is likely to give smoother results.

Work that contains holes or recesses from which the accumulated paint will drip upon other surfaces is not suitable for dipping. An example of this is shown in Fig. 1 at *A*, in which the cast-iron stove plate has a number of central depressions. If it is dipped and then allowed to drain, drops will run down from these holes, and the result will be a smear. Of course, it is possible to touch up such spots with a brush, but this takes away the low labor-cost advantage of dipping. It is much better to design the piece with this point in mind and thus overcome the difficulty without cost.

Sometimes work that cannot be dipped successfully in one position may be made to turn out all right by using a little commonsense. An example of this is shown in Fig. 1 at *B* and *C*. Here is a steel plate having an opening, not at the center, but near one edge. If it is held and dipped in the position shown at *B*, the result will be even worse than in the foregoing case; but by turning this piece around, as shown at *C*, one stroke of the brush will remove the drip between the recess and the edge of the plate.

In addition to the restrictions coming from the design or shape of the piece there are certain points to consider about the color to be used. Black, bright red and blue are good dipping colors; but olive green is a bad one, because it is composed of different pigments, which have a tendency to separate in the tank and give streaky effects.

Small-shop products are not, as a rule, large or complicated. Dipping tanks are so easily made that there is no excuse for their not being suitable for the work. A good dip tank has the least area of its contents exposed to evaporation and also contains a minimum quantity of paint. The evaporation from the surface of a dip tank causes considerable loss of material and also of time in keeping the solution at its proper consistency. A flat piece, for example, may be dipped either in a shallow tank, as shown at *B* in Fig. 2, or in a deep, narrow tank, as shown at *C*. The first way would be expensive in paint; although the first cost of the tank would be less, evaporation and waste would soon make up for this. Steel window sashes are dipped on this principle in tanks that are 6 to 10 ft. deep and only a few inches wide.

When a tank is designed to present the least surface area, it follows that the minimum amount of paint for successfully operating the tank is also reduced in proportion. Thus these two principles of good design for dip tanks are both obtained by simply trying to live up to one of them.

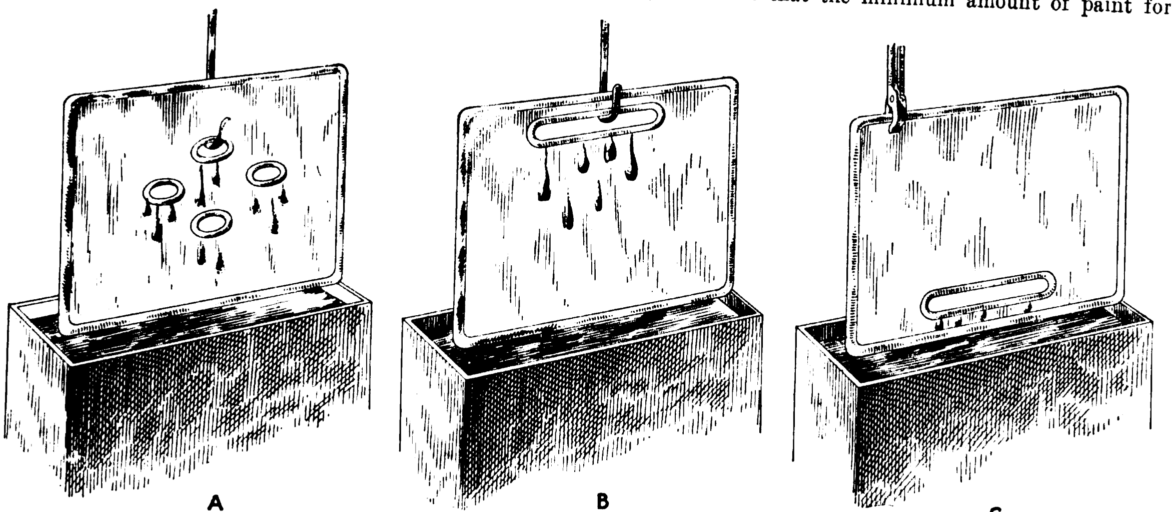


FIG. 1. THE SHAPE OF THE PIECE AND THE WAY IT IS DIPPED ARE IMPORTANT FACTORS

Many small-shop products may be dipped in tanks that are no larger than ordinary cooking utensils or paint pails. Such small pieces are dipped by hand, then placed on one edge on boards to dry. When the pieces become larger, mechanical handling is necessary. This fact restricts the process on large work to shops in which the production is great enough to call for the equipment and room required. An overhead monorail trolley is usually found in such a dip-finishing room. It is broken over the tanks, the short broken section being provided with means for raising and lowering, so that the piece may be run onto this section, be dipped, raised again and run off without undue loss of time. After dipping, it must be allowed to drain, so that the surplus paint, which is worth saving, comes back to the tank.

Some automobile manufacturers paint their wheels by dipping, then get rid of the surplus paint by rotating them. Centrifugal force throws the paint back into the tank. Such complicated apparatus is out of the question for the small shop, but the centrifugal principle may be applied on smaller pieces without much elaborate machinery, and with good results. It is a thing that is worth remembering.

One of the problems in connection with dipping is to keep paint from getting where it is not wanted. This requirement restricts the use of the dip process, especially on work that has a number of finished surfaces or holes. There are ways of getting around this point. Whether it is economical to use these expedients or not depends upon whether the time needed for using them plus the time of dipping will be less than the time of brushing.

Wooden plugs are often used to keep paint out of holes. Melted paraffin run over finished surfaces will keep them free from paint, but it must be removed by heating the article after the paint is dry. This scheme can be used only with air-drying paints, for if parts with

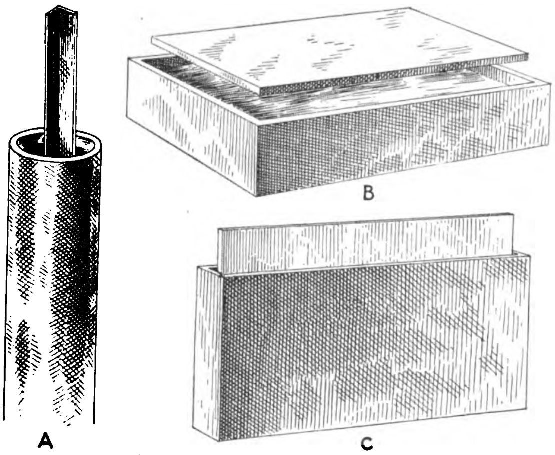


FIG. 2. THE DIPPING TANK MUST BE DESIGNED ON DEFINITE LINES

paraffined surfaces were put into an enameling oven, the wax would melt and run down and form a new and undesirable kind of finish. Hollow work, on which it is desired to keep paint from the interior, may be dipped with a closed end down, not being entirely submerged. After the piece is withdrawn from the dip tank, it is turned end for end so that the drip is downward toward the unpainted end, which is covered by a few strokes of the brush. There are hundreds of such expedients that may be used and that require only a little ingenuity and planning in advance.

A kink in connection with dipping has to do with obtaining a tag that will go through the dip tank without having its characters obscured by the paint. This problem presented difficulty to a manufacturer of small hand pumps and resulted in loss of time, because it was necessary for the man at the tank to remove each tag and fasten it on again after dipping. This trouble was overcome by the means shown in Fig. 3, which represents the product of a stencil-cutting machine. There is nothing about such a tag to become obscured in the dip.

The difference between air and oven drying is only a question of the degree of heat and the length of time required. No doubt, an enamel finish-dried in the air for several months would be as hard to remove from the surface on which it was put as one that had been baked for a few hours in a drying oven. Ovens are therefore a means of hastening the process of securing a hard, durable finish. They are not complicated, and the temperatures do not run very high, 600 deg. F. being about the limit. As far as the small shop is concerned, there is nothing complicated about the process of baking enamel or japan. The only question is whether the quantity of pieces is sufficient to warrant the expense of the labor of handling them back and forth from the ovens.

Black japan, which one finds on typewriters, business phonographs, adding machines and a similar class of work, is one of the most durable and oil-resisting finishes that can be put upon metal. The finish secured with it varies from the plain two-coat finish for small and cheap articles to the seven and ten coats used on the higher-grade machines. On this fine class of work, each coat after being baked is sanded, or rubbed with pumice, and often on work that has been stripped or gilded a protecting coat or coats of varnish are applied and baked.

Japan finish is always black, but colors are obtained by the use of enamels that are baked in the same way. The number of coats for enamel finish varies with the quality of the work, but a very respectable job can be obtained with two coats. I recently saw a test piece

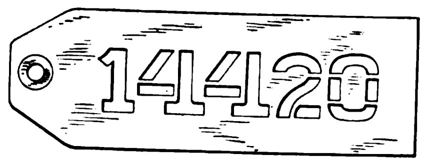


FIG. 3. PERFORATED TAGS ARE NOT DEFACED IN DIPPING

finished in two coats of enamel of ordinary quality. It had been submersed in kerosene oil for two years and showed no signs of softening.

Spraying is an ideal method of putting paint upon most surfaces, large or small. In small shops the lack of compressed air usually settles the matter at once and decisively. There are certain shops, however, which are small and yet have air compressors, and there are others in which the present method of finishing products would make it a paying proposition to install a small compressor such as is required for this class of work. Pressures as low as 14 lb. to the square inch are used, and as high as 80, painting, of course, going more quickly with the higher pressure. Filler, color and varnish can all be sprayed, but the consistency must be fixed so that the nozzle does not clog and paint does not run in waves on the work. It does not pay to spray work in which a large part is composed of open spaces—for example, bicycle wheels and wire.

Tumbling is suitable for small work that is to be japanned, where the quantities contained in the batch may vary from five hundred to fifty thousand pieces. Shoe buttons are an excellent example of this class of work, which it would be difficult to coat evenly, uniformly and as cheaply by any other method. After being tumbled for a certain length of time in connection with an amount of japan sufficient for the batch, the contents of the tumbling barrel are put on wire-mesh screens and baked in an oven. A number of coats are applied in this way.

Tool Steels for Quantity Production

By Charles F. Scribner

What steel to use for certain tools in these days of demand for large-quantity production is perhaps one of the most difficult problems for the production manager to solve. Especially is this so in concerns engaged in the production of "war munitions," where quick deliveries and quality of product must necessarily be combined.

The information herewith is based on the practice of a concern that has studied this matter extensively and shows the standard practice in the matter of tools for firearms components. Its value at this time will be especially appreciated by those who may have, or who contemplate taking on, contracts along this line.

TABLE 1. CLASSES AND BRANDS OF STEELS USED FOR DIFFERENT TOOLS

Name of Tool	Steel Used
Drills [illegible] in. and smaller	High-speed drill rod
Drills over [illegible] in.	Novo Superior
Reamers [illegible] in. and smaller	High-speed drill rod
Reamers over [illegible] in.	Novo Superior
Reamers long in proportion to diameter	Ketos oil-hardening
Counterbores [illegible] in. and smaller	High-speed drill rod
Counterbores over [illegible] in.	Novo Superior
Butt mills [illegible] in. and smaller	High-speed drill rod
Butt mills over [illegible] in.	Novo Superior
Taps [illegible] in. and smaller	High-speed drill rod
Taps over [illegible] in.	Novo Superior
Taps having fine threads	Super-Rapid White Label
Thread dies	Novo Superior
Thread dies having fine threads	Super-Rapid White Label
Chamber reamers for barrel	Super-Rapid White Label
Slotting tools [illegible] in. and smaller, used in holders	High-speed drill rod
Slotting tools with square shank to fit holder	Novo Superior
Forming tools for screw machine	Novo Superior
Cutting-off tools	Novo Superior
Broaches	Novo Superior
Milling cutters	Novo
Thread-milling cutters for coarse threads	Novo Superior
Thread-milling cutters for fine threads	Super-Rapid White Label
Profiling cutters	Novo
Saws	Novo (sheet)
Blanking dies	Novo
Drawing dies	Firth's Best Tool
Cold-trimming dies	Novo
Hot-trimming dies	Novo
Drawing punches	Chrome nickel
Heading punches	Chrome nickel
Standard drill bushings	Styrian Gold Label
Special drill bushings	Ketos oil-hardening
Standard locating plugs	Styrian Gold Label
Special locating plugs	Ketos oil-hardening
Filing jigs	Ketos oil-hardening
Small tools of intricate form	Ketos oil-hardening
Wood-cutting tools	Novo Superior

TABLE 2. LIST AND DESCRIPTION OF TOOL STEELS USED IN MODERN PRACTICE

Carbon Steels:	
Crescent Extra	1.05 to 1.15 per cent. carbon
Firth's Best Tool	1.05 to 1.15 per cent. carbon
Rose Label Styrian	1.10 to 1.20 per cent. carbon
Hobson's Choice	1.25 to 1.40 per cent. carbon
Alloy Steels:	
Chrome nickel	Chrome-nickel alloy
Ketos	Manganese alloy
Gold Label Styrian	3½ per cent. tungsten alloy
Firth's R. T.	3½ per cent. tungsten alloy
Champion Double Special	7 per cent. tungsten alloy
High-speed Steels:	
Novo	Chrome-tungsten alloy
Novo (sheet)	Chrome-tungsten alloy
High-speed drill rod	Chrome-tungsten alloy
Novo Superior	Chrome-tungsten alloy
Blue Chip Superior	Chrome-tungsten-vanadium alloy
Super-Rapid White Label	Chrome-tungsten-vanadium alloy

Carbon-Tool Steels—Crescent Extra and Firth's Best Tool steels are domestic steels of good quality and can be used for general all-around work. These steels will machine readily, if properly annealed, and harden best when heated to about 1,400 deg. F. and quenched in water.

Alloy Tool Steels—Chrome-nickel steel is made containing various amounts of carbon. Those containing the lower amounts of carbon (about 0.50 per cent.) are suitable for crankshafts and general automobile construction. Those containing the higher amounts of carbon (about 0.80 per cent.) are suitable for use in tools. This steel is very dense, tough and hard and will stand shock well. It hardens best when heated to about 1,450 deg. F. and is quenched in oil. Ketos oil-hardening is a domestic steel and is called non-shrinking and non-warping. It is very tough and hard and can be used for work that must not change in the hardening process. This steel hardens best when heated to 1,360 deg. F. and quenched in oil. Gold Label Styrian is an imported steel and has been found to hold a fine edge and put a fine finish on the work. It is hard and dense in structure. This steel can be used for tools that require an extremely hard surface or fine edge. It hardens best by heating to about 1,475 deg. F. and quenching in water. Firth's R. T. is a domestic steel similar in characteristics to Gold Label Styrian steel. Champion Double Special is also a domestic steel and has been found to be harder and more dense than Gold Label Styrian and is consequently better adapted for use under certain conditions.

High-Speed Steels—Novo and Novo sheet steel are imported steels and are capable, in the main, of being used at high speeds. They last well without sharpening. These steels can be used for all roughing tools and, under certain conditions, for finishing tools as well. In their normal state they are extremely hard and dense, hardening being accomplished by heating to from 2,100 to 2,200 deg. F. and quenching in oil or an air blast. Novo Superior is an imported steel similar to the two just mentioned, except that it will hold a keen edge longer than Novo. This steel can be used for finishing tools where only the very best is required. It is preferably hardened by heating to from 2,100 to 2,200 deg. F. and quenching in oil or water. Blue Chip Superior is a domestic steel of similar characteristics to Novo Superior and gives equal satisfaction in use. This steel is best hardened by heating to from 2,200 to 2,300 deg. F. and quenching in oil or water. Super-Rapid White Label is an imported steel, similar to the two last named. It hardens at a much lower heat, about 1,900 deg. F., which is an advantage in the construction of many tools.

TABLE 3. TOOLS FOR VARIOUS CLASSES OF WORK MADE FROM DIFFERENT STEELS

Steel Used	Tools Used For
Chrome nickel	Drawing punches, heading punches
Ketos oil-hardening	Filing jigs, special drill bushings, special locating plugs, small tools of intricate form, reamers long in relation to their diameter
Gold Label Styrian	All fine tools
Firth's R. T.	Drawing dies
Champion Double Special	Medium and large drills, medium and large reamers, standard drill bushings
Novo and Novo (sheet)	Milling cutters, profiling cutters, saws, blanking dies, cold-trimming dies, hot-trimming dies
Novo Superior	Medium and large taps
Blue Chip Superior	Threading dies
Super-Rapid White Label	Medium and large counterbores slotting tools, cutting-off tools, forming tools, chamber reamers, special drills, special reamers, broaches
High-speed drill rod	Small drills, small counterbores, small reamers small taps

Alloy and high-speed steels can be used for nearly all tools for the manufacture of firearm components with greater efficiency than carbon steels. They cannot, however, be welded in the blacksmith's ordinary fire, but must be either brazed or welded by the oxyacetylene flame. Novo sheet steel, cold-rolled, can be obtained in thicknesses of from 0.020 to 0.133 in. High-speed drill rod can be obtained in sizes from 0.0625 to 0.500 in. inclusive.

Table 3 will serve as a cross-reference to Table 1, as it lists the various classes of tools that can be most efficiently made of the various grades of steel already mentioned.

Machining Connecting-Rods

By Robert Mawson

SYNOPSIS—Details of jigs, fixtures and tools for milling, drilling, boring and reaming connecting-rods for an eight V-motor.

The small tools, operations and methods used in machining some of the parts of the automobile eight V-motor manufactured by the Ferro Foundry and Machine Co., Cleveland, Ohio, have been described on pages 14, 98 and 186. This article is the fourth of the series and shows the small tools and methods used for the connecting-rods, one of which is shown in Fig. 11. The jigs and fixtures used are representative of uptodate automobile small-tool design embodying time-saving devices.

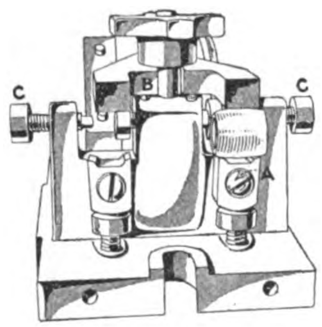


FIG. 2

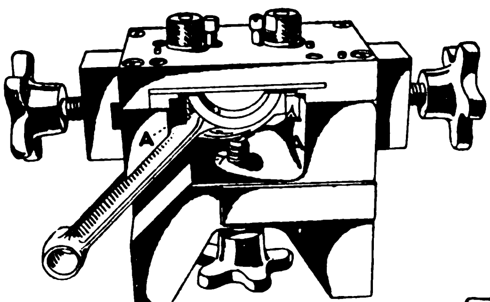


FIG. 3

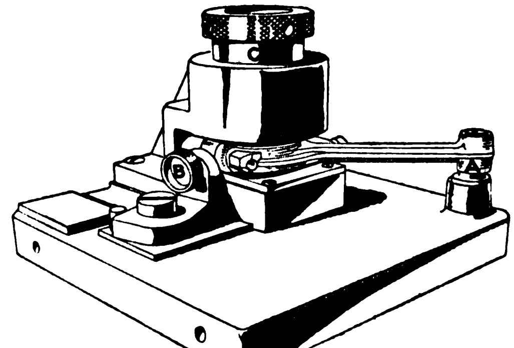


FIG. 4

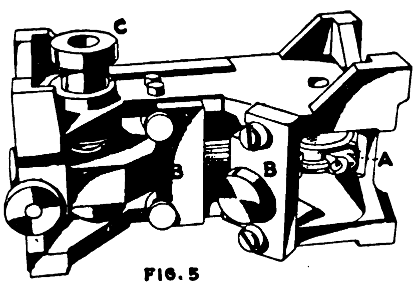


FIG. 5

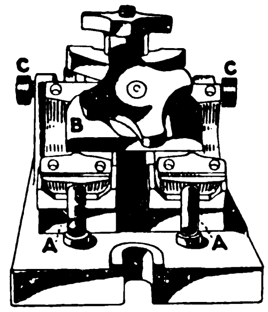


FIG. 7

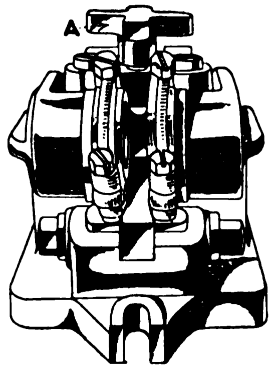


FIG. 8

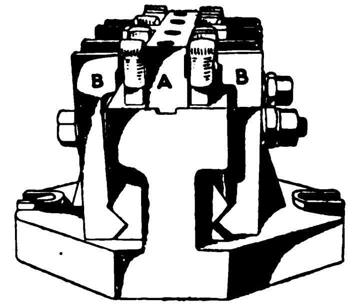


FIG. 9

JIGS AND FIXTURES FOR MACHINING CONNECTING-RODS, WITH WORK IN POSITION

FIGS. 2 AND 2-A

Operation—Straddle-milling wristpin end of connecting-rod, Fig. 1. The forging is located in pins at the large end in holes previously machined and rests on tool-steel V-blocks A. Strap B is tightened down with a knob nut and the knurled-head screws C hold the parts securely.

Surface Machined—Wristpin bosses, with a gang of cutters 5 in. in diameter by ¾ in. thick, suitably spaced. Speed, 38 r.p.m.; feed, 0.032 in. per revolution.

FIGS. 3 AND 3-A

Operation—Drilling and tapping bolt holes in connecting-rod. The forging is located by V-blocks A, operated by knob screws and held against the steel strip with screw B.

Holes Machined—Two ¼-in. holes drilled and 5/16-in. 24 U. S. F. threads tapped for screws to hold cap on the connecting-rod.

FIGS. 4 AND 4-A

Operation—Boring and reaming large hole in connecting-rod. The forging is located on pin A, fitting in the reamed wristpin hole, and is forced back against the stop with knurled-head screw B.

Hole Machined—2.115-in. hole, bored and reamed, using slip bushings at C.

FIGS. 5 AND 5-A

Operation—Drilling and reaming wristpin hole and oil hole in connecting-rod. The forging is located on two pins at end A and forced against stopscrews with knurled-head screws in the shaft B.

Hole Machined—⅞-in. hole, drilled and reamed, using slip bushings C in jig and ½-in. oil hole in end of rod.

FIGS. 7 AND 7-A

Operation—Milling recess for joint on connecting-rod fork for gang. The rough-forging is located on hardened-steel blocks at the rear and resting on steel pins A at the front. The strap B and knurled-head screws C hold the forgings securely.

Surface Machined—Recess and parting line, using gang cutters consisting of two 4x½-in. and two 3¾x¾-in., suitably spaced. Speed, 46 r.p.m.; feed, 0[illegible] per revolution.

FIGS. 8 AND 8-A

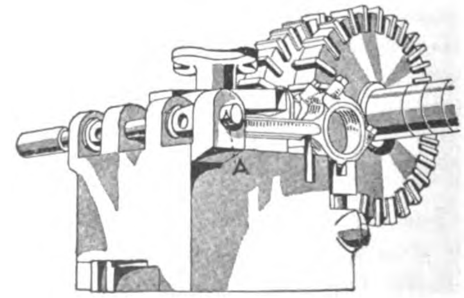
Operation—Milling out metal to form fork end of connecting-rod. The forging is located by a pin fitted in the reamed wristpin hole and resting on height pins in front; it is held down with screw A through the strap.

Surface Machined—Inside fork slot, using 6x¾-in. inserted-tooth cutter. Speed, 32 r.p.m.; feed, 0.05 in. per revolution.

FIGS. 9 AND 9-A

Operation—Milling joint surfaces on caps for connecting-rod forgings, located on steel blocks and held against the hardened-steel blocks A with straps B.

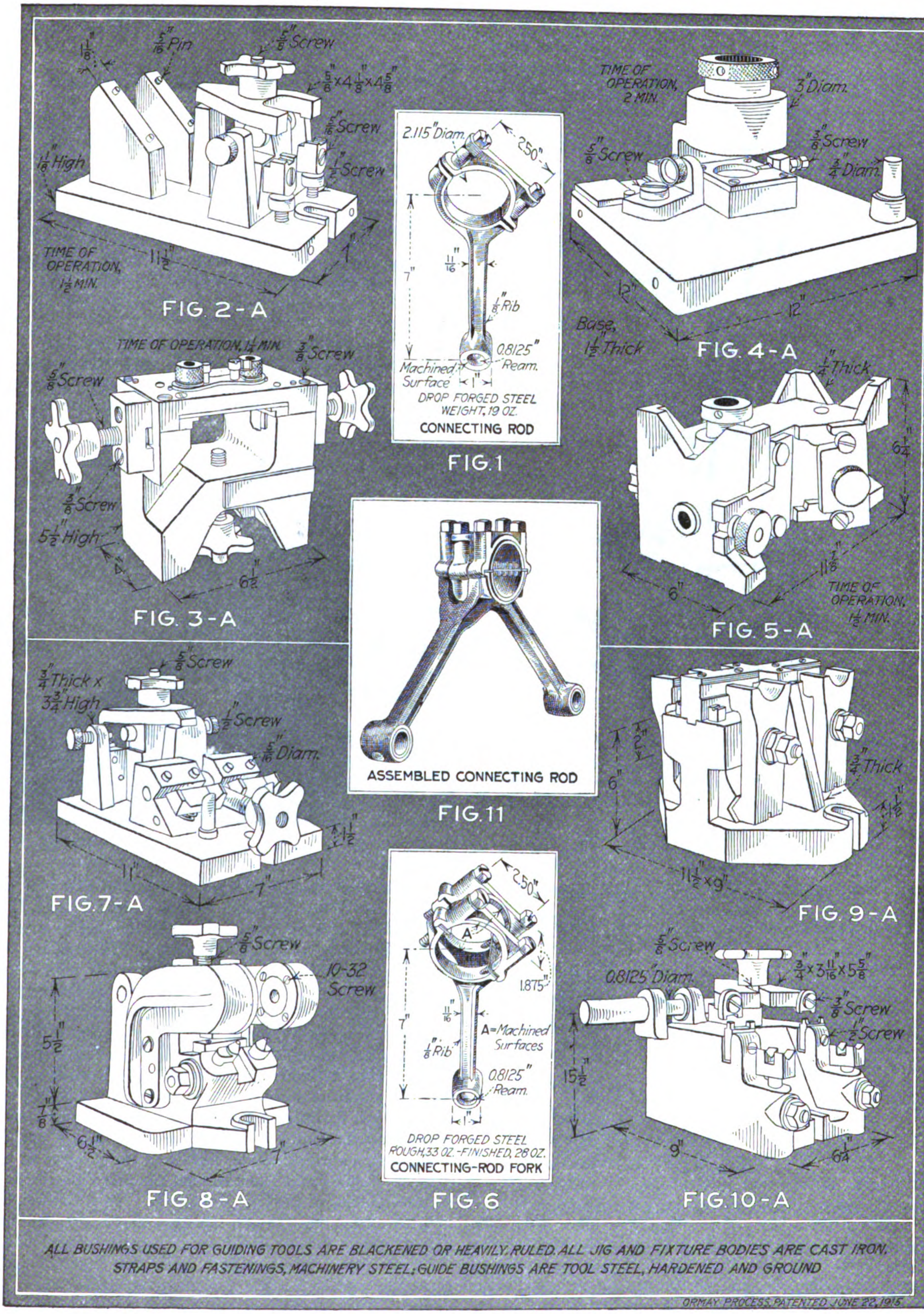
Surfaces Machined—Joint and register, using gang cutters consisting of 4x½-in. and 3⅝x¾-in., suitably spaced. Speed, 46 r.p.m.; feed, 0.06 in. per revolution.



FIGS. 10 AND 10-A

Operation—Straddle-milling the large end of the connecting-rod fork. The forging is located by pin A, which fits in the wristpin hole previously reamed and rests on hardened-steel locating blocks. The strap, when tightened down, holds two forgings.

Surface Machined—Both sides of the large end of the rod. Gang cutters, 10x1¼ in. wide; inserted cutters suitably spaced. Speed, 17 r.p.m.; feed, 0.06 in. per revolution.



DETAILS OF JIGS AND FIXTURES USED IN MACHINING 8 V-MOTOR CONNECTING-RODS

Milling an Internal Keyway

The method of milling an internal keyway in an automobile brake support is shown in Fig. 1. The brake support and the position of the keyway cut are shown in detail in Fig. 2. One of the supports is also shown in the foreground

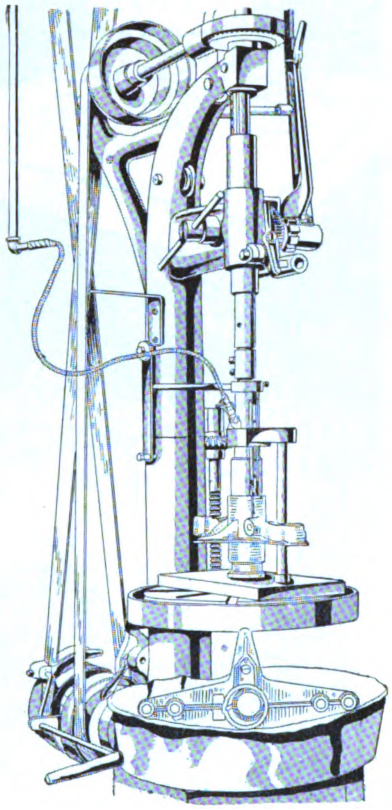


FIG. 1. MILLING AN INTERNAL KEYWAY

just below the drilling-machine table. The method of holding the work in the jig is plainly shown.

The tool used to cut the keyway is a regular internal keyseater made by the National Machine Tool Co., Cin-

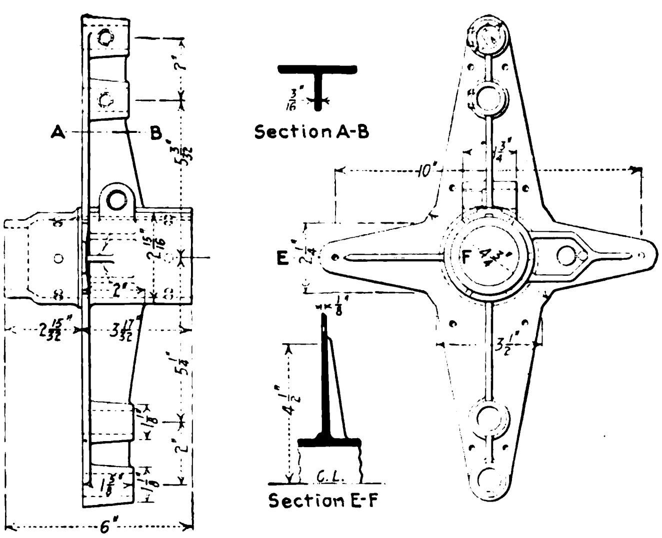


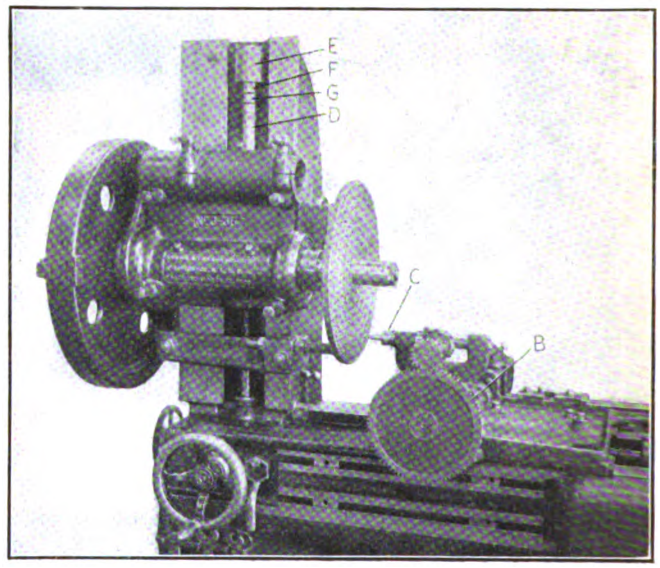
FIG. 2. DETAILS OF BRAKE SUPPORT

cinnati, Ohio, and the work is done in the shop of the Peru Auto Parts Co., Peru, Ind. The brake supports are of malleable iron, and the keyway cut is 1/4 in. wide, $\frac{3}{32}$ in. deep and 3 5/8 in. long. As the "hub" is 6 in. in length, it will be readily seen that the keyway goes only part way through and would [illegible] piece of work to do in any other way. The keyway is cut by the method described at the rate of about 4 in. per minute.

Drilling on a Gear Cutter

As part of a speed-changing mechanism used on the heads of its radial drilling machines, the Mueller Machine Tool Co., Cincinnati, Ohio, uses a gear consisting of a series of tool-steel pins set into concentric rings like crown gears. A tool-steel pinion meshes with the various rows of pins, according to the speed desired. It is necessary that these pins be set a certain distance apart in the individual rings and also that the rings be placed accurately in relation to each other. For this purpose a Brown & Sharpe gear cutter has been rigged up as shown.

The plate or gear in which the pins are to be pressed is placed on the work arbor, as shown at *A*. The drilling fixture is placed on the cutter carriage. The shaft of the spur gear *B* is connected to the cutter arbor and



DRILLING ATTACHMENT FOR A GEAR CUTTER

drives the drill spindle *C* through a pinion and pair of bevel gears. When set for a certain circle of holes, the drill feeds in and out, and the work is indexed by means of the regular gear-cutting mechanism. The spacing of the holes is obtained by gearing as for a gear with teeth corresponding to the number of holes to be drilled.

The setting for the various circles in the usual way, by turning the elevating screw a certain number of times, produced too many mistakes, so another method was thought out. A sleeve *D* was made to slip easily down over the elevating screw. A weight *E*, with a hole part way through it, rests on top of the screw. Between this weight and the long sleeve, spacing collars like *F* and *G* are placed, according to the row or circle of holes to be drilled. Suppose, for instance, that the first circle drilled requires the use of the long sleeve only. Then the weight is lifted off the screw, and a spacing collar is dropped on. The weight is then replaced and the head lowered until the long sleeve will just turn with the fingers. This gives the correct location for the next circle, which is drilled. Then another collar is slipped on to give the setting for the next circle, and so on. Each collar is marked for the number of holes and its circle.

Formulas and Alignment Charts for Taper Press Fits

By A Lewis Jenkins*

SYNOPSIS—A complete solution of the taper press-fit problem. The author has adapted tested fundamental press-fit formulas to the special case of the taper fit. Values for the numerical factors have been determined from the records of a large number of shops doing a wide variety of work. Two alignment charts plotted from the formulas provide easy use.

Taper press fits have found favor among leading manufacturers because of their simplicity and surety. By the use of proper standards and methods of gaging ("Halsey's Handbook," pages 245 and 251), systems of tapers and allowances have been developed which simplify computation.

The travel, or distance, the plug is forced into the ring by the pressure is a more satisfactory and practical criterion of the surety of a taper fit than the pressure itself. For this reason satisfactory records of taper press fits may be had even when they are made with a screw or knuckle-joint press.

The members of a taper fit may be placed together and the surfaces corrected to any degree of accuracy desired, thereby eliminating the necessity of making delicate micrometer measurements. The lubricant on a taper fit acts very effectively, and the possibility of scoring the surfaces in fitting is slight compared with the danger when making straight fits. The members of a taper press fit are easily centered, and accurate alignment is obtained at the beginning of the pressing operation.

Straight press fits have the following objections: They are difficult to measure accurately in fitting and difficult to lubricate satisfactorily when of considerable length; the surfaces of the members are likely to be scored in fitting; the operation of fitting requires extreme care on the part of the operator in starting and while pressing on, and the criterion of good design and workmanship is the total pressure required. This can only be determined with any degree of accuracy by using a hydraulic press, taking the gage reading of the liquid pressure and multiplying it by the area of the ram.

My fundamental equations for pressed fits, published in *Engineering News* of Mar. 17, 1910, and also given in the *American Machinist*, Vol. 42, p. 377, are as follows, with f and p expressed in pounds per square inch and P in pounds:

$$f = \frac{z E_2 K}{K + y_2 + \frac{E_2}{E_1}(1 - y_1)} \tag{1}$$

$$p = \frac{z E_1}{1 - y_1 + \frac{E_1}{E_2}(K + y_2)} \tag{2}$$

$$P = p \pi d L w \tag{3}$$

where

f = Equivalent tensile hoop stress in the ring or hub in pounds per square inch;

p = Equivalent hoop stress at the surface of the shaft or plug, which is equal to the unit radial pressure between the surfaces fitted, in pounds per square inch;

z = Allowance per inch of diameter $= \frac{J}{d}$;

J = Total allowance in inches;

y_1 = Poisson's ratio for plug or shaft material;

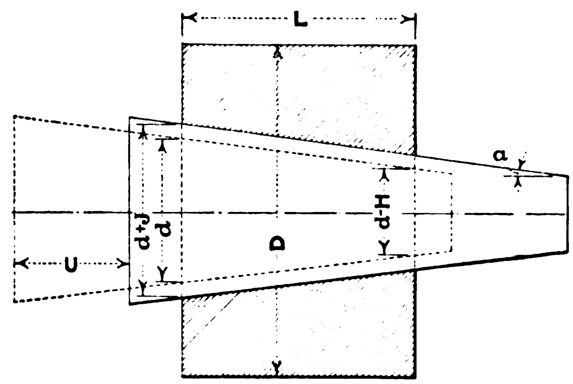


FIG. 1. RELATION BETWEEN TAPER, TRAVEL AND ALLOWANCE

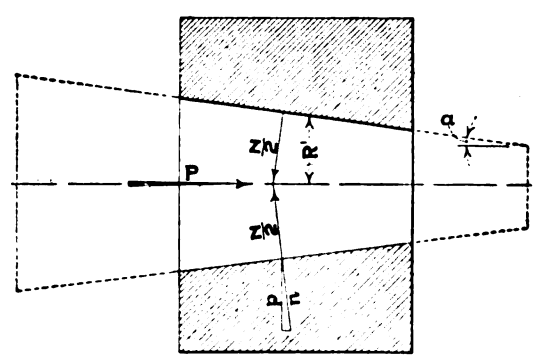


FIG. 2. FORCES ACTING IN A TAPER-PRESS FIT

DIAGRAMMATIC REPRESENTATION OF CONSIDERATIONS IN TAPER-PRESS FITS

y_2 = Poisson's ratio for ring or hub material;

E_1 = Modulus of elasticity for plug material;

E_2 = Modulus of elasticity for ring material;

K = Ratio of hoop stress in the ring to the unit radial pressure between the surfaces $= \frac{f}{p}$;

L = Length of fit in inches;

w = Coefficient of friction;

d = Diameter of plug in inches.

Although these equations were first used in connection with straight fits, they may be modified to apply equally well to taper fits by using the proper values for w, z and J.

The dotted lines in Fig. 1 show a tapered plug placed snugly in a tapered hole. By forcing the plug to the right a distance equal to U, the hole is expanded and the plug contracted (not indicated in the drawing), and the section of the plug having a diameter equal to $d + J$ is forced into the bore at the section that originally was of

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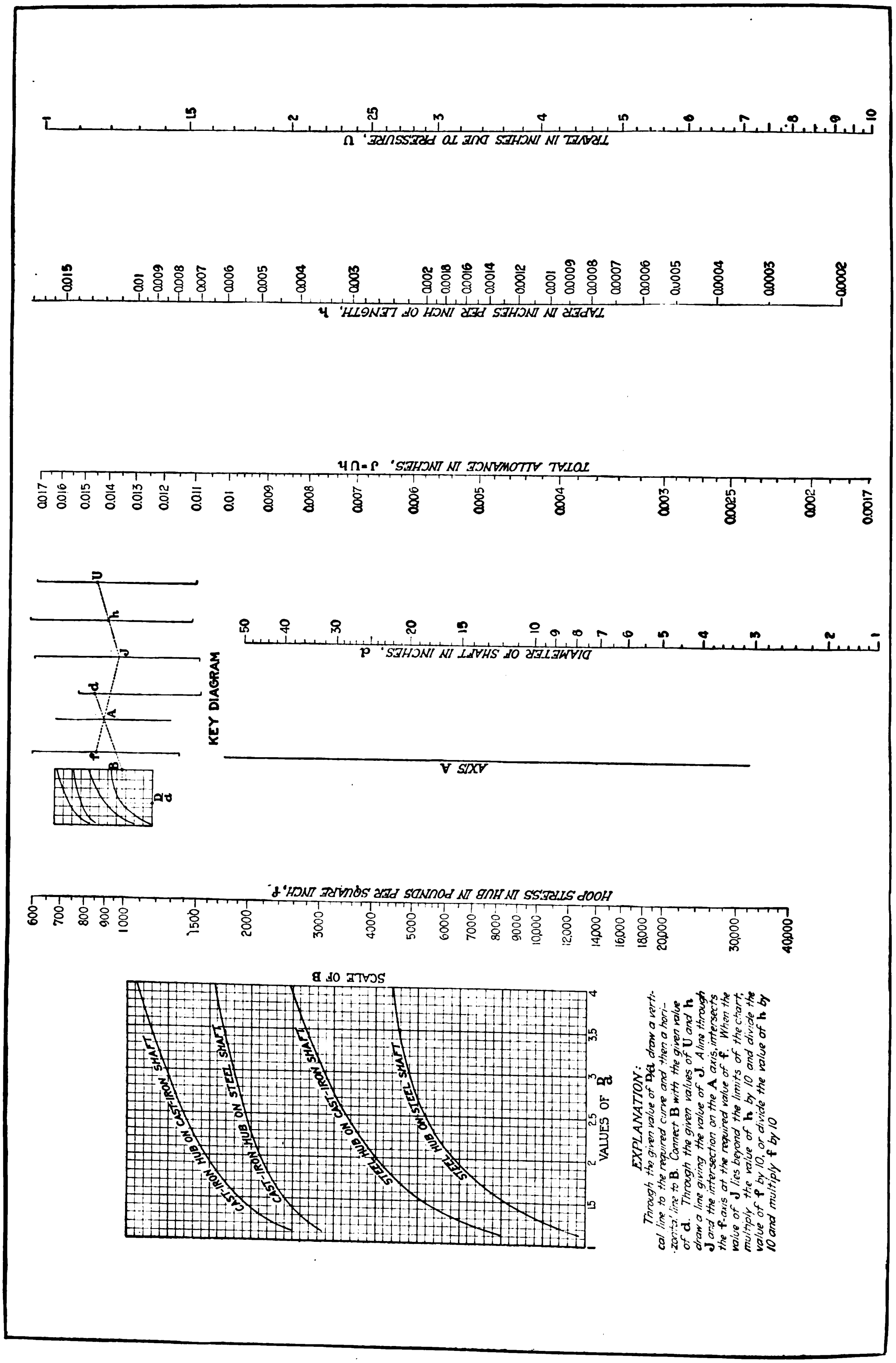


CHART 1. RELATION BETWEEN STRESS AND ALLOWANCE FOR TAPER PRESS FITS—BY A. LEWIS JENKINS

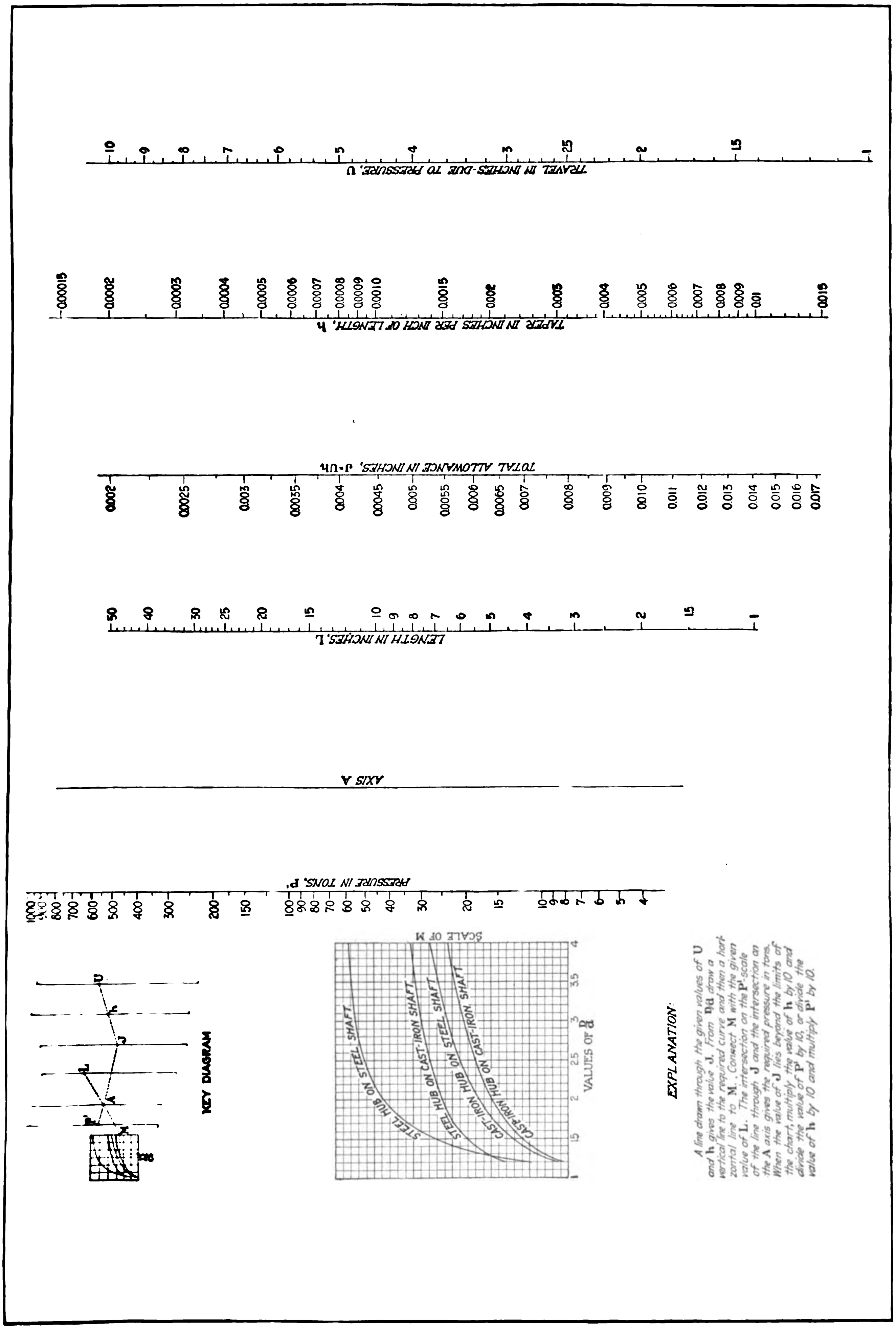


CHART 2. RELATION BETWEEN PRESSURE AND ALLOWANCE FOR TAPER PRESS FITS—BY A. LEWIS JENKINS

diameter d. For any section along the length of the fit the original diameter is changed an amount equal to the total allowance J.

The taper per inch of length is

$$h = \frac{H}{L} \tag{4}$$

where H is the total taper or difference in diameter of the bore at the ends of the fit.

The total allowance is equal to the difference in diameter of the tapered plug in a length equal to the travel U, or

$$J = Uh \tag{5}$$

The allowance per inch of diameter, or the unit allowance, is

$$z = \frac{J}{d} = \frac{Uh}{d} = \frac{UH}{dL} \tag{6}$$

Relation between Load and Radial Pressure for Taper Fits

Fig. 2 shows a tapered plug forced into a tapered hole in a ring by a load P, and thereby producing a unit normal pressure perpendicular to the surfaces equal to n and a total normal pressure between the surfaces equal to

$$N = \frac{P}{w \cos a + \sin a}$$

where a is half of the cone angle of the taper. (For derivation see "Spooner's Machine Design," pp. 342 and 111.)

Substituting the unit normal pressure, $n = \frac{N}{\pi d L}$, in this equation gives

$$P = \pi\, dLn\,(w \cos a + \sin a),$$

and since the radial pressure is equal to $p = n \cos a$, and $\tan a = \frac{h}{2}$,

$$P = \frac{\pi d Lp\,(w \cos a + \sin a)}{\cos a} = \pi d Lp\,(w + \tan a)$$

$$= \pi d Lp\left(w + \frac{h}{2}\right) \text{pounds} \tag{7}$$

and

$$P' = \frac{\pi d Lp}{2{,}000}\left(w + \frac{h}{2}\right) \text{tons} \tag{8}$$

By way of comparison, for a straight fit the total load required is $P = p\pi dLw$, where P is expressed in pounds.

This shows that for a given radial pressure p and coefficient of friction w a greater force is required to make a taper than a straight fit, the difference being equal to $\pi dLp\,\frac{h}{2}$ lb. It is also seen that the taper may be considered as having the effect of increasing the coefficient of friction an amount equal to $\frac{h}{2}$, or $w'' = w + \frac{h}{2}$, where w'' is the equivalent coefficient of friction. For $h = 0.005$, the equivalent increase in the coefficient of friction is only 0.0025, which is so small that it is well within the limits of error in observation and measurement. This does not mean, however, that the same or greater force is required for a taper as for a straight fit of the same length, allowance and diameter, because the conditions of lubrication are quite different and the coefficients of friction for the surfaces are not necessarily equal.

It is seen from equations 1 and 2 that the only physical properties of the material that affects the stress are the modulus of elasticity and Poisson's ratio. Steel has that interesting property of maintaining a constant modulus of elasticity regardless of alloys, heat treatments and mechanical treatments that change the elastic limit, ultimate strength and elongation. The influence of the variations in Poisson's ratio for ordinary grades of steel is not sufficiently great to produce an appreciable difference in the stress or in the load. Hence the variations in the physical properties of steels should have no appreciable effect on the stresses produced by a pressed fit.

The variation in hardness of the material may affect the coefficient of friction in equation (3), which in turn would affect the pressure required to make the fit, but this action is entirely independent of the stress relations. Soft materials, poor workmanship and inefficient lubrication tend to produce scoring. In practice the softness of the material is probably the least of these evils.

As regards press fits, steel is steel, whereas cast iron is a mere term applied to a mixture of iron, carbon, silicon and various other constituents, and it may have cavities and initial stresses. If cast iron has an elastic limit, it is at a point where the stress is almost zero, and its modulus of elasticity varies with the stress and grade of material. The exact error introduced by assuming a constant modulus of elasticity for cast iron within the practical limits of working stress and grades of material is small, but its exact value cannot be found.

(Our knowledge of the elastic properties of cast iron—the most used of all materials in machine construction—is very deficient. It is apparently no one's duty to discover the facts that will remove those mysteries which now often cause the designer to mistrust his calculations.)

General Formulas for Taper Press Fits

By substituting in the fundamental formulas (1), (2) and (3) the values of $E = 15{,}000{,}000$ for cast iron and 30,000,000 for steel $y = 0.25$ for cast iron and 0.3 for steel, the equivalent coefficient of friction for taper fits, $w'' = w + \frac{h}{2}$, and allowance in terms of the proportions of the fit as given by the equation $z = \frac{Uh}{d}$, the following general formulas for taper press fits are obtained:

For cast-iron hub on a steel shaft:

$$f = \frac{15{,}000{,}000\,Uh}{d\left(1 + \frac{0.6}{K}\right)} \text{ lb. per sq.in.} \tag{9}$$

$$p = \frac{15{,}0000{,}000\,Uh}{d\,(0.6 + K)} \text{ lb. per sq.in.} \tag{10}$$

$$P' = \frac{15{,}000{,}000\pi Uh\,L\left(w + \frac{h}{2}\right)}{2{,}000\,(K + 0.6)} = \frac{23{,}562\,Uh\,Lw''}{K + 0.6} \text{ tons} \tag{11}$$

For steel hub on a steel shaft:

$$f = \frac{30{,}000{,}000\,Uh}{d\left(1 + \frac{1}{K}\right)} \text{ lb. per sq.in.} \tag{12}$$

$$p = \frac{30{,}000{,}000\,Uh}{d\,(1 + K)} \text{ lb. per sq.in.} \tag{13}$$

$$P' = \frac{23{,}562\,UhLw''}{\frac{1+K}{2}} = \frac{47{,}124\,UhLw''}{1+K}\,tons \qquad (14)$$

For steel hub on cast-iron shaft:

$$f = \frac{30{,}000{,}000\,Uh}{d\left(1 + \frac{1.65}{K}\right)}\,lb.\ per\ sq.in. \qquad (15)$$

$$p = \frac{30{,}000{,}000\,Uh}{d\,(1.95 + K)}\,lb.\ per\ sq.in. \qquad (16)$$

$$P' = \frac{47{,}124\,UhLw''}{1.95 + K}\,tons \qquad (17)$$

For cast-iron hub on cast-iron shaft:

$$f = \frac{15{,}000{,}000\,Uh}{d\left(1 + \frac{1}{K}\right)}\,lb.\ per\ sq.in. \qquad (18)$$

$$p = \frac{15{,}000{,}000\,Uh}{d\,(1 + K)}\,lb.\ per\ sq.in. \qquad (19)$$

$$P' = \frac{23{,}562\,UhLw''}{1 + K}\,tons \qquad (20)$$

The only variables in these equations that depend upon the physical properties of the materials are w'' and K. The combined effect of these has been determined empirically from experimental data.

Coefficient of Friction for Taper Press Fits

Lubricant has been found to have such a great influence over the pressure required in making taper press fits that the tonnage cannot be depended upon as a criterion. The variation in pressure required because of the lubricant may be as great as 600 per cent. ("Halsey's Handbook," page 245).

The lubricant is trapped between the surfaces and if it is not too thin, it is practically impossible for it to be squeezed out or scraped off. There is some tendency for the lubricant to be scraped off near the ends of a taper fit, but even over the small portions of the length at these places the conditions are no more severe than exist throughout the complete length of a straight fit. When a heavy paint made of linseed oil and white lead is used as the lubricant, the average tonnage required for a taper fit is between one-half and two-thirds that required for the average straight fit of the same allowance and proportions.

The results of an analysis of about 800 straight fits indicate that the coefficient of friction is greater on like materials than on unlike materials, whereas data on taper fits show that the friction of steel on steel is less than for cast iron on cast iron; while cast iron on steel has an intermediate value. This difference is presumably owing to the more efficient action of the lubricant in the case of taper fits.

The formulas for f, p and P' involve w'' and K, and it is necessary to assign values to these quantities in order to determine numerical results. The value of K for a given material depends upon the ratio of the outside diameter of the ring to the diameter of the shaft, the modulus of elasticity and Poisson's ratio. The modulus of elasticity is equal to 30,000,000 for any ordinary grade of steel stressed any amount within the elastic limit. The modulus of elasticity for cast iron depends upon the stress and grade of material. The effects of the variations of E and w'' or K and w'' for taper press fits may be found as follows:

It has been seen from equations (11), (14), (17) and (20) that the total pressure in tons required to force a shaft into a hub may be written

$$P' = \frac{NUhL}{Q} = MUhl \qquad (21)$$

where

$$N = \frac{w''E}{2{,}000} \qquad (22)$$

$Q = 0.6 + K,\ 1 + K$, etc., depending on the material and

$$M = \frac{N}{Q} = \frac{P'}{UhL} \qquad (23)$$

The correct value of M includes the function of the elastic laws and corrects any error that may be introduced by assuming constant values for E and y. The values of P', U, h and L taken from experimental data were substituted in the foregoing equation and the values of M plotted against the corresponding values of $\frac{D}{d}$.

In order to obtain the necessary data for this analysis, a circular letter and "record form" were mailed to about 70 concerns that use press fits. The replies cover a large range of sizes and classes of work. These data show a much greater variaton in the pressure required than was found in making a similar analysis of straight fits. This is accounted for by the fact that the data on taper fits cover a greater variety of work, were taken from a greater number of sources and have greater personal and instrument errors, and the kind of lubricant used has a greater effect on the coefficient of friction for taper than for straight fits.

By plotting the values of M against $\frac{D}{d}$ for taper fits, the mean value of M for a cast-iron hub on a steel shaft when a lubricant of linseed oil and white lead was used, is:

$$M = \frac{1{,}260}{0.6 + K} \qquad (24)$$

where

$$K = \frac{1.7}{\left(\frac{D}{d} - 1\right)^{0.4}} \qquad (25)$$

This equation for K is of different form from the one given for straight fits, but the curves plotted from the two equations practically coincide between the values of $\frac{D}{d} = 1.4$ and 4.

The data for steel hubs on steel shafts also give considerable variation, the mean values being represented by the equation

$$M = \frac{2{,}600}{1 + K} \qquad (26)$$

where

$$K = \frac{\left(\frac{D}{d}\right)^2 + 1}{\left(\frac{D}{d}\right)^2 - 1} \qquad (27)$$

which is the ratio of the tangential hoop stress in the hub to the internal radial pressure as expressed by the Lamé theory for stresses in thick cylinders.

There are relatively few instances where cast-iron hubs are forced on cast-iron shafts, either straight or tapered. From the data for taper fits for cast-iron hubs on cast-iron shafts the mean value of M is represented by the equation

$$M = \frac{1,390}{1 + K} \qquad (28)$$

where K is the value given by equation (25).

There are apparently no available data on steel hubs pressed on cast-iron shafts, and the values of M and K for this case were chosen through a comparison of the other three cases. In deciding whether the values of K for cast-iron hubs on steel shafts or the value for steel hubs on steel shafts should be used for steel hubs on cast-iron shafts, constant values of U, h, L and w'' and a value of K—1.7 were substituted in equations (11), (14), (17) and (20) for P', and the following ratios of the required pressures deduced:

$$\frac{\textit{Cast-iron hub on cast-iron shaft}}{\textit{Steel hub on steel shaft}} = 5.00 \qquad (A)$$

$$\frac{\textit{Cast-iron hub on steel shaft}}{\textit{Steel hub on steel shaft}} = 5.88 \qquad (B)$$

$$\frac{\textit{Steel hub on cast-iron shaft}}{\textit{Steel hub on steel shaft}} = 7.40 \qquad (C)$$

$$\frac{\textit{Steel hub on steel shaft}}{\textit{Steel hub on steel shaft}} = 1.00 \qquad (D)$$

This shows that if the materials gave the same values for w'' and K, and the values of E and y assumed were correct, the force required to press a steel hub on a steel shaft is twice as great as is required to fit a cast-iron hub on a cast-iron shaft of the same dimensions.

The actual values of (A), (B) and (D) obtained from data on straight fits are respectively equal to 5.9, 5.7 and 1. The values for (A) and (B), which are for like materials, are comparatively larger than the aforementioned value of (B), as may be seen by multiplying either set of values through by a constant that will make both values of (B) equal. The fact that the actual value of (A) is greater than 5 indicates that the friction of cast iron on cast iron is greater than steel on steel. The variations in the values of E are not sufficient to produce so great a difference. By comparing the values of (A) and (B) for both cases it is seen that the friction in case (A) is greater than in case (B), or the friction of cast iron on cast iron is greater than cast iron on steel.

The actual values of (A), (B) and (D) obtained from data on taper fits through equations found for M are respectively equal to 5.28, 5.61 and 1.00 and are consistent in their agreement with the hypothetical case. By comparing the differences between (A) and (C) and (B) and (C) the influence is in favor of cast iron, hence the value of K given by equation (25) was selected.

By proportion the actual value of (C) should be

$$(C') = \frac{(B')(C)}{(B)} = \frac{5.61 \times 7.4}{5.88} = 7.05$$

which gives for a steel hub on a cast-iron shaft

$$M = \frac{2,510}{1.95 + K} \qquad (29)$$

where K is the value given by equation (25).

Substituting the empirical values of K and M obtained from experimental data in the general equations (9) to (20) gives the following empi[illegible]ulas:

For cast-iron hub on steel shaft: By combining equations (9) and (25) the hoop stress in a cast-iron ring pressed on a steel shaft having the same taper as the bore is

$$f = \frac{15,000,000\,Uh}{d\left[1 + 0.353\left(\frac{D}{d} - 1\right)^{0.4}\right]} \textit{ lb. per sq.in.} \qquad (30)$$

From equations (21), (24) and (25) the force required to press a tapered steel shaft into a cast-iron ring bored to the same taper is

$$P' = MUhL = \frac{1,260\,UhL}{0.6 + \dfrac{1.7}{\left(\frac{D}{d} - 1\right)^{0.4}}} \textit{ tons} \qquad (31)$$

For steel hub on steel shaft: From equations (12) and (27):

$$f = \frac{15,000,000\,Uh\left[\left(\frac{D}{d}\right)^2 + 1\right]}{d\left(\frac{D}{d}\right)^2} \textit{ lb. per sq.in.} \qquad (32)$$

From equations (21), (26) and (27):

$$P' = \frac{1,300\,UhL\left[\left(\frac{D}{d}\right)^2 - 1\right]}{\left(\frac{D}{d}\right)^2} \textit{ tons} \qquad (33)$$

For steel hub on cast-iron shaft: From equations (15) and (25):

$$f = \frac{30,000,000\,Uh}{d\left[1 + 0.97\left(\frac{D}{d} - 1\right)^{0.4}\right]} \textit{ lb. per sq.in.} \qquad (34)$$

From equations (21), (25) and (29):

$$P' = \frac{1,475\,UhL\left(\frac{D}{d} - 1\right)^{0.4}}{1.15\left(\frac{D}{d} - 1\right)^{0.4} + 1} \textit{ tons} \qquad (35)$$

For cast-iron hub on cast-iron shaft: From equations (18) and (25):

$$f = \frac{25,500,000\,Uh}{d\left[1.7 + \left(\frac{D}{d} - 1\right)^{0.4}\right]} \textit{ lb. per sq.in.} \qquad (36)$$

From equations (21) and (28):

$$P' = \frac{1,390\,UhL}{1 + \dfrac{1.7}{\left(\frac{D}{d} - 1\right)^{0.4}}} \textit{ tons} \qquad (37)$$

There is no question about the foregoing values of f being sufficiently accurate for all practical purposes, but owing to the great variation in the pressure required because of the different kinds of lubricant used, the formulas for P' may give values considerably greater or less than the actual pressures required. They represent average values when a lubricant of white lead and linseed oil is used.

The alignment charts provide an easy means of solving these equations.

Maximum Production from Tools

By Gustav H. Radebaugh*

SYNOPSIS—The centralized control of a school shop planned to teach the principles of production and govern the manufacturing in the shop itself. A number of special tools are shown, together with specimen time-study and instruction cards.

Tools have but one function—to produce work. Failure to perform this function according to definite standards accepted as modern practice points to fundamental defects in the manufacturing policy. Tools that do not produce a maximum quantity of acceptable work are expensive tools, while those that lie on the shelves unusued are a dead loss. If tools are good but production low,

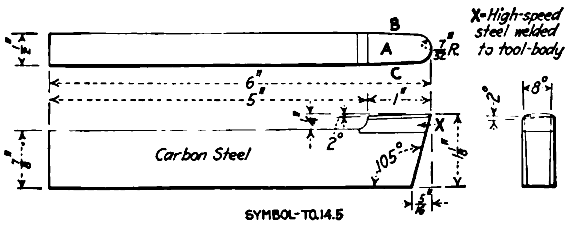


FIG. 1. ROUND-NOSE TOOL FOR HEAVY WORK

methods are at fault. In either case something is wrong with the underlying policy or with the execution of that policy.

The manufacturer who does not know is satisfied with poor tools and low production for the reason that to him his tools do not appear bad nor his production small. Who has not observed the widely varying tool practices in shops similarly equipped and engaged in the same kind of work? The tools are approximately the same and the workmen seemingly of equal ability, yet the results are in no way comparable. Plainly the tools or the workmen are not responsible, as in these respects conditions are equal. These cases leave but one conclusion—the management must be responsible for the difference in results. In one case the management is good; in the other it is bad, or at least not of an equal degree of excellence. Inefficiency is not so much a matter of tools as of methods, and observation leads to the conclusion that in the shop which is not producing results equal to those produced by other shops of the same order, the management rather than the equipment is at fault.

The problem of securing maximum production from tools resolves itself into three factors—(1) design of the tool, (2) manipulation of the tool, (3) maintenance of the tool.

Such output of course depends upon a number of items other than tools, such as dispatching and routing of materials, power, labor, etc., all of which enter directly into the larger problem of manufacturing and must, if efficiency is secured, receive equal attention with the tools. Without consistent treatment of all the fundamental elements entering into shop operation, efficiencies in one will necessarily be nullified by inefficiencies in another, and the final result average but little better than the weakest constituent. The plans outlined in this article would not in themselves effect the maximum shop output, for the reasons just given, but they will name (1) the right tool for the work, (2) the most effective use of the tool and (3) proper tool upkeep and maintenance. Such a program, if effectively executed, will furnish the fundamental elements for successful shop operation when combined with efficient organization and management.

Considering in detail each of the three leading factors in maximum tool production, it is evident that (1) to secure the most effective tool it must be selected for the work, properly designed, mechanically constructed; (2) to obtain maximum output from the tool, the most economical method of performing the work must be determined in advance, these methods and standard time for operations must be made available for the workingman's use, the workman must be trained to perform the work according to methods and in specified time; (3) to insure a constant supply of tools in efficient working condition, working standards must be established, these standards must be constantly maintained, the workman must be relieved of all responsibility for tool maintenance and not be permitted to depart from standards.

To some of the shop managers of the old school this program may appear unduly complicated and perhaps unnecessary. Its justification lies in the fact that it produces more work at less cost than does unsystematized management. Unless definite steps such as those outlined are taken to standardize shop processes, production is largely a matter of efficiency of the individual work-

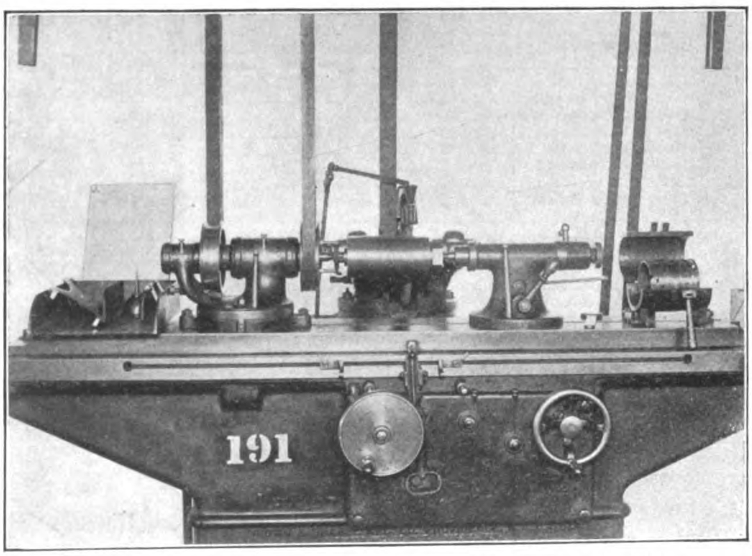


FIG. 2. GRINDING FIXTURE FOR GAS-ENGINE PISTON RINGS

*Instructor in machine-shop management and practice, University of Illinois.

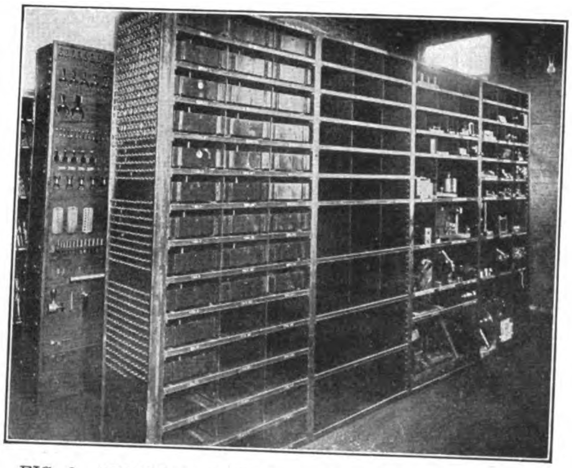


FIG. 3. ADJUSTABLE STORAGE CASES FOR STORING JIGS AND FIXTURES

man. In ability workmen vary greatly. There are equally marked differences in individual outputs, owing to the relative values of experience and training. On the other hand the average workman responds readily to intelligent instruction in modern shop practices, and it is not difficult to improve efficiency when those in charge are real leaders. Most inefficient shops are the results of poor leadership. Efficiency starts (if it starts at all) at the top and filters down through departments to the workman himself. It does not work back the other way. These facts are appreciated by the uptodate executive, which is the reason why centralized control from the office is gradually superseding the traditional plan of machine control by the individuals operating machines.

In the shops of the University of Illinois centralized control has been established for the double purpose of demonstration and of production. These shops are operated on a commercial basis. Regular products are manufactured to give students actual experience in the problems of shop management. No claim for novelty is made for the methods used, although these shops are among the first of the college shops to employ throughout the latest phases of production and management in place of manual training. The hope that some of these methods may prove helpful to those facing similar problems is the source of inspiration for this article.

FORM 7
UNIVERSITY OF ILLINOIS
SHOP LABORATORIES
RECORD OF TIME STUDY
DEPT. Machine

OPERATION Grinding Piston Rings
ARTICLE Type A Engine
INSTRUCTION CARD NO. 107 OPER. NO. 4
OPERATOR'S NAME A. Miller NO. 78 SEC. P
DATE February 17, 1914 TIME STUDY NO. 4

ITEM	DETAILS OF OPERATION	TIME ACTUAL	TIME LOST	TIME PROPOSED	EXPLANATION OF OPERATING TIME LOSSES
1	Adjusting head and foot stock	0.08	0.04	0.03	Nut too tight on platen bolt. Had to remove nut and repair it.
2	Adjusting head-stock center	0.03		0.03	
3	Placing grinding wheel on spindle	0.08		0.08	
4	Adjusting speeds	0.03		0.03	
5	Locating reversing dogs	0.02		0.02	
6	Clamping ring grinding fixture on platen	0.03		0.03	
7	Placing rings in clamp box	0.03	0.01	0.02	One ring too large to go in fixture. Had to replace with another.
8	Place equalizing dog on mandrel	0.01		0.01	
9	Placing rings on grinding mandrel	0.02		0.02	
10	Grinding to size	0.20	0.02	0.19	Took 8 cuts when it should be done in seven.
11	Removing mandrel from machine and ring from mandrel	0.03		0.03	
12	Removing fixtures from machine	0.10		0.10	
	TOTALS	0.66	0.07	0.59	

INVESTIGATED BY: O. Ritter, WORK SCHEDULE ENGINEER. STUDY MADE BY: H. Hess, WORK SCHEDULE ASSISTANT.

FIG. 4. A SPECIMEN RECORD OF TIME STUDY

This is one of a series of eight time studies made on a grinding operation incorporating an accurate record of all details in natural sequence

At present an 8-hp. two-cylinder marine-type gas engine is the principal shop product. To machine the 86 parts of this engine 214 operations at various machines are required. Each part was studied separately, and the most efficient tools and methods under existing conditions were selected. It is not presumed that these are ideal in all respects, but they represent in principle at least the working out of a sound manufacturing policy. The problem of production from the mechanical standpoint involved in the manufacture of the gas engine was considered as one having three components—the right tool, efficient operation and correct maintenance.

Each tool is designed for machine production with the ultimate idea of having it perform its functions in the most effective manner. This is accomplished by determining the machining operation routine, thus permitting the design of tools to embody both the character of the work and machining methods. In designing lathe, planer and shaper tools, practices which standardize these tools are followed. In Fig. 1 a round-nose tool for heavy work is shown. This tool is made up of a carbon-steel body with high-speed steel nose welded to the carbon steel. The construction of this tool eliminates the extravagant use of high-speed steel and also gives productive results.

A 107-4

FORM 154
INSTRUCTION CARD
SHOP LABORATORIES
MACHINE DEPT.

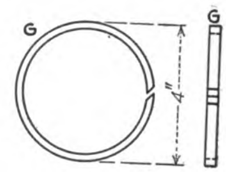
STOCK NO. A-107 PATTERN NO. 1-25

PISTON RING
PATT. NO. 1-25
OPERATION NO. 4 4 TOTAL OPERATIONS

MACHINE GRINDING
MACHINE NO. 191

TOOLS:
4" MICROMETERS. CA. 13.4

JIGS:
FIXTURES: GRINDING FX. 107.4



ITEM	OPERATION ROUTINE	STANDARD TIME
	Note:—Rings finished in lots of 18 pieces. During process of grinding prepare next set of rings on grinding mandrel No. 2.	
	Machine set up. Total time ..0.14	
1.	Adjust head and foot stock to receive work. (Par. 47).	
2.	Both center dead. (Par. 49). ...	0.02
3.	Place on wheel spindle, wheel grain 46, grade K or L shape 76. (Par. 105). ...	0.03
4.	Adjust wheel speed to No. 6 (Par. 83. Traverse speed No. 3 (Par. 84). ...	0.06
5.	Adjust reversing dogs to proper position. (Par. 52).	0.02
	Work set up. ...	0.01
	Total time ..0.07	
6.	Clamp ring grinding fixture Fx 107.4 (clamp box) on right end of platen. (Par. 183).	
7.	Place 18 piston rings in clamp box and close clamp. (Par. 187). ...	0.02
8.	Place equalizing dog on mandrel. (Par. 164). ...	0.02
9.	Place special grinding fixture mandrel thru 18 rings and clamp firmly release ring clamp box. (Par. 187). ...	0.01
	Work Production. ...	0.02
	Total time ..0.20	
10.	Place mandrel with 18 piston rings, between centers and grind to 4" diameter. (Par. 142).	
11.	Remove mandrel from machine, and piston rings from mandrel. (Par. 143) ...	0.17
	Note:—If more than 18 rings in lot, repeat items 7-9-10—11.	0.03
	Machine Take Down	
	Total time ..0.09	
12.	Remove all fixtures from machine. (Par. 10). ...	0.09
	Standard time in lots of 18 = 0.24 x number of lots	
	Standard time in one lot of 18 = 0.50	
	TOTAL STANDARD TIME	0.50

FIG. 5. A SPECIMEN INSTRUCTION CARD

Operators are not permitted to depart from the instructions but are encouraged to make suggestions for betterment

In efficient manufacturing, jigs and fixtures are the foundations for production. Their design and maintenance is an item of no brief analysis. They are designed with the double purpose of accuracy and rapid production. If designed without first analyzing the machine operation or without consideration for rapid production and the placing of work in them, they will not effectively fufill their purpose. Fig. 2 shows the fixture used for grinding the periphery of piston rings, the grinding being done under compression; 18 rings are ground at one setting. The clamping box shown mounted on the machine obviates wastes in placing the rings on the fixture.

STANDARD TOOL LIST
INSTRUCTION CARD A 140-1

6 IN. STEEL RULE	RU 19.5
1 IN. MICROMETER	CA 13.1
3-8 IN. HEX. COLLET	CO 20.6
PARTING TOOL	TO 16.2
3-8 IN. HOLLOW MILL	MI 8.4
3-4 IN. SOCKET	SO 20.3
3-8 IN. – 24 DIES	DI 7.9
GEOMETRIC DIE HEAD	DI 7.1

FIG. 6. STANDARD TOOL-LIST CARD FOR TOOLS, JIGS AND FIXTURES

In an operation of this character two grinding fixtures or mandrels are supplied with one clamping box. Thus the operator arranges the rings on one mandrel during the grinding operation with the other. Notice the rapid cam lock on the clamping box. Designs of this description aid in shortening the setting-up time.

Tools not only must be properly designed, but they must be adequately stored to facilitate issuing to the machine department in the minimum of time and to insure their proper care. Different methods of storing tools might be employed, but the fundamental factors of a correct storage plan must be the marking of tools and the use of individual storage locations. Fig. 3 shows a section of jig and fixture storage, special tools and tool trays. All jigs and fixtures are marked with symbols;

NAME OF TOOL________ SYMBOL________ SIZE________
STEEL, KIND________ DATE________
DESCRIBE FAILURE________
METAL BEING MACHINED________ HARD OR SOFT________
TIME TOOL IN SERVICE________ CONDITION AT START________
SPEED OF WORK________ FEED OF TOOL________
LUBRICANT USED________
YOUR REASON FOR FAILURE________

STATEMENT BY:________ APPROVED BY:________
NAME OF STUDENT INSTRUCTOR

FIG. 8. SHOP LABORATORIES' RECORD OF TOOL STEEL PERFORMANCE

compartments in the storage case are marked to show individual storage space. The mark on the storage space is the symbol number of the tool.

The machine operator must have such information as will assist him in effective use of the tools furnished to him. The determining of such information includes (1) the unnecessary operations performed, (2) the time consumed in performing such operations, (3) the necessary operations for the complete process, (4) the time required to perform such operations. The conclusions deduced from these observations include the most efficient method of performing the process, the logical sequence of required operations and the rational time allowance for completing the process. The collecting of this information becomes then a matter of detail which in turn involves a time study of the operation.

Fig. 4 gives an excellent idea of time study. It shows the record sheet used when a time study is being made. Time studies that do not present an accurate record of the various details in natural sequence from start to finish are unquestionably worse than none. The time-study record sheet, as shown in Fig. 4, provides an arrangement incorporating all the principles and facts concerning existing processes, such as waste and non-productive motions, imperfect facilities, uneconomical methods, improper organization and consequent inefficiencies, so that analysis may be directed to determining the best methods

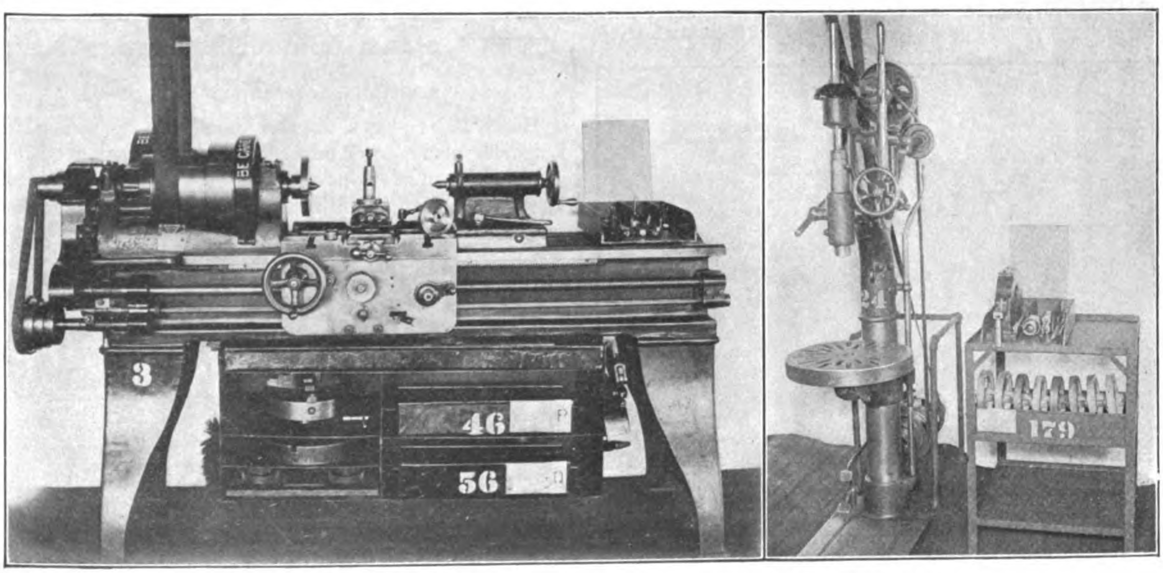


FIG. 7. TOOL TRAYS AND MATERIAL AT ENGINE LATHE AND DRILLING MACHINE

of operation. This analyzed information is conveyed to the operator in the form of a work-schedule card or the instruction card, as shown in Fig. 5.

Productive manufacturing demands standardized operations. Information for the machine operator must be clear and accurate. The instruction card provided for each operator presents the standard procedure, stating not only items of operation but the speeds and feeds of the machine as well. With such information at hand the operator does not use valuable time in trial machine set-ups but spends all his time on work of a productive nature. The instruction card also gives the standard time of the various items of operation, such information being obtained from the time-study analyses.

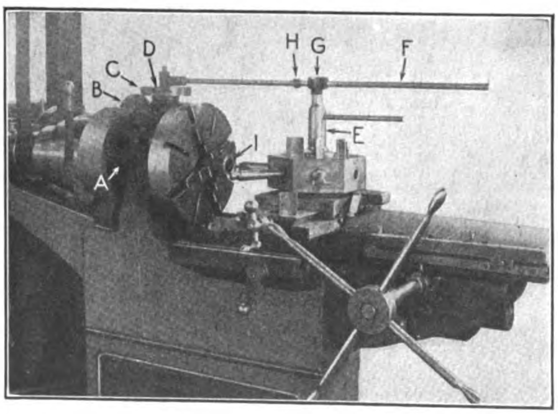
In the standardizing of machine operations the list of tools required to complete the operation is for convenience given on the instruction card. It is obvious that the tool-crib attendant, if he is to eliminate the calling for tools, must have definite knowledge of the needs of the machine operators before their arrival at work. This information is listed on a standard "tool-list card," Fig. 6. The tool, jig and fixture requisites of a standard operation are delivered to the machine before the arrival of the operator. Notice, in Fig. 7, that tools, machine and materials are awaiting the arrival of the operator.

On the return of the tools, jigs, etc., after use in the machine department they are given a close inspection for breakage and regrinding. If need be, they are repaired or resharpened before going into the service rack for future issuance. Tools needing grinding or tools breaking in service are turned into the toolroom and new tools obtained. For all tools breaking in service one copy of form 13, "Record of Tool-Steel Performance," Fig. 8, is made out and approved by the foreman or instructor before a new tool may be obtained.

Oil-Grooving Attachment for a Turret Lathe

By E. A. Thanton

An interesting oil-grooving attachment used on a Davis turret lathe is here shown. It was made in the shop of the Mueller Machine Tool Co., Cincinnati, Ohio.



OIL-GROOVING ATTACHMENT FOR A LATHE

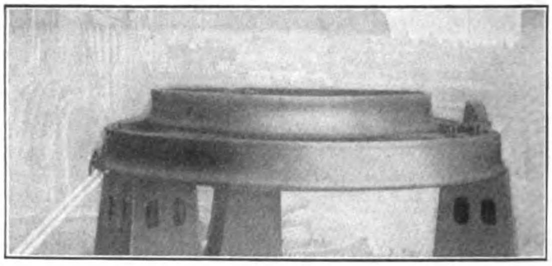
Extension studs are used in place of the regular screws on the front bearing cap of the spindle. The attachment is set over these studs.

A spur gear A remains permanently on the spindle between the cone and the front bearing. This gear meshes with another spur gear B, and through it and a series of reduction and bevel gears drives the crank disk C. The crank disk has a slide in it, adjusted by means of a screw D to vary the length of the stroke as desired. A special extension E is used on the turret. This is clamped to the connecting-rod F by means of a split bearing and capscrew at G. A stop collar H is used so that the clamp may be loosened and the turret run back for the removal or insertion of work in the chuck at I.

Either single- or double-point tools may be used in the bars in the turret, according to the grooving required in the bushings. Arrangements are also provided to give different gear ratios for different groove patterns.

An Improvised Bending Form in a Railway Shop

The illustration shows a bending form used at the shops of the Union Pacific System, at South Tacoma, Wash. It consists of two discarded locomotive tires of different



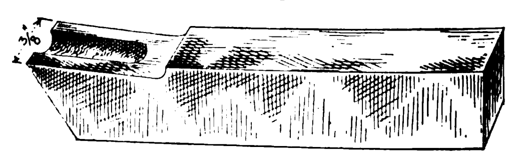
FORM FOR BENDING CURVES

sizes, held together by crossbracing and mounted on the three pedestals shown. Means are provided for clamping to the tires at any point the material to be bent. The device is located in the yard just outside the machine shop and is found very handy in many instances.

Curved-Lip Parting Tool for Planer or Shaper

By S. L. Roberts

Herewith is shown a parting or cutting-off tool for shaper or planer work on cast iron. Not having tried it on steel, I cannot say how it would work on that material. In cutting cast iron, however, the tool starts the cutting on the two corners and the chip runs to the center of the



PARTING OR CUTTING-OFF TOOL FOR SHAPER OR PLANER ON CAST IRON

radius, sometimes hanging together for an inch before breaking. It follows up the radius shown by the dotted line. I have failed to hear this tool chatter, and it is ⅜ in. wide. I find it the best parting tool I have tried during considerable experience.

Machining Methods Used on a Valveless Lubricant Pump

By Ethan Viall

SYNOPSIS—The principal parts of this valveless pump are the body, the impeller and the cover. The machining methods and the tools used are simple and free from complications and afford an interesting study.

The pump the machining of which is described in this article was designed to supply lubricant to cutting tools of various kinds. Two of the complete pumps and two sets of the principal castings are shown in Fig. 1. Both of the complete pumps shown are geared-up types, though a direct-driven type is also made. The main parts are, however, the same in both types. The castings *A* and *B* show different views of the body. *C* and *D* are impellers and *E* and *F* are covers. Only work on these parts as done in the shop of the Cincinnati Lubricant Pump Co., Cincinnati, Ohio, will be shown. The shafts, bushings and other small parts are machined in the usual way and offer nothing of special interest.

The geared-up type is shown in detail in Fig. 1-A, which gives a good idea of the operation of the pump. The body itself is 5⅜ in. in outside diameter and is bored to two diameters—4 and 2 in. respectively. With the cover in place, the pump is 3⅛ in. through, regardless of the pipe and shaft bosses. The impeller is 4 in. in diameter and 2⅛ in. at the thickest part. The cover is 5 in. in diameter and ½ in. thick at the flanges. The im-

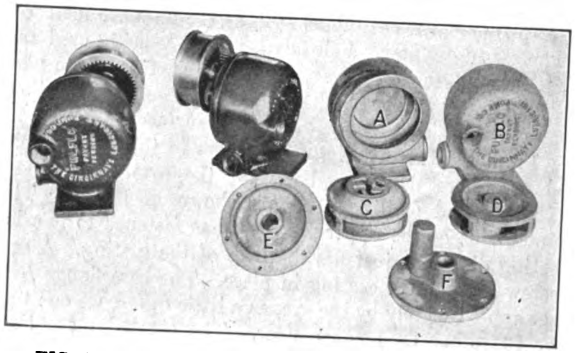


FIG. 1. FINISHED PUMPS AND PRINCIPAL PARTS

peller drive shaft is ⅝ in. in diameter. The complete pump weighs about 14 lb. With a suction lift of 12 in. and a head lift of 4 ft. the pump will deliver the following amounts of lubricant with the pulley running as

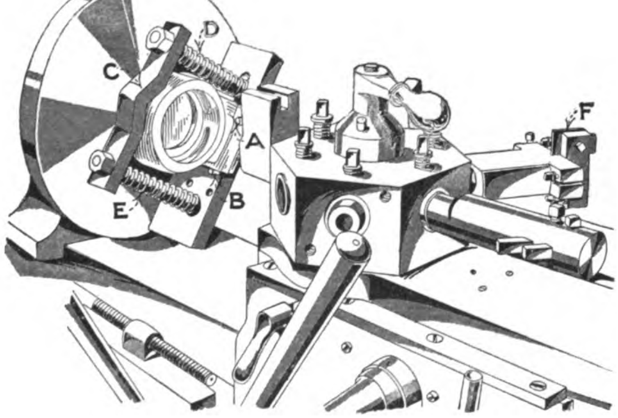


FIG. 2

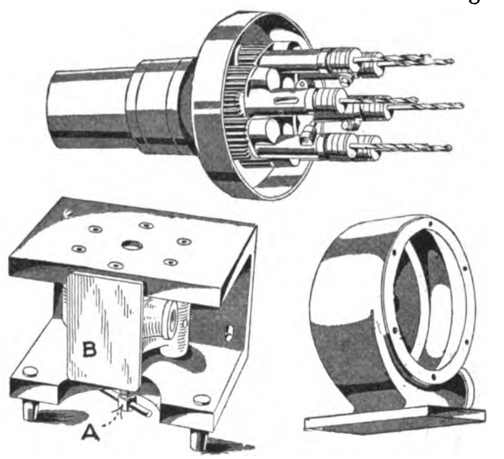


FIG. 3

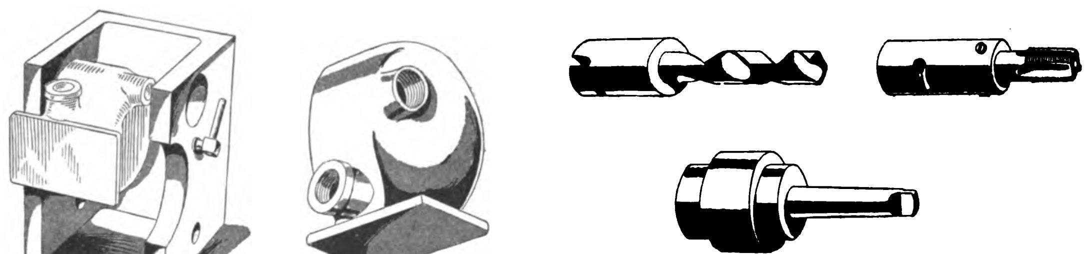


FIG. 4

FIGS. 2 TO 4. OPERATIONS AND TOOLS FOR MACHINING LUBRICANT PUMP BODIES
Fig. 2—Facing and boring bodies. Fig. 3—Drilling head and jig for body screw holes. Fig. 4—Jig and tools for drilling and tapping inlet and outlet pipe openings

indicated: 5 gal. at 250 r.p.m.; 10 gal. at 300 r.p.m.; 15 gal. at 350 r.p.m.; 18 gal. at 400 r.p.m.

If more lubricant is wanted at this head, the speed is increased. The same thing is necessary if the amount indicated is wanted with a higher head lift.

The first operation on body castings is to face and bore them. This is done in a turret lathe, as shown in Fig. 2. The rough casting is held on an angle plate bolted to the lathe faceplate. The base of the casting is located between the two pins *A* and *B*. The strap *C* is then tightened down, holding the piece securely. It will be noted that springs *D* and *E* are provided to lift the strap free of the casting as soon as the nuts are loosened. The casting is first rough-faced, two tools being used and each one taking off about half of the surface. The next step is to rough-bore both diameters. The tool *E* is then run in to finish and size all turned surfaces.

From the turret lathe a body goes to the drilling machine, where the screw holes for the cover are drilled. The jig and drilling head are shown in Fig. 3. The under side of the upper jig plate has fastened to it a locating disk that just fits the bore of the casting. A setscrew *A* locks the casting in place. The base flange *B* is set approximately by the eye, as a little difference one way or the other does not matter. The six holes are then drilled with the Covington multiple head, shown at the left.

The next operation is the drilling and tapping of the inlet- and outlet-pipe openings. The casting is placed

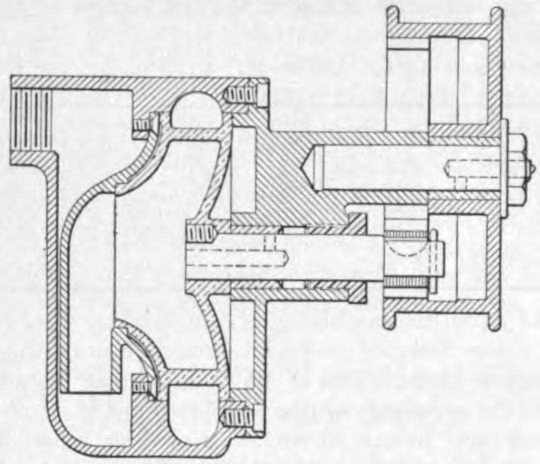


FIG. 1-A. DETAILS OF THE PUMP

in a jig, as shown in Fig. 4. The locating and holding are exactly the same as in the previous jig. The holes are cored out, so no bushing is used to guide the drill, as this is accurate enough for all purposes. The holes are

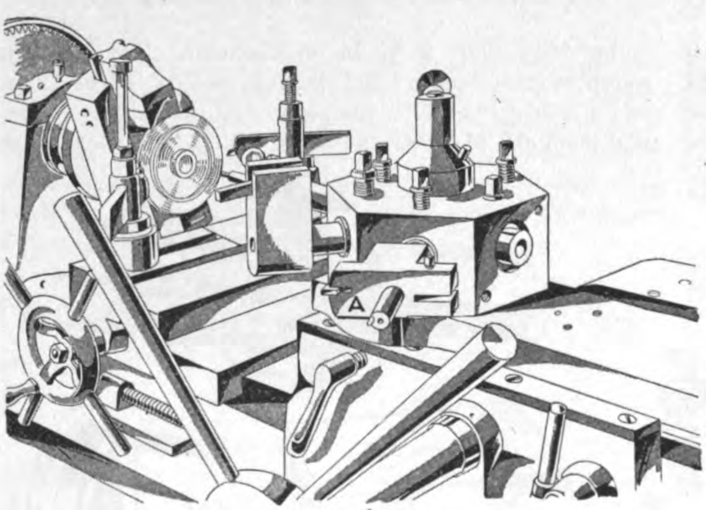


FIG. 6

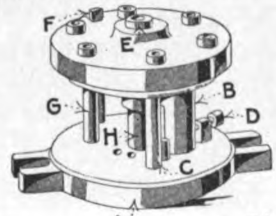
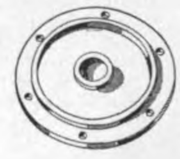


FIG. 7



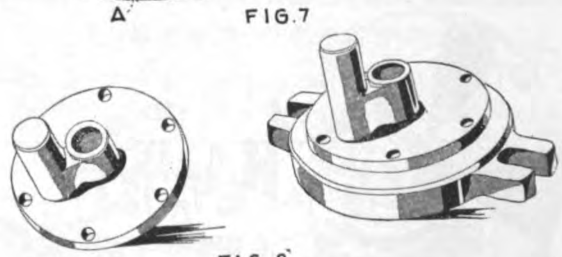


FIG. 8

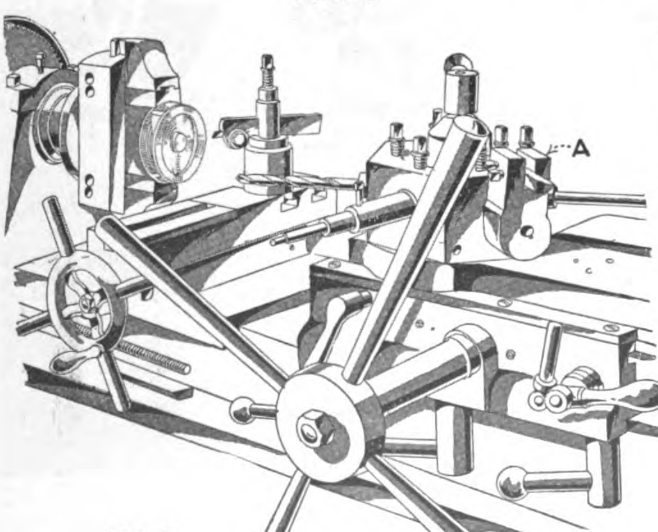


FIG. 9

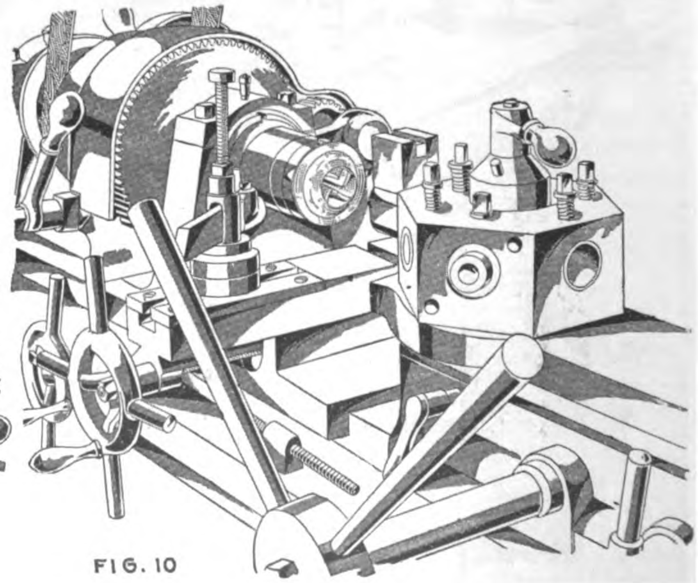


FIG. 10

FIGS. 6 TO 10. OPERATIONS ON COVERS AND IMPELLERS OF VALVELESS LUBRICANT PUMP

Fig. 6—Roughing operations on cover casting. Fig. 7—Jig for multiple-drilling screw holes. Fig. 8—Counterboring jig Fig. 9—Set-up [illegible], drilling, boring and reaming impellers. Fig. 10—Finishing impellers

then tapped out with the tap shown. Both the drill and the tap are held in a Magic quick-change chuck, shown between them.

The casting is now placed in another jig similar to the drilling jig, and the cover holes are tapped on the machine shown in Fig. 5. This machine is made by the Evans Stamping and Plating Co., Taunton, Mass., and a boy taps the holes almost as fast as he can handle the work.

The cover casting is first placed in a two-jawed universal chuck fitted with false jaws, as shown in Fig. 6. The front tool on the cross-slide roughs off the cover seat, and the rear tool roughs off the face of the narrow ring. The shaft hole is next rough-bored, and then the flange is finish-turned. The finish-boring and facing are done with the tool *A*, after which the center hole is finish-reamed.

The cover screw holes are drilled with a multiple head in a jig, shown in Fig. 7. The casting is located in this jig by slipping the bored center hole over a pin set into the center of the base *A*. The part *B* is then butted against stop *C* and locked by means of thumb-screw *D*. The cover holding the drill bushings is then placed over the center pin *E*, being located by means of the hardened piece F, which fits into a slot in the jig cover. Pins like *G* and *H* brace the casting directly under the drill bushings. The drilled holes are counterbored with a multiple head in a simple holding jig, shown in Fig. 8.

The impellers require no jigs of any kind. They are first chucked, as shown in Fig. 9. They are then faced off with the cross-slide tool, and the part of the outside diameter not held in the chuck is turned with the turret tool *A*. The center hole is next drilled, bored and reamed.

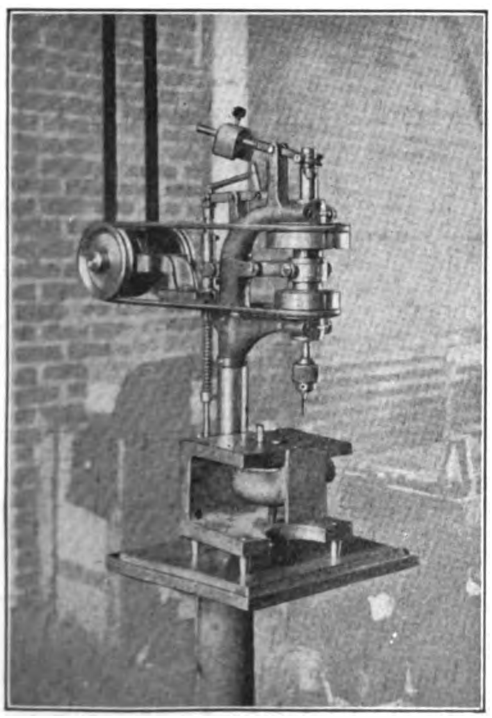


FIG. 5. SCREW-HOLE TAPPING MACHINE

The casting is now reversed in the chuck and the scale knocked off with a cross-slide tool. The finishing is done as shown in Fig. 10, with a formed tool held in the turret. This finishing is performed after the drive shaft has been pressed into place.

Indefinite Shop Terms

By Frank C. Hudson

I'm not much of a stickler for high-browed language, and most of the talk about syntax and prosody, whatever they may be, is all Greek to me. But I do like to know what a man is talking about when he writes an article or a letter, and this isn't always easy when we look over some of the names we give things in and about the shop.

When a man tells us he "scored" a bearing, we usually imagine he means that it is "cut" or "chewed up," "roughed up" or even "galled," depending upon what

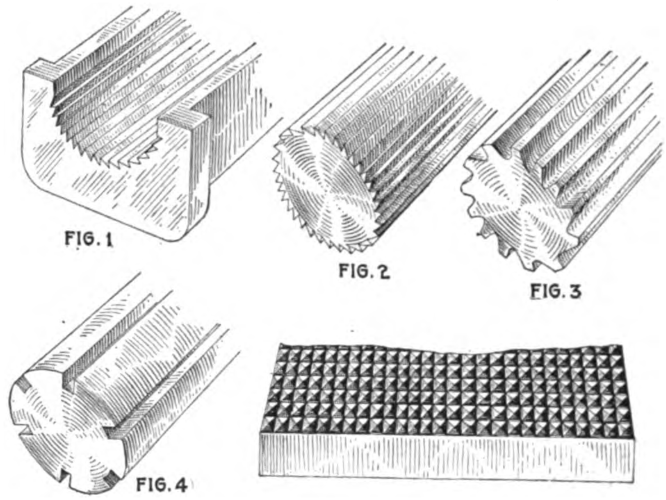


FIG. 5

PARTS EASILY CONFUSED BY INDEFINITE TERMS

part of the map we happen to hail from. And yet he may not mean that at all. He may mean that he cut small "scores," or grooves, lengthwise of the bearing so that it can wear down evenly, as was often done in railway roundhouse repairs in the days of adjustable side-rod brasses, as shown in Fig. 1. This illustration is exaggerated of course, the scores being made with a half-round bastard file.

In this case either "scored" or "grooved" is probably correct, and yet either (especially the first) might easily be misunderstood to mean one of the other terms mentioned. Yet if this same sort of grooves appeared on the outside of a piece, as in Fig. 2, we should unhesitatingly call them by the entirely different name of "knurling," if the grooves were shallow, or probably "fluted" or "grooves," if they were deeper. If they are rounded at the bottom, as in a reamer or tap, Fig. 3, we naturally call them "flutes," while if they assume a rectangular shape, as is found in many automobile transmission shafts, Fig. 4, they are "splines."

I am not objecting to this usage in the least, because "flute" and "spline" have a very definite meaning to most of us. It is only when the spline becomes a "keyway" or "featherway" in some quarters that confusion again creeps in.

The term "galled," while not very common, is probably clear to most of us as meaning a surface which has been abraded by contact. This probably comes more from the galled horse, however, than from our acquaintance with Shakespeare's "galled jade" of ancient fame. But "scored," though often used in connection with a "cut" or damaged bearing, is also frequently used as an equivalent to "checkered" and may cause confusion in this way.

Fig. 5 shows what I called "checked" or "checkered," although it does not always present a sharp point. A pistol grip is a good example. Some call it "cross-grooved," which is not confusing at any rate, but plain "grooved" seems inadequate if not actually misleading.

Small Wheel of Sheet Steel

For a majority of the ordinary jobs requiring several press operations a number of simple dies are generally better than a compound die or even certain forms of follow dies. A set of simple but effective dies used for making a small steel wheel from sheet metal is here shown. Many tool makers would have attempted to use compound dies, thereby adding greatly to the cost of making and operating, without obtaining any better results. These dies were made by the Gem City Machine Co., Springfield, Ohio, and the various steps in the making of a wheel are shown in Fig. 1. Here *A* represents the first blank, *B* the forming, *C* the blanking out between the spokes and also the rivet piercing. An assembled wheel, with a rubber tire in place, is shown at *D*.

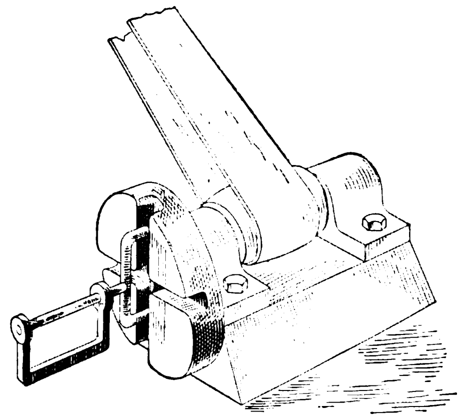
The first blank is 6 in. in diameter, made from steel $\frac{1}{16}$ in. thick. An $\frac{11}{32}$-in. hole is pierced in the center of the blank, as shown. This is done because any attempt to draw the hub without this hole would result in tearing the metal. The first pierced hole is reamed out to $\frac{1}{2}$ in. in diameter before the drawing and forming operation, in order to remove metal that might be crystallized at the edges and to provide clean, smooth metal. The blank is then placed in the die shown in Fig. 2 and the hub drawn down to a depth of $\frac{11}{32}$ in. and $\frac{7}{8}$ diameter, as the rest of the blank is formed for the spokes and rim.

The next operation is to blank out between the formed spokes, which is done in the die shown in Fig. 3. This is a simple blanking die with a stripper plate. Fig. 4 shows the die that pierces the rivet holes. The pieces like *A* are hooked-over pieces for holding down the spokes, the work being laid on the die and put under these hooks by a twisting motion that also brings the spokes over the piercing dies.

Neat Clevis Assembler

By F. W. Buerstatte.

The fixture illustrated shows a method of rapidly assembling clevises. The parts necessary are a chuck, two bearings, a driving shaft and a pulley. The chuck is bored to fit the shaft and fastened to it with setscrews.



A NEAT CLEVIS ASSEMBLER

It is provided with proper grooves, or recesses, into which fit loosely the male halves of the parts to be assembled. The clevis and pin are then put together and placed in the chuck, which when rotated with the belt, screws the parts together, saving considerable time in assembling.

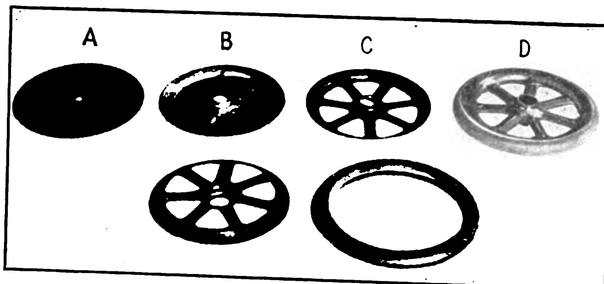


FIG. 1. STEPS IN THE MAKING OF A STEEL WHEEL

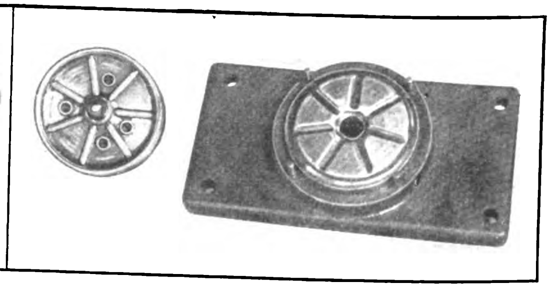


FIG. 2. THE DRAWING AND FORMING DIE

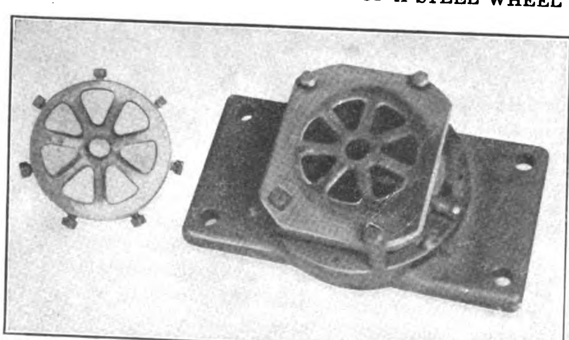


FIG. 3. DIE FOR THE THIRD PRESS OPERATION

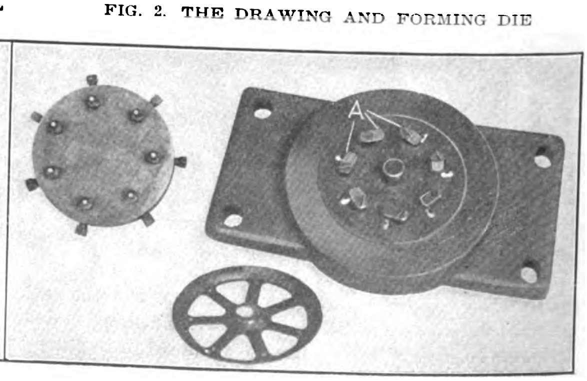


FIG. 4. RIVET HOLE PIERCING DIE

Manufacturing Rifle Cartridges--II*

By G. R. Smith

SYNOPSIS—After the cartridge case has been drawn to its full length, as described in the first article on this subject, on page 881 of Vol. 43, it passes through a number of interesting operations, among which are included trimming to length, heading, turning, indenting, tapering and mouth-annealing.

During the drawing operations the metal at the base of the cartridge has been diminished but slightly from its original thickness of 0.080 in., leaving sufficient stock for the heading, turning and indenting. The turning is usually done on automatic turning lathes, which have a capacity of some 5,000 cases per hr. When these lathes are equipped with fountain feeds, one man is able to operate three or four machines and secure a total output of from 180,000 to 190,000 cases per day of 10 hr.

In some plants girl operators are used for this class of work, while in others it is considered more advisable to use men. For example, at the Essen Works in Germany until the outbreak of the present war, male operators were used exclusively on this work. It is of interest to note that in the small-cartridge department of that noted gun and ammunition plant are found many of our American presses. With slight exceptions their procedure is an almost exact copy of what is in use in the better plants in this country.

Trimming the Case to Length

The open end of the cartridge, which is left rough from the last draw, is trimmed on a full-automatic, magazine-feed trimming machine. In the particular cartridge here described the length is made $2\frac{3}{16}$ in. in this operation. The head-turning operation consists in putting a small groove around the head of the case, so that the extractor of the rifle may take hold of the shell after it is fired. This operation is sometimes done after heading and indenting, and sometimes before, but the two operations are consecutive, whichever one comes first. Automatic lathes are used for the grooving operation.

The heading operation flattens out the bottom or head of the case. Heading is performed on either semi-automatic or full-automatic machines, the latter being desirable in a plant having as high a production as the one I am describing. In some cases both heading and indenting are done at the same time, when the production is about 60,000 cases per day of 10 hr.

Cartridges are loaded with many different charges, such as black powder, semismokeless, dense smokeless and the like. These charges differ so much in characteristics—amount used, density, rapidity of combustion, chamber pressure, etc.—that a number of different primers must be provided. Therefore the primer hole, which is pierced through the head of the cartridge during the indenting operation, is of a great variety of sizes, depths and shapes. Tools for this operation will stand up for some 1,000,000 or more cases, with proper care. The only lubricant used is a little lard oil on the punch occasionally.

*Previous installment appeared on page 881, Vol. 43.

Much has been written about the impracticability of combining successive die processes on cartridge-case work, but in spite of this I recently saw in operation a press that blanks and cuts in strips, redraws the case four times, heads, indents, and stamps the caliber size on the head before the case is ejected from the machine. This press was running at 100 strokes per min. and doing a high grade of work.

After the case is blanked and cupped in the first die, it is carried by an automatic finger arrangement to the second die, where it receives the first draw, which increases its length $\frac{3}{8}$ in. The same style of finger arrangement carries it to a third die, where the second draw is done while the metal is still warm from the first draw. This process is repeated on the fourth draw, the metal growing warmer at each drawing, which does away with the necessity of annealing between operations. The fifth die, used on the fourth draw, brings the case to its final trimming length.

The heading, stamping and indenting operations are done from the bottom of the press in two operations. When the ram of the press is down at dead center, holding the case rigid in the die, a punch actuated by a set of cams strikes an upward blow on the head of the case and performs its operation of either heading and stamping or indenting. The stock is fed from the roll and the scrap rolled up again.

This machine is a built-up press of remarkable design and is used mostly for cases of the shorter length. One operator can attend four of these machines, as shown in the group in the layout of the press room on page 881. The finished product from a machine of this type needs only to be trimmed, mouth-annealed and tapered.

Mouth-Annealing a Quick Operation

Before the case can be tapered, it has to be annealed at the mouth end, without, however, annealing the head. This operation is done very rapidly, one machine being sufficient to anneal all the cases that one shop can make. There are various styles of annealing machines. The one that I will describe is a simple affair consisting of a chain arrangement that carries the case through a series of gas flames. It is rigged upon a common work bench. Blocks of cast iron are attached to the links of the chain, and three or four holes are drilled into the blocks. These holes hold the cartridges as they pass through the flame and are made large enough so that when the chain runs over the wheel at the end of the bench, the cases will drop into a box truck.

As many gas flames as are required to do the work may be put on an apparatus of this kind. Since the thin walls of the cases heat up rapidly, the chain may run at a good rate of speed and an enormous production be taken care of with this simple arrangement. It is only necessary to bring the case to a dull red to anneal it sufficiently for the tapering operation.

Tapering is done on a ratchet dial-feed reducing or tapering press. In this operation the case is held in the dial and passes under two or more punches, receiving as many taperings as required to bring it to size before it is ejected from the dial. Three reducings are generally

required to bring the full taper from the head down to size at the mouth. This press runs at from 100 to 110 strokes per min. and is driven by a 2- or 3-in. single-ply loose belt, so that if the dial clogs or anything happens, there is not power enough to do serious damage.

Another process of tapering consists of passing the cartridge case through a set of rollers, something on the style of a roller beading machine. The reducing press runs at 110 strokes per min. and gives a production of 50,000 or 60,000 pieces per day of 10 hr. A little lard oil is used as a lubricant to keep the work from wearing or scratching.

There is one point that is very interesting and, so far as I know, entirely new to most readers—that is, the markings on the head of the United States cartridge. In the Government arsenals many of the army cartridges, more especially those loaded for advance field use and for scouting parties, are being marked in a peculiar way. The caliber size is stamped on the head of the cartridge, together with the letters U. S. A. or U. S. N. In addition to these there are other peculiar markings, such as O.F.O., V2, V4, etc. These are code symbols, that when used by an advance guard or scouting party, convey to those coming behind quite varied meanings. After the cartridges are fired, the empty cases are dropped in roads in conspicuous places and in the path of the advancing army; a set of letter combinations is used to indicate road conditions, the proximity of the enemy, and the like. A call for reinforcements, double-quick march of the main army and no end of important directions of immediate and vital value can be conveyed simply by the empty shells left behind. It is one of Uncle Sam's original and valuable ideas.

Details of Locating and Clamping Fixtures

By R. W. Beckman

A standard adjustable wedge stop for use in drill jigs is shown in Fig. 1. This stop is used directly under a drill, *A* representing the base of the drill jig. The bushing *B* is driven into *A*. The adjustable bushing *C* comes up against the work.

The finished boss on the work is set up against a solid stop. As the other boss is rough, it is evident that the dimension *K* will be different on each piece that necessitates the adjustable wedge stop. *D* is a dust cap to keep working parts clean; *E* is a sliding cover that acts as a washer and also keeps the dirt out of the slot. The wedge *F* operates the bushing *C*. The wedge *F* goes into the side of bushing *C* and not under the hole, allowing the dirt and chips from the drill to pass through the clearance hole in bush *C*. A knurled nut *G* tightens the wedge and keeps it from moving once it is in place. *H* is a little pin in the nut which strikes against the pin *I* and keeps the nut *G* from coming off and getting lost. A small pin *J* works in a slot and keeps the washer *E* from turning. The pin *L* keeps the wedge *F* from coming out in the direction of the arrow.

This stop was designed for very light and thin work, and it was necessary to have something very sensitive. After experimenting with different adjustable stops for about three years we finally adopted this design, and it has proved so good that I am sure other readers of the *American Machinist* will find it useful.

A form of holding-down clamp which we have found useful on small drill jigs is shown in Fig. 2. This clamp is very simple and easy to make. The guide pin is tight in the lid, and the clamp is prevented from falling off by the pin in the groove shown.

Fig. 3 shows a quick-acting clamp used in the lid of a small steel drill jig. The screw (which is of regular screw stock, case-hardened) fits a right-hand thread in the lid and a left-hand thread in the clamp. The clamp carries the guide pin by this case, being a loose fit in the lid to the clamp from turning. It is evident that when the screw is turned right-hand it will go down

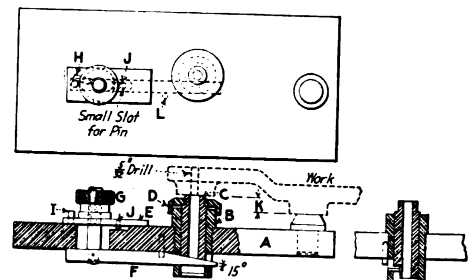


Fig.1 Adjustable Wedge Stop

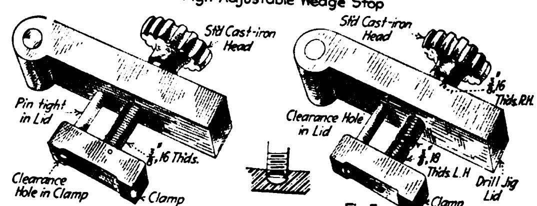


Fig.2 Fig.3

Quick-Acting Clamps

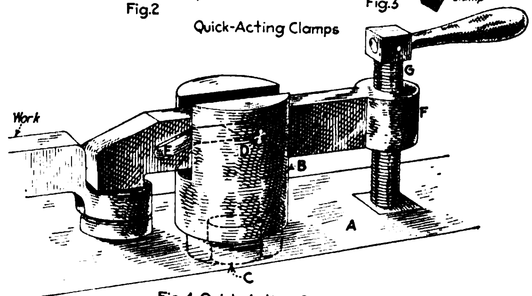


Fig.4 Quick-Acting Clamp

DETAILS OF LOCATING AND CLAMPING FIXTURES

through the lid, and the left-hand threads will also force the clamp down. This double action makes the clamp work very quickly, and by making the threads with a fine pitch the vibration will not loosen it. It works twice as fast as an ordinary screw clamp and has given entire satisfaction during the past year.

Another quick-acting clamp used on profile and small milling fixtures is shown in Fig. 4. The body *A* carries the cold-rolled stud *B*, which is a driving fit and is also held by a nut *C*. This stud has a slot in it to carry the clamp *F*. The stud *B* also carries the pin *D*. The slot *E* works on the pin. When the screw *G* is loosened, it can be pulled back with the same motion of the hand as that which unscrews the clamp. The clamp rises automatically, on account of the angle of the slot *E*. This clamp is made in very many different sizes and is extensively used in our shop.

Letters from Practical Men

Transforming a Spinning Lathe into a Screw Machine

The piece shown in Fig. 1 has been bought in large quantities, as it is an article used in our manufacturing. Due to war orders, the prices were advanced and shipments delayed so I suggested making the pieces ourselves and of steel instead of brass. Having no automatics or screw machines, I decided to change over a metal-spinning lathe for the work.

Fig. 2 shows how it was changed. A new spindle was made as at *A*, threaded at one end to receive chuck collar *B*: the other end received the clutch fingers *C*, as shown. A 1-in. hole was bored through the spindle. The spring chuck *D* has a taper of 16 deg. To close the chuck, clutch lever *E* is moved to the left, the fingers pushing sleeve *F*, which is a ¾-in. pipe turned on the outside to fit the hole loosely, thus closing the spring chuck. Chuck collar *B* is made adjustable. *G* is the driving pulley.

The changes on the other end to suit requirements consisted in making a taper socket *H* to hold the drill and to secure the spindle from turning, which was done by drilling a hole in the casting, not quite through, and inserting a ¾-in. rod passing through pulley *I* and fitting in keyway *K*. The rod was put in place and then the spindle with the pulley dropped over it, the rod being just long enough to secure a free sliding movement of spindle *L*. In this way nothing was required to secure the rod in position.

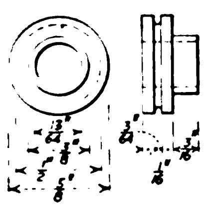


Fig.1

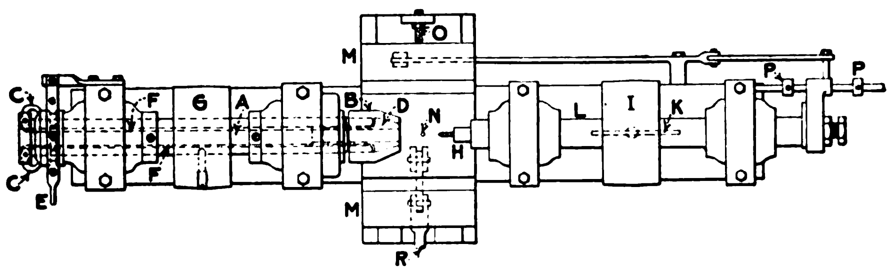


Fig.2

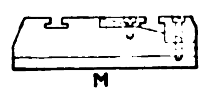


Fig.3

TRANSFORMING A SPINNING LATHE INTO A SCREW MACHINE

The tool slide *M*, which allowed only one side for a tool, was changed as shown in Fig. 3, the dotted line showing the original shape. The operation is as follows: The bar is pushed up to stop *N*, the tool slide being brought to the middle position, and the spring chuck closed. The tool slide carrying the forming tool (in front) is brought to adjustable stop *O*, thus forming the piece.

The drilling is now done, the drill being operated by the foot lever of the machine. This lever is arranged so that a force great enough to break the drill cannot be applied. The movement of the drill is adjusted at *P* and is brought back by a spring, not shown. Lever *R* is now raised, bringing the tool slide forward, and with it the cutting-off tool secured in the back, not shown. The boring tool is so constructed that while it forms the piece at the end of the bar it turns the ⅜-in. size of the next one to $\frac{13}{32}$ in., thus allowing a very narrow cutting-off tool. This saves stock. An oil pump keeps a steady stream of oil on the work. Within a few minutes the machine is changed to its original purpose, only one spindle having to be changed and the ¾-in. rod in pulley *I* removed. The whole alteration was made at a cost of $21, not including oil pump, and in production the machine equals a screw machine. C. F. Hahn.

New York, N. Y.

Turning and Threading an Axle Sleeve in One Operation

On a bearing sleeve of malleable iron, for use in adjusting the pinion in an automobile rear axle, it is necessary that the outside diameter and the thread on the barrel run concentric with the inside of the bore within a limit of 0.0015 in. The former way of getting this result was by rough and finish-turning on a lathe mandrel and then threading on a thread miller. This method required a lot of attention to keep the pieces within limits.

The accompanying illustration shows the set-up for an accurate and rapid process of completing the entire operation at one setting. An adapter *A* is screwed on the nose of the lathe spindle. A tool block *B*, carrying one finishing tool *C* and roller stop *D*, is fastened on the cross-slide of the compound rest. The tool block *E*, carrying the finishing tool *F* and chaser *G*, is fastened to the lathe carriage separate from the block *B* and is moved only as the chaser wears.

An air cylinder is fastened on the back end of the lathe spindle and operates the drawbar *H*, which carries a slotted washer *I* to permit the rapid removing and inserting of the pieces. This bar also has a removable pin *J* to push the work off the adapter.

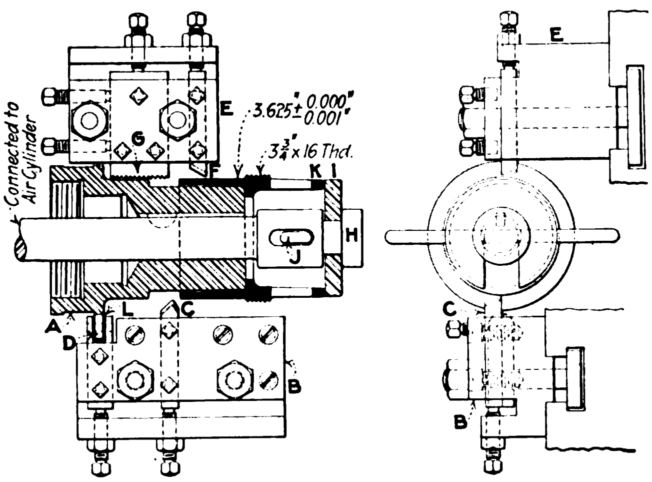
The casting *K* is placed upon the adapter and held firmly by the drawbar, collar and air cylinder. The tool block *B* is brought up to the work until the stop roller *D* comes in contact with a ground shoulder *L* on the adapter. This keeps all the lost motion of the cross-feed screw from interfering with the accuracy of the setting of the tool. Limit graduations are also noted

as a check and to guard against undue pressure on the roller stop.

A carriage feed of 0.020 in. per revolution of work and a surface speed of 180 ft. per min. are used with a cutting compound.

The finish-turning tool *F* is carried in a block separate from the finish tool *C*, to avoid any increase of pressure on the block *B* while turning the diameter of the barrel, 3.625 in. The finish-turning tool *C* is backed away from the work when the thread shoulder is reached. The lead screw is then engaged, the chaser *G* is carried across the work and the operation is completed. By reversing the air piston the casting is removed and the lathe carriage moved to the starting point before another casting is placed upon the adapter.

The castings are rough-turned, faced and chamfered on an adjoining lathe fitted with an air cylinder and adapter, and come to the finishing operation with 0.040 in. stock to remove from the diameter. The finish-turning



TURNING AND THREADING AN AXLE SLEEVE

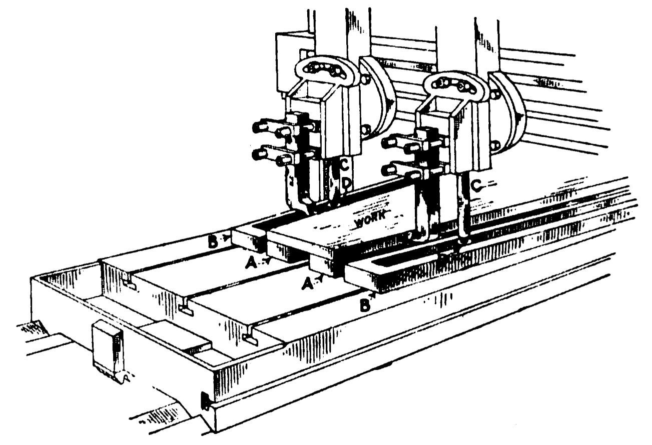
tool *C* is inverted so as not to stop the lathe when engaging the chaser *G*.

On the roughing operation the castings are completed at the rate of 29 per hr.; the finish-turning and threading is at the rate of 28 per hr. The chaser holds its edge from 3 to 5 days with one grinding and can be ground until it is but ¼ in. thick at the front. It is then annealed and recut at a small expense, thus reducing the cost of up-keep on tools.

Flint, Mich. CHARLES E. HENDRICKS.

Planing a Wedge-Shaped Part

In the illustration is shown a wedge-shaped casting the sides of which were to be finished. A widened planer was used, and owing to the size of the work it was not possible to set it up on one side at an angle and face the other side, as the work would not pass under the crossrail of the planer. The work was therefore placed on raising pieces *A* and clamped to the table of the planer in the ordinary manner. Strips *B* were fastened to the table of the planer, and their centers cut out. The strips were located at an angle on the table corresponding with the taper of the work. Studs *C* were screwed into the two saddles on the crossrail. The studs carry at their lower end a roller *D*, held by a collar fastened to the stud. These rollers run in the openings in the two strips. A uniform cut was taken on the side of the work, as the rough casting was tapered to correspond with the finished dimensions. During the operation the crossfeed screws were disconnected from the two heads on the crossrail,



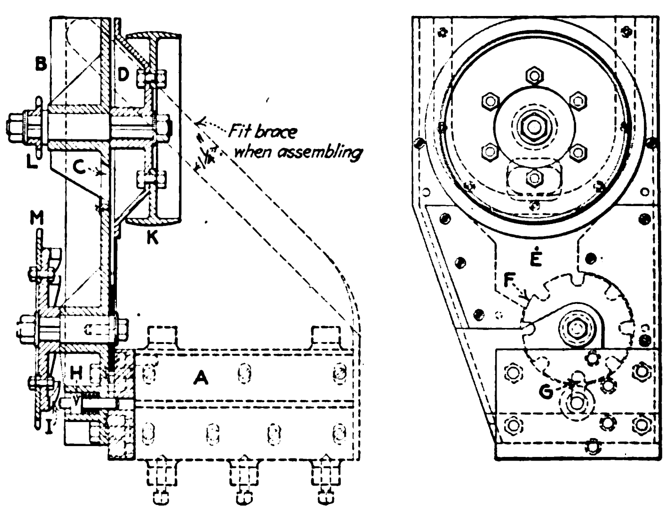
MACHINING A WEDGE-SHAPED PART

and the rollers running in the openings in the strips cause the cutting tools held in the two heads to move along the desired path to machine the face of the work properly. W. C. MAKLEY.

Birmingham, Ala.

A Positive Automatic Grinder Feed for Small Roller

An automobile concern in Milwaukee had to grind the outside of rollers $\frac{7}{16}$ in. in diameter and $\frac{5}{32}$ in. thick in large quantities. It started out to feed these rollers by hand in the grinding fixture *A*. This was too slow an operation and a positive automatic feed was designed,



POSITIVE AUTOMATIC FEED FOR GRINDER

which was later attached to the grinding fixture. This materially reduced the cost of labor, as one boy can operate three or four machines.

The unground rollers are put in a pocket *B*. From here they drop through an opening *C* in the cast-iron base into a hopper *D*, which keeps the rollers moving and drops them in their flat position into a pocket *E*. If

this pocket is filled, no more rollers can drop, the remaining ones staying in the hopper.

A wheel *F*, having notches fitting the rollers, takes them from this pocket one by one and drops them in a slot *G*. Here a pin *H*, operated by a cam *I* and a spring, feeds the rollers in the grinding fixture *A*, taking tne place of the boy previously operating the machine.

The cam *I* is shaped in such a way as to assure a slow forward and quick backward motion of the feeding pin *H* coming next to a continuous feed.

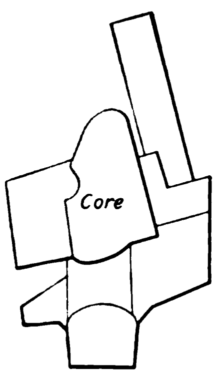
The hopper is driven by pulley *K*, which is screwed directly to the hopper *D* and keyed to a shaft on which the sprocket *L* is mounted. The latter is connected by a chain with sprocket *M*, which drives the feeding wheel *F* and cam *I*, which operates the feeding pin *H*. The feeding mechanism is very simple and reliable, as can be seen from the illustration. P. BALDUS.

Milwaukee, Wis.

Making a Duplicate Core Box

In replacing a worn-out core box, I have found the following method a great saving in time.

Fig. 1 represents a pistol core. In making a new core box, in place of adding stock onto the halves of the forms for allowance in finishing up the face of the two halves,



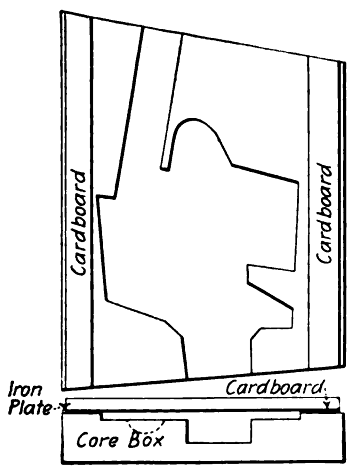


FIG. 1. A PISTOL CORE FIG. 2. MAKING THE CAST

I place two strips of cardboard on each half of the old core box, as in Fig. 2, place a strip of metal between, then pour each half with white metal.

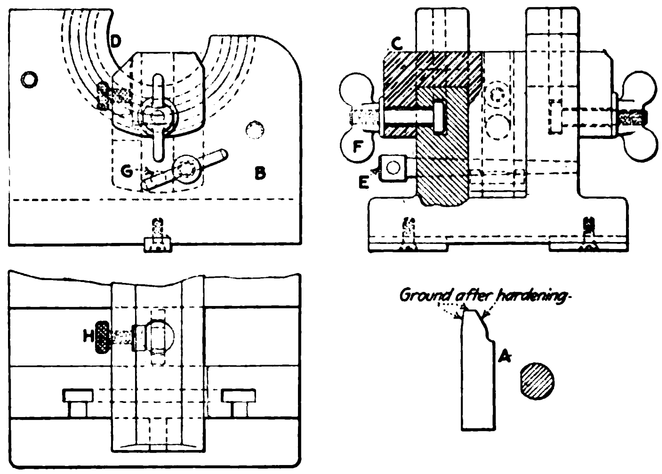
The two halves have enough stock to allow for finishing. A fin is left all around the form, but it can easily be removed. I next take the two forms and place them on a flat plate, pour the plaster over the form and have a perfect model with stock allowance for finish.

Naugatuck, Conn. A. E. HOLADAY.

Three-Position Locking Pin Grinding Fixture

The tool-steel locking pin shown at *A* had to be ground on three surfaces after hardening as shown, and these surfaces had to bear an exact relation to each other.

The fixture used is shown in the illustration. It is composed of a body with two projections finished on each face and a steel block *C*. This block is turned to fit the bored surface *D* of the casting, and by a taper pin *E* it is located in the three positions necessary to produce the proper shape of the pin. After it is located, it is clamped by two T-bolts *F*. The piece is slipped into the hole in



THREE-POSITION GRINDING FIXTURE

the block against a pin *G* and clamped by the screw and shoe *H*. P. P. FENAUX.

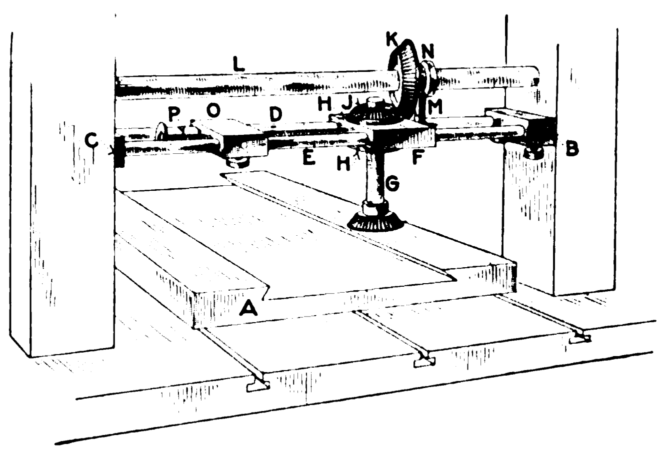
Newtonville, Mass.

Machining Dovetail Slot

At *A* in the illustration is shown a part in which it was desired to mill the dovetail shown. A planer large enough to handle this work was not available, and a horizontal boring, drilling and milling machine was used with the home-made vertical milling attachment described.

This particular machine had power crossfeed to the two columns carrying the spindle and outboard bearing, and the two crossfeed screws for traversing the columns were connected together so as to move the spindle and the outboard bearing crosswise together. Owing to the dimensions of the work, which measures several feet in width and length and only a few inches in thickness, it was not desirable to set it up on end. It was therefore clamped to the bedplate of the boring machine.

The plate *B* has two holes drilled in it and is bolted to the face of the main column of the machine, while the



MACHINING DOVETAIL SLOT

plate *C* with two similar holes drilled in it is bolted to the housing of the outboard bearing. Two rods *D* and *E* are held in the plates *B* and *C* by means of setscrews, and the casting *F* has two holes drilled in it to fit the rods *D* and *E*, on which it is mounted, being a sliding fit.

Another hole was drilled in the casting *F* at right angles to the two holes for the rods *D* and *E*, in which was placed the vertical spindle *G*. This spindle is held in the casting *F* by means of two collars *H* fastened to the spindle. A bevel gear *J* is keyed to the vertical spindle, and another bevel gear *K* is mounted on the bar *L*, turning with the latter by means of a spline. This bar was mounted in the regular spindle of the boring machine and supported at the other end in the outboard housing. The plate *M* is bolted to one end of the casting and engages with the part *N* fixed to the bevel gear *K*. The casting *O* is also mounted on the two rods *D* and *E*, being held from moving on these bars by means of setscrews.

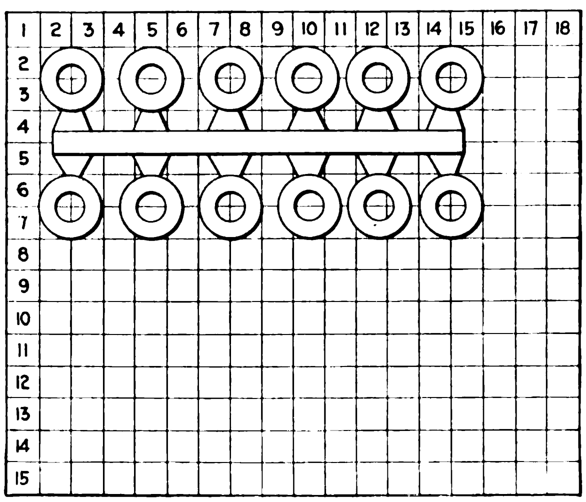
A hole is tapped in *O*, in which the feed screw *P* is placed; the other end of the screw *W* is fastened to the casting *F*, the connection being such that the screw is free to revolve in the casting *F* but will move the latter along the rods *D* and *E* when rotated. A handle is fastened to the screw *P* for turning it. By means of this screw the vertical spindle *G* may be moved along the two rods *D* and *E* as desired. As the casting *F* is moved on its rods, the bevel gear *K* is also moved on the bar *L* by means of the plate *M*. A suitable milling cutter was fixed to the bottom of the spindle *G*. W. C. MAKLEY.

Birmingham, Ala.

"Checkerboard" To Be Used for Laying Out Patterns

This device is used in laying out loose patterns to be gated, to ascertain the size of flask required, and for patterns already gated.

The illustration shows a gated pattern laid on the



CHECKERBOARD FOR LAYING OUT PATTERNS

board, allowing 1 in. of sand all around. This pattern takes a flask 8x16 in. A. E. HOLADAY.

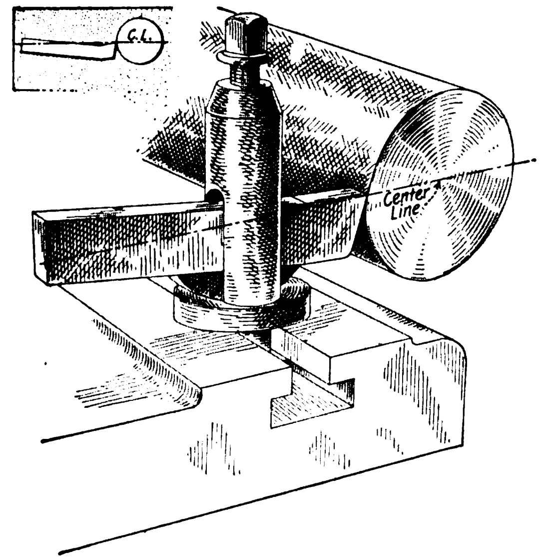
Naugatuck, Conn.

Cutting Off Steel in the Lathe

Much has already been said about parting steel in the lathe, and poor cutting lubricant is generally blamed for chattering and digging in of the tool. The cutting lubricant used has an effect on the length of time the tool may be used before resharpening, but has little to do with either chattering or digging in.

If the parting tool, when used in either the engine lathe or bench lathe, is inclined as shown in the sketch, with the cutting edge set at the center line, no trouble will be experienced in parting stock.

While lard oil or a good cutting compound is preferred when parting steel, machine oil will help preserve a tool that is properly located in the lathe. The stock being



SETTING TOOL FOR CUTTING OFF

parted may be run at the same speed as would be used for ordinary turning, and once the cut is started the tool should be fed in without stopping.

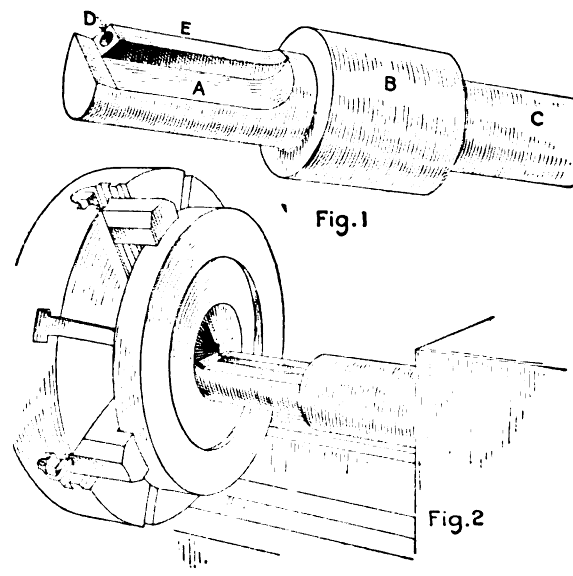
If the operator stops feeding for a moment while the piece is in motion, the tool, if slightly dulled, will produce a glazed surface that is hard for the tool to enter.

Newark, N. J. GUSTAVE A. REMACLE.

Saving Steel in Drill Design

The drill shown was designed with the intention of reducing the cost of high-speed steel.

A shows the drill proper, which is really a short bit fitting in the holder *B*. The shank of the holder fits into



SAVING STEEL IN DRILL DESIGN

the turret of the automatic screw machine. *E* shows a raised portion of metal on one side of the blade to take the $\frac{3}{16}$-in. oil hole *D*. Fig. 2 shows how the drill is used. About one-third as much high-speed steel is used.

Dayton, Ohio. RAYMOND W. BECKMAN.

Discussion of Previous Question

Counting Gear-Wheel Teeth

On page 1044, Vol. 43, H. L. Fletcher, writing on the counting of gear-wheel teeth, says, "Mark the space and you cannot go wrong." Now as there are as many spaces as teeth in a gear, it would seem to be as easy to go wrong in marking the one as the other.

But if one trains one's self to mark a tooth and count the spaces, then the chances of going wrong are materially lessened; but one must make a practice of it. It must be firmly fixed in one's mind; and always before counting the teeth of a gear, repeat the slogan, "Mark a tooth and count the spaces."

If, however, the gears are those in regular use, as the lathe change gears or those of the universal milling machine, they should not be counted more than once. They should then be marked with both the number of teeth and the pitch. Attention to this apparently small matter may easily prevent a costly mistake.

Some manufacturers of gear wheels have the number of teeth cast in, but many cases have been unreadable. The best way to mark the gears referred to is to stamp the numerals on both hub faces, taking care to remove any burr that may be thrown up. Large type should be used.

Most mechanics wipe the faces of the hub as well as the bore before assembling, so that they will hardly fail to observe the tooth number of the gear they are putting in use, if it is marked as here suggested.

Bournbrook, Birmingham, England. F. R. MANN.

[A common method used in the shop when counting gear teeth is to place a finger on a tooth and then count away from it. Then going around the gear, count all the teeth, including the tooth where the finger is placed.—Editor.]

Machining a Large Albro Wheel in a Small Lathe

On page 1062, Vol. 43, Mr. Mullin tells how he cut a worm of the Albro type in an engine lathe. He says that by this method he got "a very good job." How he got it is more than I can understand.

Let the figure represent the set-up for the job. I will use his lettering as far as possible. D represents the center of the milling-machine vise and AF the tool; FG is the link connecting the end of the tool with the carriage.

If his illustration is assumed to be to scale, the work occupies about 48 deg. of the circumference of the gear. Therefore in the extreme position of the tool (AF) the angle FDM equals 24 deg. and the line DY equals DF, sin 24 deg., or 11.25 sin 24 deg. = 4.575 in.

Assume the lathe to turn through one revolution. The carriage advances 1 in., throwing the tool into the position A_2F_2. DX then equals 4.575 in. — 1 in. = 3.575 in., and the angle $F_2DM = \sin \frac{3.575}{11.25}$ in.

In other words the angle F_2DM equals the angle whose sine is 3.575 in. ÷ 11.25, or 18 deg. 30 min. A 1-in. movement of the carriage when the tool is at the end of its swing turns the tool through an angle equal to 24 deg. — 18 deg. 30 min., or 5 deg. 30 min.

When the tool is in the position A_3F_3, the point F_3 is ½ in. from the center line. A 1-in. movement of the carriage moves the tool to A_4F_4 through an angle equal

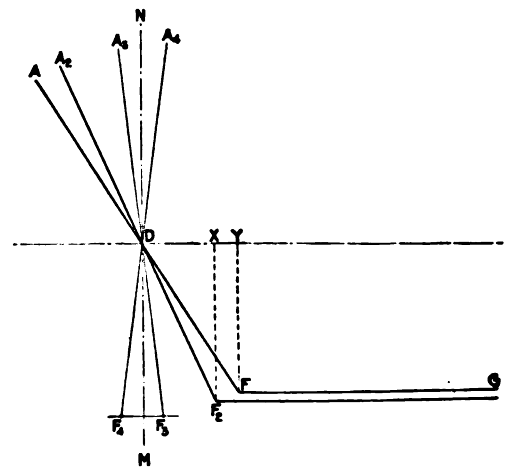


DIAGRAM OF TOOL PATH

to twice the angle whose sine is 0.5 ÷ 11.25, or 5 deg. 6 min.

The difference in the two movements amounts to 5 deg. 30 min. — 5 deg. 6 min., or 24 min., which on the 25-in. circle of the gear is equal to a difference of 0.086 in. This means that the thread on the worm is 0.086 in. thicker at the end of the worm than in the middle, which would not produce "a very good job"!

Lafayette, Ind. V. A. TRASK.

Effect of Oil in Cutting Off

The article by I. Kempt, page 936, Vol. 43, should be carefully read and remembered by all mechanics. The effect due to changing the liquid used as a coolant in machine operations has not received anything like the attention that it deserves. Mr. Kempt tells us that changing from a poor oil to a good-grade lard oil made all the difference between bad and good results in cutting off.

As I have recently had several opportunities of realizing the beneficial effects that may be obtained by changing the coolant, perhaps a recital of some of these will be both informative and interesting. That a change from oil to water-compound is an advantage when machining certain classes of steel is fairly well known among shop men, yet too often this simple fact gets overlooked.

The three following experiences will serve to illustrate the effects of such a change. The first of these occurred on a broaching machine. Here a set of spline broaches that had previously worked well began to act badly by dragging pieces out of the end of the work. After the

broaches were sharpened, they still tore the work. Knowing the benefit of using a thinner liquid for broaching, we changed from oil to a water compound. The result was entirely satisfactory; so much so that whenever we find broaches beginning to drag—this is usually on very tough heat-treated material—we change from oil to compound.

Another occasion when compound succeeded where oil had failed was on a Potter & Johnston automatic. The job was a spherical seat for a rod end used for steering an automobile. This work had been done previously on a turret lathe with success, yet when it was put on the automatic, with practically the same tooling, poor results were obtained. The finishing tool—a hemispherical balling tool with five cutting edges—dragged very badly.

A little thought soon showed that the solution—from previous practice—was to use a coolant. When this was done, the hemispherical tools produced the excellent finish we were accustomed to.

Yet another example is taken from a recent occurrence on a Cleveland automatic. A small die head, used for producing studs, began to cut anything but a correct thread. After trying the usual remedies, such as testing the alignment of the die head and changing the lead of the chasers, and still getting poor results, the operator pumped the oil from his machine and substituted water compound. Then the threads were everything desired.

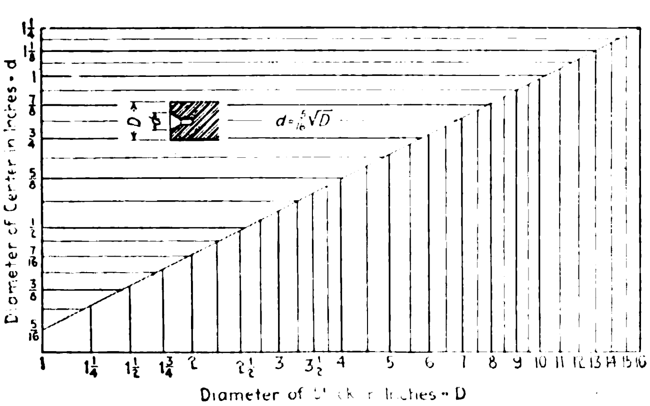
These three examples will serve to show the effect of using a thinner coolant. The name of the compound used has not been mentioned, because there is no reason to believe it is better than others. In fact, we have every reason to suppose that any strong solution of soda water, with which a small quantity of oil had been thoroughly incorporated would have given better results.

Guildford, England. WALTER G. GROOCOCK.

Lubricating Lathe Centers

The question of lathe centers, raised by Mr. Prince on page 866, Vol. 43, is a question of correct proportion between the diameter of the center and the diameter of the work. Lubrication is of course necessary to all bearings, but it is essential first to provide sufficient bearing surface. With larger work and heavier cuts the pressure on the centers increases; and to keep the pressure a minimum per unit area, the centers must be increased.

Carl G. Barth, while with the Bethlehem Steel Co. in 1900, concluded from a large number of observations that the diameter of the centers varies according to the



DIAMETER OF CEN... TURNED WORK

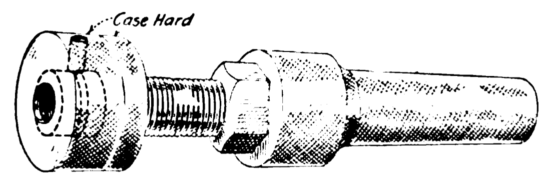
square root of the diameter of the work. It is with the permission of Mr. Barth that I give his empirical formula based on these observations; $d = C\sqrt{D}$, in which d equals diameter of centers, D equals diameter of work and C is a constant. Values of C between $\frac{5}{16}$ and $\frac{3}{8}$ have been used with very satisfactory results.

The accompanying chart, giving the diameter of centers for a range of work from 1 in. to 16 in. in diameter, was plotted from Mr. Barth's formula, using $\frac{5}{16}$ for C. These sizes of centers have been found to give satisfactory results. S. J. AURELIUS.

Chicago, Ill.

Adjustable Stop for Automatic Screw Machine

At our plant we have 150 Cleveland automatic machines working on bar stock. I have found that although just such a stop as shown on page 80, Vol. 44, by John Hoffman is good, the end of it will wear—from the stock revolving against it when being placed in the machine—



IMPROVED STOP FOR AUTOMATIC MACHINE

and the accurate lengths of the pieces to be machined are lost.

The accompanying illustration shows a similar stop, excepting that it has on the end a loose collar that revolves with the stock. Our machines will run indefinitely on the same job, without any readjustment of the stop, and have been in use over four years.

Bridgeville, Penn. ROSS ANDERSON.

Machinist Instruction in the Public-School System

Regarding the time element in trade schools, all will admit that time must be considered sooner or later in the boy's shop life, but very few will agree when to begin. In my experience with boys it has been very evident that a green boy cannot be made to appreciate that a job must be done quickly and be well done or, in fact, what a quick or a good job really is. He knows nothing of shops, life or procedure; and while he may think he is working fast, he may really be traveling in a circle.

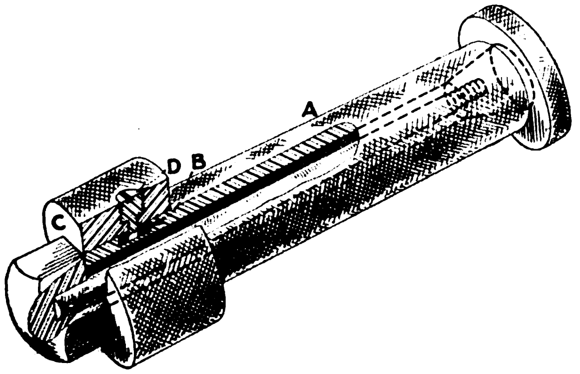
I think the first thing is to teach him what a good job is; that is, let him work on it until he gets a passable job, taking all the time he needs. This is accomplished in some schools by means of fixtures, eliminating all close work until the lesson is learned.

Once the boy can recognize a good job, gradually bring him up to a time limit—generally considerably more than a journeyman would take—but a time that will keep him hustling. If a boy starts out to hurry before he knows what is really wanted, he is much more apt to spoil work. I have seen boys take two weeks on a job at first that they would do in two days a month later.

Westfield, Mass. PAUL T. HARKNESS.

Best Way To Do Certain Things

I was as usual intensely interested in Professor Sweet's article on page 936, Vol. 43, on the "Best Way To Do Certain Things." J. P. Poland's contribution on page 35, Vol. 44, in extension of the same subject and treating of the proper method for discharging collets from spindles, brings to my mind a similar problem in relation to a machine in which the spindle was fitted with ball bearings and the collets were frequently changed by inexperienced help. Here, any pounding on the spindle



METHOD OF EJECTING COLLETS

draw-in rod would quickly destroy the bearing. While the solution of the problem is not as simple mechanically as Mr. Poland's differential screw, it has the advantage of being operated in the ordinary way.

In the illustration the spindle *A* is shown grooved for the split ring *B* and drilled for the end of the screw *D,* which holds the collar *C* from endwise movement in relation to the spindle *A*. The draw rod *E* is pinned to the collar *C,* which is milled on the end for a standard hexagon wrench. G. C. HERZ.

New York City.

Notes on Small-Tool Design

Referring to the article on page 59, by Mr. Wilder, I notice that Fig. 8 calls for a fish-tail cutter such as is used in a Pratt & Whitney spline milling machine, but the illustration is not correct. Cutters used in this machine have straight shanks, the small machine taking $\frac{5}{16}$-in. diameter shanks and the large machine $\frac{7}{16}$-in. shanks. When the diameter of the cutter is smaller than the diameter of the shank, these cutters are made double ended; when larger, single ended. They are as a general rule cut on a 15-deg. spiral. On cutters ½ in. and up, three and four teeth are used, three teeth having been found very satisfactory. Of course there is the disadvantage of not being able to measure the three-tooth cutter after it is once ground.

The point of the tool shown in Mr. Wilder's Fig. 8 is all right where a square corner is required, but stock fish-tail cutters are made up as shown in the illustration, Fig. 1, in which case the tool will cut a slot clear through the work, or it will leave a small bevel at the bottom of the cut.

Mr. Wilder shows two cutters, Figs. 2 and 4, in which the hole is threaded to suit the arbor. I do not consider that a thread can be made satisfactorily in a cutter. On gun work the limits on the hole in a cutter are 1 + 0.0005 in., and on the arbor 1 — 0.0005 in., which means a tolerance of 0.0005. I do not see the advantage of threading a cutter over the shell end mill.

In Fig. 2 I show a pair of spiral interlocking cutters. This design of cutter is desirable when cutting on the outside diameter and sides. By making the cutters this way they may be packed as the sides wear, materially increasing their life; also there is not the drag on one side of the cutter that is bound to occur when there is one spiral, either right- or left-hand.

While Mr. Wilder has given some interesting data as to the number of teeth in comparison with the diameter of the cutter, I would say that there is another matter that enters into this problem. It is a well-known fact that, for gun work in particular, the finer the teeth the better finished the part will look. I have found that with cutters up to and including 3 in. in diameter the circular pitch should be pretty close to $\frac{5}{16}$ in.

Eccentric-relief cutters can be figured about the same way, taking as a pitch circle one-third the difference

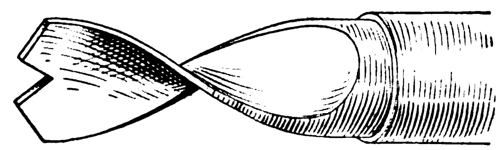
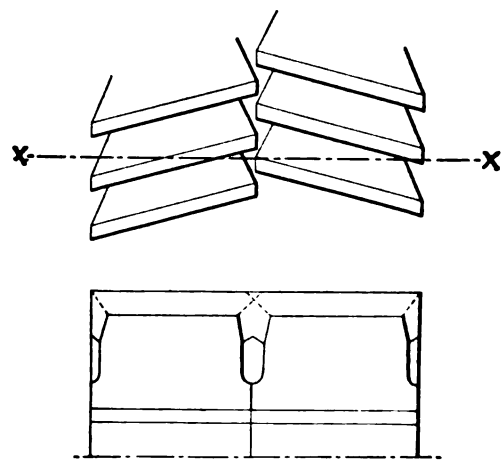


Fig. 1



Section X-X

Fig. 2

POINTERS ON SMALL-TOOL DESIGN

between the minimum and the maximum diameters of the particular cutter in question. The gashing cutter should be about 35 deg.

The circular pitch may increase from $\frac{5}{16}$ to $\frac{7}{16}$ in. on cutters 6 in. in diameter. J. W. MAYNARD.

Hartford, Conn.

Small-Shop Planers

I have followed J. H. Van Deventer's small-shop series with great interest and believe it to be a valuable contribution to the technical literature of the day.

Referring in particular to the article, "Small-Shop Planers—II," page 889 of Vol. 43, I find the statement, "The center of a planer bed should be set one or two-thousandths higher than the ends," to which I humbly take exception. While the error of one or two-thousandths is not much, it will have a tendency to cause the planer platen to develop a bow at the center. This feature is

therefore undesirable, as it aggravates the usual causes of a bowed planer platen.

As is well understood, the usual causes of a bowed planer platen are, first, the planer platen overrunning the planer bed; and, second, the planer platen is usually peened and stretched on the center of the top surface, as this is the place at which the castings are usually strapped to the platen.

It therefore seems wrong to set the center of a planer bed one or two-thousandths higher than the ends. Probably the best way to set a planer platen is to set it as nearly as possible to a true level and horizontal plane.

Mr. Van Deventer has picturesquely described the old planer in the following words, "These hale and hearty old boys are slow movers, being geared to run between 15 and 20 ft. per min. on the cutting stroke." I find that old planers can be advantageously respeeded to 40 or 60 ft. on the cutting stroke without serious inconvenience or excessive maintenance. However, it is necessary to select carefully a satisfactory means for driving. One method that I have found successful is to replace the usual pulleys with cork-insert pulleys, sometimes cork-insert aluminum pulleys; and I would add, where Mr. Van Deventer suggests using a double belt, a double belt well stitched, which will then give little trouble from stretching.

When possible to respeed a planer by changing the gearing, this method is preferable to changing the size of pulleys, provided the power of the belts is sufficient. The old planer equipped as stated will do practically as good and as rapid work as a modern planer, provided it has received good treatment and is properly maintained.

One of the most interesting features of this same issue of the *American Machinist* was the advertisement of the Cleveland Automatic Machine Co., pages 26 and 27, illustrating the fact that its mechanics get the right tools at the right time, at the right place—and probably in condition to be used—thus eliminating the lost intervals that Mr. Van Deventer has so frequently referred to. Small-shop owners, however, cannot hope to approach the ideal here referred to, but all shops, large and small, should strive harder to approach this ideal.

ROBERT E. NEWCOMB,
Superintendent, Deane Steam Pump Co.
Holyoke, Mass.

What's the Matter with Our Methods of Threading?

I noticed with special interest your editorial on methods of threading and also the subsequent article on page 173, by P. W. Abbott. While there are many good suggestions in this article, it is my opinion, based on 15 years' experience in making and using taps and dies, that some of the statements are misleading.

In the first place, as to the kind of dies best adapted to automatic screw-machine work, it is my opinion that the round adjustable die is the least economical. It is very evident that a round adjustable die that has been made 0.005 in. oversize, lapped to get a high polish, and then adjusted down until it is of proper cutting size will not be round. Therefore, it is practically impossible to make this die cut on more than two lands.

Another difficulty with using round dies, or with using any solid die, especially on material of a tough nature, is that there are as many threads spoiled while the die is coming off as while it is going on. This is due to the fact that, when the die stops cutting and reverses, there is a chip left sticking out in front of each cutting edge. As the die runs off, this chip must be broken off by the cutting teeth that come next in front, if as often happens, the chip does not break, the cutting tooth snaps instead.

The concern with which I am connected has decided, after using all kinds and nearly all makes of dies, to use opening dies wherever it is possible to do so. We are now using them on Gridley four-spindle and Brown & Sharpe automatics, doing work as small as ⅛-in. screws. While it is of course true that some self-opening die heads are not accurate, this is certainly not true of all of them.

It is my opinion that most people do not realize how much depends on getting correct lead. A variation of 0.002 in. per inch of lead is a good deal more serious defect in making a screw than twice that amount in diameter. If the screw is off in lead, it may appear to fit fairly well when it is new; but it will soon wear loose.

We do not consider a saw-tooth lead gage 1 in. long a proper tool for measuring a screw 4 in. long. We use lead gages 4 in. long on 4-in. screws. The screw must fit without any shake whatever, in order to pass inspection.

The lead of the screw is affected not only by the kind of material being cut, but by whether the die is sharp or dull, whether it is properly ground and also by the kind of cutting lubricant used. It is my experience that, contrary to the opinion expressed by Mr. Abbott, if you want to get good threads you must use good oil. We have found the so-called "fancy high-priced oils" the cheapest in the end.

Every tap and die manufacturer, as well as every screw manufacturer, is thoroughly aware that the V-thread is something that we have had "wished" on us. It has no excuse for existing. It not only costs more to make taps and dies and screws with this form of thread, but the taps and dies are not nearly as efficient after they are made. This inefficiency of taps and dies also applies to the Cadillac thread, which is half V and half U.S.S.

It is our experience that if taps are made at least 0.002 in. oversize on the outside diameter and the screws are made at least 0.002 in. undersize on the outside diameter, there will be no binding on top of the thread.

If I was called upon to name the different styles of dies in the order of their efficiency for screw-machine work, I would name, first, the self-opening die; second, the solid adjustable die; third, the spring, or prong, die; and, fourth, as least desirable of all, the round, or button, die. By the solid adjustable die I mean a die on which all the chasers are adjusted radially.

H. E. WARREN,
General Manager, Mac-It-Parts Co.
Lancaster, Penn.

Effect of Varying Sulphur in Basic Open-Hearth Steel

In the reprint of Mr. Unger's paper, published on page 191, an erroneous impression may have been obtained by the substitution of the word "more" for "less" in both the synopsis and summary. The original wording, which should have been retained, was as follows: "The author does not advocate paying no attention to sulphur content of steel, but believes firmly that a steel containing less [not "more"] than 0.100 per cent. is not necessarily bad," etc.

Editorials

Every Man His Own Designer

Two years ago one familiar with American machine tools could walk through a shop and recognize the make of each machine by general and special features, without having to study its nameplate. Since the start of the European War, however, so many new designs have come into being that our old mechanical acquaintances are apparently being pushed into the background by numerous new machine tools that assert in no uncertain terms their ability to "knock spots out of the old fellows." This fact could hardly be expected to escape the notice of machine-shop men, and that it has at least set one man thinking is made evident by the following letter:

What is the matter with the old-established makers and designers of machine tools? It looks to me as if they have been asleep for the last 20 years; for if not, how is it possible that every Tom, Dick and Harry can at a few months' notice bring out a machine tool that will turn out work as fast as, if not faster than, the machines designed by regular machine-tool people?

In the plant where I am employed we have a large contract for shells, and I have observed that several standard makes of machine tools have been put to one side in favor of machines that we have designed and built ourselves, which are more satisfactory. I have traveled about the country quite a bit in connection with my work at this plant, and I have observed the same thing elsewhere.

What I want to know is whether machine-tool builders have been bluffing us all these years. It begins to look like it, when you see built in agricultural-machinery, printing-press machinery and textile-machinery plants tools that apparently hold their own with the old-timers.

A number of others have asked us this same question. Apparently everyone is going into the machine-tool business. Experienced makers and designers of machine tools are not alarmed at the prospect, however. They know that the problem of designing a machine for one special purpose is one of the easiest problems in the mechanical world—that it is not in the least comparable with their far more difficult problem of designing a machine that will be suitable for, and satisfactorily efficient on, a broad range of work.

The designer of a machine for making shells knows what his machine has to accomplish. His problem is written out on the blackboard in plain figures and falls into the kindergarten class. The designer of a general-purpose machine tool has his problem full of unknown quantities and must make a machine that will be efficient on jobs that he has never seen or heard of. One machine corresponds to the laborer whose daily task is confined to the specialized work of digging ditches; the other, to the highly trained tool maker who is able to perform a large variety of high-grade work. An efficient ditch digger is not hard to find, nor is an efficient special-purpose machine hard to design; but years of training must go to make a high-grade tool maker and years of experience into a high-grade machine tool.

The fact that some of these new machines do the work in less time than the old ones has no bearing on the problem. By building a machine with enough rigidity, enough belt power and enough tool lubrication it is possible to reduce any record that has as yet been made. There is not an established machine-tool builder in this country who could not, if he desired, bring out a machine for this special purpose that would equal or surpass, in producing capacity any now being produced outside of the machine-tool field.

The question might be raised as to why they do not do this. Why should they? Machine-tool building plants are working to their capacity and subletting work on their standard lines, which they are best fitted through experience to build and on which they are making a greater profit than they would make by building special-purpose machines.

It is a case of the demand exceeding the supply and of a lack of competition, brought about by unusual conditions that enable almost anything that resembles a high-powered lathe to be sold. When conditions again come back to normal, competition will solve the problem and there will be a good many specialized machines standing idle while the "old fellows" come into their own.

Working for Safety, and Safety in Working

From some quarters the idea has been advanced that safety efforts have been overdone. This sentiment is probably due more to the efficient advertising of leaders in the safety movement than to any particular statistics in the hands of the skeptical of actual safety work accomplished. If any objection is raised by one or another to the use of many and diverse safety appliances, there surely can be no objection, even by the most doubtful mind, to the authoritative words of the commissioner of labor in one progressive state, who recently said that since his state has adopted systematic safety regulations for all shops and factories the number of fatal and less serious industrial accidents has been materially reduced.

After all, the final test that must be applied to any movement of this kind is to establish the results accomplished; and the economic returns due to lower fatality and reduced minor accidents, which are now more readily measurable in dollars and cents than formerly, are apt to be enormously greater than the outlay of a relatively small amount for safety appliances. Of course, abuses on the part of some few factory inspectors must be expected now and then, and sometimes the protection requirements may seem impracticable in terms of the results that follow; but these factors do not change the underlying principle of conservation of life and limb.

To anyone accustomed only to shop conditions of 10 or 15 years ago the recent exhibit of the National Safety Council in Philadelphia was a revelation of the rapidly changed attitude toward the safety of the shop worker. The statistics alone of this active organization were of a surprising magnitude, and those doubting the sincerity of the forces behind the "Safety-First" movement, on entering these spacious exhibits were compelled to leave with respect at least for work thus far accomplished.

Among the most striking features of these exhibits were the devices and aids direct from the industries themselves, bearing testimony to the effectiveness of new methods to educate the foreman as well as the workman to the needs of greater safety; further, the first-aid booth, together with first-aid cabinets used in the plants of various industries, was also of suggestive value; and a booth erected jointly by the University of Pennsylvania and the local illuminating companies contained unusual demonstrations of artificial lighting in its relation to safety. In this last-mentoned booth a number of lathes were installed, each equipped with modern lighting methods; and two shop stairways, with landings, served as a basis for showing good and bad stairway and passageway illumination in their relation to accident prevention.

There can be no reasonable doubt of the fact that exhibits of this kind, supplemented by actual statistical data, have real value and have already served to begin the education of many persons in the basic ideas upon which the safety idea has been built. It is quite true that the continual emphasis of safety on all sides gives a first impression of excessive attention to this feature. On the other hand, personal safety is such a primary instinct to all normal minds that its appeal is direct and positive. It follows therefore that any item in industrial life so closely related to the welfare of the individual, even if often overlooked with resultant accidents, is far less apt to escape notice, if by frequent repetitions each person's attention is directed not merely to safety in the abstract, but to the why and wherefore of each phase of the situation.

If the conservation of the worker means anything at all, it surely is worth the effort that is rightfully being devoted to legitimate safety means; and the evidence on which conclusions are drawn should consist largely of the actual helpful results following any of the numerous efforts now being made.

In this movement the danger of familiarity breeding contempt must be guarded against.

Job-Hunting Technical Unions

Within six months three new technical or engineering societies have been formed in the Middle West. These are the American Association of Engineers, Associated Technical Men and the Engineering and Commerce Efficiency Society of America. The first two have headquarters in Chicago, Ill., the second in Cleveland, Ohio. No one questions the right of any group of men to organize for proper objects. But why have these societies been formed? Is there a temporary situation that their organizers are trying to meet, or are there fundamental needs of engineers that the older societies do not satisfy?

It has been stated that the reason for the upspringing of these three organizations can be found in the fact that in the Middle and Far West there are at present many unemployed engineers. Construction work is at a standstill, there is no immediate prospect of its reviving, and the jobless engineers are in a discontented, downhearted frame of mind. Support is found for this belief in the stated aims and purposes of these societies.

The object of the first mentioned association is stated in article 2 of the constitution, as follows:

> The object of the association shall be to raise the standard of ethics of the engineering profession and to promote the economic and social welfare of the engineering profession.

One means for accomplishing this aim is "by maintaining a service clearing house for its members."

The objects and purposes of the second society are stated thus:

> Whereas, Under the present conditions of the technical profession there exist unintelligent competition, a lack of coöperation and organization, which is resulting in a decreasing rate of compensation among technical men, a consequent low social standing and a general lowering of ethics and honor of the profession from the former high standard;
>
> Whereas, The failure to secure suitable compensation is preventing technical men from development and from discharging their obligations to society and from discharging the position in the social scale to which their professions entitle them;
>
> We, the body assembled, undertake to form an association which will weld together in a common bond of interest all those who may be justly considered as engaged in technical pursuits.

Apparently the third society has fallen directly in line behind its two immediate predecessors. From its code of regulations the following quotations are taken, being the first and last items under the heading "object":

> To promote questions and facts relating to social service, vocational opportunities, scientific and practical information.
>
> To maintain a mutual coöperative service department, a free employment exchange, for the convenience of the unemployed or unsatisfactorily employed members of the society. Notice of all technical or commercial openings to be sent to all members alike, without reservation, except for classification.

All three organizations thus have as one principal aim the hunting of jobs for members. They are after "material results" rather than professional or altruistic benefits. One is strongly reminded of the former Society of Engineer Draftsmen that had an uncertain existence for a few years and finally disappeared through consolidation with some other society with a similar record.

Another object of these societies, gathered from reading their literature—although it is not as boldly expressed as the purpose to help the unemployed or unsatisfactorily employed—is the wish for public recognition of engineers and a true valuation of their achievements. With this wish all engineers will sympathize. But it is very doubtful if any new society is needed to further this object.

All of the older national societies are wrestling with the problem of the position of the engineer in public esteem and during the last year more progress than ever before has been made to bring the engineer into his own. The selection of the Naval Advisory Board from the members of five of the national societies and the plan now being worked out to develop munition committees from members of these same societies are two of the most striking testimonials that have ever been given to the worth and importance of the engineer and engineering in public affairs.

Although all the national societies are formed to further professional objects and not to gain material benefits for their members, each one does help in bringing together would-be employees and prospective employers. The American Society of Mechanical Engineers perhaps does more of this work than any other. During last year it registered over 400 positions and from actual record placed over 100 men. It is impossible to keep the latter kind of record complete; unquestionably more men were helped than the figures show.

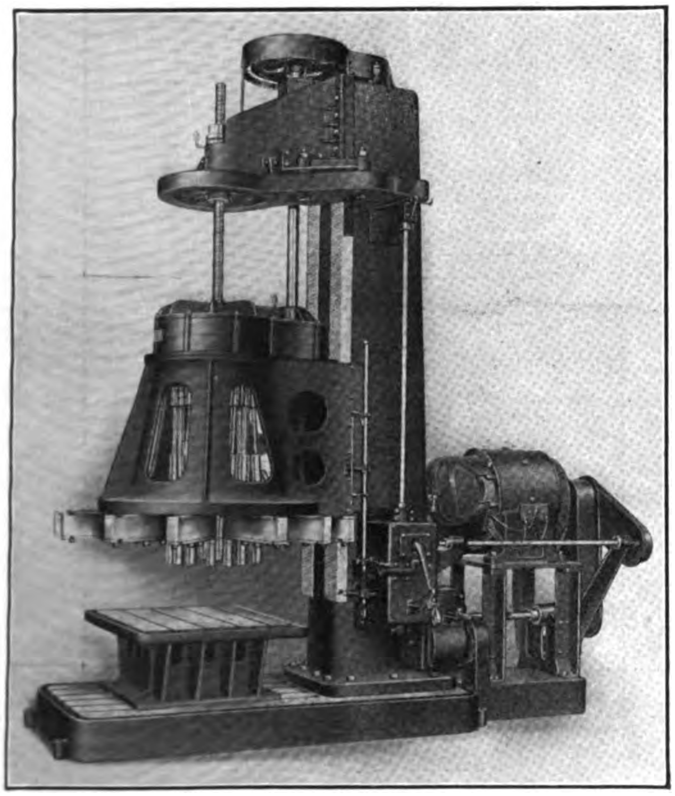
Any man before joining one of these newer societies should ask himself this plain question: Am I furthering the best interests of my profession by joining a society one of whose principal aims is to hunt a job for me?

Shop Equipment News

Multiple Drilling Machine

The special feature of the machine illustrated is the "center feed," the feeding pressure being in the center of the head, directly over the center of the drill layout, thus eliminating any tendency for the head to spring away from the guides on the post under heavy duty.

The head is 40 in. long, giving a long bearing on the post. and the gear chest is over the top of the head, giving long spindle connections and making a slight angle to the joints. The drive is by countershaft to the cone pulley, or by motor to the same shaft, through one pair of bevel gears and two pairs of spur gears to the spindle gear in the head. The bevel gears are of steel; the gears at the top of the post, of cast iron; and the gears in the head, of steel. The driving shaft to the head is 3¼ in. in diameter and runs at nearly the same speed as the drills. The feed screw is 3 in. in diameter, 2½ threads per in., Acme thread, and is fixed in the head, the nut being rotated. This nut is of bronze, the lower 10 in. being threaded, while the upper end is bored slightly larger than the screw, providing an oil pocket to insure good lubrication. The nut has a solid head on the lower end to take the feeding thrust and a large nut and check nut at the upper end to take the weight of the head, with a large ball thrust bearing at each end.



MULTIPLE-SPINDLE DRILLING MACHINE
Capacity, 16 spindles, 2½-in. drills in cast iron

There are two changes of feed, obtained by shifting the clutch lever on the lower part of the feed gear box. The feed is taken from the main cone shaft through spur gears (cloth pinion), through change gears to the worm and worm gear on the vertical shaft through the feed gear box, and spur gears near the top of the post to the feed nut. Quick motion of the head is obtained by a belt from the counter, or by silent chain from the motor, through bevel-gear reverse to the quick-motion sleeve on the vertical shaft. The feed clutch connects to the worm gear by a tooth clutch and to the quick-motion sleeve by a friction clutch.

The feed lever has a catch that locks it in place when the feed is thrown in. The catch is released by a knock-off rod, the rod first compressing a spring on top of the feed lever, so that when the catch is released, the feed clutch is thrown out, the quick-return clutch is thrown in, and the head is automatically raised to the up position. Quick motion down is obtained by reversing the quick-motion lever.

The bevel gears in the post also have ball thrust bearings, one of which supports the vertical shaft in the post, as do also the driving gear at the top and the driving and spindle gears inside the head. The spindles are equipped with ball thrust bearings. Roller bearings are used at both ends of the cone shaft and the vertical shaft in the post. All other bearings are bronze bushed.

The machine shown is the latest addition to the line made by the Baush Machine Tool Co., Springfield, Mass.

Automatic Hydraulic Lathe

The machine illustrated has been designed and built by the Lombard Governor Co., of Ashland, Mass. The spindle is belt driven through one pair of reducing gears, and in addition to rotating it advances longitudinally in its bearings, thus providing the feed movement. The power for feeding is secured through hydraulic oil pressure that acts upon the spindle as a piston. Oil is admitted through a needle valve, the opening of which is controlled by flat bar cams mounted on a control drum having a longitudinal movement synchronous with that

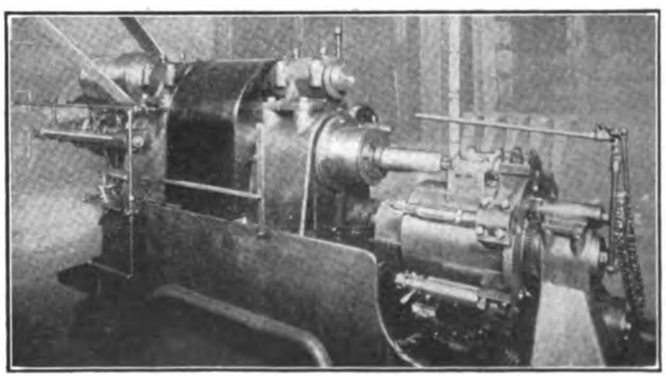


FIG. 1. AUTOMATIC HYDRAULICALLY CONTROLLED TURRET LATHE
Maximum swing, 12 in.; length of feed, 11 in.; turret drum, 14 in.; tool circle diameter, 19½ in.

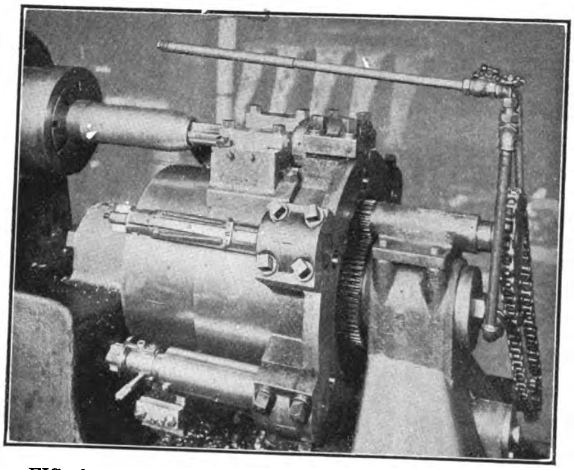


FIG. 2. TURRET AND TOOLS AT WORK ON 18-LB. HIGH-EXPLOSIVE SHELL

of the spindle and indexing with the turret, so as to present a different cam position for each turret position.

The turret is mounted on a horizontal axis and has no longitudinal movement. In the machine that has been constructed there are six turret positions, but in future machines it is proposed to add one more.

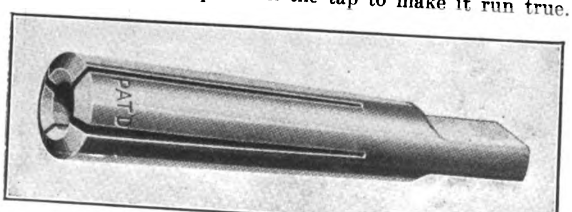
The machine is equipped with a split collet chuck for holding bar stock, corresponding to the rough diameter of British 18-lb. high-explosive shells. This chuck is operated hydraulically by means of a diaphragm that draws the collet back upon its tapered seat. The machine is geared to give a spindle speed of 120 r.p.m., and the feeds can be regulated from less than one-thousandth of an inch per revolution to one-quarter inch. A variable or increasing feed can be had by adjusting the slope of the cam bars. The revised design of this machine shows provision for a stop-valve that is to cause a dwell at the end of the feed movement when desired. The spindle return speed approximates 20 ft. per min. The weight of the machine is 6,000 lb.

As applied to machining 18-lb. British high-explosive shells, this machine has performed all the boring, tapping and outside turning and nosing operations, with the exception of band grooving, base finishing and cutting off, in 15 min. On this work two shells are turned from each piece of stock, one end being chucked while the other is operated upon.

Tap-Driving Chuck

The tap chuck shown is made of one piece of hardened steel entirely devoid of screws, pins or other separate devices.

The tap is held by the body of the shank and is not dependent on the square on the tap to make it run true.



TAP-DRIVING CHUCK MADE OF ONE PIECE

The chuck has a standard Morse taper and is readily inserted in the drill spindle. The construction takes care of a variation of $\frac{1}{32}$ in. in the tap-shank diameter.

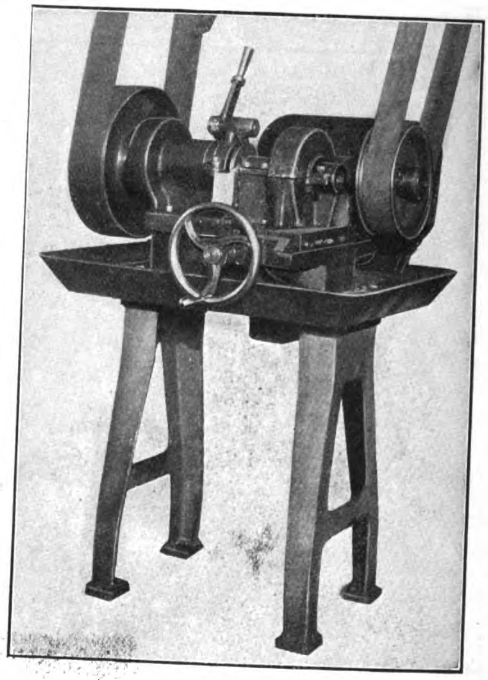
In this design the tap becomes a taper shank tool and is consequently conveniently handled and requires little room.

The tool is made by Scully-Jones & Co., Chicago, Ill.

Shell-Plug Miller

The machine shown was designed for turning and milling the threads of gas-check plugs for high-explosive shells.

All the operations of milling the thread, turning the outside diameter of the plug and facing it complete are performed in one chucking. The machine is equipped with oil pump, quick draw-in collet and automatic stop on all feeds.



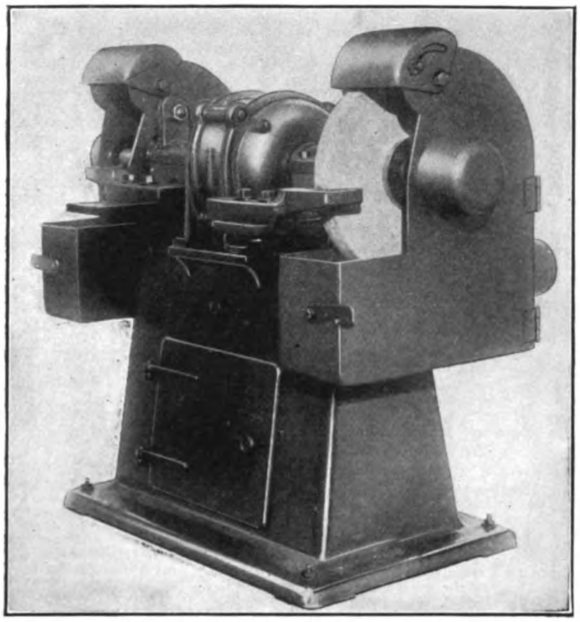
SHELL-PLUG MILLER

This machine is a late product of the A. R. Williams Machinery Co., Toronto, Canada.

Grinding-Wheel Guard

The entire guard shown, with the exception of the adjustable trap at the top, is made of boiler plate. The adjustable trap at the top is a steel casting held by large screws. The outer plate is hinged and can be opened to allow changing of wheels or cleaning out.

The guard has a box formation at the bottom, so arranged that the iron, or steel, and heavier particles from the abrasive wheel remain in the bottom of the guard, while the lighter particles, such as would otherwise float in the air, are removed by a suitable exhaust-pipe connection at the back. With this arrangement the exhaust pipes do not easily become clogged, and less damage is done to the fan. The sediment is easily



GRINDING-WHEEL SAFETY GUARD

Sizes regularly made for 16-, 18-, 20- and 24-in. wheels

removed from the guard by opening the door and cleaning with a shovel.

This guard is a recent product of the Ransom Manufacturing Co., Oshkosh, Wis., and is shown attached to one of its grinders.

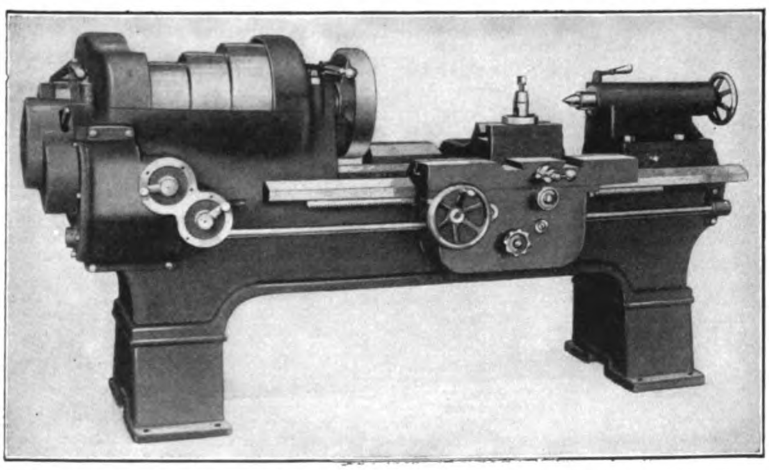
Heavy-Pattern Manufacturing 22 In. Lathe

While the lathe shown was designed along what have come to be considered single-purpose lines, it possesses practically all the features of the regular engine lathe, the screw-cutting feature being the only important omission.

The bed has an unusual vertical depth, and the rear carriage bearing is flat; the front bearing is a wide V. The headstock is of drop-brace construction, with the outside housing brought up to the center line of the cone. The cone has three steps—11, 13$\frac{11}{16}$ and 16⅜ in. in diameter for 5-in. double belt. The headstock is equipped with double back gears, giving ratios of 3.17 to 1 and 11 to 1. There are 18 spindle speeds, ranging in geometrical progression from 11 to 335.

The carriage has a bearing 32 in. long on the bed, which is 20¾ in. wide and is clamped down at the rear with a special device designed to insure easy movement of the carriage without backlash. The apron is of the box type, so constructed that all shafts have a bearing at both ends. Both feeds are operated by frictions. The feeds are positive geared through a quick-change gear box, giving six changes—8, 16, 24, 32, 64 and 96 turns to the inch.

The machine weighs about 5,000 lb. and is a recent product of the Economy Engineering Co., Willoughby, Ohio.



HEAVY-PATTERN MANUFACTURING LATHE

Swing over ways, 22 in.; length of bed, 8 ft.; swing over carriage, 13 in.; accommodates between centers, 3 ft. 1 in.

Military Reading for Civilian Engineers

By authority of the Secretary of War and in response to frequent requests, the following suggested list of reading is issued by the War Department for the information of civilian engineers desiring to inform themselves on military subjects.

These references have been selected, first, with a view to giving to engineers unfamiliar with the art of war a general survey of that subject, an understanding of which is the first essential to insure successful application of engineering knowledge and resources to military purposes; and second, with a view to setting forth, as far as practicable, the ways in which engineering is applied to military purposes and the means provided therefor.

Both military art and military engineering are progressive, and a considerable part of the latest and most detailed information published is available only in service journals of our own and foreign armies. This is particularly true of technical details of seacoast defense (including submarine mining), of field artillery, of military aviation, and the influence of these on military engineering. It is believed, however, that the fundamentals of each subject are well covered by the references given in this list. While the list is long, the relative importance of the various works is indicated, the suitable comments on each are included, so that persons using the lists of references may be able to select those which particularly interest them.

The references under each subject are generally divided into two groups, the first containing the more essential references, and the second those suitable for persons desiring to inquire further into the subject.

Suggestions looking to improvements of the lists will be gladly received.

A. MILITARY POLICY, CONDUCT OF WAR AND MILITARY HISTORY

Group 1

1. OFFICIAL BULLETIN Vol. 1, No. 2, Office of the Chief of Staff, Washington, D. C. (Especially pp. 21-39.) Publisher: Army War College, Washington, D. C. Free. (An official outline of the theory under which our forces are to be organized and administered.)

2. MILITARY POLICY OF THE UNITED STATES. Upton. May be obtained from Supt. of Docs.[1]; paper, 50c.; cloth, 65c. (A most valuable and comprehensive review of this subject.)

3. FIELD SERVICE REGULATIONS, 1914. May be obtained from Supt. of Docs.; 60c. (A condensed official statement of principles, methods and details of military operations.)

4. ELEMENTS OF STRATEGY. Fieberger, Publisher: U. S. Military Academy, West Point, N. Y. May be obtained from Book Dept.[1]; 75c. (A short outline, with historical illustrations.)

Group 2

5. CONDUCT OF WAR. Von der Goltz; translated by J. Dickman, Hudson Publishing Co., Kansas City, Mo. May be obtained from Book Dept.; $1.70. (The standard work on this subject, covering generally the same ground as 4, but more abstractly and elaborately.)

6. ON WAR. Clausewitz; translated by J. J. Graham; 3 vols.; K. Paul, Trench, Trubner and Co., 1908. May be obtained from Book Dept.; $6.60 (including postage and duty). (The greatest classic on the subject; a complete analysis of the phenomenon of war, and profound discussion of the mechanism thereof. Written early in the nineteenth century, it is still the foundation of modern military theory.)

6½. THE NATION IN ARMS. Von der Goltz. May be obtained from Book Dept.; $2.50. (An excellent modern work on war; less elaborate but more readable than Clausewitz.)

7. AMERICAN CAMPAIGNS. M. F. Steele; 2 vols. Publishers: Byron S. Adams Publishing Co., Washington, D. C. May be obtained from Book Dept.; $4.50. (In addition to careful historical surveys of all the campaigns from the Colonial Wars to the Spanish-American War, these lectures give extensive and valuable comments as to the military principles.)

8. A STUDY OF ATTACKS ON FORTIFIED HARBORS. Rodgers; Proceedings Nos. 111, 112 and 113, United States Naval Institute, Annapolis, Md.

9. LESSONS OF THE WAR WITH SPAIN. Mahan. Publishers: Little, Brown & Co., Boston, Mass. May be obtained from Book Dept.; $2. (Of special importance, as showing the true relation between our coast defense and our navy.)

10. REPORTS OF MILITARY OBSERVERS ON THE RUSSO-JAPANESE WAR. Part III, J. E. Kuhn. May be obtained from Supt. of Docs.; 60c. (In addition to an account of operations, this report contains valuable information as to fortification and siege work, organization and equipment.)

11. ORGANIZATION AND OPERATION OF THE LINES OF COMMUNICATION IN WAR. Furse, 1894. Publishers: Wm. Clowes & Sons, Ltd., London. (An old but comprehensive survey of this subject, with much historical information.)

B. PERMANENT FORTIFICATIONS

Group 1

(The references given cover chiefly the principles and general features of this subject; the details are mostly printed in unavailable form, either in service journals or in confidential documents. References to some of the former can be furnished, if desired.)

12. REPORT OF NATIONAL COAST DEFENSE. (Taft) Board, 1906. May be obtained from Army War College, Washington, D. C. Free. (The official project for harbor defenses of the United States. On account of progressive obsolescence of seacoast defenses, this project has been, or is being, modified, but still sets forth clearly the fundamentals.)

Group 2

13. LECTURES ON SEACOAST DEFENSE. Winslow. Publishers: United States Engineer School, Washington Barracks, D. C. Price, 50c. (Much of these lectures relates to technical details, and a considerable part is now obsolete.)

14. PERMANENT FORTIFICATIONS. Fieberger, 1900; United States Military Academy, West Point, N. Y.; $1. May be obtained from Book Dept. (While rather old, this work gives a simple presentation of the fundamentals on its subject, including an historical outline. A revised edition will soon be published.)

15. FORTIFICATIONS. C. S. Clarke. Dutton & Co., New York; $4.50. May be obtained from Book Dept. (A treatise on the same lines as 14.)

16. PRINCIPLES OF LAND DEFENSE. Thuillier, 1902; Longmans, Green & Co. May be obtained from Book Dept.; $3.83. (A valuable work, covering the principles of both field and permanent fortifications.)

C. ORGANIZATION, EQUIPMENT AND DUTIES OF ENGINEER TROOPS

Group 1

17. FIELD SERVICE REGULATIONS, 1914. (See A. 3.)

18. TABLES OF ORGANIZATION, 1914. May be obtained from Supt. of Docs.; 25c. (These tables represent—subject to modification and within the limits of existing law—the approved policy of the War Department with regards to organization.)

19. OFFICIAL BULLETIN, Office of the Chief of Staff, Vol. 1, No. 4 (Appendix 4). Use of Engineer Troops. Publisher: Army War College, Washington, D. C. Free. (An official statement of the principles which should govern in the use of engineers, with practical suggestions.)

20. DUTIES OF ENGINEER TROOPS IN A GENERAL ENGAGEMENT OF A MIXED FORCE. Burgess. Publisher: United States Engineer School, Washington Barracks, D. C.; 25c. (Obsolete in some respects, particularly organization, but excellent in general scope.)

21. GENERAL ORDERS NO. 6, WAR DEPARTMENT, 1915. May be obtained from the Adjutant General, United States Army, Washington, D. C. Free. (Prescribes the training of Engineer troops.)

[1]The following abbreviations are used: Supt. of Docs., Superintendent of Documents, Government Printing Office, Washington, D. C. Book Dept., Book Department, Army Service Schools, Fort Leavenworth, Kan.

Group 2

22. STUDIES IN MINOR TACTICS. Army Service Schools, 1915. May be obtained from Book Dept.; 50c. (The principles of Minor Tactics are set forth by solution of a series of problems.)

23. TECHNIQUE OF MODERN TACTICS. Bond & McDonough, 1914; Banta Publishing Co., Menasha, Wis. May be obtained from Book Dept.; $2.55. (This work covers, in a very specific way, the principles of tactics for all arms, a general knowledge of which is essential for engineers.)

24. OPERATION ORDERS. Von Kiesling; translation. May be obtained from Book Dept.; 50c. (A lucid exposition, by use of assumed cases, of the operation of highly trained troops of all arms in various phases of battle.)

25. ENGINEER UNIT ACCOUNTABILITY MANUAL. May be obtained from Supt. of Docs; 5c. (Official lists of standard equipment supplied to Engineer battalions and companies.)

26. ORGANIZATION OF THE BRIDGE EQUIPAGE OF THE UNITED STATES ARMY, 1915. (Revised edition just going to press.) (Includes description of equipage and regulations for pontoon drill.)

27. OFFICERS' MANUAL. Moss; Banta Publishing Co., Menasha, Wis.; $2.50. May be obtained from Book Dept. (Treats of routine duties of officers, customs of the service, army organization, etc.)

28. MANUAL FOR COURTS MARTIAL. May be obtained from Supt. of Docs.; 50c.

D. FIELD ENGINEERING

(Military field engineering at the front differs from ordinary engineering work in the field, it being generally simpler, of a rough-and-ready character, and especially because of the limited equipment which can be taken along with the advance of an army and because of the necessity of working in strict subordination to the military situation. In rear of the army, on the contrary, conditions are very similar to those governing ordinary engineering operations, and civilian organization is suitable, subject to directions by the higher military staff. Little attempt is made in works on military field engineering to treat of general engineering methods.)

29. FIELD FORTIFICATION. Fieberger, 1913; John Wiley & Sons, New York. May be obtained from Book Dept.; $1.90. (In addition to technical details, this work gives valuable historical illustrations of the principles of this subject.)

30. FIELD ENTRENCHMENTS, SPARE WORK FOR RIFLEMEN. John Murray, London. May be obtained from Book Dept.; 40c. (A very up-to-date little work, especially on details.)

31. NOTES ON FIELD FORTIFICATION. Army Field Engineer School. May be obtained from Book Dept.; 30c.

32. ENGINEER FIELD MANUAL. Professional Paper No. 29, Corps of Engineers, United States Army; 3d addition, 1909. 500 pages. May be obtained from Supt. of Docs.; $1. (A very complete official pocketbook for engineer officers in the field, containing many tabular and technical data, as well as brief outlines of principles and methods. The subjects covered are: Part I, Reconnaissance; Part II, Bridges; Part III, Roads; Part IV, Railroads; Part V, Field Fortifications; and Part VI, Animal Transportation. A new revision of the manual is contemplated, but will not be ready within a year. The portion of the manual relating to field fortification, being somewhat obsolete, should be considered in connection with either 30 or 31 above. The portion relating to railroads is largely superseded by 35 below.)

33. NOTES ON BRIDGES AND BRIDGING. Spalding. May be obtained from Book Dept. (A small pamphlet on military bridging.)

34. MILITARY TOPOGRAPHY FOR MOBILE FORCES. Sherrill, 2d edition; Banta Publishing Co., Menasha, Wis., 1911. May be obtained from Book Dept.; $2.25. (Besides matter given in ordinary textbooks on surveying, this work gives in detail the special methods of sketching developed in the army for rapid military mapping.)

35. MILITARY RAILROADS. Connor; Professional Paper No. 32, Corps of Engineers, United States Army. Supt. of Docs.; 50c. (Intended to cover general administration of existing railroads for military purposes and the handling of railroads by military personnel in the advance sections where railroads cannot be operated by their regular civilian organizations, or where new railroads are required in the immediate vicinity of the army. Revised edition soon to appear.)

36. NOTES ON MILITARY EXPLOSIVES. Weaver; J. Wiley & Sons, New York; 1912. May be obtained from Book Dept.; $2.20. (Elementary notes on this subject will be found in the Engineer Field Manual and other references cited. This work is more elaborate.)

E. MISCELLANEOUS

37. REGULATIONS FOR THE ARMY OF THE UNITED STATES. Supt. of Docs.; 50c.

38. THE "VOLUNTEER LAW," approved Apr. 25, 1914; Bulletin No. 17. War Department, 1914. May be obtained from the Adjutant General, United States Army, Washington, D. C. Free.

39. GENERAL ORDERS NO. 54, War Department, 1914. May be obtained from the Adjutant General, United States Army, Washington, D. C. Free. (Covers examination of candidates for commissions as officers of volunteers.)

40. GENERAL ORDERS NO. 50, War Department, 1915. May be obtained from the Adjutant General, United States Army, Washington, D. C. Free. (Amends General Orders 54, 1914, as to examination of candidates for commissions in volunteer engineers.)

41. TREATISE ON MILITARY LAW. Davis; J. Wiley & Sons, New York. May be obtained from Book Dept.; $5.30.

42. ELEMENTS OF MILITARY HYGIENE. Ashbourne; new edition; Houghton, Mifflin Co., Boston, 1915. May be obtained from Book Dept.; $1.30.

F. PERIODICALS

43. PROFESSIONAL MEMOIRS. Corps of Engineers, United States Army, and Engineer Department at Large; bi-

monthly (formerly quarterly); Washington Barracks, D. C., Engineer Press; per year, $3.

44. THE ROYAL ENGINEERS' JOURNAL. Royal Engineers' Institute, Chatham, England; monthly; per year, $4. (American agents: E. Steiger & Co., 49 Murray St., New York.)

45. JOURNAL OF THE MILITARY SERVICE INSTITUTION, Governors Island, New York. Bi-monthly; published by the Institution; per year, $3.

46. JOURNAL OF THE UNITED STATES ARTILLERY. Bi-monthly; Fort Monroe, Va., Coast Artillery School press; per year, $2.75, including Index to Current Literature; without Index, $2.50.

47. JOURNAL OF THE UNITED STATES CAVALRY ASSOCIATION. Published by the Association at Fort Leavenworth, Kan.; per year, $2.50.

Standard Lock Washers for Machine Screws

The accompanying table gives the dimensions of lock washers adopted by the Society of Automobile Engineers.

STANDARD LOCK WASHERS FOR SMALL MACHINE SCREWS

No.	Screw Diameters: Maximum Body, In.	Screw Diameters: Fillister Head, In.	Lock Washer: Inside Diameter, In.	Lock Washer Section: Radial Width, In.	Lock Washer Section Thickness: Light, In.	Lock Washer Section Thickness: Heavy, In.	Counterbores Recommended, In.
4	0.112	11/64 (0.172)	(0.114)	1/32	0.022	1/32	3/16 (0.188)
6	0.138	7/32 (0.219)	9/64 (0.141)	3/64	1/32	3/64	¼ (0.250)
8	0.164	17/64 (0.266)	11/64 (0.172)	3/64	1/32	3/64	9/32 (0.281)
10	0.190	5/16 (0.313)	13/64 (0.203)	1/16	3/64	1/16	11/32 (0.344)
12	0.216	11/32 (0.344)	7/32 (0.219)	1/16	3/64	1/16	⅜ (0.375)
14	0.24	25/64 (0.391)	¼ (0.250)	5/64	1/16	5/64	7/16 (0.438)

It contains the dimensions of the machine screws by number, with the lock washer and size of counterbore recommended.

Building New Foundry Around an Old One Kept Working

A manufacturing concern in Canada, with a foundry 87 ft. long, 54.5 ft. wide and 17 ft. high to the top of the roof, got a war order that required the building of a new and larger foundry. The old foundry was running to capacity and could not be shut down till the new one was ready. The ground occupied by the old foundry and also to be utilized for a part of the new one.

To take care of all these conditions, the new foundry was designed with a length of 168 ft., a width of 73 ft. and a height of 18.5 ft. under the roof trusses. These

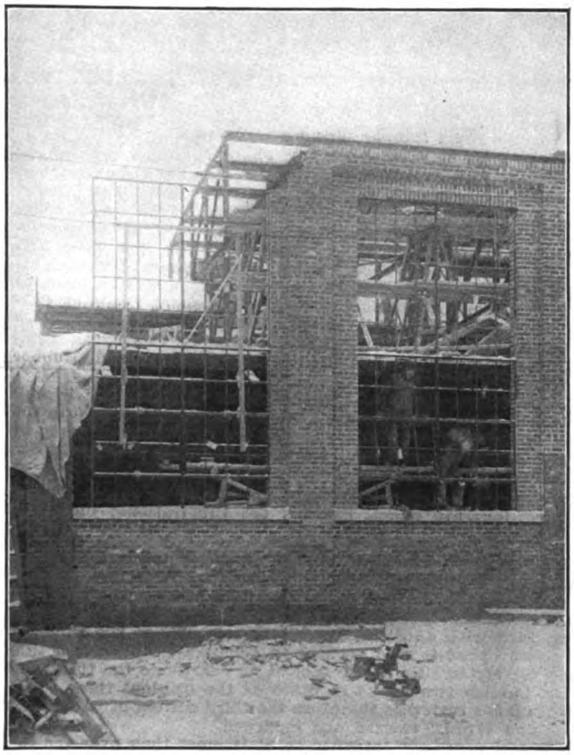


FIG. 2. JOINING UP THE NEW AND OLD WALLS

dimensions permitted the new foundry to be built entirely around the old one, as shown in Fig. 1. In the meantime business goes on as usual in the old foundry. When the new foundry is complete, the work will be done in a part of it till the old one is taken down and removed.

On the near side in Fig. 1 the new wall is outside the old one, but on the other side, shown in Fig. 2, the new and old walls are in line. The construction of the new wall, shown in Fig. 2, necessitates the removal of the old wall and a part of the roof, which is supported by shores.

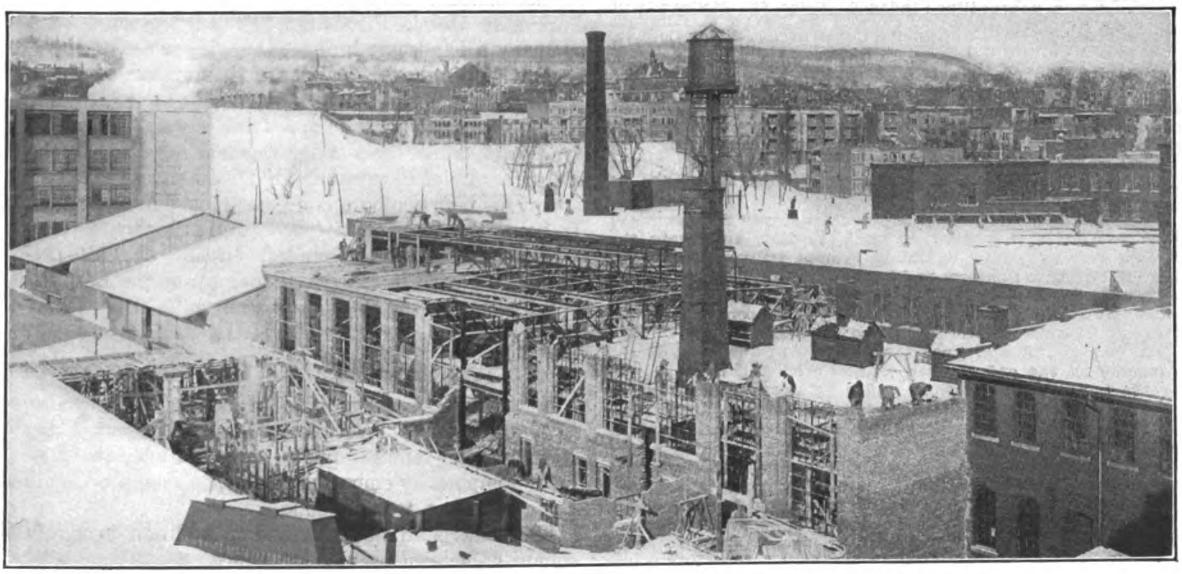


FIG. 1. BUILDING A NEW FOUNDRY AROUND AN OLD ONE WITHOUT SUSPENSION OF WORK

NEW PUBLICATIONS

RUBBER MACHINERY—By Henry C. Pearson. Four hundred and thirteen pages, 9¼x6 in.; 428 illustrations. Published by the India Rubber World, New York City. Price, $6.

This book is divided into 20 chapters which consider in detail the following subjects: The washing of Crude Rubber, Crude-Rubber Drying, Dry-Sifting and Batching of Compound Ingredients, The Mixing, or Compounding, of Rubber, Preparing Fabrics for Calendering and Spreading, Calenders, Clutches, Drives and Safety Stop for Mills and Calenders, Molds—Metal and Rubber, Vulcanizers—General Types, Vulcanizing Presses—Screw and Hydraulic, Tube-Making Machinery, Spreaders, Doublers and Surface Finishers, Doubling Calenders, Cement and Solution Machinery, Extraction of Resin from Rubber and Gutta Percha, Reclaiming, Conveyors, Temperature Recording and Controlling Devices and Rubber Laboratory Equipment.

The volume deals with each subject in detail and is well supplied with illustrations. The various machines used in the rubber industry are shown; and as the operations of many of these machines are described, much valuable information to anyone interested in the industry is given.

ADVANCED MACHINE WORK—By Robert H. Smith. Third edition; 575 pages, 5x8 in.; 609 illustrations; numerous tables; indexed; cloth bound. Price, $3. Industrial Education Book Co., Boston, Mass.

The author, who is in charge of the instruction in shop-work at the Massachusetts Institute of Technology, originally published three books on machine-shop work. The first two dealt with the elements and principles of machine work and the third with advanced machine work. When the time for revision came, it was decided to combine the first two into one, under the title of the second, to rearrange the third and thus publish two books in place of the original three. The work under review is therefore the third edition of "Advanced Machine Work," revised and enlarged.

The changes are intended to fit it more than ever for the student, instructor, apprentice, machine operator and machinist who wish to obtain a thorough grasp of the fundamental principles that lie at the basis of successful machine-shop work. It is divided into twelve sections, with these headings: Lathe Work (sections 1 to 5 inclusive); Drilling Jigs, Boring Bars and Eccentric Turning; Cylindrical Grinding; Surface Grinding, Cutter Grinding; Planing; Milling; Gear Cutting; Tool Making.

Generous recognition is due the enormous amount of labor involved in preparing this book. Its compilation and use disprove the idea that machine-shop work should be taught differently from other engineering subjects. On the contrary, the logical arrangement of the matter shows that it can be taught from fundamental principles as well as any other. The book should be a decided help to anyone who wishes either to learn or to teach machine-shop work.

PURCHASING—By C. S. Rindsfoos. One hundred and sixty-five 6x9-in. pages; illus.; indexed. Price, $2. McGraw-Hill Book Co., New York. (Reviewed by Dexter S. Kimball, Professor Machine Design and Construction, Sibley College, Cornell University.)

As the author of this book points out, considerable attention has been given to the art of selling and considerable literature bearing on selling has appeared. It is somewhat curious that so little has been written on the art of buying, since purchasing and selling are necessarily coexistent. The volume under consideration is devoted to the more important problems and principles of purchasing with a discussion of methods for departmental organization.

The subject is presented in 10 chapters as follows: (1) How to Obtain the Right Article; (2) How to Obtain the Lowest Price; (3) How to Obtain Prompt Delivery; (4) Making the Purchase Conform to Fixed Policy; (5) How to Obtain Favorable Terms; (6) Personal Characteristics and Qualifications; (7) Strategy; (8) Some of the Legal Aspects of Purchasing; (9) Departmental Organization; (10) Forms.

A very useful and important feature of the book is the summary at the end of each chapter giving a brief resumé of the important discussions and conclusions found therein.

The first three chapters, as their titles indicate, are devoted to the general methods by which successful purchasing is conducted. Chapter 4 is a discussion of the advantages of a concern having definite general policies and of making the purchasing methods conform thereto. Chapter 5 is a discussion of what constitutes favorable terms and how to obtain them. Chapter 6 contains a good discussion of the personal qualifications that a purchasing agent should possess. Quite properly the author lays stress on broadmindedness and warns purchasing agents that, in common with other specialists, they tend to become narrow and to come to believe "that the business is conducted to purchase material."

Chapter 7, entitled Strategy, is very interesting, for in it the author endeavors to show how the emotions can be used to assist in getting good prices. While he condemns so called sharp practice, he also frankly states that it is difficult to draw the line at what constitute sharp practice. One is led to wonder whether, after all, buying and selling cannot be conducted on a higher plane and entirely free from such methods as this chapter discusses. Is it really true that it is "sometimes necessary to display anger—to show one's teeth"? Most certainly it is not good ethics to include "sleepers," that is, statements so hidden as to pass unnoticed, even though the practice is legal; and, as the author states, it will not pay in the long run. It is to be hoped that both buying and selling will soon be on a much higher plane than they are now. Petty graft, wine dinners, etc. have practically disappeared from commercial transactions, and there is reason to hope that the near future will see, more and more, buying and selling done on a basis of fact rather than as an old fashioned horse-trade. Nevertheless, this chapter is well worth reading if for no other purpose than to see what some of the practices indulged in are.

Chapter 8 is a simple and brief discussion of the elementary legal principles of purchasing. Chapter 9 treats rather too briefly of departmental organization. It contains a lengthy extract from the purchasing system proposed for New York City by Richmond Smith. While this is an interesting and helpful document, the reviewer cannot but feel that the space it occupies could be better filled by several illustrative examples of purchasing-department organizations.

I cannot agree with the author's ideas regarding inspection of material, so far at least as manufacturing plants in general are concerned. He states that in cases where the inspection and tests are under the engineering department "the purchasing department will furnish the engineering department with a copy of the order and specifications in order that the engineering department may know what it is entitled to demand." As a matter of fact, the engineering department will in most cases furnish the purchasing agent with specifications so that he will know what to buy. This short but important section could be rewritten to advantage.

The last chapter is devoted to forms of various kinds including blank forms for contracts, no forms appearing elsewhere in the book; the preceeding chapters being devoted entirely to the philosophy of the subject.

The book will amply repay reading. It contains much valuable information and many very helpful hints.

Memorial Tablet to George Westinghouse

The Veteran Employees Association of the Westinghouse Electric and Manufacturing Co. at its third annual banquet, held Saturday evening, Jan. 29, in the Fort Pitt Hotel, Pittsburgh, Penn., presented to the company a handsome bronze memorial tablet of the late George Westinghouse, founder of the numerous industries bearing his name.

The memorial tablet is approximately 4x3 ft., made of solid cast bronze and weighs about 300 lb. It shows a true bas-relief likeness of Mr. Westinghouse taken from one of his best photographic poses seated in an armchair. It bears the inscription "George Westinghouse, Master Workman, Inventor, Founder, Organizer, 1846-1914." It will be placed in the reception room of the East Pittsburgh works of the electric company.

"Financially Embarrassed"

A young man claiming to be associated with Sleeper & Hartley, Inc., Worcester, Mass., is reported to be operating the familiar bunco game. Under the plea of being temporarily embarrassed for one reason or another, a request for a loan is made.

The man is an impostor and in addition to a refusal should be handed over to the police.

PERSONALS

H. Schneider has been appointed general foreman of the H. G. Saal Manufacturing Co., Chicago, Ill.

S. J. O'Niel, formerly with O'Brien Bros., Chicago, Ill., has joined the selling organization of the Moller & Schumann Co., Brooklyn, N. Y.

B. F. Russler, until recently general foreman of the American Car and Ship Hardware Co., New Castle, Penn., has been appointed superintendent.

Louis Kruger, until recently master mechanic of the Hygienic Manufacturing Co., Chicago, Ill., has become president of the Ultra Manufacturing Co., Chicago, Ill.

John W. Hertzler, for several years Western representative of the Bearings Company of America, has been appointed assistant manager, with offices at the home plant in Lancaster, Penn.

Kristian A. Juthe has been made chief engineer of the Wheelock, Lovejoy Co., Cambridge, Mass. His brother, J. Charles Juthe, is now superintendent of the manufacturing department.

OBITUARY

Alexander Saunders, president of D. Saunder's Sons, Yonkers, N. Y., died at his home in that city on Feb. 1, aged 78 years.

Richard S. Bryant, factory manager of the Standard Welding Co., Cleveland, Ohio, died at the Post-Graduate Hospital in New York City, on Jan. 24. Mr. Bryant was a recognized figure in the automobile industry and was the first to design a quick-detachable rim. He was a native of Kansas and was only 46 years of age.

BUSINESS ITEMS

The Royersford Foundry and Machine Co. has built an additional warehouse and added two stories to its factory in Royersford, Penn.

The Vanadium-Alloys Steel Co., of Pittsburgh, whose works are at Latrobe, Penn., advise that they are installing an additional thirty-pot crucible furnace.

M. A. Palmer Co., 151 Franklin St., Boston, Mass., has recently been organized and is handling tool steel, forgings and die blocks, crucible and openhearth steels. M. A. Palmer is manager.

The Wagner Electric Manufacturing Co., St. Louis, Mo., announces the opening of a new office in the Mills Building, El Paso, Tex., with F. B. Hitchings as local manager. The new office is under the supervision of O. H. Davidson, district manager.

CATALOGS WANTED

The Crown Optical Co., Rochester, N. Y., would like to receive catalogs from manufacturers of machine-shop equipment.

The O'Brien Machinery Co., 107 North Third St., Philadelphia, Penn., want catalogs, price lists and jobbers' discounts on machine tools, steam and electrical equipment, woodworking machinery and supplies from manufacturers wanting representation in that territory.

TRADE CATALOGS

Providence Engineering Works, Providence, R. I. Circular. "Providence" shaper. Illustrated.

Arthur S. Brown Mfg. Co., Tilton, N. H. Catalog. Tilton endless belt. Illustrated, 8 pp., 6x9 in.

Beaudry & Co., Inc., 141 Milk St., Boston, Mass. Catalog. Power hammers. Illustrated, 20 pp., 6x9 in.

Joseph Dixon Crucible Co., Jersey City, N. J. Booklet. "Proper Care of Belts." Illustrated, 24 pp., 3½x6 in.

Milliken Machine Works, West Newton, Mass. Folder. Ball turret heads, angle and bench plates. Illustrated.

The Standard Engineering Works, Pawtucket, R. I. Bulletin No. 11. Hand milling machine. Illustrated, 4 pp., 6x9 in.

Boston Gear Works, Norfolk Downs (Quincy), Mass. Catalog E9. Gears, racks, hobs, etc. Illustrated, 92 pp., 3½x6 in.

Wright Mfg. Co., Lisbon, Ohio. Catalog No. 7. Chain hoists, steel trolleys, hand cranes. Illustrated, 24 pp., 5x8 in.

Toledo Pipe Threading Machine Co., Toledo, Ohio. Catalog. Pipe threading and cutting devices. Illustrated, 72 pp., 4x7 in.

Diamond Clamp and Flask Co., Richmond, Ind. Catalog. Snap flasks, core machine, belt shifter, etc. Illustrated, 36 pp., 6x9 in.

Becker Milling Machine Co., Hyde Park, Boston, Mass. Catalog. Vertical and horizontal millers. Illustrated, 56 pp., 8½x11 in.

The Norma Co. of America, 1790 Broadway, New York. Catalog No. 105. "Norma" precision bearings. Illustrated, 124 pp., 6x9 in.

Newton Machine Tool Works, Inc., Philadelphia, Penn. Catalog No. 50. Rotary planing machines. Illustrated, 24 pp., 6x9 in.

Builders Iron Foundry, Providence, R. I. Catalog. Grinding and polishing machinery, "Pull" countershafts. Illustrated, 104 pp., 6x9 in.

Winter Bros. Co., Wrentham, Mass. Catalog No. 11. Carbon steel taps and dies, high-speed steel taps and dies. Illustrated, 122 pp., 5x7 in.

Millers Falls Co., Millers Falls, Mass. Catalog No. 35. Ratchet braces, hand drills, breast drills, lathe chucks, power hack saws, etc. Illustrated, 184 pp., 6x9 in.

The Watson-Stillman Co., 50 Church St., New York. Catalog No. 93. Sturcke-Watson-Stillman testing machine for cylindrical gas containers. Illustrated, 16 pp., 6x9 in.

Landis Machine Co., Inc., Waynesboro, Penn. Catalog No. 22. Bolt threading, bolt pointing, nut tapping, pipe threading and cutting machines, etc. Illustrated, 78 pp., 6x9 in.

The Richardson-Phenix Co., Milwaukee, Wis. Bulletin No. 50. Phenix force feed lubricators. Illustrated, 12 pp., 8½x11 in. Bulletin No. 60. Richardson Model M sight feed oil pump. Illustrated, 20 pp., 8½x11 in.

The Hydraulic Press Mfg. Co., Mount Gilead, Ohio. Bulletin No. 5004. "Heading Brass Cartridge Cases." 1,000-ton hydraulic press. Illustrated. Bulletin No. 5005. 800-ton hydraulic drawing press used for cupping and drawing Prest-O-Lite dissolved acetylene cylinders. Illustrated.

Niles-Bement-Pond Co., 111 Broadway, New York. C'rcular No. 101. 48-in. car-wheel borer. Illustrated. Circular No. 102. Center drive car wheel lathe. Illustrated. Circular No. 103. 36-44-in. side head boring mill. Illustrated. Circular No. 104. 90-in. driving-wheel lathe. Illustrated.

FORTHCOMING MEETINGS

A course of free lectures on military engineering will be given under the auspices of a committee representative of the four national engineering societies, by Captains Robins, Coiner and Ardery, Corps of Engineers, U. S. A. This course will be under the direction of Major-Gen. Leonard Wood and is designed to assist those who desire to enter the engineering battalion which will be formed at Plattsburg next summer. All engineers interested in preparedness will be welcome, but attendance at these lectures does not imply obligation to subsequent camp duty. Through the cordial attitude and coöperation of the United Engineering Society, the auditorium of the Engineering Societies Building has been placed at the disposal of the army officers. These lectures will be given weekly, having begun on Feb. 14, under the following divisions:

Feb. 21, 1916—The service of reconnaissance, including surveying, mapping and sketching, photography and map reproduction.

Feb. 28, 1916—Field fortifications, sieges and demolitions.

March 6, 1916—Seacoast defenses and battlefield illuminations.

March 13, 1916—The construction, maintenance and repair of roads, bridges and ferries; the selection and preparation of fords.

March 20, 1916—The selection, laying out and preparation of camps and cantonments; the service of general construction; and the special services, including all public work of an engineering nature which may be required in a territory under military control.

March 27, 1916—The construction, operation and maintenance of railways under military control and the construction and operation of armored trains.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Wednesday each month. J. A. Brooks, secretary, Brown University, Providence, R. I.

New England Foundrymen's Association. Regular meeting second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. Secretary, R. H. Barnes, Taylor Instrument Companies, Rochester, N. Y.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	Feb. 10, 1916	Jan. 14, 1916	Feb. 11, 1915
No. 2 Southern foundry, Birmingham	$15.00	$15.00	$9.50
No. 2 X Northern foundry, New York	19.75	19.50	14.25
No. 2 Northern foundry, Chicago	18.50	18.50	13.00
Bessemer, Pittsburgh	2145	21.45	14.55
Basic, Pittsburgh	18.45	18.70	13.45
No. 2 X, Philadelphia	20.00	20.00	14.25
No. 2, Valley	18.25	18.50	13.00
No. 2 Southern, Cincinnati	17.90	17.90	12.40
Basic, Eastern Pennsylvania	19.50	19.50	13.50
Gray forge, Pittsburgh	18.45	18.45	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger from jobbers' warehouse, New York:

	Feb. 10, 1916	Jan. 14, 1916	Feb. 11, 1915
Steel angles, base	2.60	2.50	1.85
Steel T's, base	2.65	2.55	1.90
Machinery steel (bessemer)	2.60	2.50	1.80

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse, New York:

	Feb. 10, 1916	Jan. 14, 1916	Feb. 11, 1915
No. 28 black	3.50	3.35	2.60
No. 26 black	3.40	3.25	2.50
Nos. 22 and 24 black	3.35	3.20	2.45
Nos. 18 and 20 black	3.30	3.15	2.40
No. 16 black	3.45	3.15	2.35
No. 14 black	3.35	3.05	2.25
No. 12 black	3.30	3.00	2.20
No. 28 galvanized	5.50	5.50	3.65
No. 26 galvanized	5.20	5.20	3.35
No. 24 galvanized	5.05	5.05	3.20

Standard Pipe—On carload lots f.o.b. Pittsburgh, the discounts follow:

	Black		Galvanized	
	Feb. 10, 1916	Feb. 10, 1915	Feb. 10, 1916	Feb. 10, 1915
¾- to 2-in. steel butt welded	76%	81%	60½%	72½%
2½- to 6-in. steel lap welded	75%	80%	59½%	72½%

At these discounts, the net prices in cents per ft. follow:

Diameter, In.				
¾	2.76	2.20	4.54	3.15
1	4.08	3.24	6.72	4.67
1¼	5.44	4.38	9.09	6.30
1½	6.60	5.25	10.86	7.55
2	8.88	7.05	14.62	10.15
2½	14.63	11.70	23.69	16.70
3	19.13	15.25	30.98	21.80
4	27.25	21.80	44.05	31.00
5	37.00	29.60	59.94	42.20
6	48.00	38.40	77.76	54.60

Swedish Drill Steel—The following prices are base in cents per pound to consumers f.o.b. warehouse, New York:

Carload lots and over	6.50
Over 10 tons, less than carload	7.00
Over 1 ton, less than 10	7.50
Over 500 lb., less than 1 ton	8.00
Less than 500 lb.	8.50
Hollow steel—	
Carload lots and over	10.50
Over 10 tons, less than carload	11.00
Over 1 ton, less than 10	12.00
Over 500 lb., less than 1 ton	13.00
Less than 500 lb.	14.00

Swedish Steel Sheets—To consumers requiring fair-size quantities tool steel sheets sell at 16c. base and spring steel sheets at 12c. base. These prices are f.o.b. warehouse, New York.

Bar Iron—Prices are as follows in cents per pound at the places named:

	Feb. 11, 1916	Jan. 13, 1916
Pittsburgh, mill	2.15	1.95@2.00
New York	2.25	2.10@2.15
From storehouse, New York	2.55	2.40@2.50

Swedish (Norway) Iron—This material sells at $4.50 base per 100 lb. f.o.b. New York. In coils an advance of 50c. is charged.

Cold Drawn Steel Shafting—From New York warehouse to consumers requiring fair-sized lots the price is 15% off list.

METALS

Miscellaneous Metals—The present New York quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	Feb. 10, 1916	Jan. 14, 1916	Feb. 11, 1915
Copper, electrolytic (carload lots)	27.00	24.00	14.87½
Tin	41.25	41.00	35.87½
Lead	6.25	5.90	3.80
Spelter	19.50	17.62½	8.50
Copper sheets, base	33.00	30.00	19.75
Copper wire (carload lots)	33.00	30.00	15.50
Brass rods, base	38.00	35.00	16.50
Brass pipe, base	43.00	38.00	17.50
Brass sheets	38.00	35.00	16.75
Solder ½ and ½ (case lots)	26.00	25.75	24.50

ST. LOUIS

Lead	6.10	Spelter	19.50

Old Metals—In New York, the following are the dealers' purchasing prices in cents per pound:

	Feb. 10, 1916	Feb. 5, 1915
Copper, heavy and crucible	21.50	12.10
Copper, heavy and wire	21.00	11.75
Copper, light and bottoms	18.00	10.50
Lead, heavy	5.00	3.20
Lead, tea	4.50	...
Brass, heavy	13.50	8.25
Brass, light	11.00	6.75
No. 1 yellow rod brass turnings	13.00	...
Zinc	12.50	4.50

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	31.50	32.00	32.50	33.00	36.00
¼ to 5/16	31.25	31.75	32.25	32.75	35.75
⅜ to 1⅞	31.00	31.50	32.00	32.50	35.50
1 15/16 to 2⅞	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3 7/16	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3½ to 3 15/16	32.25	32.75	33.25	35.75	36.75
Squares					
3 1/16 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4 15/16	33.00	33.50	36.00	36.50	37.50
5 to 6 15/16	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Babbitt Metal—In New York, quotations are as follows in cents per pound:

Best grade	55@60
Commercial grade	25@30

Antimony—For spot delivery on Chinese and Japanese brands the quotation is at 45c. per lb., duty paid.

SHOP ACCESSORIES

Turnbuckles—From New York warehouse, on sizes smaller than 1¼ in. diameter, 50% off list is charged, and on 1¼ up to 2 in. diameter 40%. At this rate prices follow:

Size		Size		Size	
⅜	$0.20	⅞	$0.38	1½	$0.90
7/16	.21	1	.44	1⅝	1.05
½	.23	1⅛	.50	1¼	1.20
⅝	.25	1¼	.75	1⅞	1.35
¾	.32	1⅜	.83	2	1.59

These prices are for buckles having right and left stub ends and with openings between the heads measuring 5½ in.

Nails—Wire nails f.o.b. Pittsburgh sell at $2.20; galvanized 1 in. and longer, $4.20, and shorter, $4.70. These prices are to regular customers and delivery is made at the mill's convenience.

Nuts—On hot pressed nuts $3 off list is allowed and on hexagon $3.20. At this rate the base price per 100 lb. for fair-sized orders from New York warehouse is as follows:

Hot Pressed Square Short Diam.	Blank	Tapped	Hot Pressed Hexagon Short Diam.	Blank	Tapped
1/2	....	$12.00	1/2	....	$17.70
9/16	$8.00	9.50	11/16	....	11.30
11/16	6.00	6.90	7/8	$6.40	7.40
7/8	5.00	5.70	1 1/4	5.20	5.80
1 1/8	4.50	4.90	1 7/16, 1 5/8, 1 13/16, 2	5.10	5.70
1 7/16, 1 5/8, 1 13/16, 2	4.40	4.80	2 3/16	5.20	5.90
2 3/16	4.50	5.00	2 3/8	5.50	7.30
2 5/8	4.80	5.40			

Semifinished nuts are sold at 70 % from list price.

On cold punched square nuts $3 from list is deducted and on hexagon $3.75. At this rate the base price on fair-sized orders from New York warehouse is as follows in cents per pound:

Bolt	Square Blank	Square Tapped	Hexagon Blank	Hexagon Tapped
1/4	17.00	19.00	23.25	25.75
5/16	15.00	16.50	20.25	22.25
3/8	11.50	12.60	14.75	16.35
7/16	11.00	11.90	14.25	15.55
1/2	8.30	9.00	10.25	11.25
9/16	8.30	8.90	10.25	11.15
5/8	7.00	7.50	8.75	9.45
3/4	6.70	7.10	7.65	8.25
7/8	6.60	7.00	7.35	7.95
1	6.60	7.00	7.35	7.95

The base price for fair-sized orders of case-hardened nuts from New York warehouse is 70% from list price.

Rivets—The following are the base quotations for fair quantities from New York warehouse:

	Discount from List
Steel 7/16 and smaller	65 and 10%
Tinned	65 and 10%

	Price per 100 Lb.
Button heads, 3/4, 7/8, 1 in. diam. by 2 in. to 5 in.	$4.25
Cone heads, same sizes	4.35

	Extra per 100 Lb.
1 1/4 to 1 7/8 in. long, all diameters	$0.25
5/8 in. diameter	0.15
1/2 in. diameter	0.50
1 in. long and shorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

Wrought Washers—From New York warehouse, the base price on fair-sized orders is $4.50 from list price. At this rate the following prices per 100 lb. hold:

Diameter, In.		Diameter, In.	
9/16	$9.50	1 1/2	$4.80
3/4	7.70	1 3/4	4.70
7/8	6.90	2	4.60
1	6.00	2 1/4, 2 1/2, 2 3/4	4.50
1 1/4	5.30	3 3/4, 4, 4 1/4, 4 1/2	5.00
1 3/8	4.90	3, 3 1/4, 3 1/2	4.70

For cast-iron washers, the base price is $2.50 per 100 lb.

Carriage Bolts—On 3/8 by 6 in. and smaller 60 and 5% off list is allowed; for larger and longer sizes 50 and 5% off list is charged. For fair-sized orders from New York warehouse the following net prices at this rate would be charged:

Length, In.	Diameter 1/4	5/16	3/8	7/16	1/2	5/8	3/4
1 1/2	$0.38	$0.53	$0.72	$1.05	....	....	....
2	.41	.58	.78	1.14	....	....	....
2 1/2	.46	.62	.84	1.24	$1.54	$2.73	$4.04
3	.49	.67	.90	1.33	1.68	2.91	4.28
3 1/2	.53	.71	.97	1.43	1.81	3.09	4.51

Machine Bolts—From New York warehouse, the base price for fair quantities are as follows: From 3/8 in. by 4 in. and smaller, 60 and 10% off list is discounted; for larger and longer sizes up to 1 in. by 30 in., 50 and 10% is allowed. At this rate prices per 100 are as follows:

Length, In.	Diameter 1/4	3/8	5/8	3/4	7/8	1 In.
1	$0.61	$0.86	$2.34	$3.47	$4.73	$6.80
2	.64	.92	2.51	3.71	5.04	7.20
2 1/2	.67	.98	2.68	3.96	5.36	7.61
3	.70	1.04	2.85	4.21	5.67	8.01
3 1/2	.73	1.09	3.02	4.46	5.99	8.42

Base prices on other sizes would be as follows: 1 1/8 and 1 1/4 in. by 3 in. and up to 12 in. take 40% off list. On longer lengths a special pound price is quoted. For cold punched square nuts, 40% is discounted from list; for hot pressed hexagon nuts up to 1 in. by 30 in., 50%; up to 1 in. diameter, cold punched nuts, 40%. Buttonhead with hexagon nuts, 40% off list, as do hexagon head with hexagon nuts.

Bolt Ends with hot pressed nuts sell at the base price of 50 and 10% from list price. This is for fair-sized orders from New York warehouse.

Coach or Lag Screws—Quotations from New York warehouse are unchanged at 65 and 10% from list. This is for fair-sized orders.

Tap Bolts—The discount from New York warehouse remains unchanged at 25% from list.

Copper Rivets from warehouse, New York, sell at 25 and 5% off list and burs at 2 1/2% the net list price.

MISCELLANEOUS

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire	
3/8, 11/32, 5/16, 1/4, 7/32, 3/16	8.50
No. 8, 5/32 and No. 10	9.25
1/8	10.00
No. 12	11.00
3/32, No. 14 and 1/16	12.00
No. 18	14.00
No. 20	16.00

Special Welding Steel	
1/8	33.00
5/32	30.00
3/16	28.00

Cast-Iron Welding Rods	
1/4 by 19 in. long	22.00
3/16 by 12 in. long	26.00
3/8 by 19 in. long	20.00
1/2 by 21 in. long	20.00

Vanadium Wire in Coils or Sticks	
1/16	15.50
3/32	15.00
1/8	14.00
5/32	12.00
3/16 and larger	11.00

These prices are subject to change according to quantity and shipment desired.

Seamless Drawn Tubing—The base price per pound from New York warehouse is 39c. for brass and 40c. for copper. For immediate stock shipment 3c. is added, which gives the following quotations:

Diameter, In.	Copper Feb. 10, 1916	Copper Feb. 11, 1915	Brass Feb. 10, 1916	Brass Feb. 11, 1915
3/4 to 2 1/2	43.00	21.50	41.00	17.00
3	43.00	22.00	41.00	18.00
3 1/2	44.00	22.50	42.50	18.50
4	45.00	23.00	43.50	19.00
4 1/2	47.00	24.00	45.50	20.00
5	49.00	25.00	47.50	21.00
6	50.00	28.00	48.50	24.00
7	52.00	30.00	50.50	26.00
8	54.10	32.00	52.60	28.00

Tin Plates—The following prices are in effect from warehouse, New York:

Coke tin plate, 14x20:

100-lb.	$4.45
I. C. 107-lb.	4.60

Terne plate, 20x28:

Base Weight	Net Weight	Coating	Price	Base Weight	Net Weight	Coating	Price
100-lb.	200	8	$8.30	I. C.	226	20	$13.50
I. C.	214	8	8.60	I. C.	231	25	14.25
I. X.	270	8	10.60	I. C.	236	30	15.50
I. C.	218	12	12.00	I. C.	241	35	17.00
I. C.	221	15	13.00	I. C.	246	40	19.00

Zinc Sheets—The following prices in cents per pound prevail at New York:

Carload lots, f.o.b. mill	24.00
In casks, New York	24.50
Broken lots, New York	25.00

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Jan. 22	Jan. 29	Feb. 5	Feb. 12
Prompt furnace	$3.00@3.25	$4.00@5.00	$3.00@3.25	$3.00@3.25
Prompt foundry	3.50@4.00	3.50@4.00	4.00@4.50	3.75@4.25

Sal Soda—These quotations are per 100 lb. at the places designated:

New York	$1.35
Philadelphia	1.10

Roll Sulphur in 360-lb. bbl. sells in New York at $2.25 per 100 lb.

Cotton Waste—In New York, the prices in cents per pound are as follows:

White	9.50@11.50
Colored mixed	6.50@9.00

Linseed Oil—Raw, in barrels sells at 77c. per gal. and in 5-gal. cans at 87c. Boiled, it is 1c. per gal. higher.

White Lead, dry and in oil, in cents per pound sells as follows:

100-lb. keg	8.75
25- and 50-lb. kegs	9.00
12 1/2-lb. keg	9.25
1- to 5-lb. cans	10.75

Red Lead, dry, in cents per pound sells as follows:

100-lb. keg	8.75
25- and 50-lb. kegs	9.00
12 1/2-lb. keg	9.25

In oil, the price in cents per pound is as follows:

100-lb. keg	9.25
25- and 50-lb. kegs	9.50
12 1/2-lb. keg	9.75

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

Plans are being prepared by E. T. Stewart, Arch., 201 Devonshire St., Boston, Mass., for the construction of a garage at Belmont, Mass., for Henderson & Ross, 30 State St., Boston.

Bids are being received by S. S. Eisenberg, Arch., 45A Everett Ave., Chelsea, Mass., for the construction of a 3-story garage at Boston, Mass. Estimated cost, $40,000.

The contract has been awarded for the construction of a 2-story, 55x140-ft. garage at Brighton, Boston, Mass., for John D. Long. Estimated cost, $38,000.

E. F. Barney, care of F. W. Barlow, Jr., Arch., 80 North Main St., Brockton, Mass., will construct a 1-story garage. Estimated cost, $20,000.

The Colonial Realty Trust Co., Boston, Mass., has awarded the contract for the construction of a 2-story, 110x240-ft. garage at Medfield, Mass. Estimated cost, $100,000. Noted Feb. 3.

Bids have been received for the construction of a 4-story, 64x175-ft. garage for the Smith Carriage Co. on Park St., Springfield, Mass.

H. J. Hartnett plans to build a garage at Franklin and Vine St., Worcester, Mass. Estimated cost, $50,000.

The Woodlawn Screw Machine Co. has purchased the 2-story mill of the Seamless Wire Co. on Newell St., Pawtucket, R. I., and will install new machinery.

The Brown & Sharpe Manufacturing Co., manufacturer of machinery and tools, has awarded the contract for the construction of a 1-story addition to its factory No. 5 at Providence, R. I. Noted Feb. 10.

The Blue Ribbon Auto and Carriage Co. has awarded the contract for the construction of a 3-story, 63x98-ft. factory at Bridgeport, Conn. Noted Jan. 27.

The contract has been awarded for the construction of a 1-story, 110x300-ft. foundry at North Washington Ave. and Frederick St., Bridgeport, Conn., for the R. E. Parsons Foundry Co. Estimated cost, $35,000. Noted Jan. 27.

The New London Ship and Engine Co. plans to construct a plant at Groton, Conn.

The contract has been awarded for the construction of a 1-story, 48x68-ft. addition to the plant of the Risdon Tool Co. on Andrew Ave., Naugatuck, Conn. Noted Feb. 10.

Plans have been prepared by C. E. Joy, Arch., for the construction of a 2-story, 75x111-ft. factory on Commerce St., New Haven, Conn., for the United Smelting and Aluminum Co. Noted Sept. 23.

Bids are being received by the Standard Engineering Co., Center St., Waterbury, Conn., for a 1- and 2-story shop and garage.

MIDDLE ATLANTIC STATES

The American Body Co., Buffalo, N. Y., manufacturer of carriage and automobile bodies, will construct a 2-story factory at 1257 Niagara St. Estimated cost, $12,000.

Louis E. and Nathan Levy, 3287 3d Ave., New York, N. Y. (Borough of Bronx), will construct a garage. Estimated cost, $15,000.

Pennsylvania & Blake Corporation Realty Co., New York, N. Y. (Borough of Brooklyn), is having plans prepared by L. Schillinger, 167 Van Sicklen Ave., for the construction of a 50x100-ft. garage at Glenmore and Pennsylvania Ave.

Edward Schenk, 159 25th St., New York, N. Y. (Borough of Brooklyn), has had plans prepared by Shampan & Shampan, Arch., 772 Broadway, Brooklyn, for a 1-story shop and garage. Estimated cost, $12,000.

Plans being prepared by J. C. Cocker, Arch., 2017 5th Ave., New York, N. Y. (Borough of Manhattan), for the construction of a factory for the New York Central R.R. to be leased by Thomas F. Devine, 83 West End Ave., for the manufacture of automobile tops.

J. Bradley, 316 West 105th St., New York, N. Y. (Borough of Manhattan), is having plans prepared by E. H. James and A. W. Cordes, Archs., 124 West 45th St., for the construction of a 4-story garage. Estimated cost, $30,000.

The Tasker-Halstead Realty Co., 154 Nassau St., New York, N. Y. (Borough of Manhattan), will construct a 1½-story garage at Yonkers, N. Y.

The machinery and stock of the Standard Meter Co., 19th St. and 10th Ave., Watervleit, N. Y., will be offered at auction at 1 p.m., Feb. 24. Catalogs of tools may be obtained from Hiram H. Parke, Auctioneer, 2 East 23rd St., New York, N. Y.

The Pouvailsmith Corporation, Poughkeepsie, N. Y., recently incorporated with 2,500,000 capital stock, to manufacture all kinds of condensite products for automobiles, has awarded the contract for the construction of three 2-story factory buildings. Estimated cost, $100,000. E. C. Vail is interested. Noted Dec. 30.

The contract has been awarded for the construction of an addition to the plant of the International Arms and Fuse Co., Bloomfield, N. J. The new addition will be known as Building No. 4 and will cost $30,000. Noted Nov. 25.

The contract has been awarded for the construction of a 1-story addition to the plant of Kraeuter & Co., Newark, N. J., manufacturer of punches, chisels, etc. Estimated cost, $7,000. Noted Feb. 3.

Bids will soon be received by the Hutchinson Motor Co., Woodbury, N. J., for the construction of a 1-story, 50x105-ft. garage at Swedesboro, N. J.

Plans are being prepared by M. R. Evans, Arch., Lancaster, Penn., for the construction of 3 garages for David Rose, Lancaster.

Plans are being prepared by Bart Tourison, Arch., Land Title Bldg., Philadelphia, Penn., for the construction of 50 garages for John H. McClatchy, Wayne Ave. and Washington Lane.

The W. J. Gruhler Co. will construct a garage at 2234 George Lane, Philadelphia, Penn.

Newberry & Ferry, Wilkinsburg, Penn., are having plans prepared for the construction of a garage. B. F. Kreider, 1119 Pitt St., Arch.

The contract will soon be awarded for the construction of a garage at 27 South Charles St., Baltimore, Md., for the city. Estimated cost, $90,000.

The Maryland Metal Cross Tie Co., 627 Munsey Bldg., Baltimore, Md., will construct a foundry at Havre de Grace, Md.

SOUTHERN STATES

The Acme Garage, Martinsville, Va., recently incorporated, is in the market for equipment for a garage which it plans to establish. H. V. Price, Pres.

The Charleston Interurban Railroad Co., Charleston, W. Va., has awarded the contract for the construction of a 1-story addition to its factory.

Plans are being prepared by E. N. Alger, Arch., 608 Robson-Prichard Bldg., Huntington, W. Va., for the construction of a garage for C. W. Phellis, 1348 6th Ave.

J. E. Thompson, 633 5th Ave., Huntington, W. Va., has had plans prepared for the construction of a 2-story garage. Estimated cost, $10,000.

The Peninsular Iron Works, Lakeland, Fla., will construct several factory buildings. Estimated cost, $20,000. C. V. Turner is interested.

The Ford Automobile Co., Detroit, Mich., plans to construct an assembling plant at Birmingham, Ala.

The Gulf States Steel Co., Birmingham, Ala., has awarded the contract for the construction of a by-products plant at Gadsden, Ala. Estimated cost, $900,000. Noted Dec. 30.

The Southern Ry. has awarded the contract for the construction of repair shops at Knoxville, Tenn. W. H. Wells, Washington, D. C., Ch. Engr. Noted Feb. 10.

G. T. Harris, Morristown, Tenn., and K. T. Kenner, Rogersville, Tenn., plans to construct a garage at Morristown, Tenn. Estimated cost, $10,000.

The contract will soon be awarded for the construction of a garage at Covington, Ky., for the Charles Schlear Motor Car Co., Cincinnati, Ohio. G. Bernens, 124 East 8th St., Cincinnati, Ohio, Secy. and Treas.

MIDDLE WEST

The Timken Roller Bearing Co. has awarded the contract for the construction of a 2-story, 60x100-ft. addition to its plant at Canton, Ohio.

The Chisholm & Moore Manufacturing Co., manufacturer of malleable castings and chain hoists, Cleveland, Ohio, has awarded the contract for the construction of a 2-story addition to its plant at 5046 Lakeside Ave. Estimated cost, $10,000.

The Cleveland Motor Plow Co., recently incorporated with a capital of $600,000, will build a plant at Cleveland, Ohio., for the manufacture of motor-driven farm implements.

We have been advised that the Electric Railway Improvement Co., 2070 East 61st St., Cleveland, Ohio, will not construct an addition to its plant at Cleveland this year. Noted Jan. 27.

Plans have been prepared for the construction of a 70x105-ft. addition to the plant of the Loew Manufacturing Co., manufacturer of gas engines, etc., at 9100 Madison Ave., Cleveland, Ohio. Noted Feb. 3.

Plans are being prepared for the construction of a 5-story, 100x300-ft. addition to the plant of the Overland-Cleveland Co., 6604 Euclid Ave., Cleveland, Ohio. Estimated cost, $200,000. Noted Nov. 18.

The Superior Machine Tool Co. plans to construct a 70x 200-ft. addition to its plant at Kokomo, Ind. Estimated cost, $50,000. A. L. Thalman is Pres.

We have been advised that the Portland Body Works, manufacturer of vehicle bodies and parts, has awarded the contract for the construction of an addition to its plant at Portland, Ind. Noted Feb. 3.

The contract has been awarded for the construction of an addition to the plant of the Portland Forge and Foundry Co. at Portland, Ind. Estimated cost, $20,000.

Bids has been received by J. G. Kastler, 524 Chamber of Commerce Bldg., Detroit, Mich., for the construction of a 2-story, 120x150-ft. foundry and shop for Anthony N. and John B. Lukomski, 2468 East Grand Blvd., Detroit.

The Motor Truck Body Co., 320 Franklin St., Detroit, Mich., is constructing a 1-story, 64x245-ft. factory at Detroit.

The J. N. Murray Manufacturing Co., manufacturer of auto parts, Detroit, Mich., has awarded the contract for the construction of an addition to its plant. Estimated cost, $10,000.

The Puritan Machine Co. has awarded the contract for the construction of a factory on Lafayette Blvd., Detroit, Mich.

Plans are being prepared for the construction of a 3-story, 100x158-ft. garage and factory at Detroit, Mich., for A. Wegner & Sons. Estimated cost, $50,000.

The H. M. Reynolds Roofing Co. plans to construct an addition to its factory at Godfrey Ave. and Pere Marquette R.R., Grand Rapids, Mich. Estimated cost, $8,500.

The Consolidated Engineering Co., Jackson Blvd. and Clinton St., Chicago, Ill., is constructing a machine shop at 2800 Shields Ave., Chicago. Estimated cost, $14,000.

We have been advised that the contract has been awarded for the construction of a 1-story, 75x120-ft. factory at Chicago, Ill., for the Cyclone Blow Pipe Co. Estimated cost, $25,000. Noted Feb. 3.

N. Landon Hoyt, Wilmette, Ill., will build a 4-story garage on East 21st St., Chicago, Ill. Estimated cost, $118,000. S. N. Crowler, 30 North La Salle St., Arch.

F. E. Kelley will construct a 1-story, 40x100-ft. garage at 628 North Green St., Chicago, Ill. Estimated cost, $10,000.

The contract has been awarded for 4521 Ogden Ave., Chicago, Ill., for Charles F. L'Hommedieu & Sons Co., 24 South Clinton St., Chicago, manufacturer of platers' supplies. Estimated cost, $22,000.

S. Linderoth & Co. plans to build a 1-story, 96x106-ft. garage at East 59th St. and Maryland Ave., Chicago, Ill. Estimated cost, $20,000.

Plans are being prepared for the construction of a 5-story garage at Chicago, Ill., for J. B. Murphy. Carl W. Westerling, 111 West Washington St., Chicago, is Arch.

The contract will soon be awarded for the construction of a 1-story, 40x50-ft. factory at Chicago, Ill., for the Planer & Sticker Bolt Supply Co., 4632 West Ohio St. Estimated cost, $10,000. Noted Jan. 27.

The Charles Stecher Co., Chicago, Ill., has purchased a factory at 1574 Crossing St., Chicago, and will be in the market for equipment for the manufacture of hand screw machines.

The contract will soon be awarded for the construction of an addition to the garage of the U. S. Auto Supply Co., 3845 South Wabash Ave., Chicago, Ill. Estimated cost, $12,000. A. L. Levy, 111 West Washington St., Arch.

The Wilson & Bennett Manufacturing Co., 58th St. and 65th Pl., Chicago, Ill., is in the market for steel barrel machinery.

The Ogren Motor Works will construct a plant at Waukegan, Ill. Estimated cost, $15,000.

Plans are being prepared by Edward Tough, 343 West Mifflin St., Madison, Wis., for the construction of a 3-story, 45 65-ft. garage at Pinckney and Doty St., Madison, for Edward Fisher, 8-9 Tenney Bldg.

N. C. Woodin and H. O. Hafemeister, Antigo, Wis., have organized a company to be known as the Hoist and Elevator Manufacturing Co. and will establish a plant at 2-4 Jackson St., Oshkosh, Wis., for the manufacture of contractors' hoisting machinery.

Loper & Loper has awarded the contract for the construction of a 2-story, 54x160-ft. garage and machine shop at Oshkosh, Wis. Estimated cost, $18,000. Noted Feb. 10.

John J. Felt will remodel building at Division and McCulloch St., Stevens Point, Wis., into a garage.

The Peninsula Automobile Co. will build a 50x130x50-ft. garage and machine shop at Cedar and Garland St., Sturgeon Bay, Wis.

The Kearney & Trecker Co., manufacturer of milling machines, will construct a 1-story, 60x250-ft. addition to its factory at West Allis, Wis.

WEST OF THE MISSISSIPPI

The Bettendorf Co., Bettendorf, Iowa, manufacturer of steel cars, contemplates adding 2 new furnaces to its foundry.

Press reports state that the Prusia Hardware Co., Ft. Dodge, Iowa, will rebuild its plant which was destroyed by fire. Estimated cost, $60,000. J. F. Nelson, Mgr. Noted Dec. 2.

The Chicago, Burlington & Quincy R.R., West Burlington, Iowa, will enlarge its shops. Estimated cost, $1,000,000. T. E. Calvert, Chicago, Ill., Ch. Engr. Noted Feb. 10.

Plans are being prepared for a 1-story reinforced-concrete plant for the Western Iron and Foundry Co. Wichita, Kan. Estimated cost, $4,000. Noted Feb. 10.

Plans are being prepared by F. A. Cole, Arch., 23 West Monroe St., Chicago, Ill., for a 2-story garage at Summitt and West Pennway St. for the American Express Co., Kansas City, Mo. Estimated cost, $50,000. J. S. Johnson, 1109 Grand Ave., Local Mgr.

The Koehring Machine Co., Dallas, Tex., recently organized, will construct a machine shop. George W. Smith is interested.

The plant of the Ft. Worth Boiler Works Ft. Worth, Tex., recently destroyed by fire with a loss of $15,000, will be rebuilt.

The Duff-McNew Foundry and Machine Co., Temple, Tex., will increase the capacity of its plant for the manufacture of disk-plow attachment for cultivators, stalk cutters and iron meter boxes.

The Western Tire and Garage Co., Texico, Tex., has been organized with a capital stock of $1,000,000 for the purpose of constructing a machine shop and garage. C. D. Robertson is interested.

Plans being prepared for a 2-story garage at 8th and Scott St., Wichita Falls, Tex., for C. W. Snider and J. J. Perkins.

WESTERN STATES

J. H. Flynn will build a garage and machine shop at 131 Lakeside Ave., Seattle, Wash. Estimated cost, $16,000.

The General Machinery Co. plans to build a plant on East Riverside Ave., Spokane, Wash., for the manufacture of mine accessories such as cages, ore cars, etc. E. J. Simos is Mgr.

The Pacific Coast Steel Co., San Francisco, Calif., contemplates the construction of a rolling mill at Portland, Ore.

The White Auto Co. will build a shop at Portland, Ore. Estimated cost, $24,000. MacNaughton & Raymond, Arch.

The Homer Laughlin Engineering Corporation, 2652 Long Beach Ave., Los Angeles, Calif., has increased its capital from $100,000 to $500,000 and plans to enlarge its plant at Los Angeles for the manufacture of drop forgings.

E. J. Swayne and A. H. Frost plans to build a 100x100-ft. garage and machine shop at 2nd and E St., San Diego, Calif. Estimated cost, $10,000.

CANADA

The Hamilton Gear Machine Co. has been granted a permit for the construction of an addition to its plant at Concord Ave. and Van Horne St., Toronto, Ont. Estimated cost, $4,500.

GENERAL MANUFACTURING

NEW ENGLAND STATES

The Goodall Worsted Co. will build a 1-story, 90x150-ft. addition to its mill at Sanford, Maine.

The Morley Button Co. will construct a plant at Portsmouth, N. H. Estimated cost, $100,000.

The Vacuum Fumigating Co. has awarded the contract for the construction of a plant at Boston, Mass. Estimated cost, $20,000.

The contract has been awarded for the construction of an addition to the plant of the Fisk Rubber Co., Chicopee, Mass. Estimated cost, $5,000.

The Elmwood Cleaning and Dyeing Co. contemplates the construction of a plant on Main St., Holyoke, Mass. Frank J. Hegy is interested.

The Converse Rubber Co., Pearl St., Malden, Mass., will construct a 4-story, 72x159-ft. addition to its plant. Estimated cost, $75,000.

The contract will soon be awarded for the construction of a 5-story, 40x56.8-ft. addition to the plant of Bickford & Sweet, manufacturer of slippers, at King St., Worcester, Mass.

The contract has been awarded for the construction of a 1-story, 60x78-ft. addition to the plant of Young Bros., manufacturer of paper boxes, at Eddy and Rhodes St., Providence, R. I.

Work will soon be started on the construction of a 2-story addition to the plant of the Clark O. N. T. Thread Co., Ansonia, Conn. Estimated cost, $200,000.

MIDDLE ATLANTIC STATES

The F. N. Burt Co., manufacturer of boxes and cartons, Buffalo, N. Y., plans to enlarge its factory at Niagara St., Potomac Ave. and the New York Central R.R. Estimated cost, $25,000.

The Danahy Packing Co., Buffalo, N. Y., will enlarge its cold-storage plant at Metcalfe and Clinton St. Estimated cost, $25,000.

Fire, Feb. 2, destroyed the canning factory of J. Whitham & Son, Middleport, N. Y. Loss, $21,000.

The Becker Aniline and Chemical Works, Ditmas Ave., New York, N. Y. (Borough of Brooklyn), has awarded the contract for the construction of a 1-story, 80x93-ft. factory.

The Hayes Knitting Co., Oswego, N. Y., plans to build a mill at West 2d and Schuyler St.

The McLaren Knitting Co., West Sand Lake, N. Y., is building a 2-story addition to its plant.

The contract has been awarded for the reconstruction of the plant of the Farr & Bailey Manufacturing Co., manufacturer of linoleum and oil cloth, Camden, N. J., recently destroyed by fire. Estimated cost, $55,000. Noted Dec. 23.

The Harrison Chemical Co., Harrison, N. J., will build a plant for the manufacture of chemicals on the Newark Meadows.

The Celluloid Co., 290 Ferry St., Newark, N. J., has awarded the contract for the construction of an addition to its plant at 25 Magazine St. Estimated cost, $8,000.

The Samuel J. Aronsohn Silk Co., 448 East 18th St., Paterson, N. J., plans to construct a silk mill. Estimated cost, $40,000.

The Scott Paper Co. will construct a plant at Chester, Penn. Estimated cost, $250,000.

The plant of the Linenwear Hosiery Co., Clifton Heights, Penn., recently destroyed by fire, will be rebuilt.

The contract has been awarded for the construction of an addition to the plant of the Griswold Worsted Co., Darby, Penn. Noted Feb. 3.

Gibralter Hosiery Mills, Gibraltar, Penn., plans to build an addition to its factory.

The contract has been awarded for the construction of a 1-story, 50x55-ft. addition to the plant of C. F. Simonin's Sons, manufacturer of fertilizers, Tioga and Belgrade St., Philadelphia, Penn.

The Peerless Bleach Works, Philadelphia, Penn., has awarded the contract for the construction of a 2-story, 32x60-ft. factory at Unity and Elizabeth St.

The Roessel Silk Co., McKinley St., Philadelphia, Penn., will soon receive bids for the construction of a 2-story factory. Estimated cost, $10,000.

The contract has been awarded for the construction of a 2-story rug factory at Pittsburgh, Penn., for P. R. Geragocian, 309 South Highland Ave.

J. V. Poley, Arch., 162 2d Ave., Royersford, Penn., is preparing plans for a 2-story, 50x192-ft. mill at Spring City, Penn., for the Century Knitting Co.

The Artillery Fuse Co. will construct 3 factory buildings at Wilmington, Del. Estimated cost, $13,400.

The contract has been awarded for the construction of alterations and additions to the plant of the Baltimore Cold Storage Co., 117-23 East Pratt St., Baltimore, Md. Estimated cost, $40,000.

A 2-story, 52x86-ft. addition will be constructed to the plant of the Kingan Provision Co., 350-352 North Holliday St., Baltimore, Md.

The Maryland Cold Storage Co., Baltimore, Md., has awarded the contract for the construction of a cold-storage plant. Noted Nov. 11.

The American Metal Crosstie Co., Havre de Grace, Md., recently incorporated with $250,000 capital stock, will construct a 15,000 spindle mill for the manufacture of sea island cotton.

The Security Cement and Lime Co., Security Md., will construct a potash factory. Estimated cost, $50,000. John J. Porter, Mgr.

SOUTHERN STATES

The Caldwell Chemical Co., Spottsville, Ky., will build a plant at Sistersville, W. Va. Estimated cost, $100,000.

An addition will be built to St. Pauls Cotton Mill, St. Pauls, N. C., and new machinery installed.

The Shelby Hosiery Mills Co., recently incorporated with $25,000 capital stock, is establishing a cotton mill at Shelby, N. C.

The Thread Mills Co., Spray, N. C., has awarded the contract for the construction of a new mill. Estimated cost, $100,000.

The Hawthorn Spinning Co., Clover, S. C., is building a new cotton mill.

The American Potash Co. will construct a plant at Atlanta, Ga., for the manufacture of a fertilizer. Frank P. Cochran, Chicago, Ill., and E. M. Priest, New York, N. Y., are interested.

N. C. Doss, Rome, Ga., is interested in a project to construct a factory at Atlanta, Ga., for the manufacture of a new puncture-proof inner tube for tires.

The Cedartown Cotton and Export Co., Cedartown, Ga., will construct several additions to its plant and also install new equipment. Estimated cost, $125,000.

The Muscogee Manufacturing Co., Columbus, Ga., manufacturer of cotton goods, will expend about $350,000 for enlarging its plant. The company has secured a permit for the construction of a 5-story, 150x250-ft. building estimated to cost $90,000, which will be one of the first additions to be built.

The Russell Manufacturing Co., manufacturer of yarns, will construct an addition to its plant at Alexander City, Ala.

The contract has been awarded for the reconstruction of the plant of the Texas Oil Co., Birmingham, Ala. Estimated cost, $150,000. Noted Jan. 27.

According to press reports a tar-paper plant may be constructed at Gadsden, Ala.

J. F. Carter, Jr., Mobile, Ala., plans to establish a plant for the manufacture of woolen sweaters and sweater coats.

The Chamber of Commerce, Talladega, Ala., is organizing a company to construct a packing plant at Talladega.

J. W. Greer, Moultrie, Ga., is interested in a project to construct a packing plant at Tuscaloosa, Ala.

Frank P. Grace, Harrisburg, Ill., plans to establish a glove factory at Nashville, Tenn.

MIDDLE WEST

Plans have been prepared for the construction of an addition to the plant of the Highland Body Manufacturing Co., Elmwood Pl., Cincinnati, Ohio. The company is in the market for woodworking equipment.

The National Lead Co. has awarded the contract for the construction of a 1- and 2-story addition to its plant on Freeman Ave., Cincinnati, Ohio. Estimated cost, $35,000. Noted Feb. 3.

The Yardlet Screen and Weather Strip Co. will build an addition to its plant at Columbus, Ohio.

The Central Ohio Paper Co., 5th and Naghte St., Columbus, Ohio, awarded the contract for the construction of a 5-story plant on North 5th St., Columbus. Estimated cost, $200,000. Noted Jan. 20.

We have been advised that the contract has been awarded for the construction of a 2-story, 52x196-ft. and 42x115-ft. factory at Kent, Ohio, for the Mason Tire and Rubber Co. Estimated cost, $50,000. Noted Jan. 27.

The La Belle Box and Barrel Co., Martins Ferry, Ohio, has awarded the contract for the foundation of its new factory. The superstructure will be built by day labor. Estimated cost, $25,000. Noted Sept. 16 and Dec. 23.

Bids will soon be received for the construction of a plant at Kalamazoo, Mich., for the Riverview Coated Paper Co. Estimated cost, $400,000. Noted Dec. 30.

The American Bromine Co. will construct a plant at Midland, Mich. Walter N. White, Inglewood, N. J., is Pres.

Plans are being prepared for the construction of a 3-story, 125x175-ft. factory at Chicago, Ill., for the Commercial Furniture Co., 2718 West Superior St., Chicago. Estimated cost, $60,000.

The contract has been awarded for the construction of a 3-story, 31x136-ft. factory at 4846-48 South Halsted St., Chicago, Ill., for Globe Mills. Estimated cost, $16,000.

The Smith Form-A Truck Co. will build a 176x362-ft. plant at Clearing, Ill.

Plans are being prepared for the construction of the superstructure of a 3-story, 50x100-ft. cold storager plant at Monticello, Wis., for E. Wittwer & Bros. Estimated cost, $25,000. Claude & Stark, Badger Annex, Madison, Arch.

WEST OF THE MISSISSIPPI

The Foot Schultze Co., Minneapolis, Minn., will build a shoe factory. Kees & Colburn, Donaldson Bldg., Minneapolis, is Arch.

The Marionville-Logan Cold Storage Association, Marionville, Mo., will build a cold storage plant. Estimated cost, $40,000.

The United States Aniline and Chemical Co., St. Louis, Mo., will construct a building at Laclede and Vandeventer Ave., for the manufacture of aniline dyes. Estimated cost, $50,000.

The Memphis Cotton Compress Co., Memphis, Tex., which was recently destroyed by fire, will rebuild its plant.

The Cuero Packing Co., Nixon, Tex., will build a packing plant at Nixon.

WESTERN STATES

The Filice & Perrilla Canning Co. will construct 3 additions to its plant at Gilroy, Calif.

Plans are being prepared by J. Schulz, Wright and Callender Bldg, Los Angeles, Calif., for the construction of a plant on Santa Fe Ave., Los Angeles, for the manufacture of boxes for the Southern California Box Co., 1335 East 6th St.

The Western Electro Chemical Co. is constructing a plant at Pittsburg, Calif. Estimated cost, $500,000. Mortimer Fleishacker, 2418 Pacific Ave., San Francisco, is interested.

The Sunset Canning Co. plans to improve its canning plant on East Bertie St., Pomona, Calif.

John Osborne, of the San Diego Fish Co., has leased a site at the foot of F St., San Diego, Calif., and plans to build a fish canning plant. Estimated cost, $25,000.

Swift & Co., Chicago, Ill., plans to construct a potash manufacturing plant on the water front near E St., San Diego, Calif. S. G. Smith is local representative.

The Coast Folding Paper Box Co., 560 Mission St., San Francisco, Calif., plans to enlarge its plant at San Francisco. J. Golinsky is Mgr.

CANADA

The Avon Hosiery Co. plans to build an addition to its factory at Stratford, Ont.

The plant of the Gold Medal Furniture Co. at Toronto, Ont., which was recently destroyed by fire, will be rebuilt.

The Dominion Canners Association, Hamilton, Ont., contemplates the construction of a plant at Vernon, B. C. D. Marshall is interested.

Classified Advertising

The Classified Advertising section appears on pages 159, 160, 161, of this issue and will in future appear in the same relative position in the paper.

American Machinist

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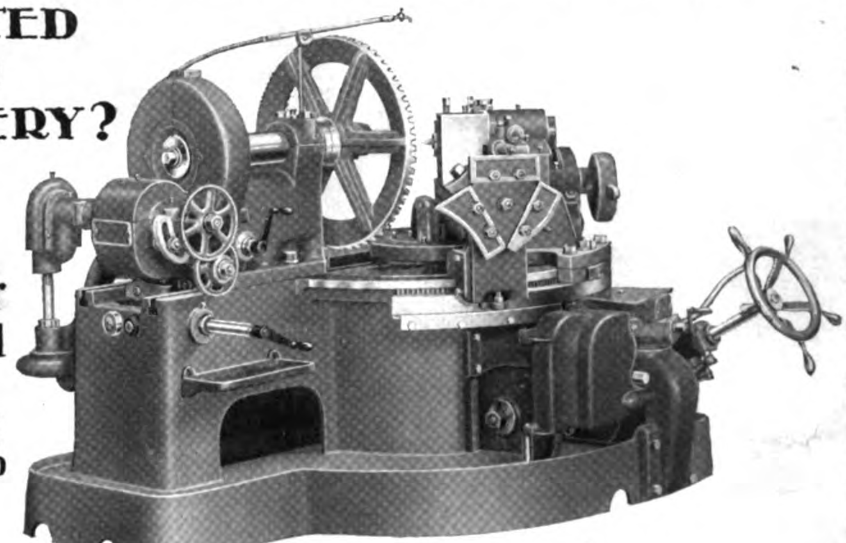
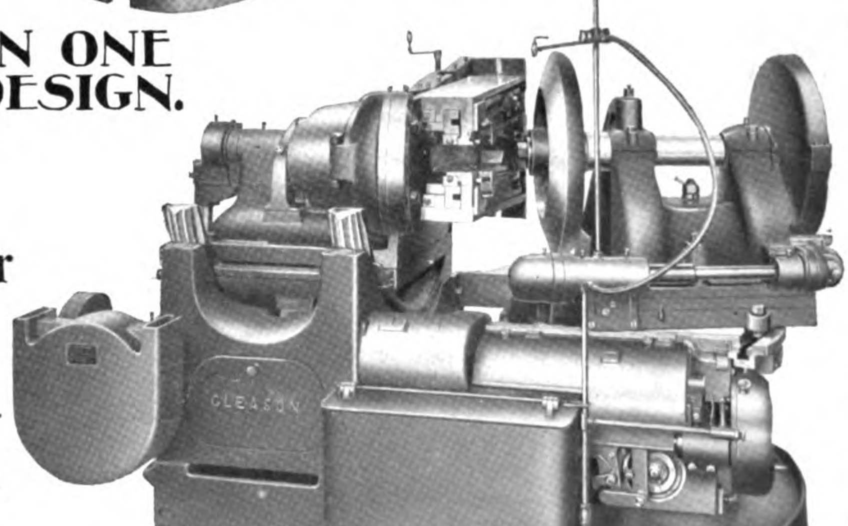
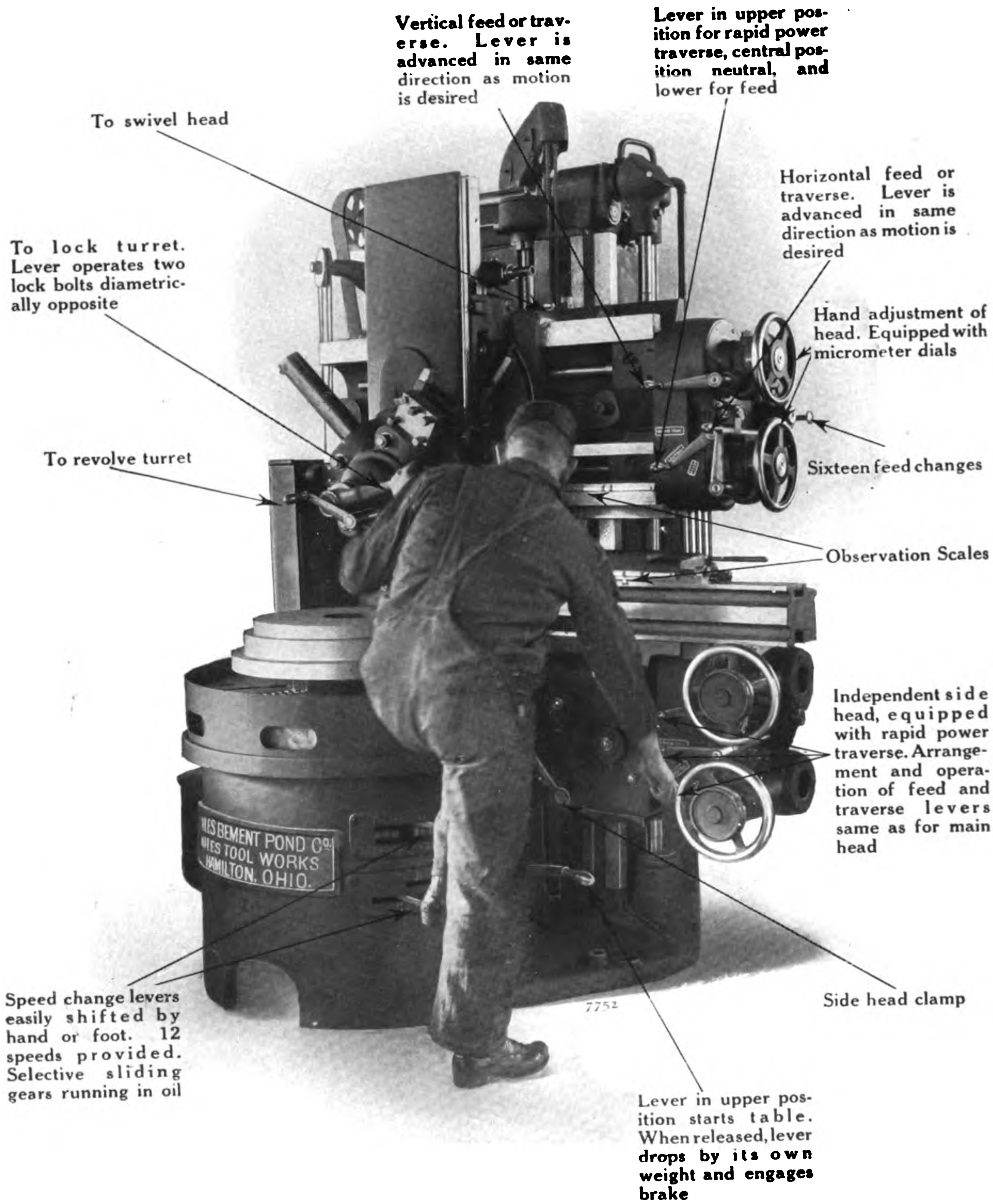




SIDE-HEAD BORING MILL

Embodies every feature known to modern design for the highest production of accurate chucking work



CENTRAL CONTROL It is not necessary for the operator to take a single step to control the entire machine. Furthermore, he does not have to bend or stretch himself unduly to reach speed or feed-levers. Operator is shown above standing practically erect and watching his work while changing speed with his foot and controlling rapid-traverse of side head with his hand.

NILES-BEMENT-POND COMPANY,

111 Broadway, NEW YORK CITY
25 Victoria Street, LONDON, S. W.

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VOLUME 44 — FEBRUARY 24, 1916 — NUMBER 8

CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormay processes, protected by United States patent issued June 22, 1915, and another pending

NUMBER OF COPIES PRINTED THIS ISSUE, 23,000
This includes the English Edition. None sent free regularly, no returns from news companies, no back numbers.

President Wilson's Message on Advertising

Contained in the following letter to the President of the Associated Advertising Clubs of the World

THE WHITE HOUSE
WASHINGTON

October 11, 1915.

My dear Mr. Houston:

Advertising is a factor of constantly increasing power in modern business and it very vitally affects the public in all its phases, particularly since the mediums for the dissemination of advertising have increased so remarkably in recent years. For business men, therefore, it is of the utmost importance that the highest standards should be applied to advertising as to business itself.

The country is to be congratulated on the work of the Associated Advertising Clubs to establish and enforce a code of ethics based upon candid truth that shall govern advertising methods, and the effect of its work should be of the greatest benefit to the country. It augurs permanence and stability in industrial and distributive methods because it means good business judgment, and more than that, it indicates a fine conception of public obligation on the part of men in business, a conception which is one of the inspiring things in our outlook upon the future of national development.

Cordially and sincerely yours,
(Signed) WOODROW WILSON

The AMERICAN MACHINIST has been one of the leaders in the movement for clean advertising

Making Five Million Primers for Cartridge Cases

By Fred H. Colvin

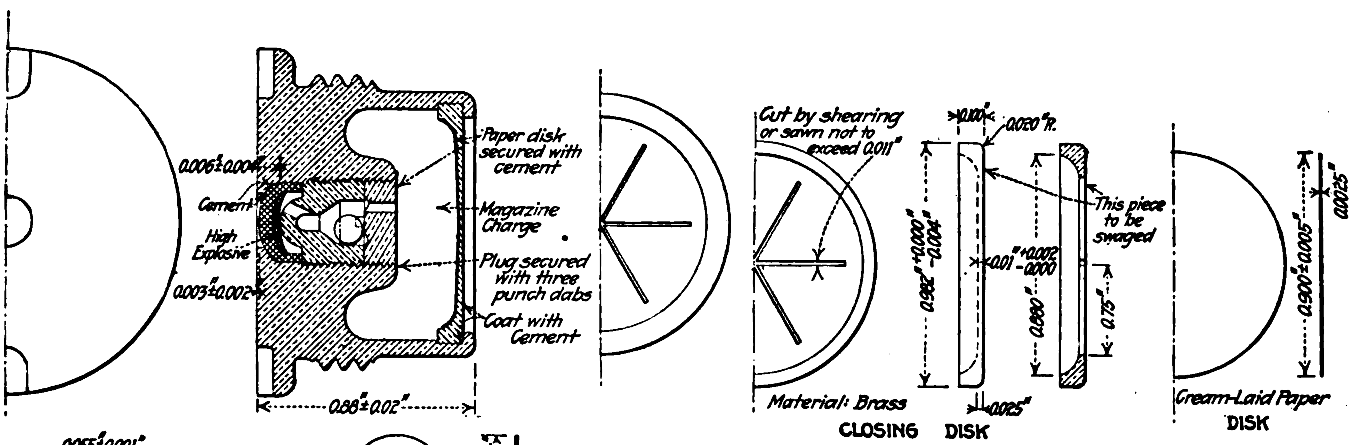
SYNOPSIS—This articles gives an excellent example of how an apparently simple automatic screw-machine job has to be split up into several operations to secure maximum output of work accurate enough to pass inspection. It also shows how special machines have been designed to assist production on a single order for 5,000,000 primers, making it a particularly interesting job in this respect.

Five million primers, which screw into the base of the brass cartridge case and carry the percussion element, are being made by the American Multigraph Co., Cleveland, Ohio. These primers fire the charge in the cartridge case that expels the projectile from the gun, just as the percussion cap in the fuse of a shotgun shell fires the powder inside. One of these primers does more, however, for it must not only fire the charge of powder ahead of it but prevent the gases from getting back into the breech of the gun.

The small exploding charge is contained in the small copper cup that fits into the base of the body. Just above this is the anvil to receive the blow of the firing hammer. Next is the plug, which backs up the anvils and also forms a cover for the safety pocket in the anvil. Surrounding the central stem is a recess for a powder charge that is ignited by the small exploder in the base. The explosion of this charge bursts through the paper cover and the copper closing disk, igniting the main charge in the cartridge case and firing the projectile from the gun. The reaction, however, forces gas backward and bends the points of the closing disk in. It is for this reason that the small copper ball is used as a check valve in the anvil cavity.

This ball normally rests on the lower side of the cavity and allows the flame to shoot through the three small holes in the anvil and out through three similar holes in the plug. The ball is forced against the plug, and to prevent its interfering with the flame reaching the powder in the surrounding cavity, a groove is cut in the inside face of the plug to allow free passage no matter what the position of the ball.

The general appearance of the primer and its parts is shown in Fig. 1. They are seen in place in a cartridge case in Fig. 2. While the primer is very simple as compared with the time or even the detonating fuse, it involves more problems than might appear, especially when



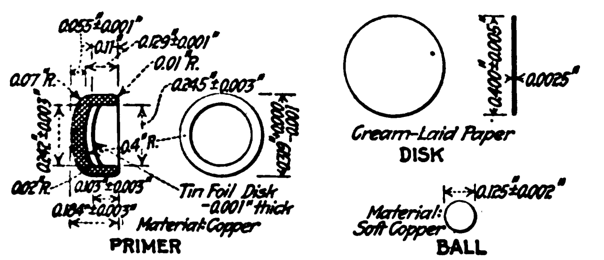


FIG. 1. THE COMPLETE PRIMER

5,000,000 are being made on one order. The way in which these problems have been met and solved reflects credit on the organization and should prove helpful to others in similar lines.

The primer body is shown in Fig. 3. It is made from bar stock 1.410 in. in diameter. As the outside finish size is 1.4 in. with a tolerance of 0.004 in., this gives from 0.01 to 0.014 in. to clean up, which means a very true running chuck to start with. The material must have a tensile strength of 26,880 lb. per sq.in., a breaking strength of 44,800 lb. and an elongation of 30 per cent.

As with most work of this kind, it was expected to turn out the piece practically complete from the automatic screw machine, but the general experience seems to have been that, no matter how good the machine, the desired accuracy cannot be secured in this way. So instead of a complete primer body the automatic now turns it out without threads, with stock for finish counterboring and with the back sufficiently thick to allow finish facing in a separate operation. This back, by the way, must be perfectly flat. The slightest variation, either concave or convex, is sufficient to cause rejection of the piece.

The first operation is performed on $1\frac{3}{4}$-in. Gridley four-spindle automatics, the tooling set-up being shown in Fig. 4. The sequence of operations is shown beneath the figure, the outside turning and the counterboring

being done simultaneously, in both roughing and finishing. This is made possible by the cross-slide forming tool being run into the flute of the counterbore, although the tool layout indicates an interference, as the counterbore has been turned to show the shape of the cutting edges.

The outside was threaded when the work was started, but a hand sizing die was found necessary to maintain

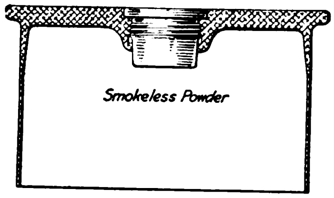


FIG. 2. PRIMER IN PLACE IN CASE

sizes. So a special threading machine, shown in Fig. 5, was built for this work. The first-operation tools and gages are shown in Fig. 6.

Second Operation—Facing Primer Body

From the Gridley the fuse bodies go to the face-milling attachment, shown in Fig. 7, that was built for the Brown & Sharpe vertical miller. The table holds 30 bodies, gripping each body in a pair of jaws that are drawn down in a wedge-shaped pocket by the levers with rollers on the end, these rollers passing under a cam at the proper time. This draws them down against the face of the plate just before they pass under the single-pointed fly cutter which runs at top speed and makes a flat, smooth surface.

Just behind the milling cutter is an ingenious device that stamps the back with the company mark "M," saving one operation. This punch, or stamp, is actuated by the small wedges E which lift the punch and then

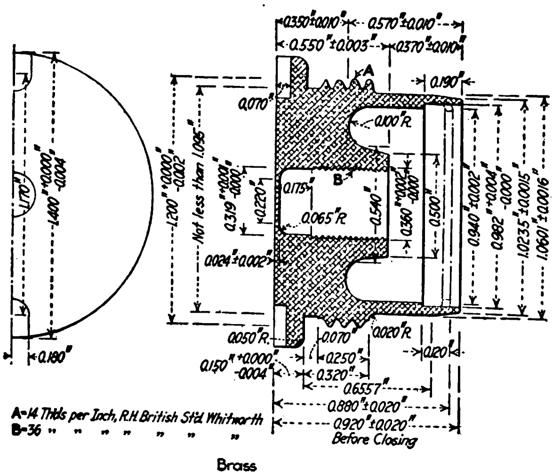


FIG. 3. THE DETAILS OF THE PRIMER BODY

release it, a spring behind the punch giving it a quick blow which does the stamping.

Details of this can easily be seen. The milling spindle A carries a single point fly cutter. Each set of gripping jaws has a roller B on the outer end which is actuated by the cams C and D. The first draws the jaws down, locking the primer, while the second D raises the roller and the jaws for releasing and reloading. The wedges E raise the marking stamp and release it for the blow. Air jets keep the chips clear of the work and the holding jaws.

A very ingenious method was employed before this rotary attachment was designed and built. It consisted of several steel blocks containing six holes threaded to fit the primer body, as in Fig. 8. These blocks were loaded by boys at the bench who passed them to the milling-machine operator. He simply laid them against a raised edge on a magnetic chuck, threw the switch

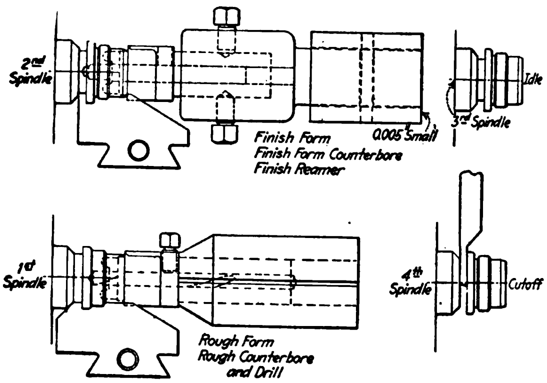


FIG. 4. BODY OPERATION 1: TURNING AND BORING
Machine Used—Gridley 1¾-in. automatic.
Special Fixtures—Tools in automatic; see Fig. 5.
Production—150 per hr. per machine.
Gages—See Figs. 5 and 6.

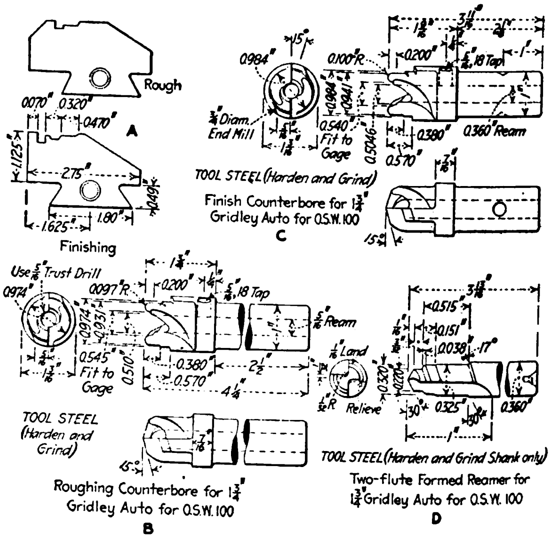


FIG. 5. FORMING TOOLS AND COUNTERBORES

and allowed the table to feed the bodies under the single-point fly cutter. While this was being done he stamped the letter "M" on the six he had just milled and passed them to the bench to be removed and the blocks reloaded. One pass of the table finished the face, and that method secured very rapid production. The new attachment, however, cuts out the boys loading the blocks, as one operator handles it.

The thread milling comes next, being done at the rate of 10 per minute on the special machine shown in Fig. 9. This machine has one hob with alternately re-

lieved threads, and two spindles which carry the primer bodies. The primer bodies are automatically gripped by the flange, carried against the hob, rotated and moved endwise at the proper speed, and moved away from the hob, the other spindle then coming into operation. The time for loading and unloading, although there is no lost time, is at the rate of 6 seconds each.

The fourth operation is to wash in gasoline, it having been found the most suitable cleanser. It is used

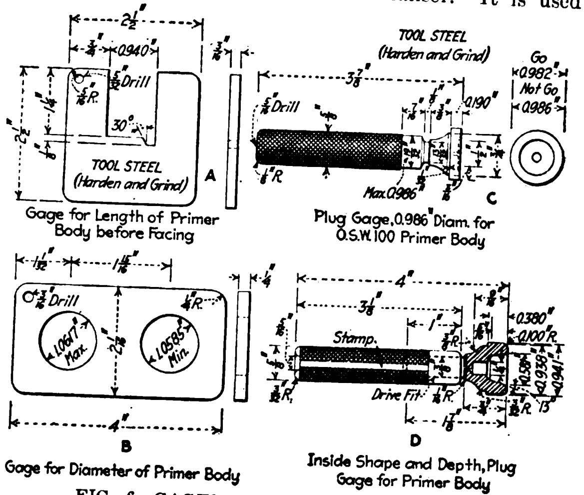


FIG. 6. GAGES FOR FIRST OPERATION

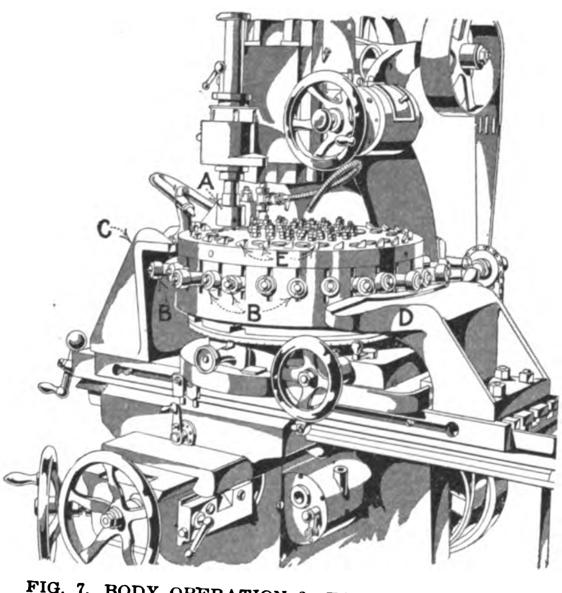


FIG. 7. BODY OPERATION 2: FACING THE HEAD
Machine Used—Brown & Sharpe vertical miller.
Special Fixture—Table for continuous milling.
Production—500 per hr.
Gages—See Fig. 14.

in small quantities only, kept in shallow pans, and every precaution taken to prevent flame from coming anywhere near it.

The fifth operation is to mill the key, or wrench slots, another special machine, Fig. 10, being used for this purpose. Both of these machines are covered by patents. This slot-milling machine carries five horizontal milling spindles, three running in one direction and two in the other, and works on four bodies simultaneously. The bodies are placed in the cylinder of the machine, two operators being kept busy in loading it. The bodies are indexed into position; the five spindles move sidewise, first one way and then the other, and in so doing mill the two slots in all four bodies. The cylinder is turned at a rate of 40 bodies, or 10 movements, per minute, or 2,400 per hour.

The illustration shows two views and gives the essential details. The cylinder *G* is removed from the shaft

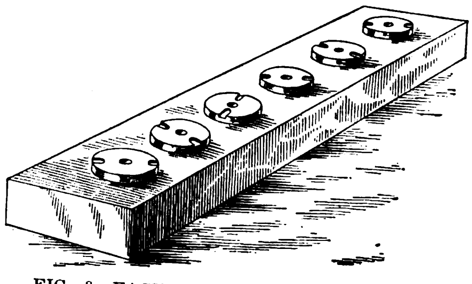


FIG. 8. FACING HEADS—OLD METHOD

F in one view. The five spindles are shown at *A* and the four holding fingers at *B*. The arm *C* carrying the pawl *D* and actuated by the lever *E* indexes the cylinder by means of the ratchet *H*. It is a very compact and very efficient little machine for this kind of work.

Tapping, the sixth operation, is done under a sensitive drill with the aid of Errington tapping devices at the rate of nearly 500 an hour, the body being held in the fixture shown in Fig. 11. The body is set over the two pins, to hold against turning, and the fork is slid over the flange to prevent lifting.

The Seventh Operation—Finish Counterboring

Following the tapping cames the finish counterboring to get the seat for the percussion cap the correct distance from the face of the primer body and also to insure the

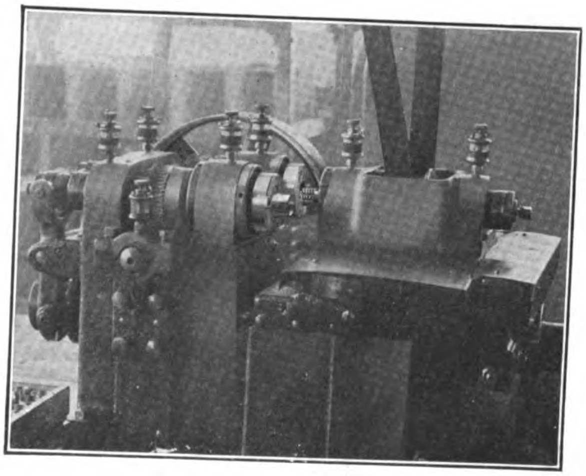


FIG. 9. BODY OPERATION 3: MILLING THREAD ON PRIMER BODY
Machine Used—Special thread miller.
Production—450 to 500 per hr.
Gages—See Fig. 13.

length of this recess being exactly correct, so as to hold the anvil and plug in proper relation to the tap.

This counterboring is done under a sensitive drilling machine similar to that used for the tapping previously referred to. the fixture and methods being clearly shown

in Fig. 12. The key slots of the fuse body are placed over the two locating pins, and the combined counterbore and spacing cutter, *A* and *B* respectively, are brought down into the recess until the collar *C* rides on the hard-steel bushing *D*. This insures the correct depth and can be handled very rapidly, a production of about 600 an hour being maintained throughout the day.

The eighth operation is to wash again in gasoline, preparatory to the ninth operation, or final inspection. The inspection gages are shown in Fig. 13, the purpose of each being clearly shown by the caption beneath.

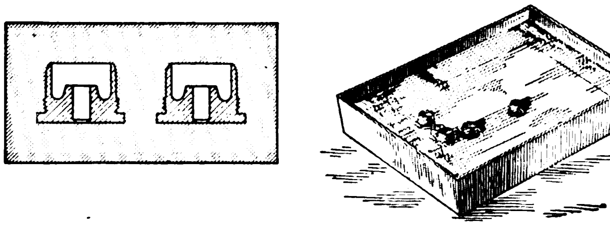
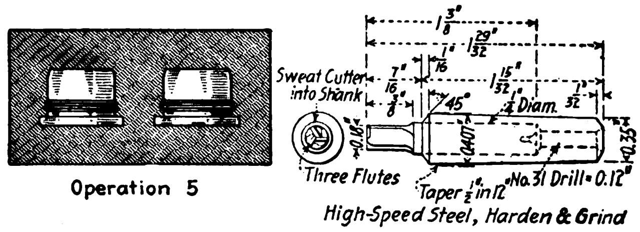


FIG. 9-A. WASHING IN GASOLINE



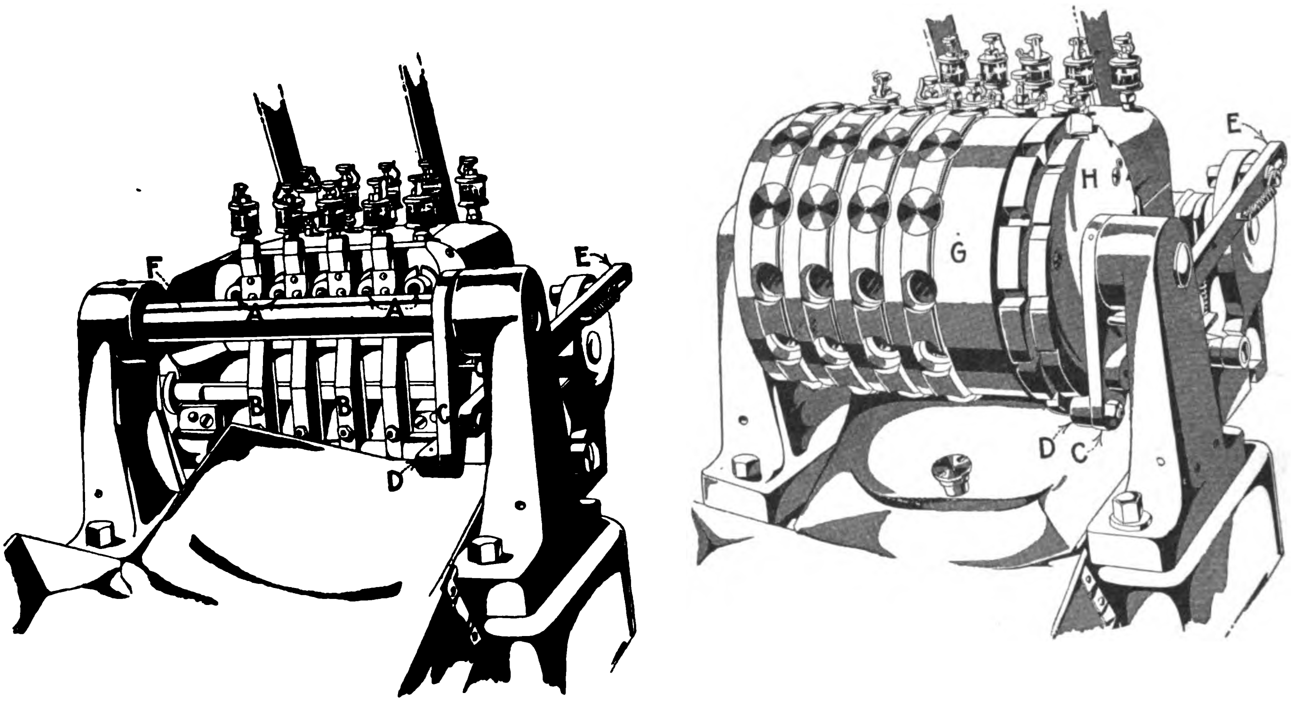


FIG. 10. BODY OPERATION 5: MILLING KEY SLOTS
Machine Used—Special five-spindle miller. Production—2,400 per hr. Gages—See Fig. 13.

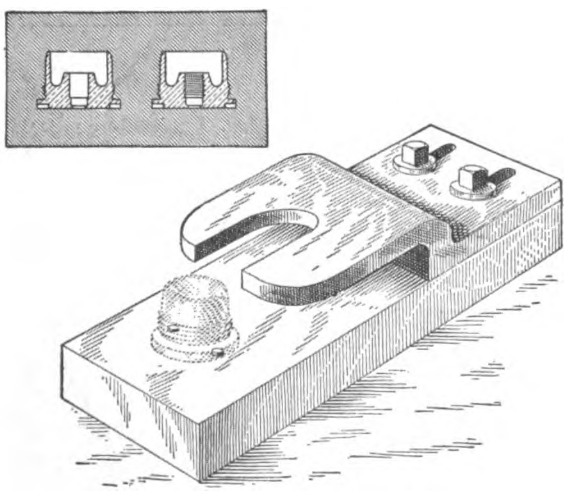


FIG. 11. BODY OPERATION 6: TAPPING FOR ANVIL
Machine Used—Vertical drilling machine.
Special Fixtures—Errington tapping head and fixtures.
Production—250 per hr.
Gages—See Fig. 13.

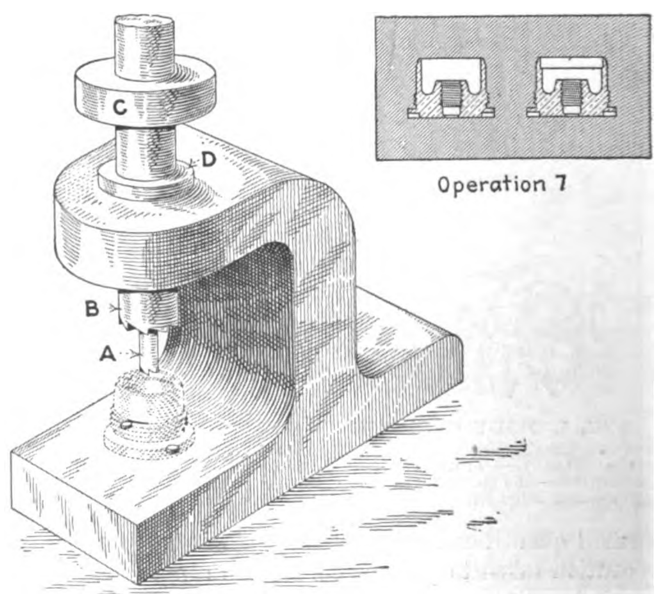


FIG. 12: BODY OPERATION 7: FINISH COUNTERBORE
Machine Used—Vertical drilling machine.
Special Fixtures—Holding fixture and tools.
Production—600 per hr.

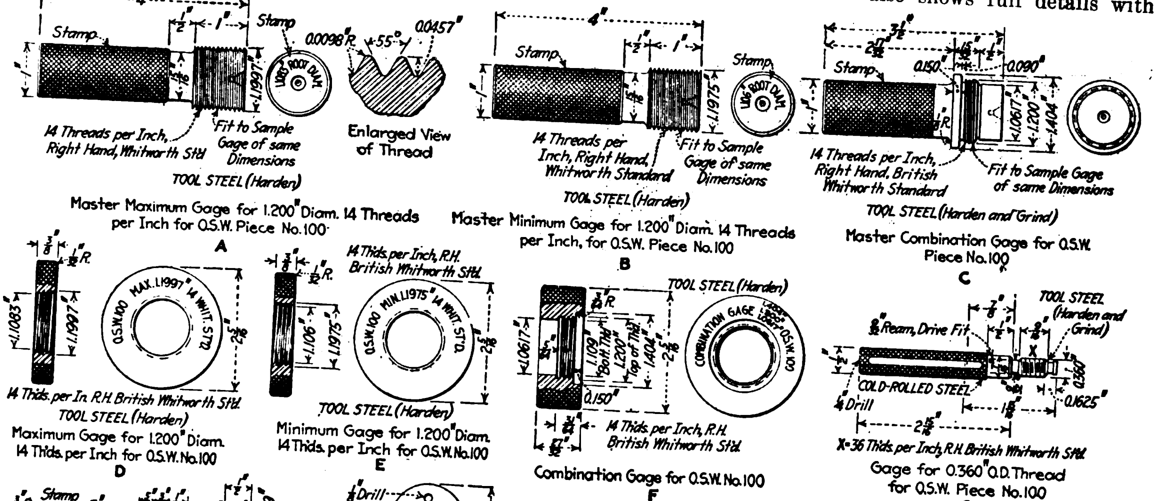
The combination gage makes a particularly severe test, as it not only gages the diameter of the flange, the thread, and the front portion of the body, but also their concentricity. The tolerance is so small that the utmost accuracy is required to have the body screw into this piece without binding on the nose and flange.

It will be noted that master gages are provided from which other gages are to be made, this being found neces-

sary where such large quantities are inspected. The wear on gages in cases of this kind is greater than might be imagined.

The method of boxing for shipment to the loading factory is shown in Fig. 14. The boxes are 12⅜x14¾x9⅝ in. deep and hold 100 primers in each lawer. The primers are staggered in packing, as can be seen. A sheet of corrugated cardboard is placed between each layer and also over the top. When packed in the box in this way the upper layer sticks up quite a little beyond the box. As the cover is nailed down, the thin edges of the primers force their way into the corrugated paper and make it impossible for any shifting to take place, thus effectually preventing injury. The boxes weigh about 180 lb. ready for shipment.

The anvil is made from a brass rod on a National Acme No. 515, the dimensions being shown in detail in Fig 15. This illustration also shows full details with



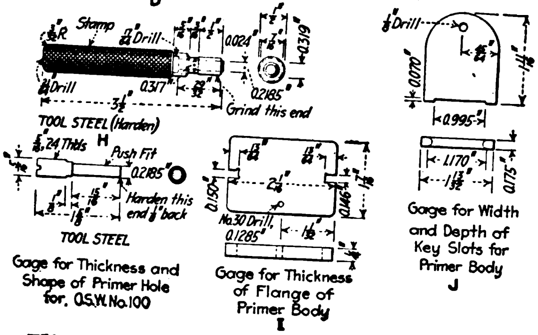


FIG. 13. INSPECTION GAGES FOR PRIMER BODY

all dimensions and tolerances, as well as the tool layout for the automatics. The sequence of sub-operations is form, counterbore, thread and cut off. The machines are single tooled and average 12,000 pieces in 21½ hours, which is the length of time the machines run each day.

The tool layout is shown in Fig. 16, while the forming and counterboring tools are given in detail in Fig. 17.

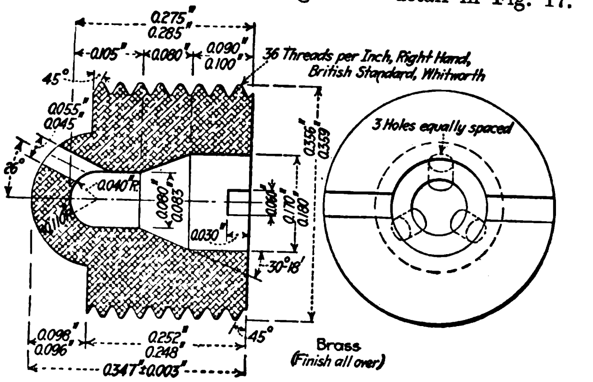


FIG. 15. DETAILS OF THE ANVIL

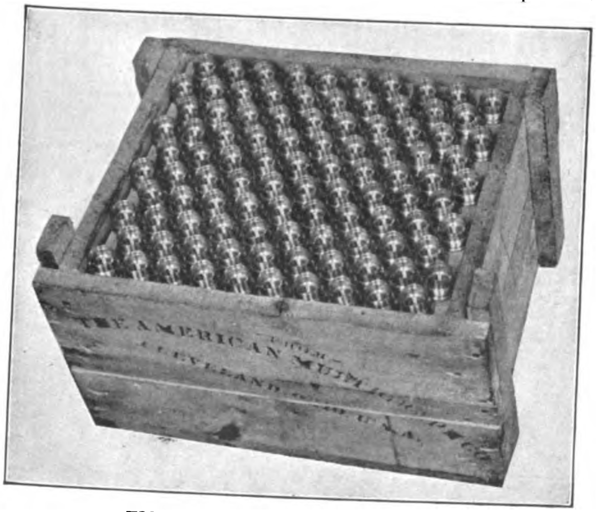


FIG. 14. BOXED FOR SHIPMENT

The gages used for the machine operations are given in Fig. 18. All the gages for measuring the counterbore are cylindrical. Those which gage the depth, *A* and *C*, Fig. 18, have notches cut on opposite sides. One of these gives the low, and the other the high limit in each case.

Second Operation—Drilling

The second operation on the anvil consists in drilling the three flash holes in the rounded end of the anvil. This work is done in the fixture shown in Fig. 19, the drill being 0.05 and run in either a small Burke drilling machine or one of the new high-speed machines built by Langelier. The latter handle about 4,000 in 9 hours.

The base of the indexing fixture is inclined so as to give the desired angle to the hole, and no guide bushing is found necessary, as the drill is allowed to project only a

short distance from the chuck. The anvil to be drilled is dropped into the opening *A*, resting on the plunger *B*, and held by a slight movement of the knurled setscrew *C*. It is indexed around by hand, from notch to notch; when the last hole is drilled a movement of the lever *D* into the dotted position shown ejects the anvil by means of the plunger *B*. This plunger is normally held in its lower position by the helical springs, and the indexing

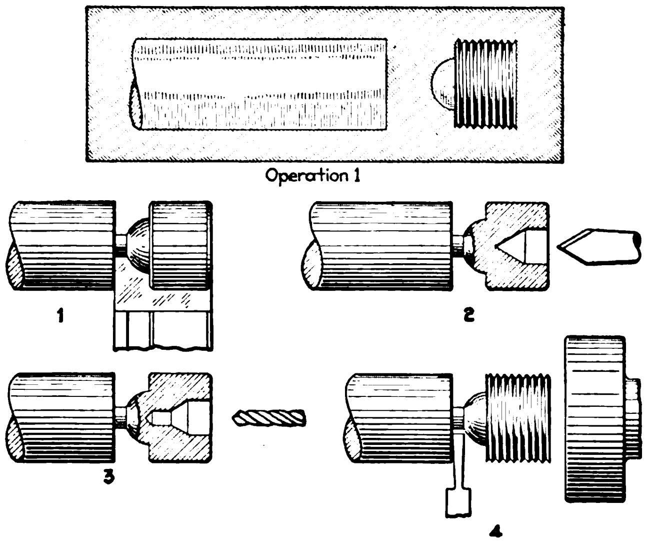


FIG. 16. ANVIL OPERATION 1: FORMING
Machine Used—National Acme automatic No. 515.
Special Fixtures—See Fig. 17.
Production—550 per hr.
Gages—See Fig. 18.

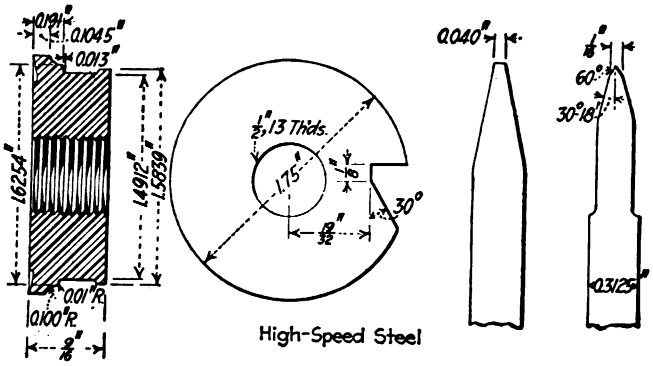


FIG. 17. THE TOOLS USED FOR TURNING AND FORMING ANVIL

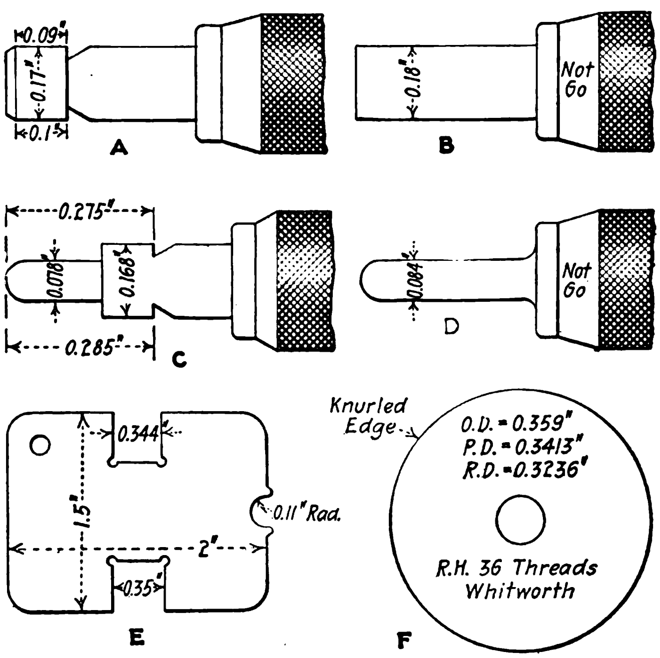


FIG. 18. INTERNAL AND EXTERNAL GAGES FOR ANVILS

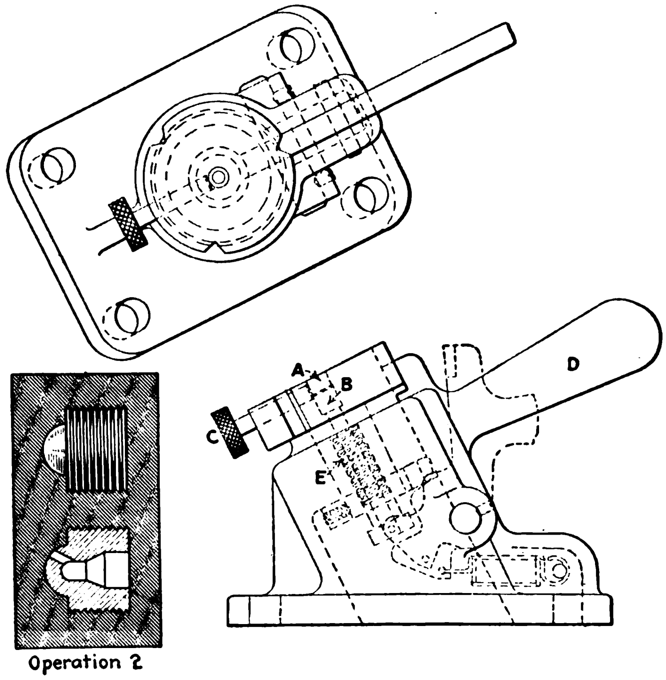


FIG. 19 ANVIL OPERATION 2: DRILLING
Machines Used—Langelier and Burke bench machines.
Special Fixtures—Drilling fixture.
Production—440 per hr.
Gages—See Fig. 18.

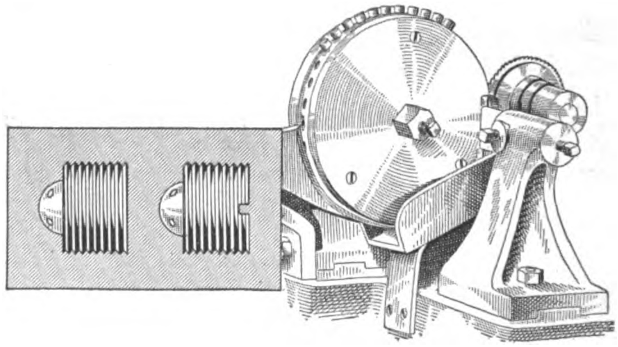


FIG. 20. ANVIL OPERATION 3: SLOTTING
Machine Used—National Acme slotter.
Production—1,800 per hr.
Gages—See Fig. 18.

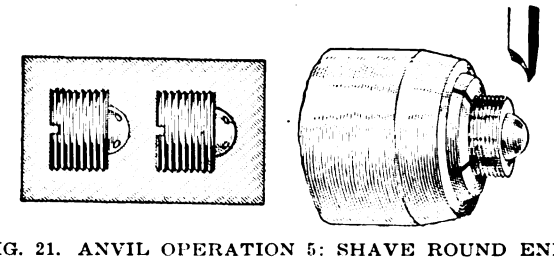


FIG. 21. ANVIL OPERATION 5: SHAVE ROUND END
Machine Used—Brown & Sharpe bench machine.
Special Fixture—Split chuck.
Production—550 per hr.
Gages—See Fig. 18.

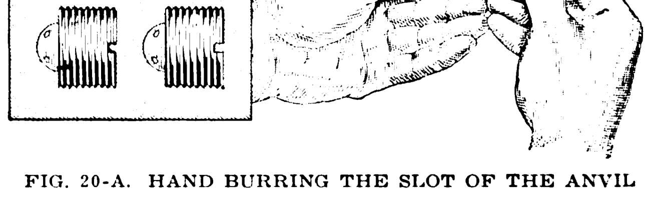


FIG. 20-A. HAND BURRING THE SLOT OF THE ANVIL

lever can be moved only far enough to cause ejection when the holder is in one position.

The third operation on the anvil is slotting in a National Acme screw slotter provided with suitable holding plates, and with a production of 17,000 in 9 hours. The burr is then removed from the slot by hand, the fifth and final operation being the shaving of the rounded end on

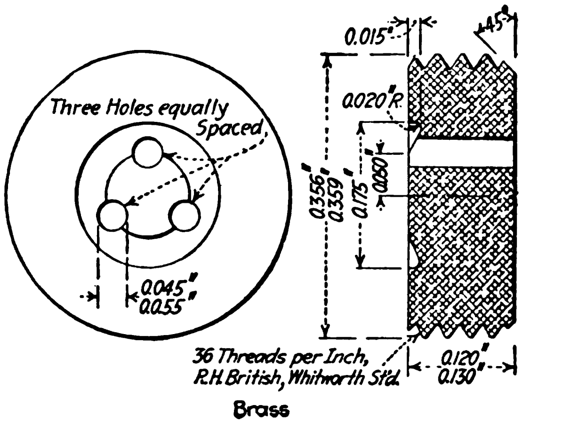


FIG. 22. THE PLUG, ENLARGED AND DIMENSIONED

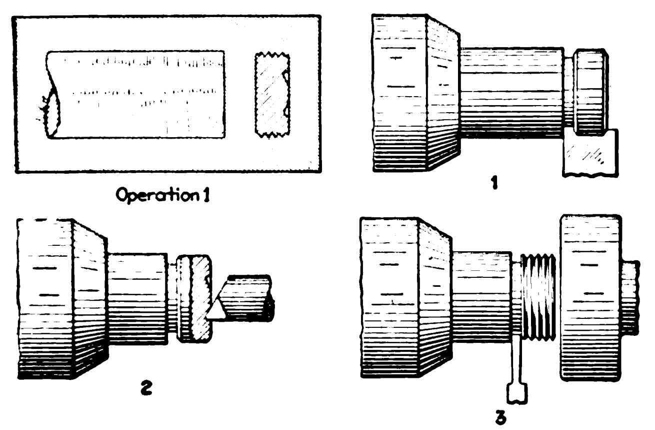


FIG. 23. PLUG OPERATION 1: FORMING
Machine Used—National Acme automatic No. 515.
Special Fixtures—Forging tools.
Production—600 per hr.
Gages—See Fig. 26.

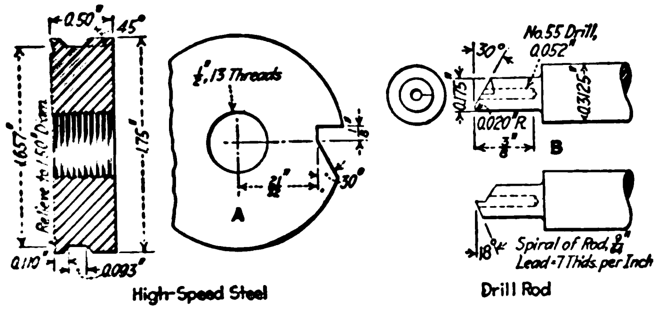


FIG. 24. THE TOOLS USED IN THE AUTOMATIC

a small Brown & Sharpe bench machine, consisting solely of a bed, headstock and cross-slide. The anvil is held in a grip chuck, the production averaging 5,000 in 9 hours. The third and fifth operations are shown in Figs. 20 and 21. The gages used on the anvil are shown in Fig. 26.

The Plug—Screw-Machine Operation

Making the plug is also a simple screw-machine job and is shown with full details in Fig. 22. The tool layout appears in Fig. 23. This work is also done on a No. 515 National Acme automatic, the production being about 13,000 during a day's run of 21½ hours.

The tools are shown in Fig. 24. The circular groove in the face of the plug is cut by the single-lipped tool shown in Fig. 24, which is rather interesting. It has a helix equivalent to a 7-pitch thread cut on the end, so that it can be ground back almost indefinitely, as with a circular forming tool.

The second operation on the plug is to drill the three small flash holes in the fixtures shown in Fig. 25. The operation of this fixture is practically identical with

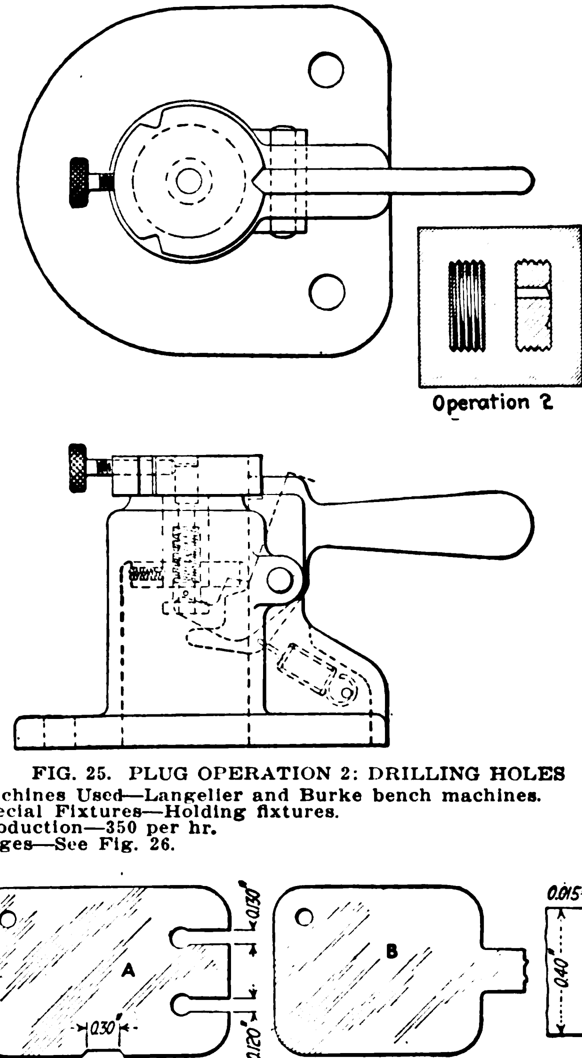


FIG. 25. PLUG OPERATION 2: DRILLING HOLES
Machines Used—Langelier and Burke bench machines.
Special Fixtures—Holding fixtures.
Production—350 per hr.
Gages—See Fig. 26.

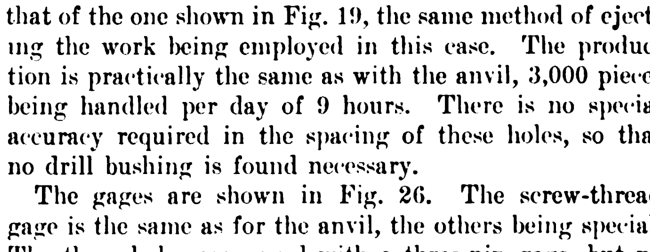


FIG. 26. THE GAGES FOR THE PLUG

that of the one shown in Fig. 19, the same method of ejecting the work being employed in this case. The production is practically the same as with the anvil, 3,000 pieces being handled per day of 9 hours. There is no special accuracy required in the spacing of these holes, so that no drill bushing is found necessary.

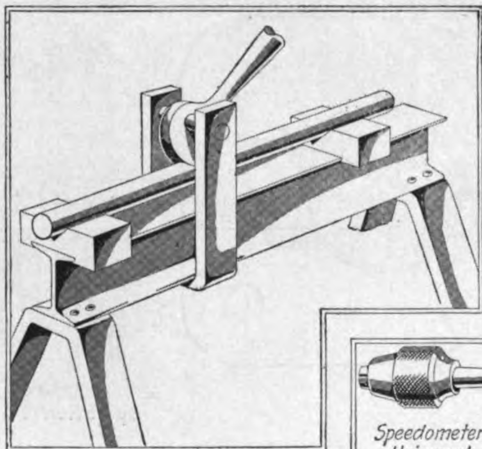
The gages are shown in Fig. 26. The screw-thread gage is the same as for the anvil, the others being special. The three holes are gaged with a three-pin gage, but no special limits are set.

Both the anvils and the plugs are shipped in lots of about 100 lb., no assembling being done until they reach the loading plant. They are boxed in a substantial manner, no special packing being found necessary to prevent the threads being damaged in transit.

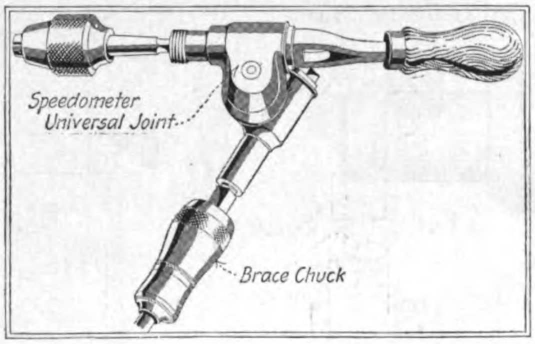
From A Small-Shop Notebook

By John H. Van Deventer

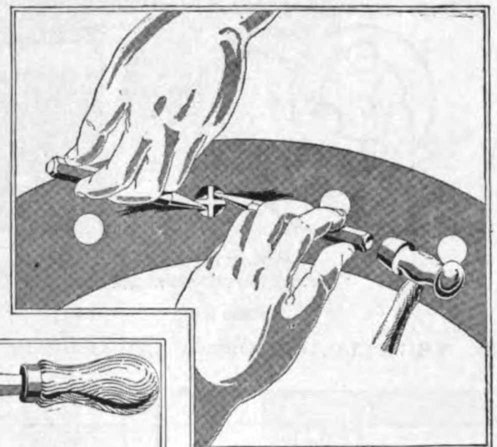
Shaft-Straightening Press Made with I-Beam



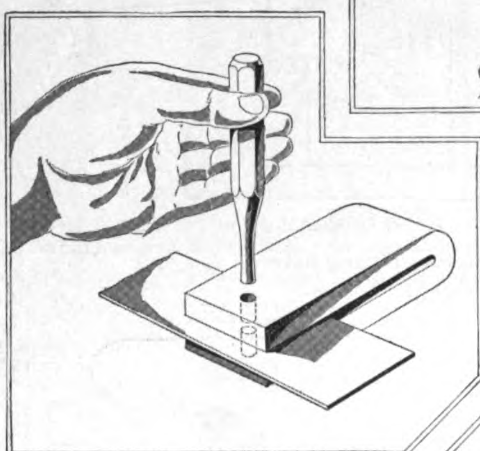
Close-Quarter Drill Made in Auto Repair Shop



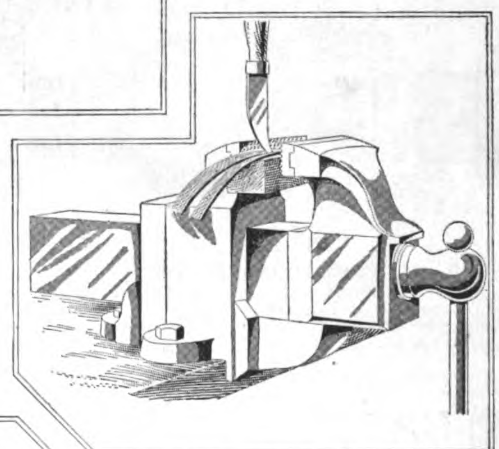
Removing Broken Tap Easily with Two Punches



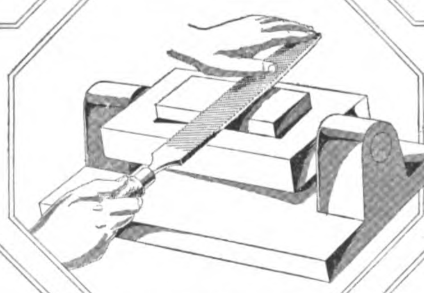
Easily Made Punch for Thin Sheets



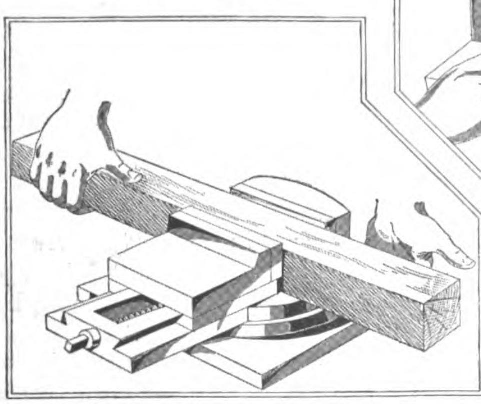
Belt Lace, Split in the Bench Vise



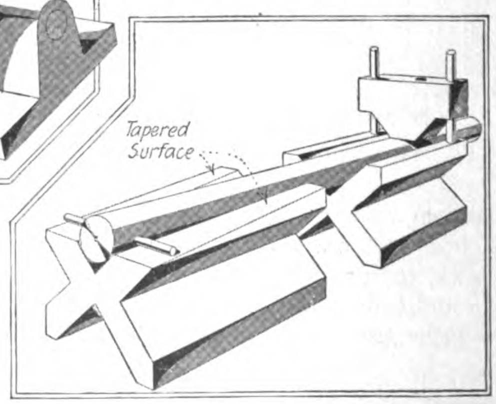
Swivel Filing Table for Straight Surfacing



An Easy Way to Lift a Planer Chuck

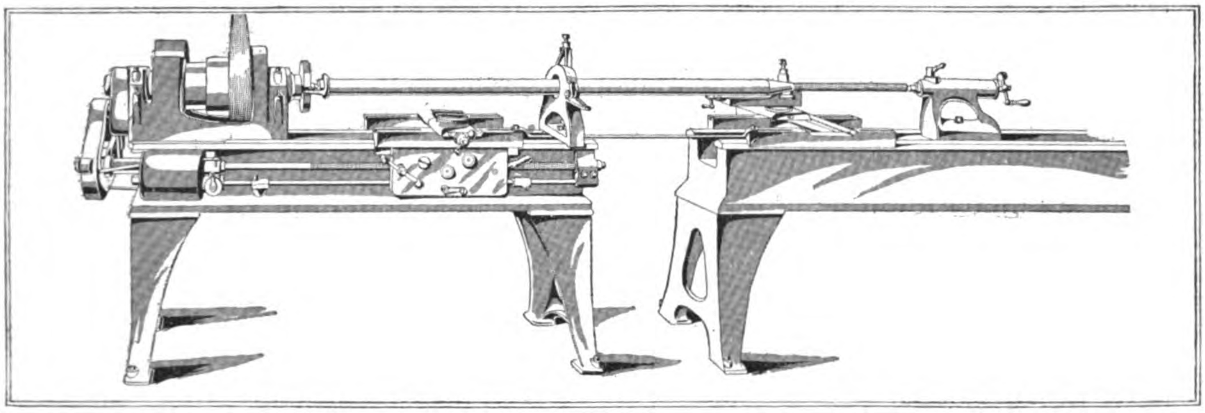


Taper V-Blocks for Cross Drilling

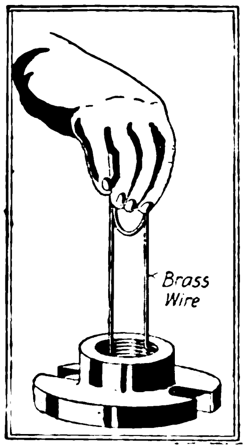


Bench, Vise and Assembling Methods

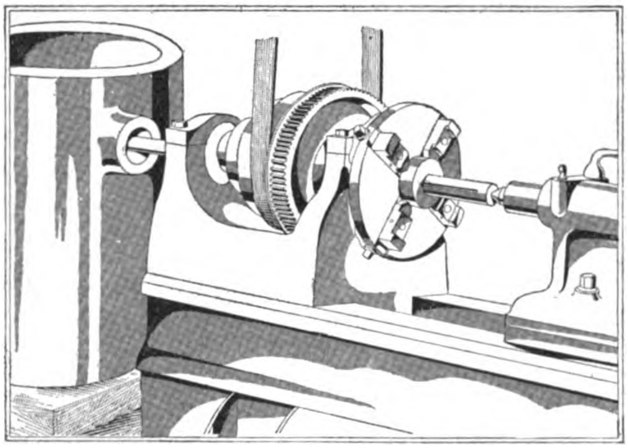
THREADING THE END OF A LONG SHAFT ON TWO LATHES



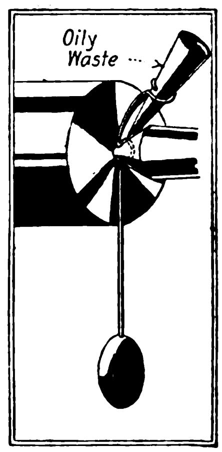
SIMPLE THREAD CLEANER



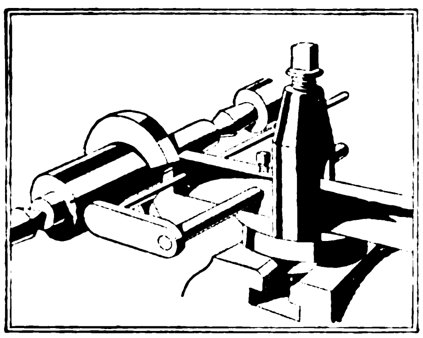
THIS ENGINE LATHE IS TACKLING A BORING MILL JOB



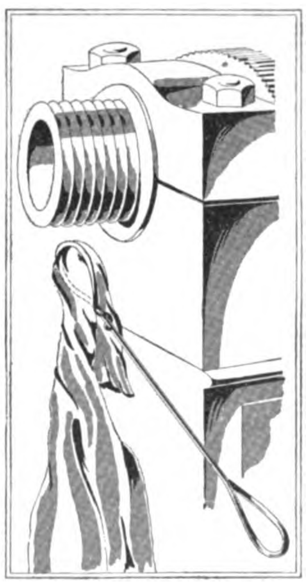
CENTER-OILING DEVICE



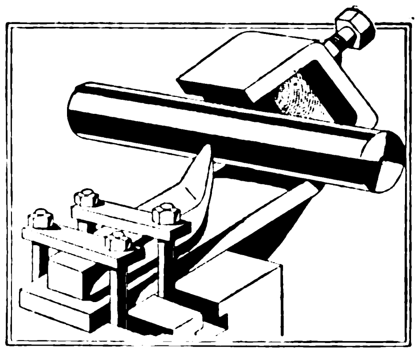
SHEARING SMALL PINS IN THE LATHE



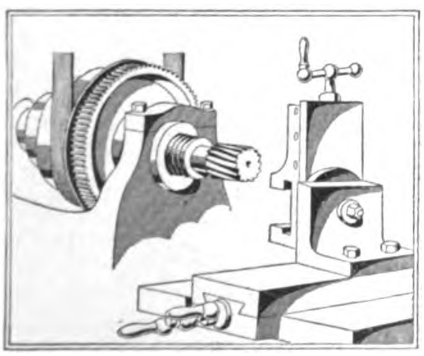
CENTER-BEARING SWAB



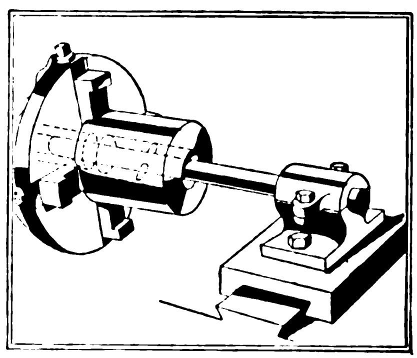
SIMPLE BUT EFFECTIVE FOLLOW REST



ARRANGING A LATHE FOR MILLING



RIGID BORING WITH PILOTED BAR



Devices That Make Lathes Profitable

Jigs for Machining Cylinder Details for a Printing Press

By Robert Mawson

SYNOPSIS—As the elements used on the cylinders must be accurately machined, the jigs employed are of rigid construction. Further, the parts after being placed in the jigs are held securely so that they cannot be moved by the tools during the machining operations.

The two-sheet rotary printing press manufactured by the United Printing Machinery Co., Woonsocket, R. I., was described on page 58. Articles illustrated on pages 138 and 232 describe jigs and fixtures used in machining the various elements comprising this type of rotary press.

The operations on the parts covered in this article are confined to drilling and reaming. The parts are a feeder, cylinder frame, trip-connection lever, gripper-rod coupling and cylinder eccentric, which constitute the cylinder mechanism.

The jigs shown, as well as the others mentioned, represent high-grade modern small-tool design and construction actually meeting the requirements of commercial work and production. In most cases the parts are milled before drilling, the tools being supplied with fixed locating pads. Where rough surfaces are used for locating the jigs are fitted with adjustable stops which may be changed to accommodate any variations in contour of castings.

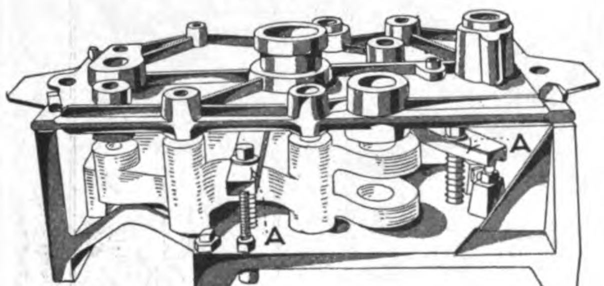


FIG. 2

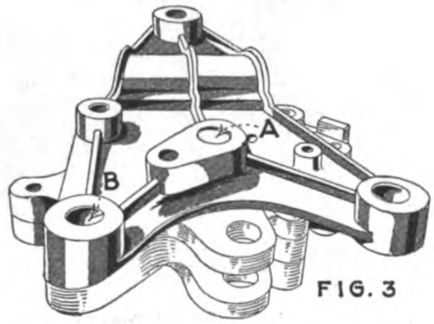


FIG. 3

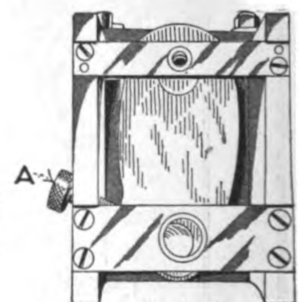


FIG. 9

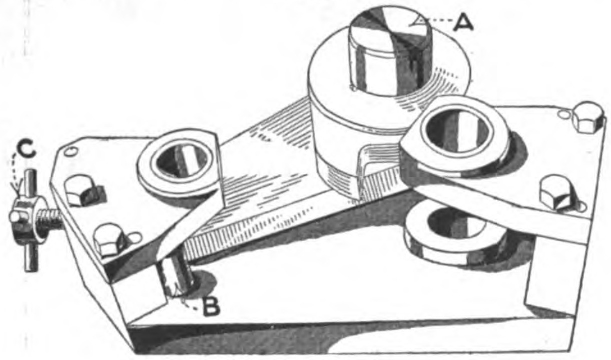


FIG. 5

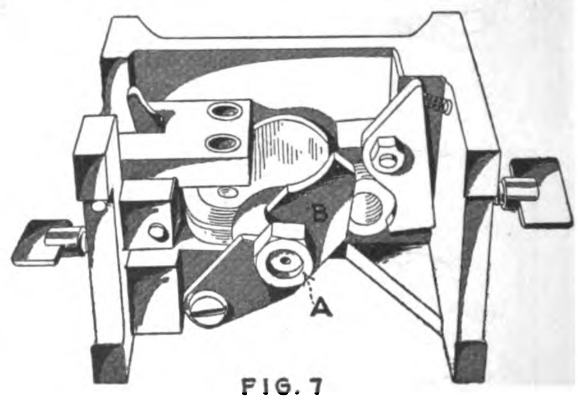


FIG. 7

JIGS FOR MACHINING CYLINDER DETAILS OF A PRINTING PRESS WITH WORK IN POSITION

FIGS. 2 AND 2-A

Operations—Drilling and reaming holes in face of feeder cylinder frame, Fig. 1. The rough casting is located by a V-block being forced against it with a knurled-head screw; straps, as A, hold the piece in position. The jig cover is then dropped, located by two dowels and held down with thumb-screws.

Holes Machined—One $2\frac{63}{64}$-in. drilled, one 3-in. reamed, one $1\frac{31}{64}$-in. drilled, one $1\frac{1}{2}$-in. reamed, one $1\frac{63}{64}$-in. drilled, one 2-in. reamed, one $\frac{59}{64}$-in. drilled, one $\frac{15}{16}$-in. reamed, three $\frac{25}{32}$-in. drilled, two $1\frac{7}{64}$-in. drilled, one $1\frac{1}{8}$-in. reamed, one 1-in. drilled, one $\frac{47}{64}$-in. drilled.

FIGS. 3 AND 3-A

Operations—Drilling and reaming holes in ears of feeder cylinder frame. The jig is located by a 3-in. turned plug A fitting into a reamed hole in the piece; the jig is then slid around until the hole B is central with the casting. After this hole is machined, it is used to hold the jig in position.

Holes Machined—Two $1\frac{31}{64}$-in. drilled, two $1\frac{1}{2}$-in. reamed, one $\frac{33}{64}$-in. drilled, one 1-in. drilled.

FIGS. 5 AND 5-A

Operations—Drilling and reaming hole in arm of trip-connection lever, Fig. 4. The casting is located by a $2\frac{1}{2}$-in. pin A that fits into a reamed hole. The piece is then accurately and rapidly positioned by being forced back against the pin B with the pin-headed screw C.

Hole Machined—One $1\frac{1}{8}$-in. spot drilled and reamed.

FIGS. 7 AND 7-A

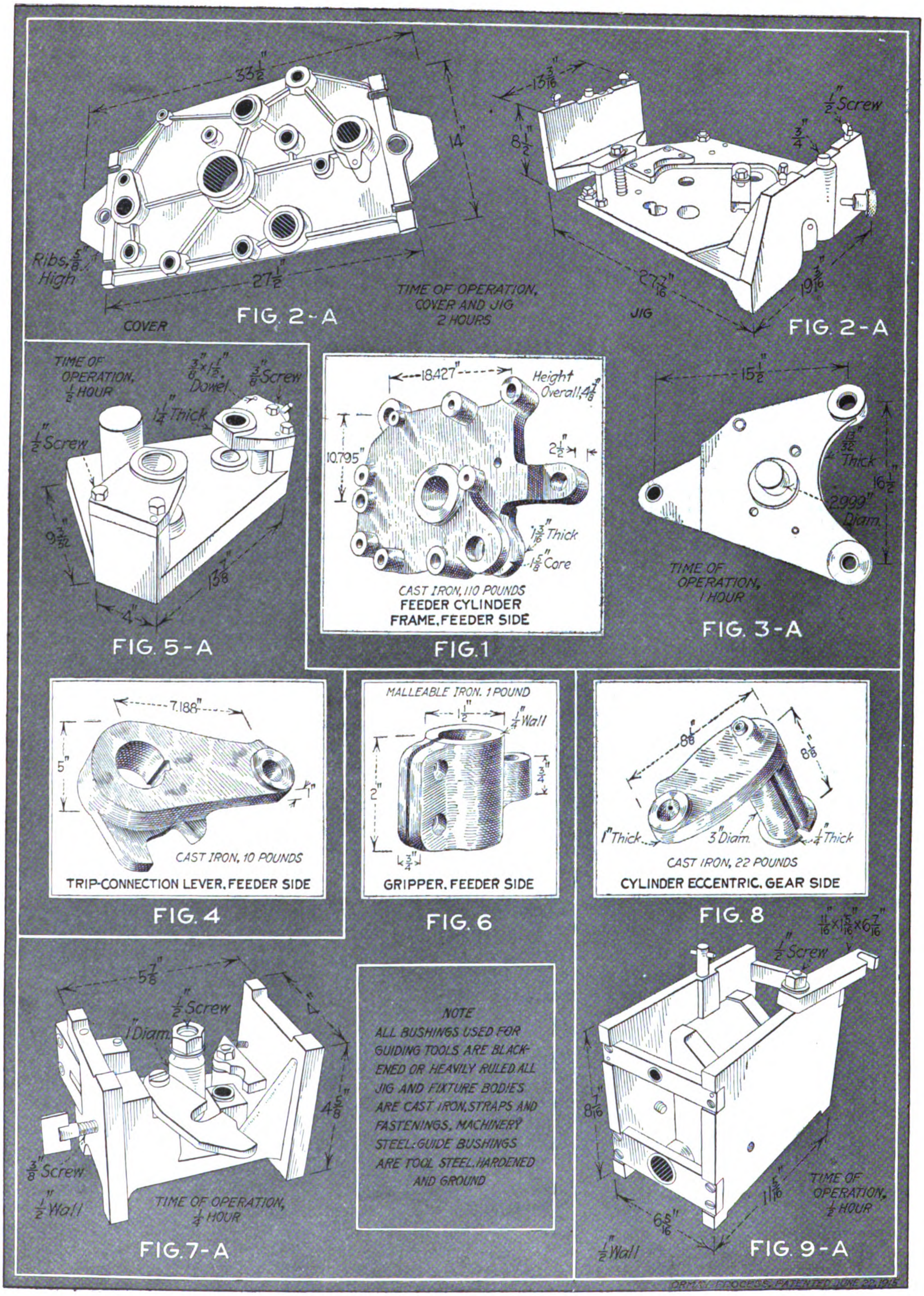
Operations—Drilling and reaming gripper-rod coupling. Fig. 6. The casting, which has been previously bored and faced, is placed on the 1-in. stud A. The part is located by a V-block inside of which the circular boss rests. The strap B is then swung over, and the nut, tightened against the strap, holds the casting securely.

Holes Machined—Two $\frac{11}{32}$-in. drilled, one $\frac{27}{64}$-in. drilled and one $\frac{7}{16}$-in. reamed. The former holes are later remachined, the upper part being $\frac{13}{32}$-in. drilled and $\frac{3}{4}$-in. spot faced, and the lower portion tapped with $\frac{3}{8}$-in. U.S.S. threads.

FIGS. 9 AND 9-A

Operations—Drilling and reaming holes in cylinder eccentric, Fig. 8. The rough casting is dropped into a V-block and the cover swung over. The knurled-head screw A then forces the casting against a stop pin.

Holes Machined—One $\frac{3}{8}$-in. drilled, one $1\frac{7}{64}$-in. drilled and one $1\frac{1}{8}$-in. reamed.



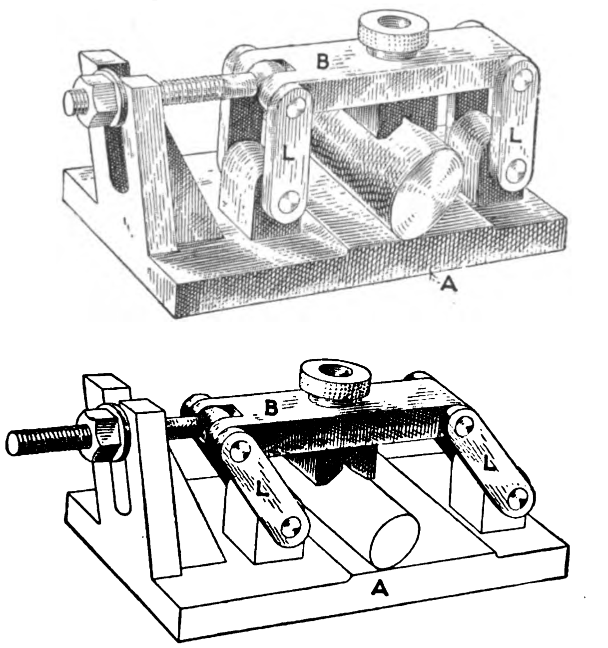
DETAILS OF JIGS USED IN MACHINING PRINTING-PRESS CYLINDER ELEMENTS

Drill Jig for Round Stock

By W. Burr Bennett

Herewith is shown the design of a universal drill jig for round stock. It is adaptable to a large range of sizes and when equipped with a set of various-sized slip bushings, becomes a very handy jig to have around the shop.

The jig consists of two bars held parallel to each other by four links *L*. The lower bar *A* is a casting and forms the base. The top bar *B*, which is made of machine steel,



DRILL JIG FOR ROUND STOCK

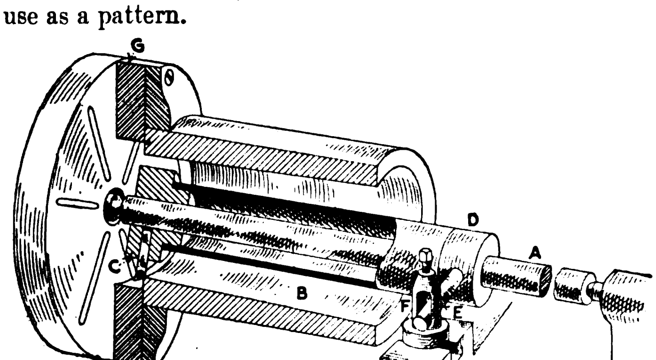
carries the V-block and bushing and has an eye-bolt attached to one end. By screwing up the nut on the eye-bolt the upper bar is pulled over horizontally and also downward, thereby clamping the work in place.

In order that the top bar may tend to pull downward in all positions, the bracket which the nut bears against is set at an angle, thus inclining the eye-bolt from the horizontal and giving the desired effect. The dotted lines show the position of the V-block and top bar when used on smaller-sized stock.

Improvised Taper-Boring Bar

By Howard Brady

A casting about 11 in. in inside diameter and about 18 in. long came to the shop of the Traverse City Iron Works, Traverse City, Mich., to be bored and turned for use as a pattern.



IMPROVISED TAPER-BORING BAR

It was easy enough to put a slight taper on the outside by feeding in a little with the cross-feed and then finishing with a file, but it was a different proposition to make a smooth finish in the hole, where a file could not be used. The work was done very simply, and the method can be used to advantage in a good many different ways.

First a piece of $1\frac{15}{16}$-in. shaft *A* about 44 in., or more than twice the length of the casting, was cut off and centered. Then a piece of 3-in. pipe *B* was cut off about 24 in. long, and cast-iron heads *C* and *D* were shrunk into the ends, which had previously been bored a $1\frac{15}{16}$-in. slip fit. One head *C* was fitted to take a cutting tool *E*, and the other to take a piece of $\frac{1}{2}$x1-in. steel to fit in the tool post *F*.

After the casting was chucked at *G*, the pipe was slipped on the shaft and the shaft placed on the lathe centers.

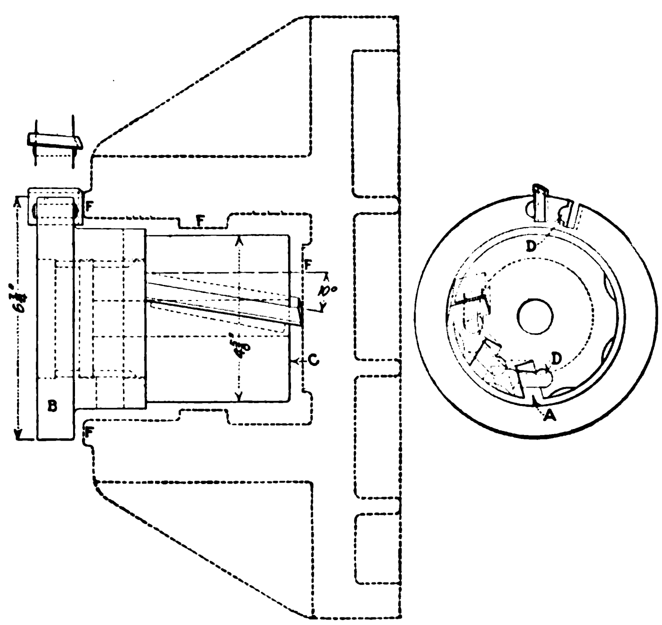
The tailstock was then set over to give the required draft to the pattern, and having fastened the piece of steel in the tool post *F*, the feed was put on and the operator sat down.

Milling Multiple Surfaces with One Milling Cutter

By Raymond W. Beckman

The illustration shows an inserted-blade double-face mill that was designed to mill the surfaces marked *F*. They were first roughed out with the same cutter, allowing 0.015 in. for finishing.

We could not do this job with a gang, on account of the large dies of the cutters. We could not plane it, because that was too slow. So after trying several different kinds of end mills and face mills, we finally hit upon the idea shown, which has been working satisfactorily.



MILLING MULTIPLE SURFACES WITH ONE CUTTER

The work to be machined is a gray iron casting, and it must be held within 0.0025 in. without scraping. The cutter is made in two pieces to facilitate milling the slots *A*. The body *B* contains two sets of threads—one for the spindle of the vertical milling machine and the other for the body *C*.

The holes *D* are first drilled and reamed; then the slots are milled and the cutters set in place, the pins driven in and the blades ground.

Methods and Tools for Making a Pressed-Steel Wheel

EDITORIAL CORRESPONDENCE

SYNOPSIS—In this article are shown the tools and methods used in making a pressed-steel automobile wheel. Two types are being made at the factory, the operations here described being for the light, small cars. The wheels are made in halves, blanked, pierced and formed, the punches and dies used being here shown. The halves are then ground on the joint surface and the cups spot welded in position. Two parts—back and front—are then flame welded and the joints ground smooth. The ends of the spokes are machined, a special arrangement of gear cutter being used.

The Hydraulic Pressed Steel Co., Cleveland, Ohio, has recently developed a pressed-steel automobile wheel, as shown in Fig. 1. The first operation in making the front part of the wheel is blanking. One of the blanks is shown in Fig. 2.

The punch and die used for blanking out the part are shown in Figs. 3 and 4. It will be noticed that the cutting edges of the punch and die are separate steel blocks. This is an advantageous arrangement, as it enables repairs to be made more cheaply. These tools are used in a 900-ton press. The rate of production for blanking the half-wheel is 300 per hour. On the punch may be seen the spring-operated pads for holding firmly the sheet metal while it is being blanked.

In Fig. 5 is shown one of the blanks used for making the back half of the wheel. This is made in a manner similar to the way described for making the front.

The next operation is punching out the necessary holes in both the front and back blanks to fit Ford hub and hub bolts. The punch and die for this operation are shown in Fig. 11. The blank is set with four of its arms resting in the matrix at A on the die. The punch parts are hidden by the stripper plate on the punch, but the large center hole and the six bolt holes are all punched at one operation in a small single-acting press having a capacity of about 500 per hour.

The next operation is forming the blank. In the case of the front half, this work is done in two operations, because the step on which is the clip used for securing the rim to the wheel is a very sharp bend, or draw, and when done in only one operation it shears through. The first-operation tool is shown in Fig. 9. The wheel blank is set on the die over the stud A. This stud fits the center hole of the blank, and each spoke is rotated about

FIG. 1. A COMPLETE PRESSED-STEEL WHEEL

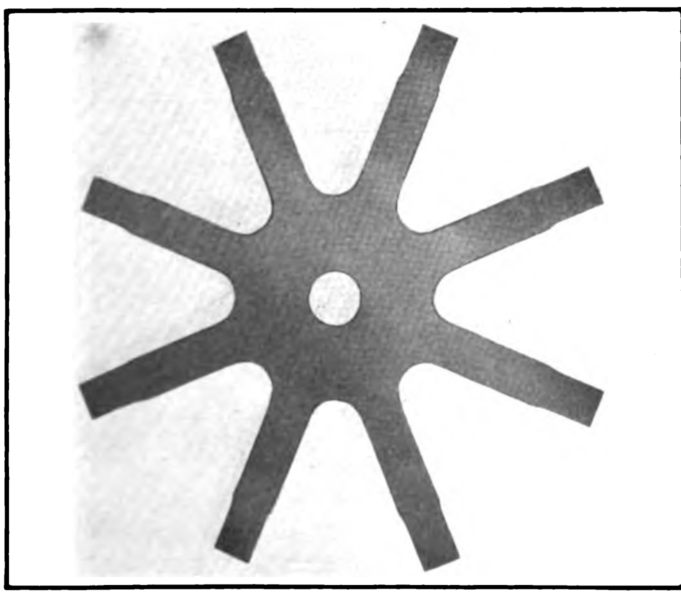


FIG. 2. A BLANKED SECTION OF WHEEL

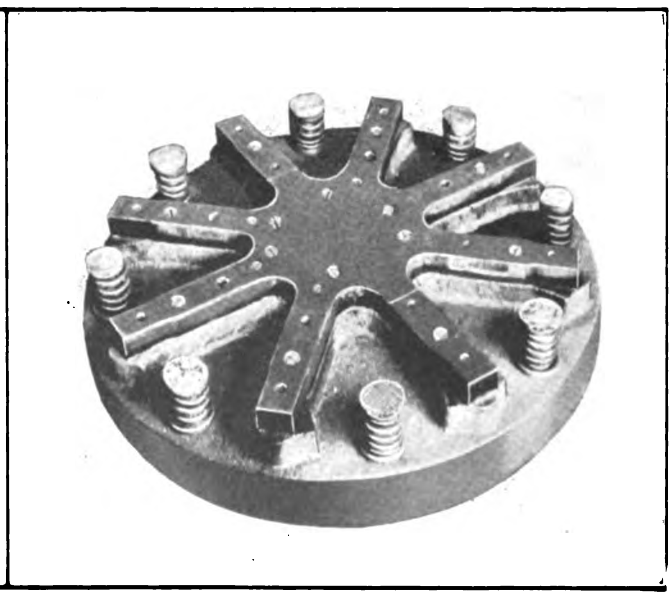


FIG. 3. PUNCH FOR BLANKING SECTION

this center against the stop pin *B*. The punch *C* in descending necks the end of the spoke, as shown in Fig. 10. These tools are used in a small single-acting press.

The next operation is the actual forming of the front and back halves. One of these halves is shown in Fig. 6. The punch and dies for this operation are shown in Figs. 7 and 8.

The blank is set with its center hole over the pilot in the center of the die and with the arms of the blank resting in the matrix pieces *AA*. Then the punch is made to descend. This operation is performed in a 900-ton press and will produce about 300 per hour. The tools are made with loose forming pieces so that the same body tools may be used for forming both the front and the back sections of the wheel.

The next operation for the front is piercing the holes at the ends of the spokes for the clip bolts and shearing off the ends of the spokes. By means of a combina-

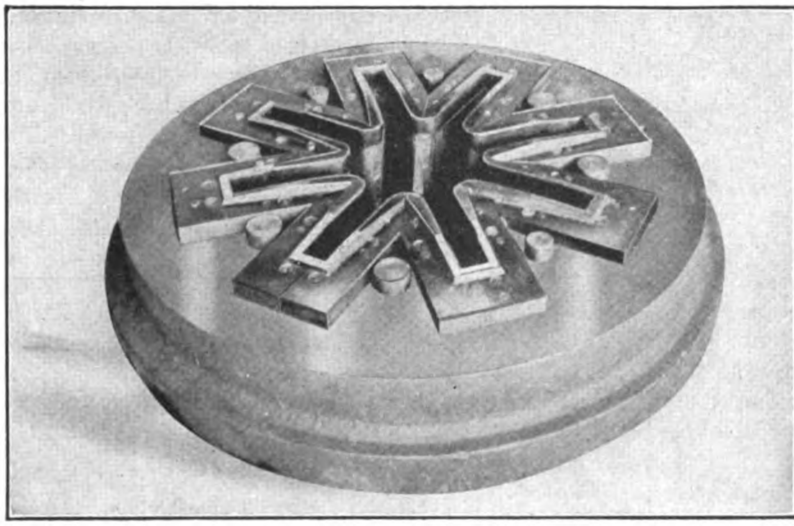


FIG. 4. DIE FOR BLANKING SECTION

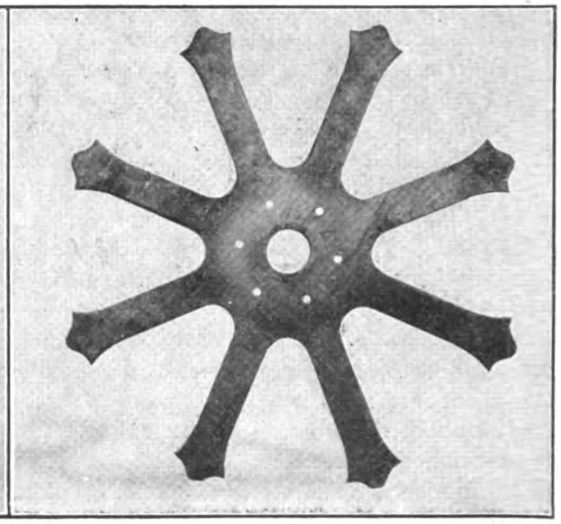


FIG. 5. A BLANK FOR REAR HALF

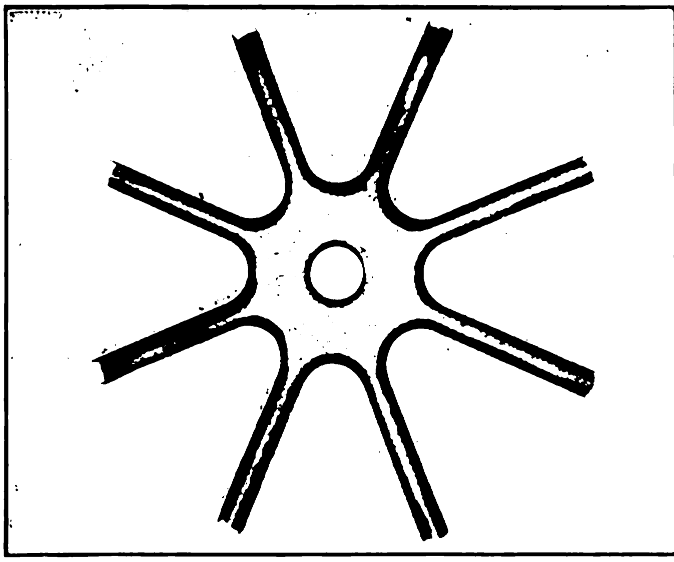


FIG. 6. FORMING THE WHEEL

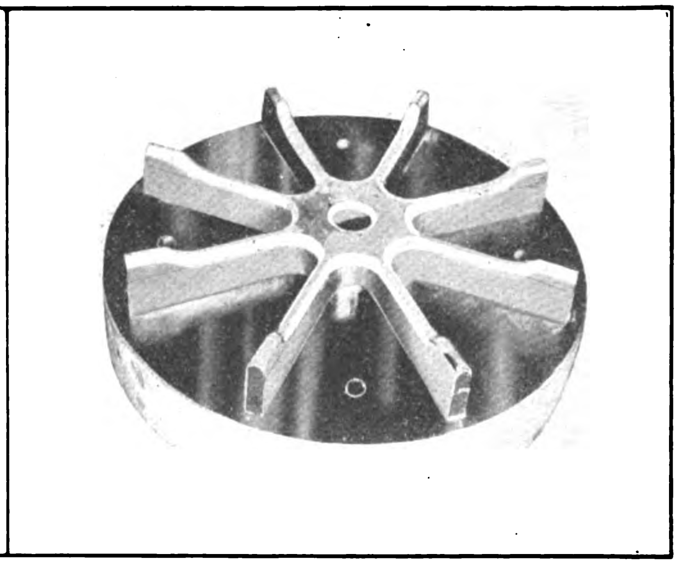


FIG. 7. PUNCH FOR FORMING WHEEL

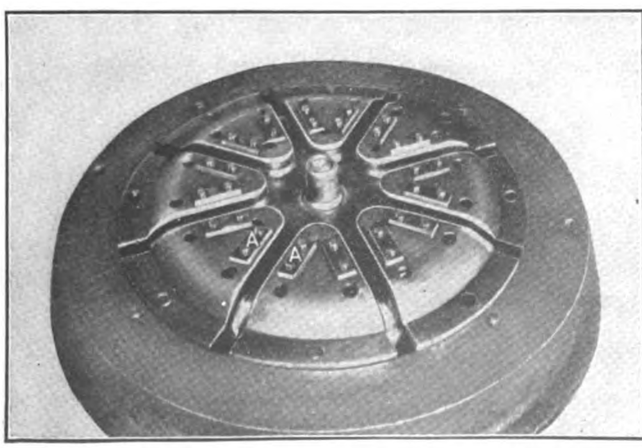


FIG. 8. DIE FOR FORMING WHEEL

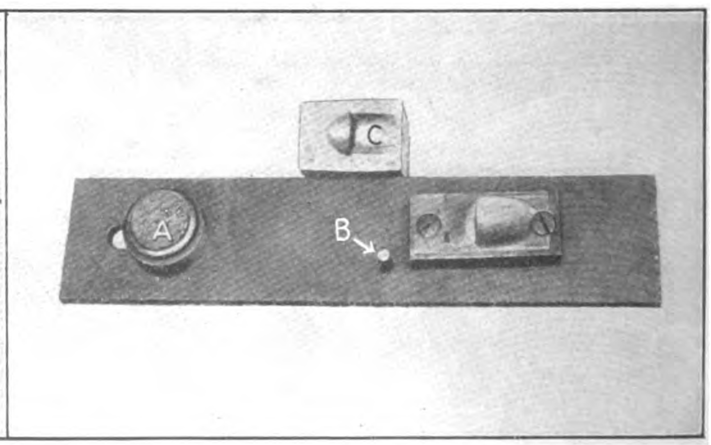


FIG. 9. NECKING TOOLS FOR SPOKES

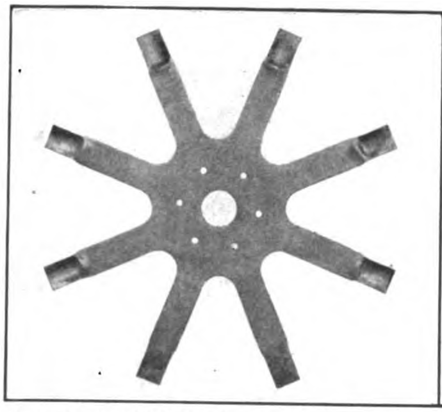


FIG. 10. A WHEEL WITH SPOKES NECKED

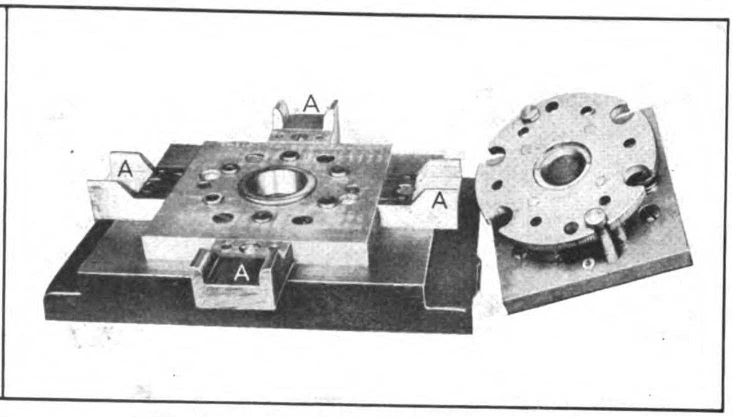


FIG. 11. PUNCH AND DIES FOR BOLT HOLES

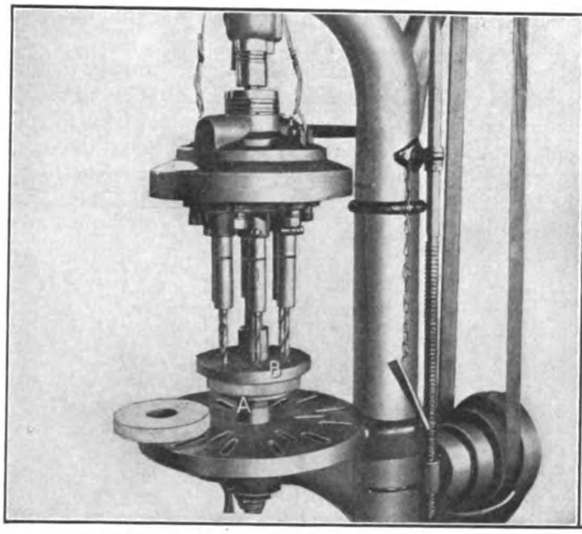


FIG. 12. DRILLING WOOD CENTERS

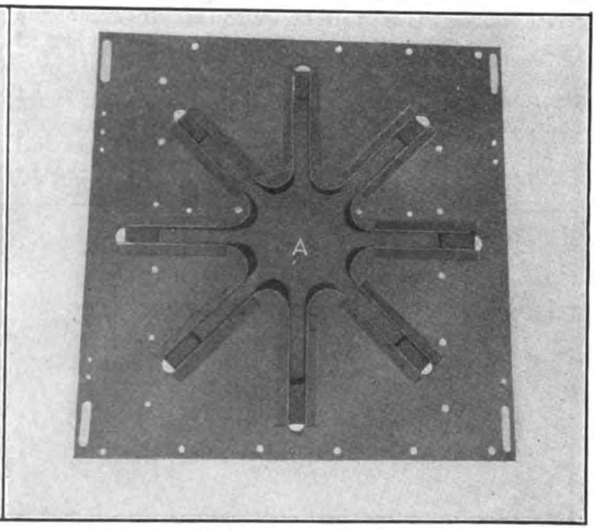


FIG. 13. GRINDING FIXTURE FOR SECTIONS

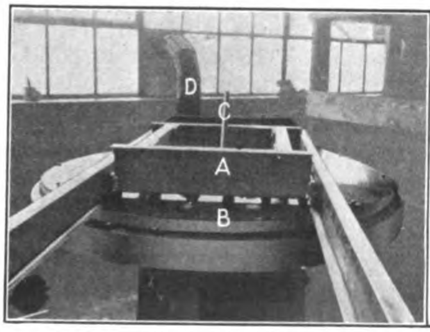


FIG. 14. GRINDING THE WHEEL

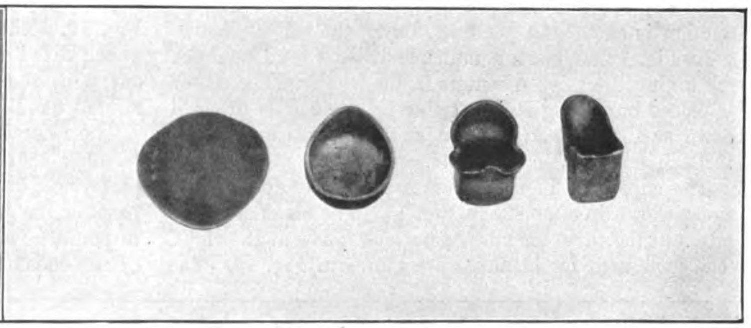


FIG. 15. SEQUENCE OF CUP OPERATIONS

tion punch and shear, this work is done at one operation.

From the presses the blanks are taken to a large 53-in. disk grinder which has been especially rigged for grinding the joint edges of the two halves to a surface for welding. This grinder and fixture are shown in Fig. 14, *B* being the grinding surface, *A* the carriage to which are fastened the blanks, holding them in a perfectly flat or level condition. *C* is the handle for lowering the carriage with the blank down on the grinding surface *B*, and *D* is the exhaust from a centrifugal fan. It carries the abrasive and steel dust away from the grinder.

Fig. 13 shows one of the formed blanks held in position on one of the matrix plates by the spider *A*. This matrix plate, when used, is bolted to the bottom of the carriage *A*, Fig. 14.

The method of operation is as follows: The carriage is drawn away from the grinder on the ways, a formed wheel blank is inserted and held rigidly in the matrix plate, which is bolted as already explained. The carriage is then shoved on its roller over the grinding surface *B*, Fig. 14, and, by means of the handle *C*, made to descend gradually until it rests directly on the ways. These ways

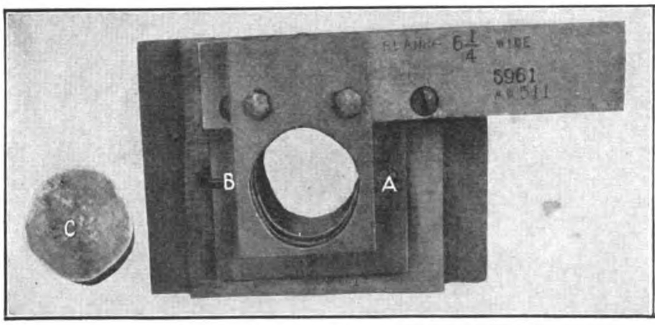


FIG. 16. BLANKING TOOLS FOR THE CUPS

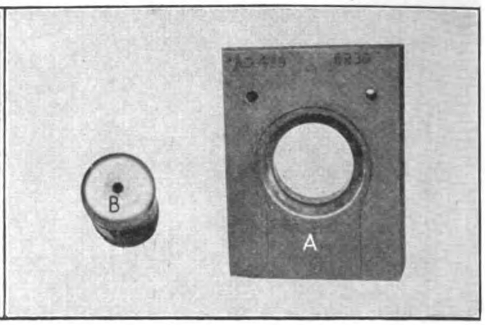


FIG. 17. FIRST FORMING OPERATION

are adjusted so that the formed blanks are ground to the exact size and surface necessary when the carriage rests on them without the rollers intervening.

The carriage is then drawn off so that all parts of the grinding surface may come in contact with the formed blank, leaving no high spots. The carriage is raised again, the spider *A* unclamped and the ground form taken out and another one put in.

The dust caused by the grinding operation is carried through the hoods on each side of the ways, drawn out by

stock is fed into the die at *A* against the stop *B*, the punch *C* making the blank.

The first forming operation is performed with the tools shown in Fig. 17. The blank is fed into the die at *A*, and the punch *B*, fed down onto it, makes the first forming of the cup. In making the second forming, the tools shown in Fig. 18 are used. The part is fed onto the die, which is located by the circular contour shown. The punch *A* is then fed down by the machine and the second forming operation is made. The third, and final, form-

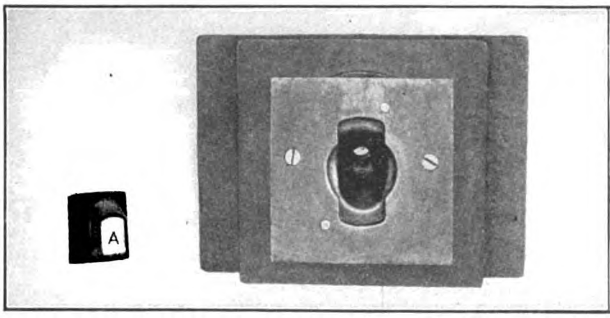


FIG. 18. SECOND FORMING OPERATION

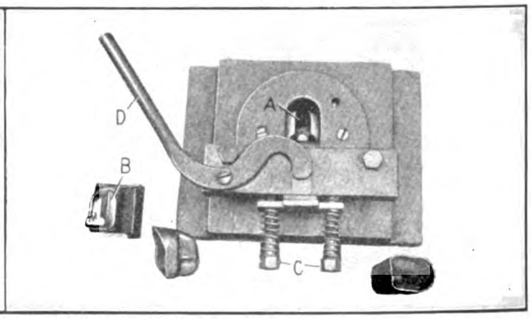


FIG. 19. FINAL FORMING TOOLS

a fan and forced through the pipe *D*. The rate of production is about 125 per 8-hr. day.

In Fig. 12 is shown a multiple-drilling head used for machining the wooden centers in the wheels. The center is placed on a plug *A*, the guide jig plate *B* is dropped down as the holes are drilled, and the tools are guided through bushings in the plate, as shown.

The cups used in the spokes are made in four operations, shown in sequence in Fig. 15. The blank is at the left, and the three forming operations follow at the right. The tools used for blanking are shown in Fig. 16. The

ing operation is done with the punch and die shown in Fig. 19. The part is placed in the die at *A* and the punch *B* fed down onto it. The finished part is knocked out with the springs *C*, actuated by the conveniently located handle *D*.

The rate of production for each of these blanking and forming operations is 1,000 per hour, and the work is performed on a small simple-acting press. The front parts of the cups are then punched and the ends sheared to conform to the punching and shearing of the outer or rim ends of the spokes of the front halves of the wheel.

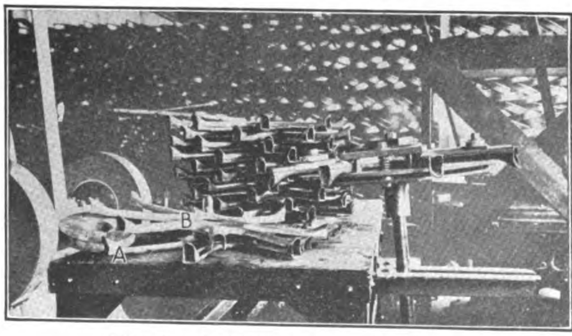


FIG. 20. ASSEMBLING THE WHEELS

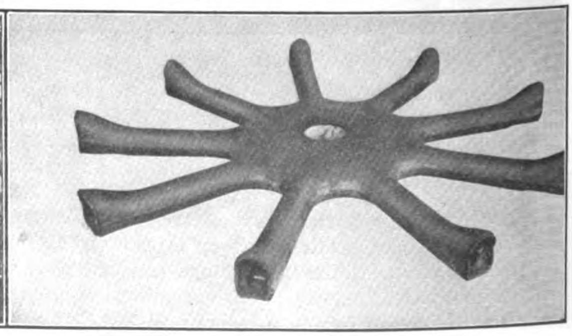


FIG. 21. A FLAME-WELDED WHEEL

The front halves, after being ground on the surface grinder, are ready to have the formed cups welded into them. This work is done by laying the front half on the jig, shown in Fig. 20. By means of a small clamp the cups are located and held firmly in place, after which they are spot welded electrically. After a sufficient number of fronts have been thus welded, the front half with the cups welded in is assembled on a jig, together with a wooden filler block and a back. This jig holds the pieces firmly together at the center and aligns the hub-bolt holes of the front, back and wooden filler block. This assembled wheel, with the jig, is then clamped to the faceplate, as shown in Fig. 20, so as to hold the spokes and center in one plane while the back is being spotted on electrically. One of the fronts with the cups welded in position is shown at *A*, a back at *B*, and the wooden block at the left of the table. The longitudinal seams of the wheel are then welded with oxyacetylene while the wheel is held securely in the fixture. The average time required for making the flame weld is 7½ minutes.

One of the wheels after the flame-welding operation is shown in Fig. 21. The joint is burred with an emery wheel and afterward smoothed with an endless abrasive belt. It is expected that the longitudinal seams will be electrically welded in the near future, experiments along that line now being conducted. By this method the surfacing will be eliminated and the cups inserted after the front has been welded.

The last machining operation is milling the ends of the spokes. They are machined with a slight bevel, sufficient to allow the rim to be put on or taken off easily. To obtain this bevel, the wheel is carried on the fixture, which is off center. The necessary drive is obtained by gearing, as shown in Fig. 23. The wheel is held on the fixture, being located by the plug *A*, and each spoke rests in a matrix arrangement. Clamps are tightened to hold the wheel securely. The table carrying the revolving cutter *B* is fed to a predetermined stop and the end of the spoke machined. The fixture and wheel are then indexed around by the machine and the operation repeated until all the spokes have been milled. The result of the machining operation may be observed in the illustration.

By referring to Fig. 23, it will be seen that the fixture is fitted with a roller support *A* to resist the machining stresses of the cutter and secure a better-finished surface. The average time required to machine the spoke ends of a wheel is 8 min.

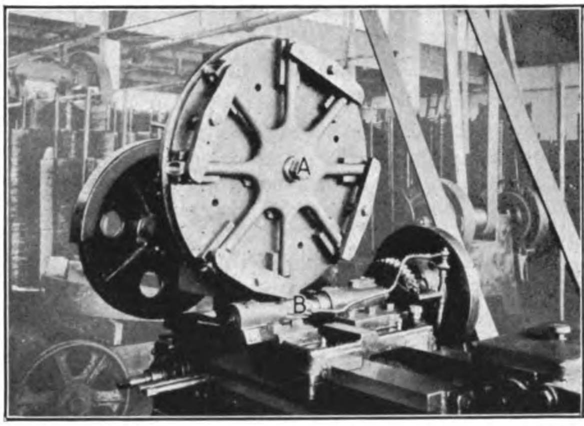


FIG. 22. FRONT VIEW OF MACHINE

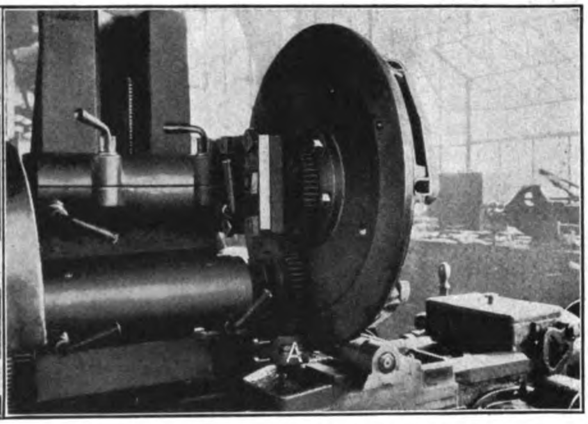


FIG. 23. REAR VIEW OF MACHINE

Machine-Shop Oil Cans

By A. D. Vance

This article refers particularly to the small individual oil cans that are more or less common property in a shop and for that reason get very little care or attention. Of all the accessories of a machine shop, none are in a more dilapidated condition than the average shop's oil cans—their bodies dented, spouts bent and cut off, showing hard usage and often direct abuse.

The usual round design of the body lends itself readily to rolling off the machine or bench, with consequent damage to its appearance and usefulness. A polygonal or equivalent design of body, without the faults of the present round body but equally cheap to manufacture, is much needed.

Usually several kinds of oils are necessary for different materials and operations; the oil cans should necessarily be easily distinguished from each other. Where oil cans are all of the same size and form, small brass plates of different shapes have been soldered to the bodies of the cans to indicate the kind of oil contained, but this method, by thorough trial, has proved to be more productive of errors in filling the cans than where different shapes of bodies are used.

The small brass plates on the bodies of the cans do not stand out with sufficient distinctness to make an immediate impression on the eye of the class of labor usually employed on this work, and many errors result. Seeing a difference in the shape of the body of the can, supplemented by the feeling when it is picked up in the hand, makes the impression more definite and reduces the liability of error.

This principle of appealing to both the sense of seeing and the sense of feeling, while not of universal application, can be profitably used in many cases.

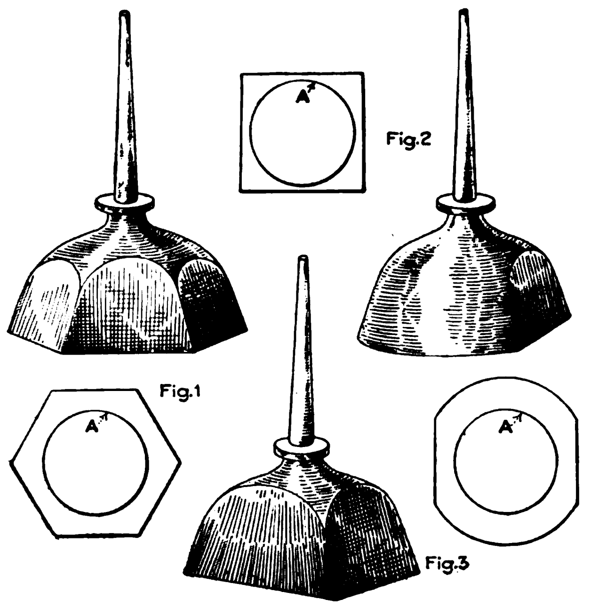
Oil cans made with different-shaped bodies, as shown by Figs. 1, 2, and 3, will not roll off the bench when tipped over. Not only do they look different, but by picking them up the difference is felt very plainly.

A few cans have been roughly made by hand, from the commercial copper can to the shapes shown in the illus-

tration, by forming the bodies over a hardwood block after removing the bottom, then fitting a new bottom in place. The circles A are slight U-shaped rings, formed in the bottom to give the required diaphragm action to eject the oil as usual.

These roughly made cans proved very satisfactory. They did not roll off the bench, and very few mistakes were made as to the kind of oil they contained.

This matter was never taken up with the manufacturers of oil cans, but I have every reason to believe that if



NONROLLING OIL CANS FOR DIFFERENT OILS

cans were produced similar to the shapes suggested, they would appeal very strongly to the foremen and the men in the shop.

The bodies can be spun of steel or copper, as is now done for the commercial can with round body, only requiring an extra operation in a forming die, at a very slight cost, to get the shapes suggested.

The spout of an oil can is likely to get mashed between gears, caught between work and cutter, bent from falling on the floor, besides receiving direct abuse by the workman's cutting off the end to get a larger opening than is proper for the consistency of the oil being used. It is customary in some shops to have a supply of spouts on hand, with various-sized openings suitable for the several kinds of oils used, so that in case of damage the spout can be easily replaced. These parts can be obtained in quantities very cheaply, and by replacing damaged ones promptly a considerable amount of oil will be saved that would otherwise be wasted by using spouts with too large openings.

Usually when a workman needs an oil can, unless one is in plain sight, he invariably looks around on the floor for it, and generally finds it. Very seldom is any provision made for taking care of the cans, so when work is finished on a machine, all tools, etc., are picked up, except the oil can. If it contains high-priced oil taken out on check, it remains on the machine or falls to the floor and rolls under the bench, where it stays until hunted up for another job. I should be very much surprised if the foreman of any shop started out on a tour of inspection for oil cans and did not find several reposing under a machine, or a bench in a dark corner.

A bracket shelf, holding three cans, attached to the wall at the bench or to the machine, has been provided in one shop and practically overcomes this trouble, as a place for the cans has been made, and they are supposed to be in that place when not in use. It is just as easy to put an oil can on its shelf as it is to put in their proper racks the special tools belonging to the machine.

Each machine tool ought to be thoroughly oiled before starting up, and a small can of machine oil should be provided for each machine and kept full and on its shelf by the shop oiler.

Methods of handling lard oil in cans vary in different shops, depending largely on their size, class of work, etc. Ordinarily a foreman's order provides the lard oil, the workman uses what is required and leaves the can at the machine. Occasionally it is used for oiling the machine in the morning, and the repair department is perfectly familiar with the results which show up later.

Oil cans, like umbrellas, are more or less public property and should be distributed to a workman or a group of workmen, holding someone responsible for the oil can's being on its proper shelf when it is not in use.

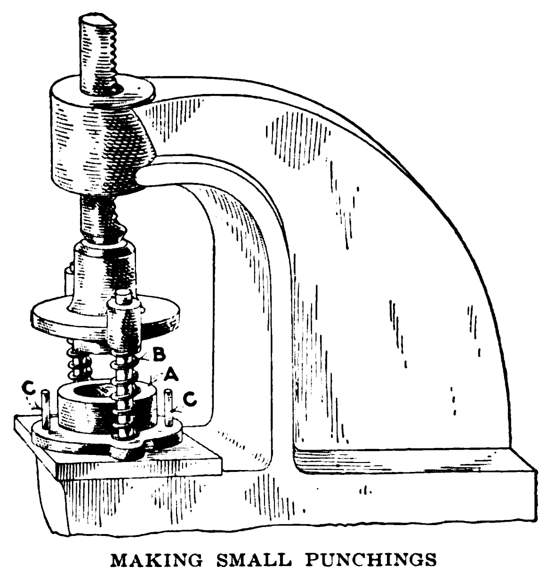
A little attention given to the much abused oil can will pay well in saving of oil, which is one of the many perplexing problems of the shop.

Small Hand Punchings

By George G. Little

Small punchings can be made as shown by an arbor press and a subpress. Two stop pins CC are driven into the base A and left standing sufficiently high to allow the punches to come down into the die far enough to work properly.

Two stout open springs that have strength to pull the punches up out of the strip are placed one around each



MAKING SMALL PUNCHINGS

guide pin, the ends of the springs having been leveled.

This arrangement is very handy and will soon pay for itself where there is enough work to warrant making a subpress and where no power presses are available.

Care should be taken to have the cap of the subpress work smoothly, the stop pins of the right height and the springs correct in length and size.

The cap does not need to be secured to the ram of the arbor press, though some means of holding the subpress in position is desirable.

Design and Characteristics of Four Torsional Springs

BY C. R. MOORE

SYNOPSIS—Four torsion springs, a single flat-blade, double flat-blade, helical and "squirrel cage" were made and tested to find the most suitable design to use in a power meter where a straight-line characteristic of torque and deflection was needed. Details for design and curves of the tests are given. The last mentioned spring was finally adopted.

In connection with the development of an apparatus for the direct measurement of mechanical power[1] I had occasion to determine experimentally the operating characteristics of several forms of springs designed to transmit torsional stresses. Inasmuch as some of the designs gave results more or less contrary to the generally accepted theory concerning such types, a discussion of a few of those tested, together with records of performance, will be of interest. It is not claimed that what follows is necessarily new, particularly to those familiar with the design of springs, but so far as I am aware test curves like those which follow have not heretofore been published. A complete discussion of the theories underlying the shape of the performance curves will not be attempted, since the material offered herein is only a byproduct of another development.

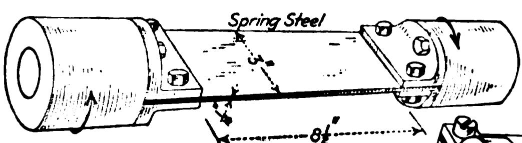


FIG. 1. DETAILS OF THE SINGLE FLAT-BLADE SPRING

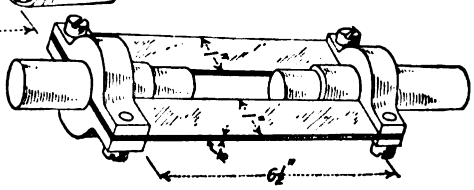


FIG. 2. DETAILS OF THE DOUBLE FLAT-BLADE SPRING

REQUIREMENTS OF THE SPRING

The nature of the machine for which these designs of springs were constructed is such that a satisfactory spring must answer the following requirements:

(a) The angular deflection or twist must be proportional to the torque producing it over a fairly large angle—that is, the spring should obey the straight-line law.

(b) The spring should give the same angle-torque characteristics for both positive and negative stress, so that the power meter may be operated in either direction.

(c) The spring must return to the zero position when the torque is removed.

(d) The effect of centrifugal force must be practically eliminated since the rotative speeds vary over a wide range.

(e) The design should be simple so that changes necessary to accommodate a wide range of torque may be easily and quickly made.

(f) The spring must occupy only a limited space.

Several designs suggested themselves. The first to be built consisted of a simple helical spring made of round stock, coiled to the proper pitch and diameter, and held rigidly in heads at each end as shown in Fig. 4. This gave fairly good results and will be referred to later. The machine described in the preceding reference was equipped with this spring.

DESIGN AND CHARACTERISTICS OF A FLAT-BLADE SPRING

It appeared later that a simple flat steel blade might be used (see Fig. 1). This form apparently answered favorably most of the requirements, particularly (b), (c), (d), (e) and (f), and was thought to be worth a trial. As to requirement (a), the formula for angular deflection in terms of torque indicated that at least for small angles such a spring would obey the straight-line law. At what point the change of blade shape would seriously alter the angle-torque characteristics could be determined only experimentally. Accordingly a spring having the dimensions shown in Fig. 1 was built and tested. The blade was of spring steel, properly treated and carefully made. It was held firmly at each end in the jaws as shown.

Test results are given by curve OA of Fig. 3, in which the torque in foot-pounds is plotted vertically and the deflections in degrees horizontally. It will be noted that the spring gets uniformly stiffer as the angle of deflection increases, the curvature beginning practically at the zero point. Requirements (c), (d), (e), and (f) were fully met; but owing to the fact that even near the zero point the torque increased much faster than the angle, the design was not suitable to the machine in question. Obviously the shape of the curve OA is the same for negative as for positive torques, a fact verified by experiment.

For this type of spring the generally accepted formulas are

$$M = 2/9fb^2h \text{ and } a = \frac{QM(b^2+h^2)}{b^3h^3E_s}$$

where

M = Maximum twisting moment in inch-pounds;
f = Fiber stress in pounds per square inch;
b = Thickness of blade in inches;
h = Width of blade in inches;
a = Angular deflection in radians per unit of length of blade;
Q = A constant = 3.56 to 2.75;
E_s = Modulus of elasticity in shear, taken usually at 12,000,000.

[1]See "Direct-Reading Power Meter," "Electrical World," Aug. 31, 1912.

Substitution in the first formula (for maximum torque), using a fiber stress of 50,000 lb. per sq.in., gives a maximum torque of 130 in.-lb. If this torque be placed in the second formula a deflection of 0.0406 radians per inch of length, or 19.75 deg. for the entire spring results.

The angle experimentally determined for the torque used is 12.1 deg. or somewhat more than half the calculated values. This wide discrepancy between test and calculated values may partially be accounted for by the choice of the constant Q, although the value used is even lower than that indicated by values generally given. It is well known that the modulus of elasticity in shear is very close to 12,000,000 (for steel). Therefore, the increased stiffness is probably due to change of shape of the blade as stress is applied.

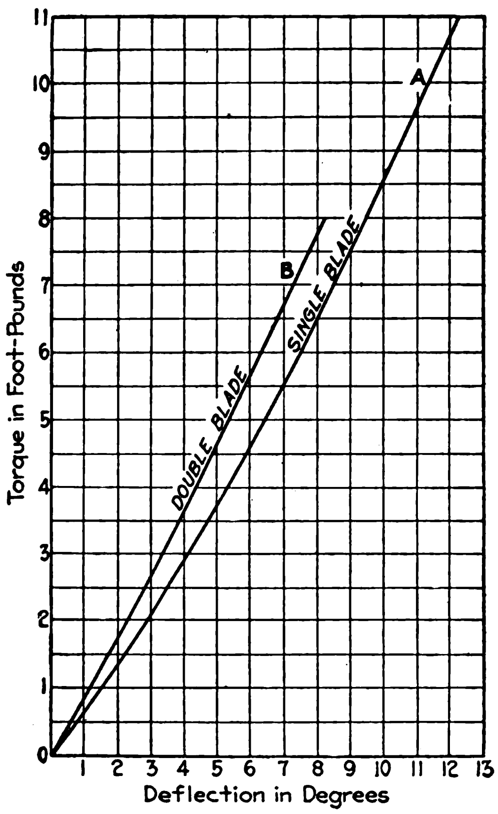


FIG. 3. PLOTTED RESULTS FOR TESTS OF FLAT-BLADE SPRINGS

If the effect of the jaws be neglected, the edges of the blade probably take the form of a helix as deflection occurs, whereas the center fibers remain straight. The stresses acting along the edges are therefore tension and shear and on the center portion shear alone. Assuming a 12 deg. twist, the edges of the spring will be 0.06 in. longer than the center portion, a condition not accounted for in the above formulas.

On account of the simplicity of this design I was reluctant to abandon it, and thought that by removing material along the axis a straight line relationship near the zero point might be found having sufficient range to be practical. A double spring was therefore built having dimensions shown in Fig. 2.

A careful test of this spring gave results shown by the curve OB, Fig. 3. It will be noted that the curvature is somewhat less than that given by OA, but for practical purposes the linear relationship might be considered as limited to angles less than 2.5 deg. While this design is an improvement over that shown in Fig. 1, the gain is so slight as to make the spring unsuitable. No attempt was made to find or develop equations applicable to this form of spring; but, in explanation, it might be said that in this type the inner and outer edges of each blade assume approximately the form of a helix, but of different lengths, so the result is similar to that given by the single broad blade.

Design of a Helical Spring

Returning to the helical form of spring one having dimensions as shown in Fig. 4 was built. Other dimensions were as follows:

Free length of stock 38.4 in., mean diameter of coil $1\frac{13}{16}$ in., mean radius of helix 0.906 in.

The heads were so constructed that the spring had a definite point about which to bend, thus fixing the free length for all angles of deflection. One head was feather keyed to its shaft so that longitudinal motion was permitted as the stresses were applied. For this type of spring Lanza gives:

$$P = \frac{\pi}{32} f \frac{d^3}{R} \text{ and } D = \frac{64}{\pi} \cdot \frac{lR^2}{d^4} \cdot \frac{L}{E}$$

where

P = Maximum pull at end of mean diameter of helix in pounds;
f = Maximum fiber stress in pounds per square inch;
d = Diameter of stock in inches;
R = Mean radius of helix in inches;
D = Deflection along the mean circumference of the spring in inches;
l = Free length of stock in inches;
L = Load applied at end of mean radius of helix in pounds;
E = Modulus of elasticity in tension = 30,000,000.

Using a maximum fiber stress of 80,000 lb. per sq.in., the first formula gives for the above spring a maximum pull of 135 lb. or a torque of 122.7 in.-lb. For this loading the second formula gives a maximum deflection of 0.675 in. or 42.4 deg. The nature of the power meter, however, did not permit the use of angles much in excess of 30 deg. so, for purposes of checking, the maximum values were not used. Using a torque of 7 ft.-lb. (or 92.7 lb. applied at end of mean diameter of the helix) the calculated angle is 32 deg.

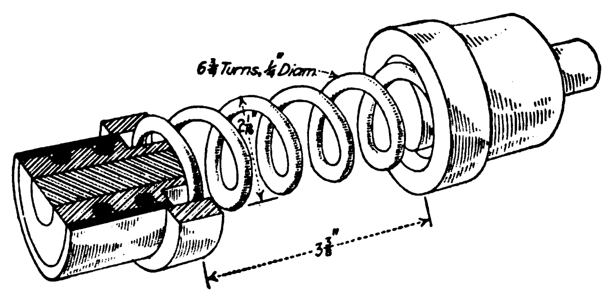


FIG. 4. DETAILS OF THE HELICAL SPRING AND HOLDING FLANGES

Upon testing this spring it was found that angular deflection for a given torque depended somewhat upon the direction of twist, or whether the spring was stressed in such a way as to increase the number of coils or the reverse. Therefore stress which tends to wind up the spring will for convenience be designated as positive torque, and the opposite as negative torque.

Fig. 5 shows the results of a static torque test of this spring. It will be noted that a positive torque of 7 ft.-lb. gives an angular deflection of 33.8 deg. while the same value applied negatively gives 34.6 deg. For either positive or negative torques the points plot as straight lines within the limits of the test, but the slopes of the two lines are different. The equation for deflection indicates that the deflection varies as the product of the load applied and the square of the mean radius, so that in use should the mean radius be seriously changed the deflection will not follow a straight-line law. It can be shown that within limits R is a function of D, which for small angles is a linear function.

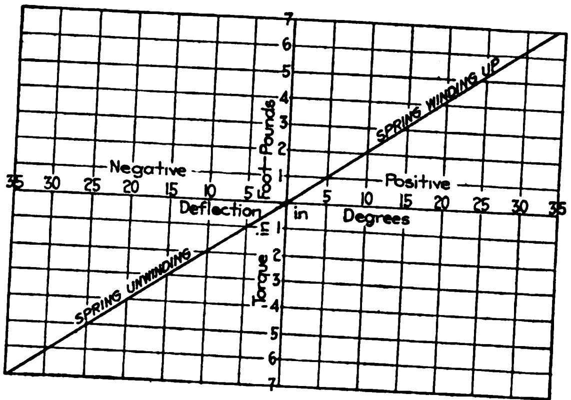


FIG. 5. PLOTTED RESULTS FROM STATIC-TORQUE TESTS OF HELICAL SPRINGS

However, if the angle be made too large the general shape of the spring is no longer cylindrical but more or less cup-shaped, the smallest turn being at the middle of the length. This obtains for positive stresses. If negative stresses be applied the convolutions have increasing radii from the heads toward the middle, the center turn being the largest. We should expect, therefore, that the angle-torque-characteristic curves would not be straight lines but curves. Positive stress should show increasing stiffness and negative stress decreasing stiffness.

Within the limits of the test this change of stiffness amounted to about 2.5 per cent. although for either curve the points plot so nearly straight that a straight line might be drawn through them with very little error. Upon doing so, however, the slopes of the two straight lines are sensibly different. When applied to the machine in question this fact means that the scale of the instruments would not be the same for positive as for negative rotation; an objectionable feature though not necessarily detrimental.

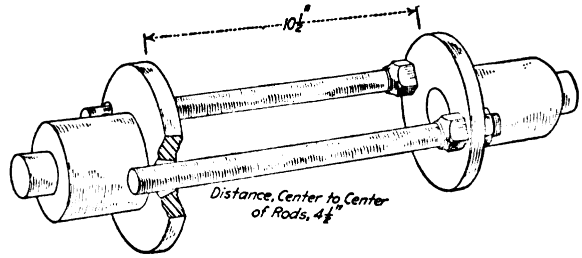


FIG. 6. DETAILS OF "SQUIRREL-CAGE" TYPE OF SPRING

Obviously springs of this character should be long and wound to a large radius, so that the total number of turns will be as large as possible. The change of mean radius with deflection will, therefore, be small so that a linear relationship having sufficient range for practical purposes might be established. In fact two other springs of this type were constructed embodying the above feature, which gave static tests of the required accuracy. However, it was found that as the mean radius increased, the effect of centrifugal forces was more marked, each spring having what might be termed a "critical" speed which was below the maximum speed for which the power meter was designed. That is before the highest desirable speed was reached this error due to centrifugal force became so large that the accuracy of the meter as a whole was seriously impaired. Also these springs were cumbersome to handle and changes were difficult.

In passing it might be mentioned that the critical speed for the spring shown in Fig. 4 was not determined as it seemed to be well above the highest speed at which the power could be operated.

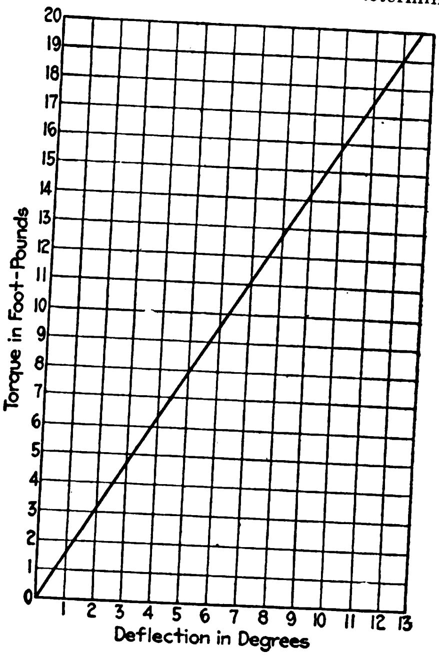


FIG. 7. PLOTTED RESULTS FROM TESTS OF "SQUIRREL-CAGE" SPRING

The next and final design tested was as shown in Fig. 6. It might be termed a "squirrel-cage" spring since it consists of a set of parallel rods fastened rigidly at one end in holes near the outer periphery of a flange or disk, the opposite ends being inserted in corresponding holes in a similar opposed flange. One of these flanges is mounted on the driving shaft and the other on the shaft to which torque is to be transmitted. The rods shown in Fig. 6 were cut from drill rod $\frac{7}{16}$ in. diameter, and the flanges were spaced 11.25 in. apart.

Fig. 7 shows results of a static test to determine the angle-torque characteristics. As will be noted this relationship is linear. Careful test showed that the slope of this line is the same for positive as for negative torques. The design is very simple and easily constructed. Also changes are very easily made to accommodate various

torques by adding rods or removing them, as the case might require. In making such changes the rods are inserted or removed by twos on opposite ends of a diameter to preserve rotational balance.

Obviously in designing this spring calculations are made for one rod only, the final result being obtained by multiplying that for a single rod by the number of rods used. Each rod may be considered as a simple beam fixed at one end and having load applied at the other. Tests at high speeds showed that this spring is unaffected by centrifugal forces, a result which might reasonably be presupposed since such forces act practically at right angles to the forces of flexure which transmit the torque. This design gives a spring which answers favorably all the requirements as laid down.

Molding a Cone Pulley Without Making a Pattern

By L. M. Johnston

A short time ago I had to make a large cone pulley, which, as shown by Fig. 1, is somewhat out of the ordinary. It has a bearing *A* and a driving disk *B* cast on. Only two castings were required. As the pulley is large, it would have taken much time and timber to make a full pattern, and then there was the possibility of its never being required again. I thought it advisable to follow as cheap a way as possible in making the pulley, and therefore decided to strickle it up. Clean and accurate castings were obtained.

In Fig. 2 is shown the method used. A bearing *A*, Fig. 1, and a disk *B* are made and a hole put through the center to fit the spindle *A*, Fig. 2. The floor is

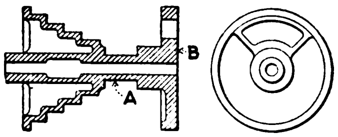


FIG. 1 The Casting

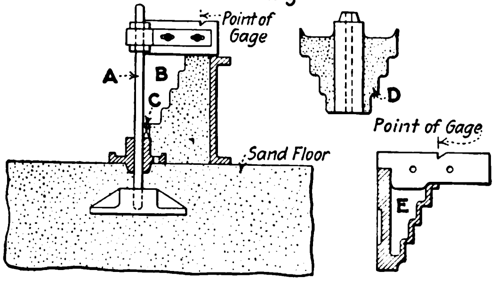


FIG. 2 The Method Used

MOLDING A CONE PULLEY WITHOUT A PATTERN

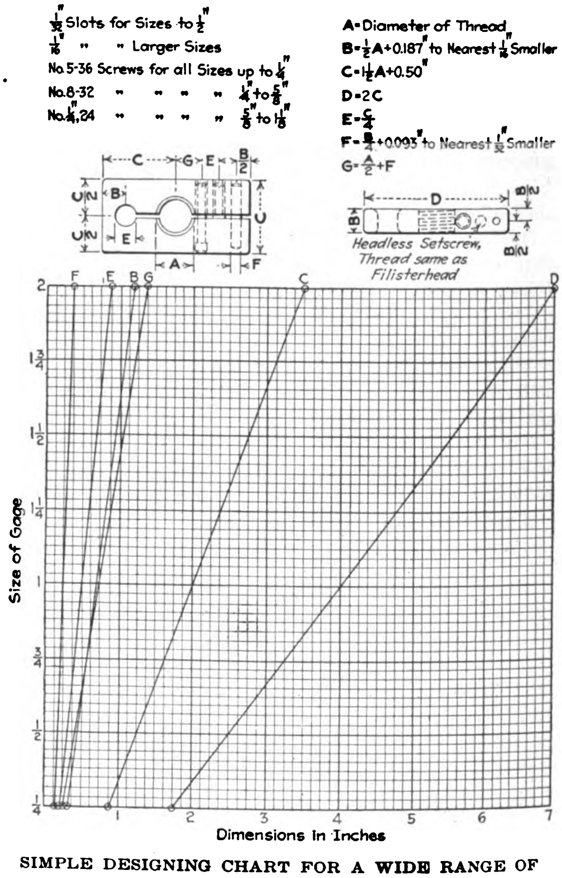
leveled above the spindle socket, and the disk slipped over the spindle and placed on the level bed. The molding box is then placed in position and the strickle *B* fixed. At the bottom end of the strickle is a piece *C* that rests on top of the bearing and keeps the strickle the correct height. The inside of the pulley is then run up, the strickle removed and the boss and webs *D* put in position, resting on the sand at the bottom and covering the recess left by *C*. The top box is put on and rammed up, all the risers, gates, etc., being provided for, when the top is removed. The strickle *E* is put on and the thickness of the metal scraped away, leaving the cope correct for the outside shape of the pulley. The box is lifted, the disk drawn out of the bottom, and the mold skin-dried and placed in position again. The center cone is then set and the mold closed, when all is ready for casting. Although the strickles are all made to fit against the spindle, a gage is provided for setting them, as a check against any inaccuracy which might creep in.

Thread-Gage Designing Chart and Formulas

By R. G. Dickens

In the illustration are shown a chart and a formula for use in the drafting room when designing the standard forms of thread gages.

The manner of using the chart will be readily understood when it is noted that the vertical scale gives the size of gage required in inches and fractions, while the horizontal scale gives the dimensions needed. Therefore



SIMPLE DESIGNING CHART FOR A WIDE RANGE OF THREAD GAGES

for any desired size of gage, follow the horizontal line to the intersection point with lines *B, C, D, E, F, G,* and read directly the dimensions required for the gage.

For instance, the dimensions required for a 1-in. gage are as follows: *B*, 11/16 in.; *C*, 2 in.; *D*, 4 in.; *E*, 1/2 in.; *F*, 1/4 in.; *G*, 3/4 in.

Methods of Locating Machinery-Foundation Templets*

By Paul M. Meyers

SYNOPSIS—A description of the needful equipment and the methods of using it in laying out machinery foundations and locating the anchor bolts. The methods include the application of the 3-4-5 rule, the measuring rod and the radius board.

When any machine which requires a foundation is to be installed it is frequently imperative and always desirable to locate accurately the anchor bolts in the foundation by using a templet. Where a new machine is to drive, or be driven by, some existing machine or appliance, it is usually necessary that the new machine be precisely located in relation to the other. This positioning obviously involves the the correct locating of the anchor-bolt templet. In this article will be described some methods for locating templets, which practice has demonstrated to be satisfactory. Although the illustrations and descriptions relate specifically to small foundations, the principles involved apply to large and small alike. Small-machine installations are considered merely to insure conciseness of illustration and description. The necessity of accurate templet location is almost apparent. The location of the anchor-bolt templet determines the location of the machine which the anchor bolts are to fasten down. Thus it is essential that the templet be placed over the foundation excavation in such a position that the machine, after it is installed, will be at the correct elevation and in correct alignment with the other units to which it is related. Locating a templet means setting it in correct alignment (in relation to whatever is to drive, or be driven by, the new machine) and setting it at the required elevation. Grout is commonly used between the top surface of the foundation and the bedplate of the machine; hence allowance should always be made for the thickness of grout in locating a templet as to elevation.

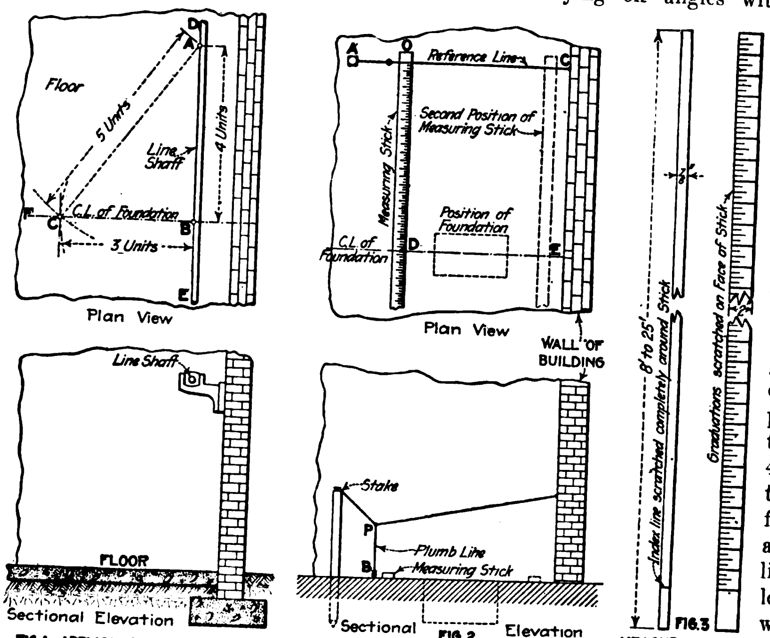


FIG. 1. APPLICATION OF 3-4-5 RULE IN LAYING OUT

FIG. 2. METHOD OF ALIGNING TO TRUSS CENTERS USING A MEASURING STICK

FIG. 3. MEASURING ROD FOR ALIGNING AND LAYING OUT

FIGS. 1 TO 3. METHODS AND DEVICES FOR LAYING OUT FOUNDATIONS

Locating a templet usually involves the location of at least two center lines of the machine—the longitudinal and the transverse. In addition secondary lines must frequently be located.

The laying off of one line at right angles to another is nearly always necessary in locating a templet. Therefore three practical methods involving the use of simple equipment for laying off such lines will be described. These methods are (1) with a cord by the 3-4-5 rule, (2) with a measuring stick (3) with a radius board. Usually where a transit is available and the installation is a relatively large one, it will prove economical to use that instrument in projecting lines; but inasmuch as the methods of laying off angles with transits are well understood by the men who use them, such methods will not be treated here. The method of laying off a right angle with a chord by the 3-4-5 rule, sometimes called the 6-8-10 rule, is illustrated in Fig. 1. It involves the well-known principle of geometry that if the ends of three lines proportional respectively in length to 3, 4 and 5 are joined together so as to form a triangle, the angle between the line which is 4 units long and the one which is 3 units long will be a right angle. Suppose it is desired to lay off a reference line in the general direction of *BF*, so that it lies exactly at right angles to the direction of the line shaft *DE*.

A plumb bob is dropped down over the shaft from *B*, and the point directly under the point of the plumb bob is marked on the floor. The plumb bob is now dropped down at *A*, and a point indicating this location is marked on the floor. The distance from *A* to *B* should be just 4 units in length; that is, it may be 4 ft. if we take 1 ft. as our unit, or it may be 8 ft. if 2 ft. is taken as the unit. With radii of respectively 5 units and 3 units, arcs are now struck from the points *A* and *B*. These arcs intersect at *C*. They can be drawn by using a pencil, a piece of chalk or a nail tied at one end of a piece of cord and a nail tied in the cord at the correct distance from the marker, to act as a center. Then the line *BCF* through *C* will be at right angles to the shaft. The location of

this line may be preserved by stretching a chalk line over it, by marking it on the floor or by indicating the points of its course on walls, columns or girders.

The measuring stick or measuring rod, or measuring pole (it has various names in different localities), Fig. 3, may be used as shown in Fig. 2. For laying out lines at right angles to one another it is detailed in Fig. 4. It is merely a rod of clear-grained wood, preferably white pine, planed smooth on all four faces. It should be 2 in. or 3 in. wide, of ⅞-in. stock and from 8 ft. to 25 ft. long, as conditions demand. An index or zero line should be scratched near one end of the rod, "squared" around on all four faces, and the rest of its length should be graduated in feet and half-feet, or in feet and inches. The graduations are marked on only one face of the rod. The rod should never be narrower than 2 in. on its wide face, because when it is used for laying out one line parallel to another the reference line (a string) lies over, and when the rod is at right angles it coincides with, the index line on the rod. If the rod be too narrow, the reference line may seem to coincide accurately with the index line when it actually does not. It is apparent then that, within reasonable limits, the wider the graduated face of the rod the more accurate will be the locations made with it.

Let us assume that it is desired to lay off a line from the point *C*, Fig. 4, at right angles to *AB*, as shown in the first step. A stake, or pin, Fig. 5, should be driven in the ground or floor at *C*. Then a length 3 units long (usually 6 ft. in practice) *CD* is laid off along *AB*, as shown in the second step. Another pin or stake is driven at *D*. Now a cord *CM* is stretched from *C*, as shown in the third step, in a direction, as nearly as can be determined with the eye, at right angles to *AB*. Lay off a distance 4 units long (usually 8 ft. in practice) *CE* and drive a pin or stake at *E*. Batter boards or trestles should now be arranged, on which the measuring stick, Fig. 3, may rest while it is being adjusted. The trestles or batter boards should be as nearly as possible of such a height that the measuring stick when it is laid on them will lie just under the lines but will not touch them. Now swing line *CM* around *C* by moving *M* until the distance between *D* and *E* is 5 units long (usually 10 ft. in practice). The 3-4-5 triangle is completed, which insures *CE* lying at right angles to *AB*.

The radius board is an arrangement whereby right angles can be laid off with a minimum expenditure of time and labor. The arrangement, which is illustrated in Fig. 6, was, it is believed, first proposed by James F. Hobart and is described in his book, "Millwrighting." The device comprises two components—the marker board and the radius strip, Fig. 6. Almost any plank may be used for a marker board, but it should preferably be about 12 ft. long, ⅞ in. thick and 10 in. wide. It has a line *AB* scratched longitudinally along the center of one of its faces, which should be planed smooth. The radius strip is a wooden piece 2 in. or 3 in. wide, which has two nails *G* and *F* driven through it, one at each of its ends. The distance between the nails *F* and *G* may be any desirable length, but 5 ft. is a convenient one. The nails should be so driven as to be at right angles to the wide faces of the strip. A hole *O* is now made in the center of the marker board. This hole may be made conveniently by driving one of the nails of the radius strip into the board. Then one of the nails *F* or *G* in the marker board is inserted in the hole *O* and the marks locating the points *C* and *D* are scribed, using the radius strip centered at *O* as a tram. The radius board is now completed and should appear as shown in Fig. 7.

The method of laying off a right angle with a radius board is shown in Fig. 7. It is assumed that it is desired to lay off a line, as *GZ*, at the point *G* at right angles to the base line *XY*. The assembled radius board is placed on the ground or floor or on a couple of battens or horses, as shown. Then with one nail *F* of the radius strip in position in the hole *O* of the marker board, the whole device is shifted until the other nail *G* of the strip is at the point from which the line at right angles to *XY* is to be projected. Now the trestles or battens are adjusted so as to lie directly under the board, and it is shifted until the point *B* lies directly under the line *XY*.

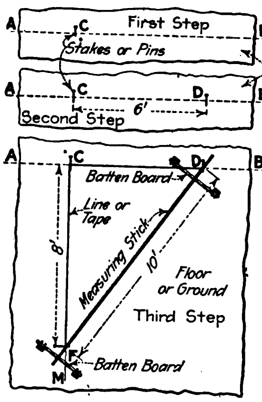


FIG. 4. APPLICATION OF 3-4-5 RULE USING MEASURING STICK

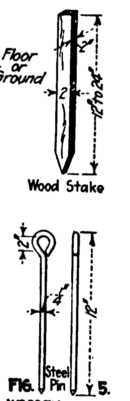


FIG. 5. WOODEN STAKE AND STEEL PIN USED FOR MARKERS IN LAYING OUT

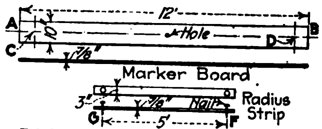


FIG. 6. CONSTRUCTION OF RADIUS BOARD

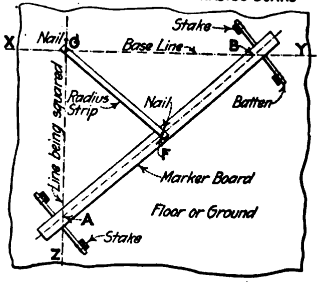


FIG. 7. METHOD OF USING RADIUS BOARD FOR LAYING OUT

FIGS. 4 TO 7. METHODS FOR USING MEASURING ROD AND RADIUS BOARD

Then a line *GZ*, passing over the hole *A* in the marker board, will be at right angles to *XY*. The angle *AGB* will be a right angle regardless of the location of *B* along *XY*. However, it is desirable to maintain the distances *GB* and *GA* about equal, because this tends to insure maximum accuracy. Although in description this method may appear complicated, it is really very simple in practice and doubtless provides the most rapid method for laying off lines at right angles to one another. The radius board is based on the geometric principle that any angle described in a semicircle is always a right angle.

The method of using the measuring stick to lay off one line parallel to another is shown in Fig. 2. Assume that it is desired to locate the center line *DE* of a foundation, it being necessary that *DE* be exactly parallel with some reference line *AC*. This reference line in the case shown is a cord which may be strung between the centers of two columns or between a stake and some other point. A plumb bob *B* is hung at a convenient location on the reference line. Then the measuring stick is placed on the ground or floor, in the position shown in Fig. 2, and its outer end is shifted around *O* as a center until, to a per-

son sighting with one eye from a position *P*, the index line on the measuring stick, the plumb line and the reference line coincide. Then the stick is at right angles to the reference line, and a mark is made on the floor at *D* at the required distance from the reference line. This operation is repeated with the stick in the position shown dotted, and the point *E* is obtained. A line through *D* and *E* is parallel to the reference line, at the correct distance from it and is a longitudinal center line for the foundation and the templet that is to locate it. Obviously the line *OD* must be at right angles to *AC*.

Typical examples illustrating methods of locating templets are given in Figs. 8 and 9. While these views show small (4-bolt) templets, the general procedure indicated is the same as would be followed for large machines. In each case it is necessary to locate a longitudinal and a transverse center line.

The method in aligning a templet to a line shaft is shown in Fig. 8, which illustrates the interior of a mill building where a motor to drive a line shaft is to be installed. The foundation center lines are located from the dimensions D^4 and D^6, distances from the center line of a roof truss and center line of a line shaft respectively. In the case illustrated the soil was so firm that no form was required for the foundation, the excavation itself constituting the form. Hence the templet, after having been accurately aligned in the manner to be described, was held in position by nails driven through it into wooden stakes driven into the ground. The procedure in aligning the templet was as follows: A plumb bob dropped over the line shaft indicated its location with reference to the ground. The plumb bob was adjusted at the point *M* and the distance *LM* laid off with a measuring stick (see Fig. 3). A tape line could have been used instead. Then the plumb bob was adjusted at *O* and the distance *ON* similarly laid off. The cord *LN*, representing the transverse center line of the foundation, was drawn taut between the two stakes, located as shown. The templet was then adjusted over the foundation hole until the corresponding index lines on it coincided with the line *LN*. Then the templet was shifted until the distance *JK* measured from the truss center line was correct. It was then nailed securely to the stakes which had previously been driven, and held firmly in position. The elevation of the templet was determined by measuring up from the floor line, and it was adjusted until it was level in all directions. The boards composing the templet were purposely left long enough so that they would extend beyond the excavation and rest on the stakes for support.

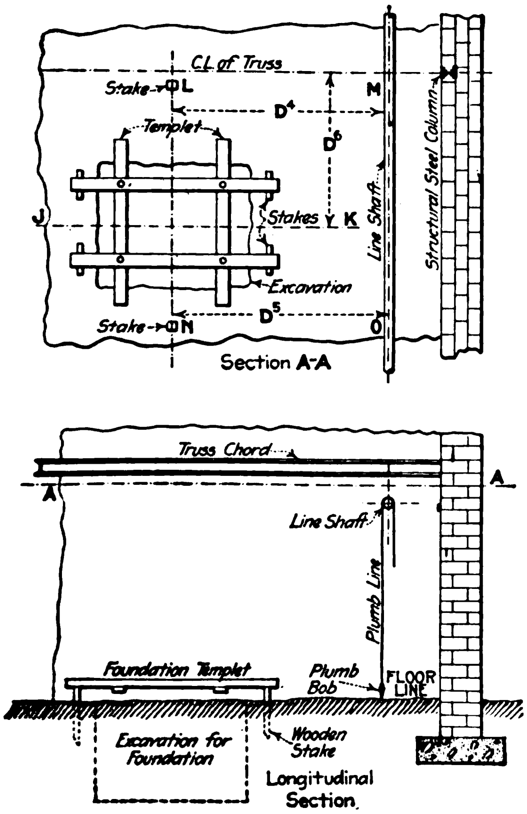


FIG. 8. METHOD OF ALIGNING TEMPLET TO LINE SHAFT

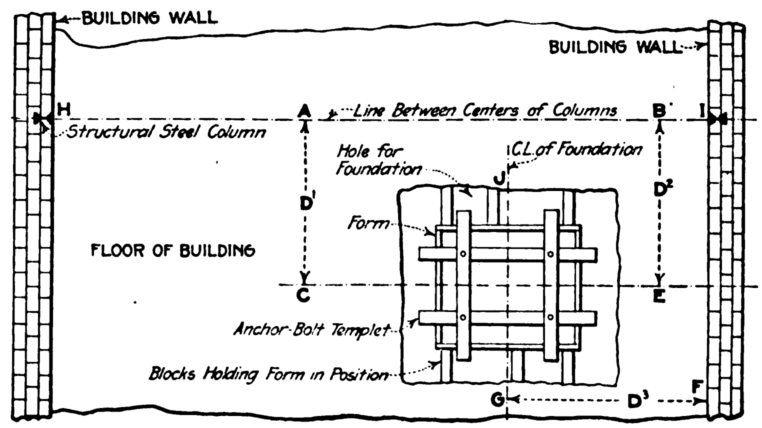


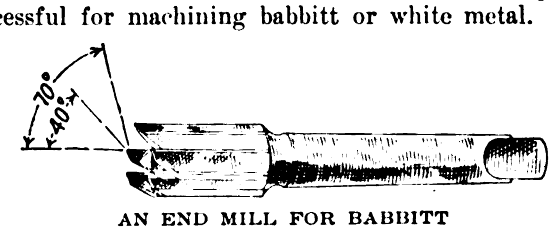
FIG. 9. METHOD OF ALIGNING FOUNDATION TO TRUSS CENTER

The process of aligning a templet from a roof-truss center line is diagramed in Fig. 9. In this case a form was used for the foundation, and the templet, after being properly aligned and leveled, was nailed to the top edge of the form. The longitudinal center line of the templet *CE* was made parallel with the roof-truss center line *HI* by measuring the distances D^1 and D^2. The distance D^3 is from the inner face of the wall to the transverse center line. The distance D^1, D^2 and D^3 were all specified on the erection drawing. All three of the center lines (*HI*, *CE* and *GJ*) are, in practice, taut cords. After the templet and form have been accurately located in their correct positions, blocks are wedged between the outer face of the form and the face of the excavation to prevent the form from shifting while the concrete is being poured. Sometimes, if the form is not worth saving, the space between it and the foundation is filled with earth before the concrete is placed, and the form is left in the ground.

End Mill for Babbitt

By A. E. Holaday

The illustration shows an end mill which has proved successful for machining babbitt or white metal. It is



AN END MILL FOR BABBITT

a regular end mill with every other tooth cut back to the angles given. It was found not to clog up with metal as a regular mill does.

Machining Gears and Pinions on the Boring Mill

By J. W. Thayer

I had occasion recently to visit a shop in which a large number of rough gears and pinions are machined each day and was somewhat surprised to see these gears and pinions being set up and clamped on two small vertical boring mills while being machined. My surprise was the greater in view of the fact that the shop had four heavy turret lathes admirably adapted for this purpose. The foreman in charge was also surprised when I told him that many of these pinions could be finished completely,

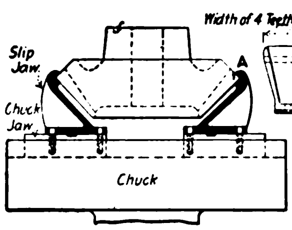


FIG. 1. CHUCK FOR BORING PINIONS

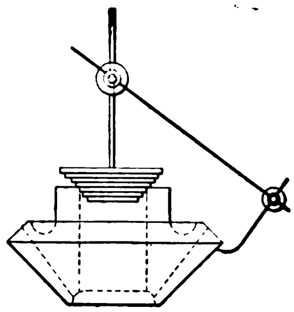


FIG. 2. GAGE FOR INSPECTING PINIONS

that is, bored and faced, in less time than he could chuck them on the vertical mills. Now that I have demonstrated this fact to him, the method may be of added interest and value to readers of the *American Machinist.*

The illustration shows the slip jaws used. They are bolted to the jaw of an ordinary three-jaw chuck. For the purpose of illustration, I have shown two jaws diametrically opposite, though this of course does not occur with a three-jaw chuck. After these slip jaws are fitted to the chuck jaws proper, they can be adjusted to the proper diameter and machined at *A*. Jaws bored for 12-in. pinions can be used for 10- to 14-in. pinions satisfactorily. I have used these jaws many years in machining gears up to 40 in. in diameter with perfect results.

I inclose also a sketch of a gage used in inspecting pinions. It is simply a surface gage with a circular base, on which are turned different diameters to suit different bores. This tool is very satisfactory, and by its use the truth of a pinion relative to the bore can be quickly and accurately determined. The needle is first adjusted and the base is then revolved in the pinion.

Indexing Jig for Automobile Rear-Axle Housing

By E. A. Thanton

The indexing jig shown in Figs. 1 and 2 was made for drilling, reaming, chamfering, spot facing or tapping the various holes in an automobile rear-axle housing. There are 33 holes in all to be machined in this jig.

The housing is located in the jig between two sliding plugs *A* and *B*. The hinged cover *C* is held down by means of two latches *D* and *E*. Two large slip bushings are shown at *F* and *G*. They have large wing-handles, so as to be withdrawn easily. The method of locking them in place is plainly shown. The indexing lock pins are double, in order to engage from each end at the same time. They are worked by means of the hand lever *H* through a series of link levers at *I*, and on the opposite end at *J*. The jig runs on a track, so as to be pushed from one machine to the next. For this purpose grooved wheels are placed under it, as shown at *K* and *L*.

The opposite side of the jig is shown in Fig. 2. Here, 10 smaller slip bushings are shown in a circle. They are fitted with wing-handles the same as the larger ones and also locked in the same way. The jig was made by the Gem City Machine Co., Springfield, Ohio.

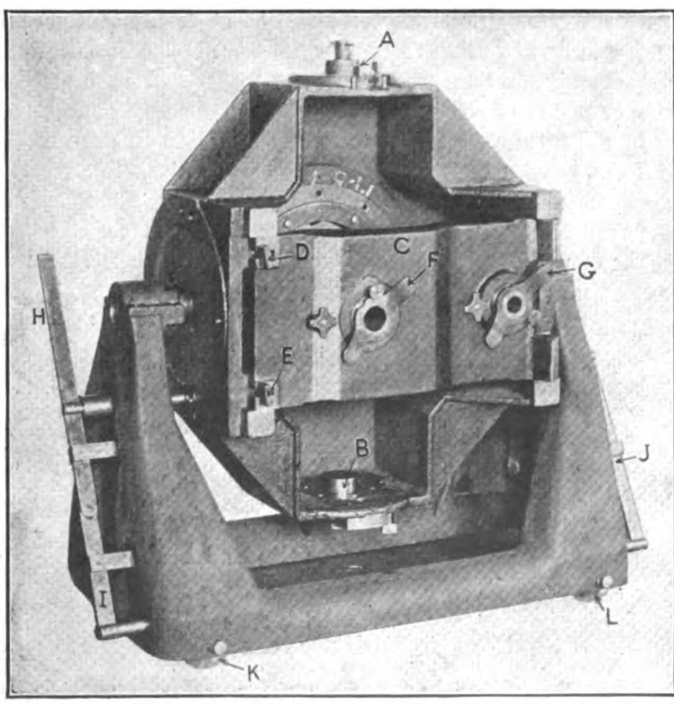


FIG. 1. INDEXING JIG FOR VARIOUS OPERATIONS ON REAR-AXLE HOUSINGS

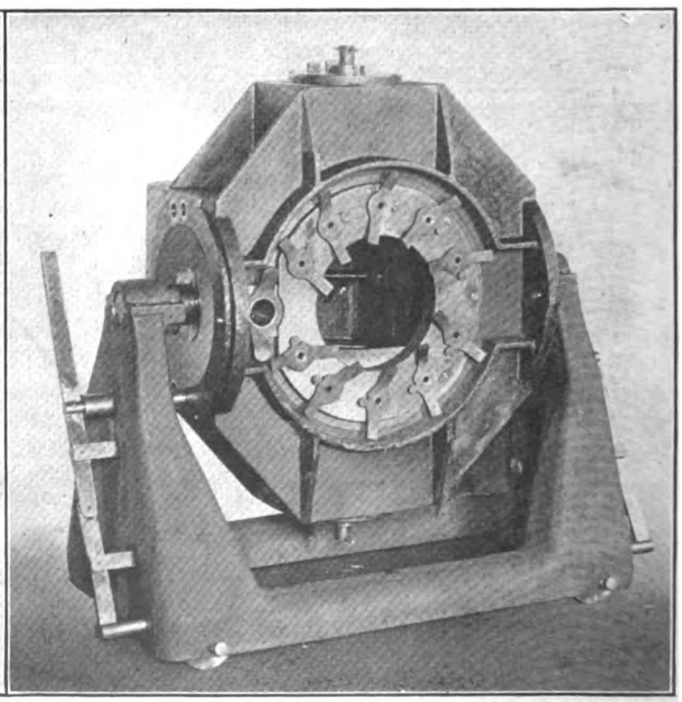


FIG. 2. THE HOUSING HOLDER TURNED OVER, SHOWING SMALLER SLIP BUSHINGS

Machining Drill Heads

By E. V. Allen

A multiple drill head in which the spindles are adjustable for various layouts is an entirely different proposition from one in which the heads are stationary. The former, principally suited to small lots of work, may be "juggled" until it conforms to the desired layout. The latter type, used for machining work in manufacturing quantities of an interchangeable quality, must be made accurately in the first place. The Hoefer Manufacturing Co., Freeport, Ill., makes a large number of multiple-spindle drilling heads for special layouts. For the purpose of accurately locating the holes for the spindles, this company has fitted two of its regular 32-in. drilling machines with special tables. One of the machines fitted with a circular table 24 in. in diameter is shown in Fig. 2.

The method of locating the spindle holes is to drill, bore and ream one hole, fit in a hardened and ground plug and then with a similar plug in the spindle of the machine locate the next hole by means of a micrometer.

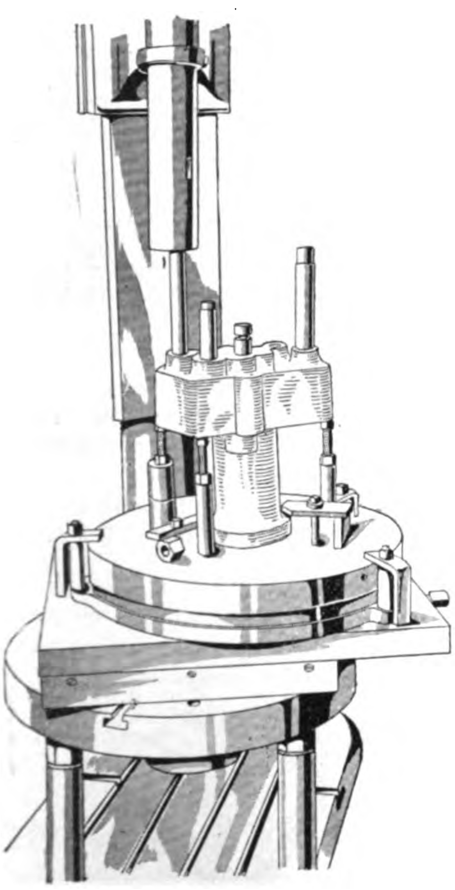


FIG. 1. LOCATING MULTIPLE SPINDLE HOLES

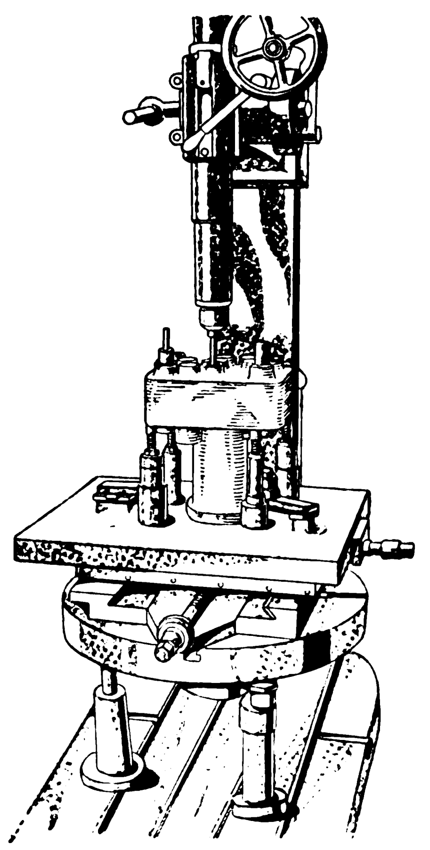


FIG. 2. USING THE RECTANGULAR TABLE

In the view shown, three locating plugs have been fitted in, and the spindle of the machine is set for a fourth. With this table, spindle holes to be set in a circle may be located the corrected distance from the center by first locating one hole the correct distance and then rotating the table. In this way, only the radial distances need to be measured after the first hole is located from the center.

For convenience on most work, the sliding table is kept set with its center line in line with the spindle center. The machine table is carefully braced and leveled to avoid springing in any way, and the entire fixture is frequently carefully inspected to insure extremely accurate work.

The machine shown in Fig. 2 is fitted with a table having both cross and parallel feeds. The table is 22x27 in., and the holes to be drilled, bored and reamed are located in the same way as on the other machine. The machine is shown with a boring tool in the spindle. It will be noticed that the machine table is well braced and that the work is not only securely clamped to the work table, but braced with small jacks at the corners to insure solidity.

By using these tables and the plug method of locating, the spindles can be depended upon to be in the correct location, and holes drilled by the multiple heads will be according to the original layout.

Fatal Shrink Fit

By F. G. Flickinger

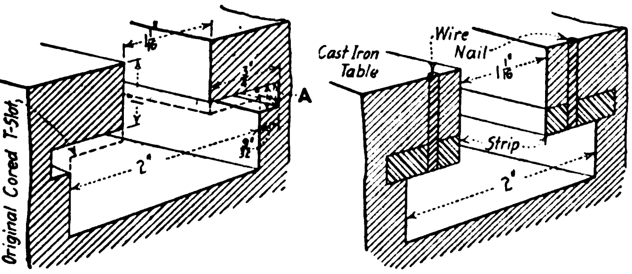
Last Saturday afternoon a local machinist met sudden death in a manner that I believe may serve as a warning to others engaged on similar work. It was desired to fit a new piston rod to a cast-iron piston head for a 16x14-in. simple high-speed engine. The piston was of the ordinary hollow cored variety, $5\frac{1}{4}$ in. thick and divided into six ribbed compartments. Each section had screwed into it a plug that was afterward sawed off, the holes probably being used to remove the core. To get a shrink fit, the piston was heated outside over a fire to the desired heat, it being intended to drive the piston rod to a fit in the taper of the piston. When all was ready to do this and four men were standing close by, one man kneeled to turn over the piston. Just as he did this, it let go with a loud report, one piece tearing off the whole side of his face, another breaking an arm and one taking off part of his hand. Another man had his arm and finger cut, but not seriously. The other two were only badly shaken up. There must have been some water inside the piston, but just how it got there is not certain. I believe that turning over the piston was the last straw, for no doubt the piece was unevenly heated. Perhaps the small amount of water, as it hit the hotter surface, went into steam and added just the pressure needed to break down the strength of the casting. However, whatever the cause of the accident, the experience was costly and shows that similar jobs should be handled with the greatest care.

Repairing Worn T-Slots in a Boring-Mill Table

By Roland V. Hutchinson

A vertical boring mill, which had seen hard service for several years, had the T-slots in the table worn quite badly. The method of repairing them, shown in the illustrations, was resorted to.

The table was removed, set on the planer, and the T-slots planed out, as shown in Fig. 1. Carbon tool-steel strips were cut ¾x½ in. and as long as the T-slot. They were made a tight fit sidewise at *A* and fitted back into their seats by wedges at both ends of the slots. While they were held back in this way, a $^{15}/_{64}$-in. hole was drilled at each end of a strip. A piece of a big wire nail was



FIGS. 1 AND 2. REPAIRING SLOTS IN BORING-MILL TABLE

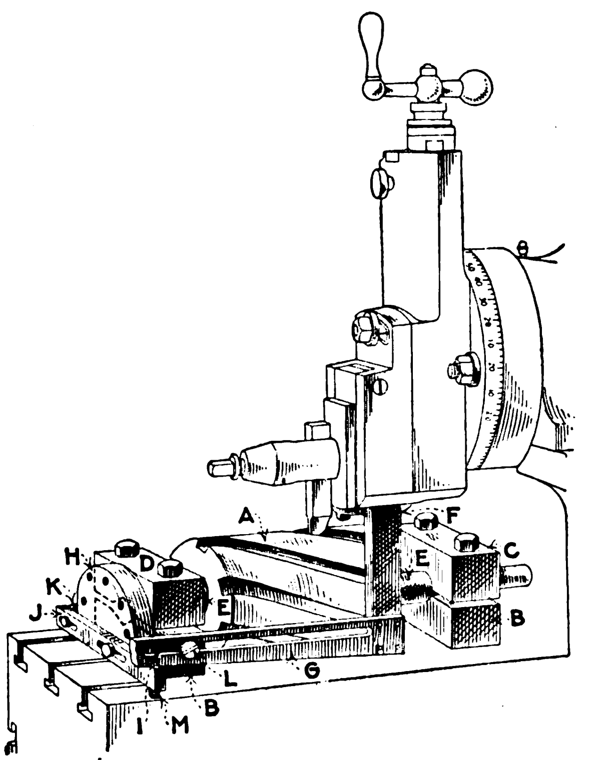
then driven through both the cast-iron table and the tool-steel strips, holding the strips from moving endwise. The pull of the clamping bolts also tightens them in place.

Fig. 2 shows the strips in position. Had table bolts with finished heads been used for the work in the first place, this repair would have been unnecessary.

Machining Spiral Slots

By W. C. Makley

The work shown at *A* in the illustration is to have eight spiral slots cut in it. As it is quite small, a shaper is used for this operation. The work is mounted in the two V-blocks *B* fastened to the shaper table,



MACHINING SPIRAL SLOTS

blocks *C* and *D* being clamped down on the reduced diameter. The V-blocks are not clamped tightly on the work, but permit it to rotate freely.

The bushings *E* are placed on each side of the reduced diameter of the work in order to prevent its moving lengthwise. One side of the angle plate *F* is bolted to the under side of the clapper box of the shaper, while the tapered plate *G* is fastened to the other end of the angle plate. One end of the reduced diameter of the work has previously had a keyway cut in it (for carrying a gear), and the index plate *H* is placed thereon, this index plate turning with the work by means of a key placed in the keyway in the work and in a keyway cut in the index plate.

Eight holes are drilled in the index plate, corresponding to the number of grooves to be cut in the work. A bar *J* is fastened at one end by a stud *K* fastened to the shaper table, a hole being drilled in the head of this stud, in which is placed a pin holding the bar. A pin is placed in *J* to engage one of the holes in the index plate, a small spring (not shown) holding the pin in the hole. A screw *L* is placed in the end of the V-block, engaging a slot cut in the tapered bar, thus guiding the bar at its outer end, the head of the screw holding the tapered bar on the screw. After one groove is cut, the pin in the bar is withdrawn from the hole in the index plate; the latter is turned until the next hole engages with the pin, thus rotating the work.

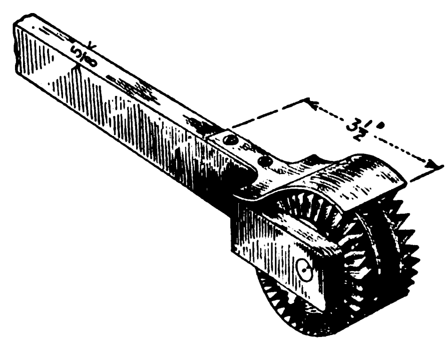
The spiral slot is formed by means of the tapered bar *G* pulling the free end of the bar down, thus partly rotating the index plate and the work. A compression spring *M* is fastened to the outer end of the bar and also to the top of the shaper table, thus keeping the free end of the bar in contact with the tapered bar.

Emery-Wheel Dresser Guard

By Joseph K. Long

Herewith is shown a guard for an abrasive-wheel dresser. In truing up wheels, the operator is in danger of getting chips in his eyes. Even if he wears goggles, they are soon nicked up by flying particles.

The guard consists of a piece of $\frac{1}{16}$-in. sheet steel of the shape shown and about 2 in. wider than the cutting



GUARD FOR ABRASIVE WHEEL DRESSER

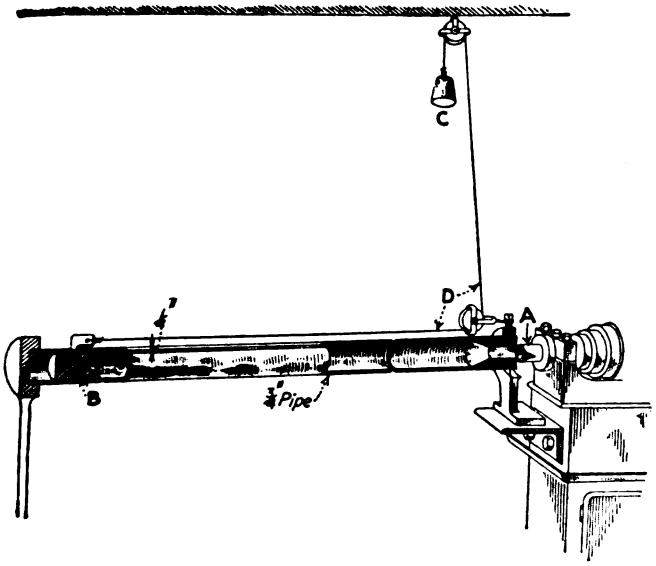
wheels of the dresser. It is fastened by two $\frac{3}{16}$-in. screws ⅜-in. long. This guard affords a much needed protection and does not in any way interfere with the use of the dresser.

The Lead Resources of the United States are capable of meeting consumption, and the production is limited only by the ability of the market to absorb the output from domestic mines and from ore and base bullion imported from Mexico for smelting and refining. The production of lead in the United States in 1880 was 98,000 tons, as compared with 542,000 tons in 1914, or about 34 per cent. of the world's production. The increased mine yield has resulted in part from larger recoveries of metal by more efficient milling methods.

Letters from Practical Men

Improvised Weight Feed

The illustration shows an automatic feed which I rigged up for a 1-in. machine on a long job of making $\frac{3}{16}$-in. pins. The device consists primarily of a ¾-in. pipe 16 ft. long, with a ¼-in. slot at the top. The end next the machine is supported by an angle bracket bolted against the headstock, this end carrying a bushing of approximately the size of the bushing *A*. A pusher *B* is



IMPROVISED WEIGHT FEED

made of steel and hardened and is an easy sliding fit in the ¾-in. pipe. It is held against the end of the pipe by means of the weight *C* acting through the sash cord *D* with the pulleys shown. A pin *E* is put in so that the pusher is held back to insert a new rod. A weight of 6 lb. is found necessary to give the desired result in feeding the bar, a bag of sand being found most convenient for this purpose. O. S. Meier.

Milwaukee, Wis.

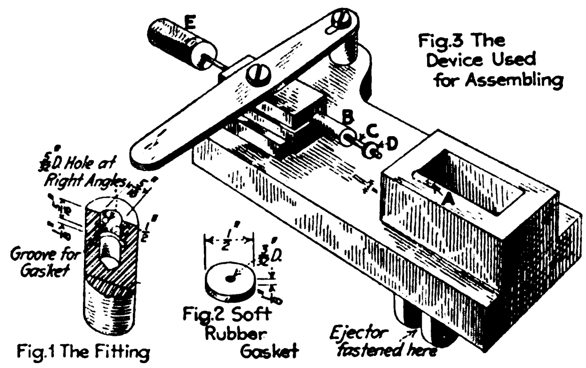
Difficult Assembling Operation

Sometimes an operation that appears to be perfectly simple turns out to be quite difficult. One such little operation, which might be said not to be mechanical work at all but which had to be done along with other work strictly in that field—merely the placing of rubber gaskets in recesses provided for them—proved a difficult task.

The dimensions of the fitting are shown, in Fig. 1, and also the gasket, Fig. 2. The device used for the work is shown in Fig. 3. The fitting was dropped into a pocket of just the correct size, with the drilled end toward the hole *A*. This hole was of the same size as the hole on the inner end of the fitting and bell-mouthed toward the outer end. It was highly polished, to facilitate the forcing of the rubber gasket into position.

The inserting mechanism consisted of the rod *B*, of the same size as the hole *A*, and a piece of hardened drill rod *C* passing through the center of *B* and having a head *D* one-quarter inch in diameter. Over the projecting tit of the rod each gasket was slipped, ready to push into place.

The inserting operation was a two-handed job, the handle *E* serving to push the gasket through the guide hole *A* and partly into the whole in the fitting before the head *D* would finally squeeze through the center hole in the gasket. Meanwhile the concave end of the



A DIFFICULT ASSEMBLING OPERATION

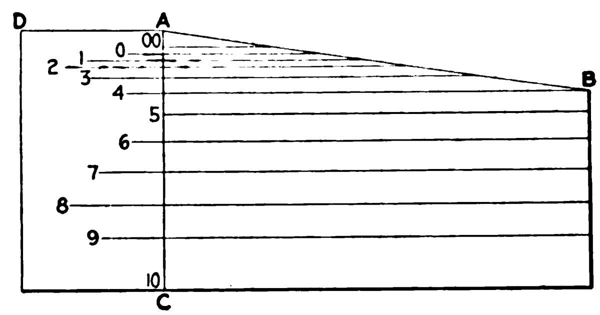
rod *B* was brought forward, filling the hole completely. It pushed the gasket before it and into the recess, with the head *D* on the inner side of the gasket acting as a hold-back. The "feel" proved a better guide to the proper depth than a stop. When the gasket was felt to line up with the recess, a couple of slight back and forth movements of the rods forced the gasket into place.

So close was the fit that withdrawing the head *D* back through the center hole failed to displace the gasket. With this method a thousand gaskets were successfully inserted per day. Donald A. Hampson.

Middletown, N. Y.

Method of Drawing Taper Pins

In drafting-room practice there arise innumerable occasions when it is necessary to draw taper pins. The illustration shows a device which has proved useful for this purpose. It avoids looking up a table of the pin numbers and their corresponding diameters, then the conversion to the nearest fractional equivalent, again dividing this result in half and laying it out on either



METHOD OF DRAWING TAPER PINS

side of a center line at the proper angle, namely ¼ in. taper per ft.

In constructing the device an old triangle or any other transparent material may be used. The figures are punched, and the lines are drawn with a scriber, then blackened with india ink.

The horizontal lines designated by the pin numbers ranging from 00 to 10 are laid off on the line *AC*, equal to one-half their respective pin diameters (large end). The line *AB* is drawn with the same angle as that of the standard taper pin.

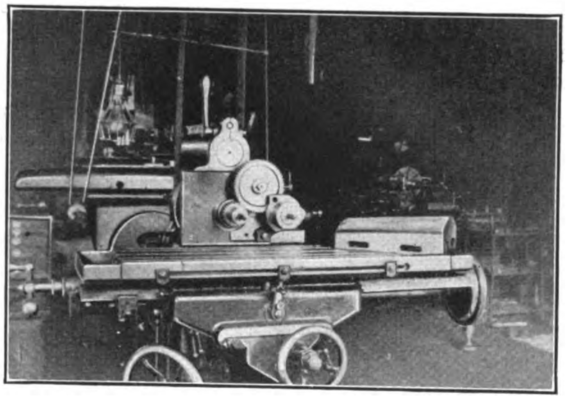
When using this contrivance it is only necessary to place the horizontal line corresponding to the desired pin number on the center line of the shaft and the line *AC* tangent to the outer circle, through which the pin is driven. To draw the other half of the pin, invert the device, still maintaining the same relation of the line *AC* and the horizontal to the center line of the pin.

New York, N. Y. EDWARD FISH.

Double Slotting Fixtures

The illustration shows a fixture I designed and made for slotting brass crosshead shoes, two slots at once. The fixture is attached to a No. 1½ Brown & Sharpe plain milling machine.

The fixture drills and slots both the openings, which are 1 1/16 in. wide by 2½ in. long, in metal ¾ in. thick.



DOUBLE-SLOTTING FIXTURE

The fixture can be adjusted to cut from 3½-in to 6-in. centers and to slot all sizes of shoes. The cutters run left-handed. The fixture works very well and has been in use one year or more, reducing the time of slotting from 7 to 3 min. for each shoe.

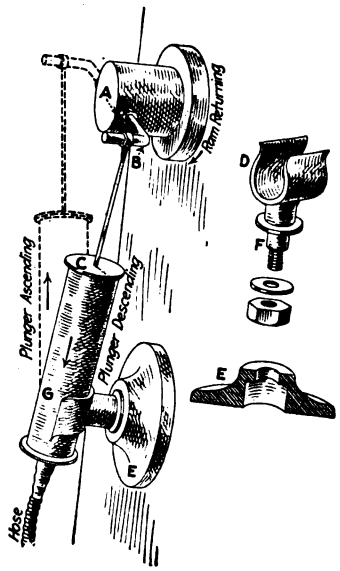
Grove City, Penn. H. W. BARTHOLOMES.

Air Pump for Punch Presses

The illustration is of a device for blowing away the work or punchings from the top of the die in blanking and forming operations. The fulcrum stud *A* passes through a hole in the end of the shaft on the press and is threaded to allow for the adjustment of stroke obtained by the threaded rod *B*. A collar clamped on the end of the shaft would also answer the purpose.

The pump is in position at the side of the press at *C*. Plate *E* is screwed to the side of the press and has a hole drilled through the center to allow for the extension of clamp *D*, as shown at *F*, to take care of the oscillation of pump *C*.

The device is adjusted so that when the ram is returning, the plunger is descending, as shown at *G*. When the ram is descending, the plunger is ascending, as shown by dotted lines. This may appeal to some as a cheap



AIR PUMP FOR PUNCH PRESSES

contrivance to overcome the annoyance of removing light or extremely small work from the die by hand, particularly when it is not convenient to connect an air blast to the press. GEORGE F. KUHNE.

Rutherford, N. J.

Stock Stop for Taper Pins and Cams to Operate It

On account of considerable trouble in making taper pins to the proper length, the stop shown in Fig. 1 was designed for use on a No. 0 Brown & Sharpe automatic screw machine. It is fastened to the rear cross-slide, as shown. It has a spiral face that the stock hits up against when fed out.

The reason for the helical face is to get adjustment so that the pins are cut off to the proper length. It is evident

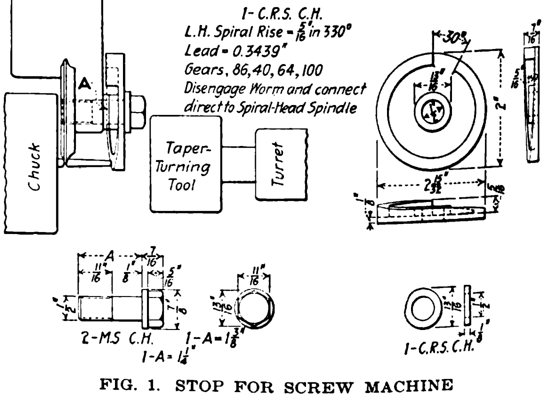


FIG. 1. STOP FOR SCREW MACHINE

that when the piece is turned, a point on the helical surface comes nearer to the spindle, or *vice versa*, according to which way it is turned. The helical provides for about $\frac{7}{16}$ adjustment, as the high part of the helical surface can be turned to the stock, the washer *A* removed and the plate put directly up against the cutting-off tool holder, to which the helical plate is fastened with the same screw that holds the tool.

Fig. 2 shows a set of cams designed to go with this stop. They are different from ordinary pin cams inasmuch as

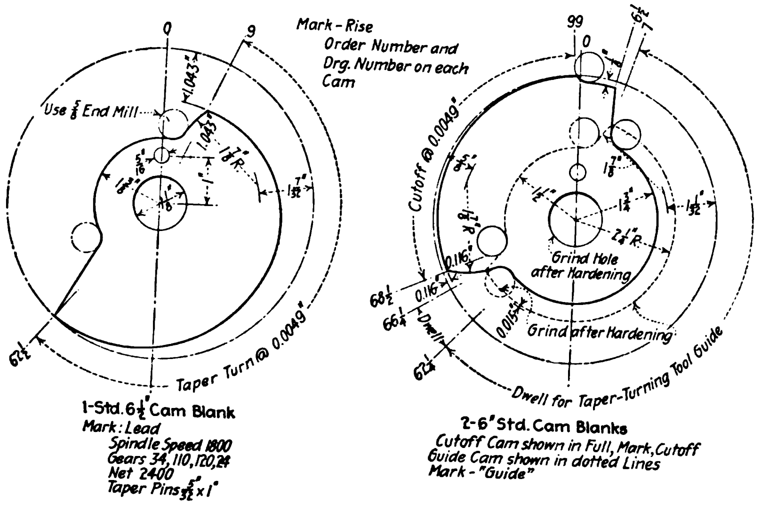


FIG. 2. CAMS TO OPERATE SCREW-MACHINE STOP

they allow the cutoff tool to come back 1/8 in., permitting the stock to pass. The stop is held in this position until the stock is clamped in the collet. Then it lets the rear cross-slide back far enough for the taper turning tool to pass. In this way the pins are all cut to the exact length.

RAYMOND W. BECKMAN.

Dayton, Ohio.

Some Materials for Firearms

Owing to the demand for certain materials required for the construction of war munitions, it has been found necessary to arrange for the use of others in order to satisfy contract requirements and meet delivery demands.

Generally speaking, the material that has been in the greatest demand, owing to the numerous large contracts which have been placed in this country, is the so-called smokeless barrel steel. This material has the following chemical analysis:

	Per Cent.
Carbon	0.40 to 0.50
Manganese	1.10 to 1.20
Silicon	0.20 to 0.30
Phosphorus	Not over 0.08
Sulphur	Not over 0.06

This material, used in its untreated condition, which is the condition in which it is converted into rifle barrels, will possess the the following average physical properties:

Tensile strength per square inch	105,000 to 115,000 lb.
Elastic limit per square inch	65,000 to 70,000 lb.
Elongation in 2 in.	20 per cent.
Reduction of area	45 per cent.

Previous to the outbreak of the war in Europe, American manufacturers of firearms had to a considerable extent profited by the experience of the Ordnance Department and adopted for their product, especially in the more important parts such as the receivers and the bolts, the material used by our own Government in the manufacture of the Springfield rifle, which is known as class C steel and has the following chemical analysis:

	Per Cent.
Carbon	0.30 to 0.35
Manganese	1.00 to 1.30
Silicon	0.05 to 0.10
Phosphorus	Not over 0.06
Sulphur	Not over 0.06

One point in this specification that may be of sufficient importance to warrant further explanation is the high manganese content. This element is most necessary, as it not only increases the physical qualities, but neutralizes the harmful effects of the phosphorous and sulphur as well and tends to make the crystals of the steel smaller, so that they adhere to each other more firmly.

Whether components have been made of this steel in its cold-rolled state or whether they have been forged under the hammer, it is necessary that they be annealed before machining. To carry out this annealing process, it is necessary that the steel be heated from 10 to 20 deg. above the lowest absorption point, or to about 1,285 deg. F. This will make the steel easy to work, keep the grain size as small as possible and remove entirely the effects of cold-rolling or forging. When thus treated, this material should possess the following average physical properties:

Tensile strength per square inch	92,000 to 97,000 lb.
Elastic limit per square inch	55,000 to 60,000 lb.
Elongation in 2 in.	About 28 per cent.
Reduction of area	About 56 per cent.

Owing to the difficulty in obtaining smokeless barrel steel in sufficient quantities, some concerns have begun the use of a 3½ per cent. nickel steel for this component. The analysis of this material follows:

	Per Cent.
Carbon	0.40
Manganese	0.57
Silicon	0.27
Phosphorus	0.04
Sulphur	0.04
Nickel	3.35

When heat-treated as follows—heated to from 1,425 to 1,440 deg. F., at which temperature it is held for 1½ hr. and then quenched in oil, then annealed at 1,020 to 1,045 deg. F. and held for 1½ hr., when it is allowed to cool with the furnace—its physical properties will be as here given:

Tensile strength per square inch	133,000 lb.
Elastic limit per square inch	120,000 lb.
Elongation in 2 in.	20 per cent.
Reduction of area	40 per cent.

One concern using large quantities of nickel steel in the manufacture of firearm components has standardized its heat-treatment of this material. The results of this standardization, as well as the details of the procedure, follow:

Nickel steel should always be heat-treated, using a pyrometer to check the required temperatures, as a few degrees' variation in the temperature makes a large variation in the resulting physical properties. Extreme care should be taken in heating nickel steel to see that the pieces are heated thoroughly and uniformly throughout.

The treatment of nickel steel may be divided into two general classes: (1) Those components which can be heat-treated after all machining operations are completed; (2) those components which, on account of their liability of warping and scaling, cannot be treated after machining and must be heat-treated in the bar or forging before any of the machining operations are started.

In the first class the components will be heated to 1,500 deg. F. and quenched in oil. When cold they will be drawn to 600 deg. F. When the components come from the oil they should not be "file hard," but they cannot be successfully machined after this treatment, which is applicable to such parts as screws, pins, studs, etc. Components treated in this manner will have the following physical properties:

Tensile strength per square inch........	About 212,000 lb.
Elastic limit per square inch............	About 200,000 lb.
Elongation in 2 in.......................	About 14 per cent.

If a piece of steel put through this heat-treatment is loaded to any amount below its elastic limit, when the load is removed the piece will return completely to its original dimensions; but if loaded beyond its elastic limit, it will take a permanent set. In other words, the elastic limit shows the greatest safe load that can be applied to a piece of this steel and is of more practical importance than the breaking strength. The elongation is an indication of the ductility of the steel, the greater the elongation the more ductile being the steel.

In the second class the material is heated to the same temperature as in the first class—namely, 1,500 deg. F.—and quenched in oil. When cold it is then reheated to 1,200 deg. F. Material treated in this way will have about 50 per cent. lower tensile strength and elastic limit but considerably greater elongation.

In general, annealed nickel steel has an elastic limit 40 per cent, greater than that of machinery steel.

In addition to the foregoing materials, extensive use is made of spring steel and carbon tool steel in the manufacture of firearms components, and the physical properties required in these two materials are as follows:

Spring steel (hardened and drawn to blue):	
Tensile strength per square inch	195,000 lb.
Elastic limit per square inch	115,000 lb.
Elongation in 4 in.....	About 2 per cent.
Tool steel (annealed):	
Tensile strength per square inch	85,000 lb.
Elastic limit per square inch	65,000 lb.
Elongation in 4 in.....	About 14 per cent.

The following shows under what conditions nickel steel, spring steel and tool steel should be used in the production of firearms components in order to obtain the best results in the firing and action tests: Nickel steel—3.5 per cent. nickel, 0.30 to 0.40 per cent. carbon—heat-treated, is used where great strength is required, where the component must resist compression, shock and vibration, where the component must stand heavy blows and where it must be tough rather than hard. Spring steel—0.90 to 1 per cent carbon—is used where the component is required to take a spring temper or to act as a spring in its function and where the component is required to be hard as well as tough. Tool steel—1 to 1.50 per cent carbon—is used where the component is required to be very hard, where it must be hard, but bears very little strain or shock, where it must resist abrasion and where a sharp edge must be maintained.

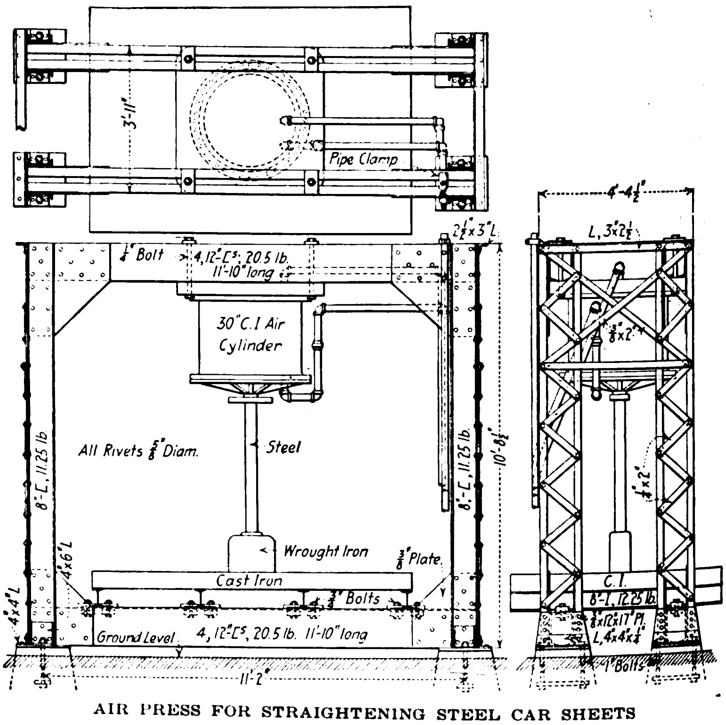
Hartford, Conn. CHARLES F. SCRIBNER.

Air Press for Straightening Steel-Car Sheets

The sketch shows an air press for straightening sheets for steel cars.

The foundation consists of four concrete pillars, on which are four 12-in. 20½-lb. channels 11 ft. 10 in. long from side to side. On top of the channels are four 6-in. 12¼-lb. I-beams laid in the opposite direction, and on these, the cast-iron faceplate 5½ in. thick by 6 ft. by 8 ft. 6 in.

The uprights in all consist of eight 8-in. 11¼-lb. channel irons, 10 ft. 8½ in. long. Two extend up from each pier and are on the outside of long channels laid horizontally and securely riveted to the uprights. A ⅜-in. plate is placed between the horizontal pieces to strengthen the parts, and the vertical channels are well latticed too. The I-beams are held down on the long channels by a bolt and two plates, one under the inside flanges of the channels and the other on top and extending over the flange, or web, of the I-beams.



AIR PRESS FOR STRAIGHTENING STEEL CAR SHEETS

The uprights are riveted at the top to the horizontal channels in the same manner as at the bottom.

Four 1¼-in. bolts support the cylinder. This air cylinder is 30 in. inside diameter. Air is admitted above and below the piston for lowering or raising it.

Renovo, Penn. JOSEPH K. LONG.

Discussion of Previous Question

Influence of the Automobile on Machine-Tool Design

On page 81 is a discussion of the "Influence of the Automobile on Machine-Tool Design," which touches upon a phase of the machine-tool industry that does not seem to have received due consideration in the past. While the points brought out cover quite a number of the marks left by the development of the automobile industry on the design of machine tools, there are several other features which I have in mind that may be of interest.

Probably one of the most extensive and far-reaching effects of the development of automobile manufacturing is the growth of the jig and fixture and other methods of securing interchangeability of parts, both as regards economy of manufacture and convenience to the ultimate purchaser.

While the convenient and simple change-speed mechanisms that have been brought to such a high state of perfection in the automobile cannot be considered as being the one and only cause of the adoption of quick-change speed and feed units on machine tools, their influence has had a most decided effect.

When automobile design was in its infancy in this country during the late nineties, ball and roller bearings were so unreliable and expensive that their use was necessarily very much restricted. As the service that these types of bearings were required to render was of such great severity as regards grit, shock and neglect, it was absolutely necessary that great strides be made in their manufacture and design. The rapid growth of the automobile brought this great new field to the attention of the anti-friction bearing manufacturers who, up to this time, had produced no ball or roller bearings suitable for any service more severe than they might receive in such a light-weight vehicle as the bicycle. As the result of this impetus, these bearings have been brought to an extremely high state of efficiency. They are now available, when properly mounted, for the most arduous duties that they may be called upon to perform in many types of machine tools. Advancement along these lines has been slow, but constant.

The rapid increase in the power and speed of motor vehicles brought a very important factor to the minds of engineers—the fatigue of steel under constant shock and vibration. This fact necessitated the coöperation of the steel manufacturers. It gradually led to the alloying of nickel, vanadium and tungsten, thereby greatly increasing tensile strength and the reduction to a minimum of the effect of continued vibration. About this time the increasing use of high-speed cutting steels made much greater speeds and feeds of machine tools not only desirable, but necessary. The immediate result was that such a great increase of shock, stress and strain was imposed that cast iron, cold-rolled and machinery steels were not at all suited in many cases to the service they were called upon to perform. The alloy steels, developed in the first place for automobile use, were the answer to this problem.

In the early types of machine tools before the advent of high-speed steels the matter of lubrication did not receive very great consideration. Almost all bearings were supposed to receive their proper supply of lubricant by the use of an oil can at each individual point once or twice a day. As the severity of the service increased, this method of lubrication was found to be inadequate. In casting about for an answer to this problem the machine-tool designer found a suggestion in the multiple-jet, drip and automatic forced-feed oiling systems, which were being developed to such a great degree in automobile design. This feature is a comparatively recent adoption.

The automobile is a fine piece of machinery, when properly built, and no piece of mechanism of its size has previously been produced on such a large scale. This vast production has necessitated the design of many special and automatic machines, which have created a new line of thought in the design of machine tools.

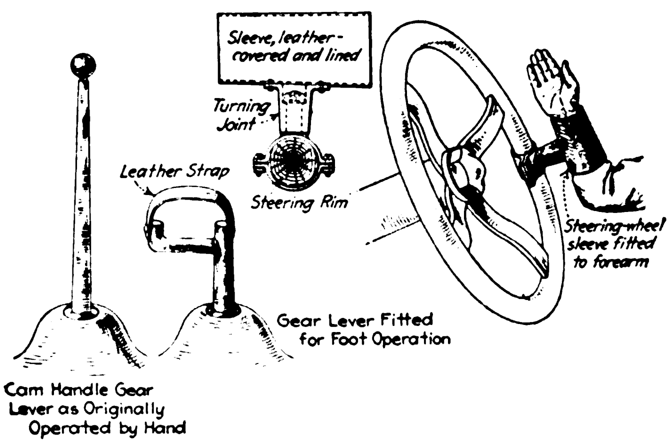
Several of the influences of the automobile on machine-tool design mentioned in this article were touched upon in the editorial, but I have added points that provide further food for thought along the line of the adoption of other features of automobile design by the machine-tool designer.

NORMAN R. EARLE.

Central Falls, R. I.

Mechanical Aids for the Crippled Soldier

The efforts now being made to adapt victims of the European War to the new order of things, as brought out in the editorial, Vol. 43, page 825, applies no less to the victims of industrial accidents in our own country. The



DEVICES TO FIT AUTOMOBILES FOR OPERATION BY A CRIPPLE

future of these persons who are deprived of the use of an arm or a leg depends on their mentality and their willingness to assist themselves and on the amount and manner of assistance given them.

A man with a slightly deformed hand or limb is often seen begging on the street, while another with much greater disadvantages holds a position which would seem to belong only to a person of sound limb having the use of every faculty. That such men should be given the advantage of employment on lighter work for which they are adapted is obvious.

Railroads and large corporations have solved this problem to a degree, so that positions such as watchmen, crossing and switch tenders, and numerous other light jobs fall to the lot of the cripples from other departments, or to men well advanced in years who have given the best of their life to the service.

However, a large proportion, with proper encouragement, may still follow their chosen work in the mechanical trades; witness the great number of mechanics having artificial legs. The ambition to keep active is shown in the case of a man injured in a railway accident.

This man had his left arm amputated near the shoulder, thus depriving him of its use in any manner. His right hand was amputated and was replaced to some extent by a steel hook and an artificial hand. Both legs were amputated, fortunately below the knee, the right close to the ankle. Artificial legs were applied in both cases. While he is as helpless as a babe in his personal care, he is able to walk without the assistance of so much as a cane and is considered a competent automobile driver, doing a renting business.

The automobile, which is left-hand drive, center control, of American make, is fitted especially for his use and would be very inconvenient for an able-bodied man to handle. The steering is accomplished by the use of a steel leather-covered sleeve which fits the forearm, being fastened by means of a clamp to the steering-wheel rim and having a joint to allow freedom of action.

This device is fastened about midway between top and bottom toward the right, when the wheels are set dead ahead. The steering action, except on sharp turns, is a slight movement of the forearm to or from the body.

The clutch and service brake are incorporated in the same pedal, which makes easy control possible. The emergency brake is of the pedal type and is operated by the right foot, as is also the accelerator pedal.

The spark is what is known as a set spark and requires no advance at high speeds. The cane handle for gear shifting is cut off and bent at a right angle toward the left and fitted with a stirrup. The ease and rapidity with which the gears can be shifted by the right foot is surprising. All switches, door latches and starter buttons are fitted with extensions so that they are operated by a push from the artificial hand.

After a demonstration of this kind one ceases to wonder at the opportunities open to ambitious crippled men.

Fresno, Calif. O. D. CARTER.

German Employment Methods

The recent correspondence dealing with the employment methods of American industrial establishments has been very interesting. It illustrates clearly the lax methods of employing help prevalent in this country and the growing demand for improvement.

Many German methods do not meet the approval of Americans, but we certainly must admire the splendid structure erected about German industries. The employment of a man in a German factory is considered an important event. The German manufacturer does not wait for some man to come along and apply for a position and then endeavor to ascertain the man's ability by a few questions. The manufacturer applies to governmental bureaus and is entitled to and receives a thorough record, showing the places where each applicant has previously been employed.

A man who wishes to leave his employer is expected to give a notice of two weeks or more, depending upon the character of work in which he is engaged. Sometimes clerks are expected to give three months' notice. An employer who wishes to discharge a man must also give a correspondingly lengthy notice. These notices are very formal affairs, and it is usual to go through them with considerable ceremony. Ordinarily the employee who is about to leave mails his notice, so that the canceling stamp of the post office can be submitted as actual proof of the time the notice was sent.

An employer, in discharging a man, must give the employee a notice of two weeks or more and then must permit him to spend one hour each day in searching for another place. The employer is permitted to state what hour this shall be, but he is expected to give the employee full pay while so engaged.

The employee who leaves without giving his employer due notice as prescribed by the industrial rules will find it quite impossible to obtain employment elsewhere. Every employer demands references from previous employers. The employers are looking after their own interests by taking such steps, and this is one point which American manufacturers might do well to imitate.

Americans would probably resist any attempt to introduce such methods into this country at this time, but all must admit that such a system is fair both to the employer and to the employee. The employee is guaranteed at least a two weeks' notice and is given an opportunity to find other employment before he is thrown on his own resources. The employer, on the other hand, does not run the risk of finding his entire factory shut down because his help has left him at the invitation of some outsider. He does not find a department demoralized because some foreman has left to go with a competitor, and he has an assurance that a clerical employee who has spent some months in learning new duties will not leave him before he has a chance to "break in" another clerk.

Ultimately we may expect some such means of control of both elements as now exists in Germany. It is likely to be the result of a series of progressive steps, each of which throws some of this regulation onto a Government commission. W. F. ROCKWELL.

Dorchester, Mass.

Counting the Number of Teeth in a Wheel

A method that I used in finding the number of teeth in a gear has not been mentioned in the discussion. Suppose the number to be 136. I set a pair of dividers so that the points enter two spaces. Then I count the teeth between them—say, 7 teeth. Then I mark the starting space and step around 7, 14, 21 . . . 133. By counting and adding the remaining three teeth I get the total—136. J. SCHWING.

Buffalo, N. Y.

Machinist Instruction in the Public School System

Machinist instruction in public schools is a part of the general subject of industrial education. While this at the present time is only in its infancy, it is receiving the thought of some of our ablest educators. Until the various methods of instruction have been given the tests of time, we, as individuals, may only express our opinions for what they may be worth.

In continuation of the point raised by George Heald on page 122 my own experience indicates that the time limit is an essential element in vocational education and in line with commercial practice. It is not necessary or possible to make as small an allowance as would prevail in a factory; but unless a specified time is allotted for each job, the student is apt to get the impression that a first-class job is of more importance than time, whereas in commercial work the time limit is of equal importance on the usual run of shop work.

It is also found that if a student is forced to work beyond a certain period on one piece, his interest begins to wane and the work becomes distasteful to him; this indicates the danger line and is to be avoided.

Therefore, a reasonable time limit should be set for all jobs. As some students are much brighter mechanically than others, they will finish their work sooner. When the limit is reached, the entire class should be started on new work, thus renewing their interest and assuring a better grade of work. Upon completion of the second piece the slower students should return to the first exercise, for which they will have a renewed interest, while the faster workers will proceed with their third project.

The slower students will realize their deficiencies by this time and will put forth their best efforts to be on an equal footing, or nearly so, with the more advanced students. Should they fail in this, then the assumption will be fairly justified that they are not fitted for that particular class of work. WILLIAM J. SANSOM.

Madison, Wis.

Economics in the Shop

Your editorial on page 739, Vol. 43, "Economics in the Shop," is a subject of great importance and one on which the writer has spent much thought. The self-evident truth, "The greater the production the greater the amount available for distribution," has been presented in many forms, and the workmen have been urged to produce and to base their demands for compensation upon evidences of production. Probably the greatest trouble in England today is the limiting of production, which even the extremities of the war have not been able to overcome. So little is produced that there is little to distribute, and England has been obliged to purchase outside articles that she should manufacture and to borrow the money with which to pay. England has thus mortgaged future production and, unless production is increased, will be unable to pay off the mortgage.

However, there is little use of preaching economics to the workmen when their everyday experiences contradict the teaching. Rate cutting has shown the workmen over and over again that a greater production means less for themselves. Under such circumstances can anyone blame them for limiting production? If a man can get $1 apiece for producing certain articles when he makes only four of them a day and but 80c. apiece when he makes five, why should he make five? Yet this is the kind of economics that many manufacturers have been teaching the workmen for years.

Consider an actual example that occurred in a large Eastern shop only a few weeks ago: Four pieces for a boring-mill operation were put out in the shop at a piecework price of $2.25 each. Every boring-mill operator on the day shift refused to touch the job, but a man on the night shift took it and completed four pieces in one night.

A few days later 16 of the same pieces came into the shop, but carried a price of $2 each. This time everyone, including the night man who had taken the former job, refused to take the work. After standing in the shop for several days, the price was put back to $2.25, and the same night man started work on the job. This time the job could not be completed in one night and was therefore continued by the day man, but he was able to complete only one piece as against four by the night man. The day man complained to the night man, who instructed him so that he was able to finish three pieces on the second day. Of course, the night man completed the job on the third night.

When payday arrived, the day man received $2.25 for the day in which he finished only one piece, but the night man added $1.75 out of his own pocket in order that his fellow worker might not be short in his pay. Neither the workman nor the company was teaching true economics, and both teachings were dangerous. The company taught that a greater production meant less pay, while the workman taught that pay would be given without production. The company was at fault in carelessly setting a rate, in reducing the rate and in not instructing the workmen. No doubt the higher officials of the company know nothing of this case or of similar instances and would correct the evils if known.

Thousands of cases of rate cutting could be cited, and all have tended to teach the workmen to limit production. Conditions are rapidly becoming serious, and it would pay employers to begin to instruct the workmen in economics by showing them that increased production means increased compensation. Such practical demonstrations constitute the only way in which shop economics can be taught, and it behooves manufacturers to begin teaching before it is too late. C. J. MORRISON.

New York City.

A Lever, Its Fulcrum and the Machinist's Strap

John E. Sweet's article on page 163 is a good one and ought to attract the attention of employers and foremen. From my own experience I wish to say that nine out of ten shops have straps such as described by Professor Sweet, and nine out of ten machinists and tool makers use these straps against their will. They know that they are not doing a practical thing; but this kind is all they have in hand, and they cannot stop their work to make proper ones. They feel that it is up to the shop to provide them. Why do not the foremen or employers have some of the boys make up a set of well-proportioned straps? LOUIS KRUGER.

Chicago, Ill.

Preventing Rod Vibration on Automatic Screw Machines

In the devices shown on page 75 for preventing rod vibration Raymond Grant seems to have gone to considerable trouble. Of course, if the machines are in close proximity to the office or drafting room, they would have to be practically noiseless.

We have eliminated a great deal of the noise and, at the same time, thoroughly protected the corners of square or hexagonal rod by a simpler method. The iron pipes for holding the metal are removed altogether. In place of them are installed long wooden pipes, which are obtained from a manufacturer of wooden bushings for pulleys.

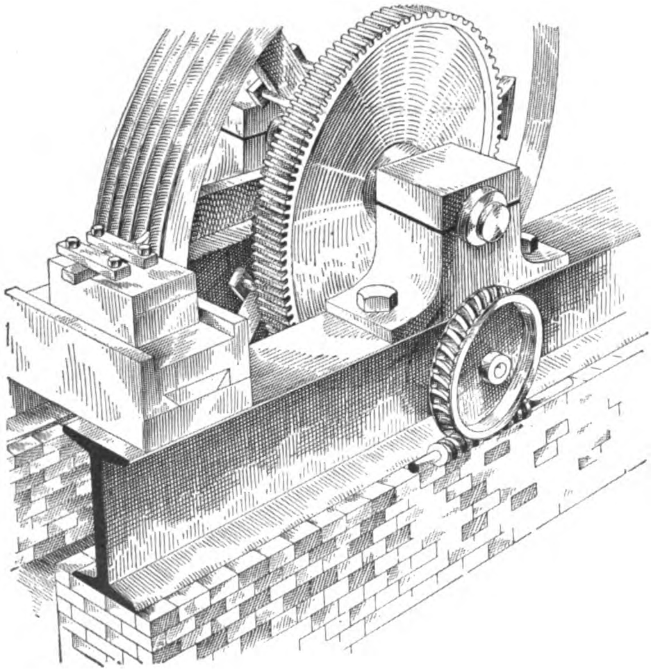
Only a small proportion of the work on our automatics requires odd-shaped rod, and to this may be due the fact that the wood shows very little wear.

Mr. Grant is evidently using single-spindle machines, whereas ours are four spindle. However, that should make no difference. H. D. MURPHY.

Jersey City, N. J.

Turning a Large Pulley

The illustration on page 427 of Vol. 43 reminds me of events that happened some years ago, when I was an apprentice. The shop was a large and growing one in the eastern counties and was managed by one John Buck, a very energetic engineer who never stopped at anything. Contracts were taken on one after the other, ever growing in dimensions and power and requiring larger and heavier flywheels, until they grew to such size that the



TURNING A LARGE PULLEY

old flywheel lathes were inadequate. So Mr. Buck set to work, with bricklayer and joiner, to rig up a lathe that would be suitable for turning flywheels up to 24 ft. in diameter and weighing 20 tons.

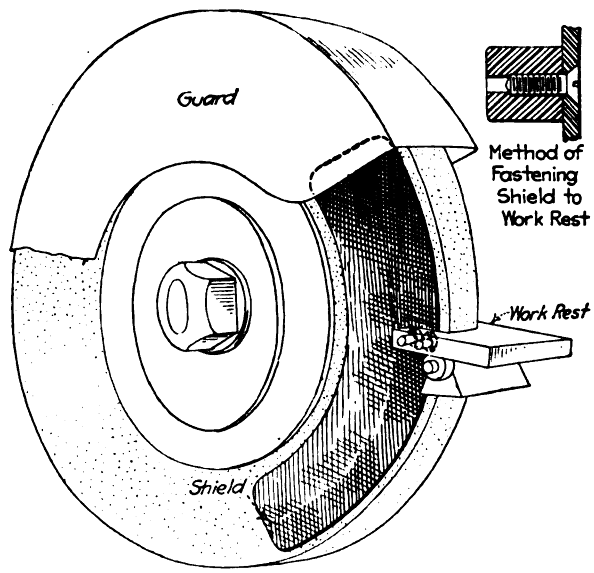
A pit was dug out some 4 ft. deep by 5 ft. wide and about 20 ft. long, the sides and ends being bricked as shown. Two cast-iron guides were placed upon the top of each side wall of the pit. These girders weighed about 2 tons each and were planed on their upper faces, upon which two old standards, found in the yard, were mounted. These carried a mandrel 8 in. in diameter, and upon this was keyed a large spur wheel having double flanged arms, to which three dogs were attached, so placed as to act as drivers. By means of bushings any wheel of 8-in. bore or over could be turned upon the same mandrel.

The drive was through a pinion geared into the large spur wheel. The pinion was driven by a wormwheel and worm, upon the shaft of which was a pair of 18-in diameter tight and loose pulleys driven by a high-speed engine. A pair of double slide rests was fitted to each end of the pit, resting upon the girders. The traverse of these rests was by rack and pinion actuated by a chain worked on a crank attached to the end of the mandrel. Some hundreds of very large flywheels have been turned on this machine. H. MAPLETHORPE.

West Bromwich, England.

Side Shield for Emery Wheels

It has often been mentioned in the pages of the *American Machinist* that it is objectional and dangerous to grind on the side of an emery wheel. Although this seems to be a self-evident truth, very little has been done to make a wheel foolproof in this respect. In a recent issue painting the side of a wheel was suggested. This method



SIDE SHIELD FOR EMERY WHEELS

will work well in a civilized shop, but sometimes an inquisitive person will be possessed to scrape off the paint and leave the side of the wheel unprotected.

The illustration herewith shows a sheet-metal shield for preventing this abuse. It consists of two sheet-metal sectors, shaped as shown, fastened to the inside of the long arms of the work rest and covering both sides of the wheel. As the wheel wears down the work rest will be moved in closer; hence the wheel sides will always be covered. The shields should be arranged to slide under the guard and should be shaped to cover as much of the exposed sides of the wheel as possible.

Bridgeport, Conn. W. BURR BENNETT.

Editorials

Federal Aid for the Promotion of Vocational Education

The report of the Committee on Education of the Chamber of Commerce of the United States of America indorses the principle of liberal appropriation by the Federal Government for the promotion of vocational education in the states. The committee accordingly recommends that the Chamber of Commerce of the United States should reaffirm its belief in this principle.

It will be recalled that in May, 1914, Congress inaugurated a new series of appropriations to be devoted "to aid in diffusing . . . useful and practical information on subjects relating to agriculture and home economics" and made permanent appropriations accordingly. In the present year the Federal appropriation is $1,080,000, and this is to increase without further action on the part of Congress until in six years it will be $4,580,000, at which figure it will continue year after year. To each dollar of these appropriations the states will have to add at least a dollar from their own funds, and the Federal law provides for efficient use of the appropriations by preventing their investment in buildings or other plant facilities and by limiting to 5 per cent. the part that may be spent for printing.

This committee earnestly believes that both general and national welfare require that the Federal Government should at once extend its aid to the states for training in trade and industrial subjects, just as it has, with great success and national benefit, for many years assisted the states in agricultural instruction. This help, it is believed, will develop vocational education much more rapidly and effectively than can be done by the states alone. It is not suggested that the Federal Government should do more than extend its financial assistance and its encouragement, which will come from its appropriation and from the examples set by the interest shown.

The administration of the schools is to remain wholly in the hands of local authorities, the instructors being municipal or state employees instead of Federal. Just how advantageous this plan may be remains to be seen. It depends so largely on the politics of the state, which as a rule, change more frequently than the national policies, and may on that account not be entirely advantageous.

Instruction that this committee has in mind is of a vocational nature for the great number of children who now leave school at 14 years of age and go to work. This training the committee believes to be imperatively and immediately necessary as a distinct Federal asset. The committee recommends that the Federal appropriations should be allotted among the states on a uniform basis and should bear a uniform relation to appropriations made by the states for like purposes.

In order that the Federal Government may have administrative means of giving effect to any Federal laws making appropriations for vocational education, it is recomended that a Federal board be created to administer the proposed national functions in vocational education, this board to be representative in its personnel of the interests vitally concerned and to be given compensation sufficient to command in its membership the great ability appropriate for the task to be performed. The committee further recommends that the Federal board, however constituted, should be required to appoint advisory committees of five members each, representing industry, commerce, labor, agriculture, home-making and general or vocational education. The members of these committees should receive reimbursements for traveling expenses and compensation for the time they actually spend in the active discharge of their duties. In order to prevent undue expenditure for committees of this kind, the aggregate amount to be spent for all advisory committees in any one year might be limited to $50,000.

No one can deny the advisability of vocational education, but the great difference of opinion comes in determining what to teach and how and where to teach it. Advocates of the corporation school feel that this is the only correct way to teach the mechanical trades and that it is impossible to obtain practical results outside the shop. Vocation- or trade-school advocates, on the other hand, point out that only the very large manufacturing plants can maintain schools of this kind and that the smaller shops must either give inadequate apprentice instruction or draw their boys from the trade schools. Then, too, there is a decided difference of opinion as to what kind of instruction should be given.

We believe much good can be accomplished by a suitable advisory board, but much depends upon the experience of its personnel. If those who are supposed to represent vocational education bring to such a committee only the usual idea of the schoolmaster, as is so evident in too many of the so-called trade schools, we have but little to hope for in this direction. We strongly believe that it is fully as essential to have the boy know why he performs each operation as to learn how to do it, both from the viewpoint of making him a better workman and to give him an added interest in his work. If we are only to teach how an operation is to be performed, this is a comparatively small task in most cases, as can be readily proved by the astonishingly short time in which an absolutely green boy will learn to perform a simple operation on almost any kind of machine.

One of the first things to be decided upon is how much a boy is to be taught. If vocational schools are simply to train operators for the special machines used in a particular locality, it is an easy and uninspiring task. But if the schools are to add to the mechanical knowledge of the country, so as to increase its productivity, no matter in what shop a boy happens to find a job, it is an entirely different proposition and one which should and will attract the attention of the best men. Vocational education must be conducted along broad, and in many cases radical, lines if it is to fulfill its promises and be of real value to the country as a whole.

The Most Foolish Suggestion

"It's a good thing, push it along," seems to be the motto of a few interested persons who are hurrahing for industrial preparedness on one side, and on the other suggesting that the United States Government should buy the jigs, fixtures, cutters, tools and special machines now being used in this country for the manufacture of munitions for the belligerent nations of Europe. If these hints take concrete shape, they will form the most stupendous attempt to sell junk to the Government that history has ever recorded. The suggestion is "the most foolish" one that has been made in connection with American industrial preparedness.

The machines, special tools and small tools designed to manufacture European ammunition over here are of very little use for any other purpose. European munitions do not correspond with American standards, and the equipment now in use to produce them would have to be built over and revamped before it could be used for American designs. Most of the foreign ammunition seems to have been planned by men who had a spite against manufacturers, for much of the machine work called for is as nearly impossible of accomplishment as can be imagined. As these munitions are being made for at least six European governments, there is no such thing as standardization. For example, four different screw standards are employed—metric, Whitworth, United States Standard and A. S. M. E. Standard. In addition there are square and buttress threads and a nondescript lot of bastards, without pride of ancestry. How can anyone suggest handing down to our posterity the equipment to manufacture such a collection of freaks!

Under no conditions should anyone urge on the Government the purchase of the special tools now in our munition factories, on the plea that some day these tools will be of value to the United States. They never can be of value. Every dollar spent for them would be worse than wasted. It would be far better to squander national funds on "pork" than on such jigs and fixtures.

What should be done is to have sensible ordnance experts get together with skilled mechanics and design sensible ordnance and ammunition that can be manufactured in sensible machines with sensible tools. Once this is done, let the American munition manufacturers adapt to make American war material any part of their machines and tools that they choose. In this way, and in this way only, can the present munition equipment be made to serve the interests of the United States.

Leader and Leadership

A party of travelers was sitting in the buffet car of an overland train, headed eastward down the mountains. The train had been going "steadily by jerks," so to speak—now running along at a good speed, now standing still, now under bare headway, but all the time getting farther and farther behind schedule.

Presently the train, after running for almost ten minutes, came to a stop, with much grinding and whistling and general disturbance; then the quiet of the car—a disgusted sort of quiet—was broken by one impatient traveler, who exclaimed, "If that blasted locomotive would but get out of our path we could make good headway!"

This is a true story, but its veracity is not its only good attribute. It serves admirably as a parable to illustrate a condition that unfortunately obtains in a good many businesses, particularly manufacturing businesses.

If a business is to get anywhere it must advance. If it hustles right along, everybody works with a will and with enjoyment of the passing landscape—especially when passing locals and sidetracked affairs. But when the advance is steady by jerks, then instead of vim there is sluggishness; instead of enjoyment there comes disgust—real, live disgust that stimulates desire to engage passage with a competitor.

Sometimes there are perfectly good reasons for this unsteady sort of advance, and it cannot be helped. Incidentally, it makes all hands concerned feel much better if they know why. But usually it is because of vacillating policy—or no policy at all—or of plain ignorance. In a manufacturing plant this factor of plain ignorance is a common one, often accompanied by self-sufficiency—ignorance of true conditions in the plant, of the desire in the heart of every good mechanic to see things move, combined with placid self-sufficiency on the part of the management, based on the belief that it is probably the best management in captivity.

Now, if that locomotive really had been taken away, the train would have met quickly with destruction, which is a way of saying that an enterprise needs a leader. Still, there should never be the feeling that the leader is in the way; instead, it should be perfectly plain that the leader really *leads*.

Lack of Attention to Want Ads

There has been much discussion of the ethics of firms that advertise for men and ask for detailed information as to experience, family, etc., and then do not reply to applicants. It is discouraging to spend an evening in writing a detailed account of one's experiences and never get even an acknowledgment. A letter of this kind means much more to a mechanic who is not accustomed to letter writing than it may appear to those who simply dictate a letter, either to a stenographer or to a machine. After a few experiences men become discouraged and then cease to apply, often depriving themselves and employers of the opportunity for mutual benefit.

Much unnecessary correspondence on both sides can be avoided by being more explicit in advertising. Many ads, which almost ask for the color of one's hair, forget to mention what type of automatic screw machine is to be run or the class of work. Advertisements for pattern makers fail to specify whether wood or metal patterns are meant, etc.

A little more care about the details of an ad. to make sure it covers all the points, will often prevent applications from those who do not meet the requirements and who would not answer if the conditions were made clear.

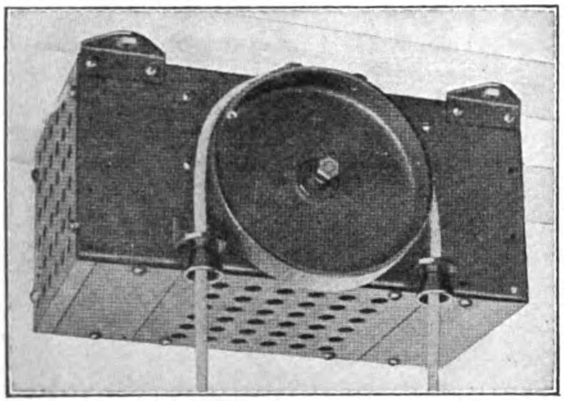
There are many good men in the wrong position, through no fault of their own, who would be of more value to themselves and to others in the right position. It is no more a favor to employ than to be employed, if the services and remuneration are mutually satisfactory.

By remembering that any transaction of this kind is, or should be, mutually beneficial and by putting oneself in the other fellow's place, many unpleasant experiences can be avoided.

Shop Equipment News

Universal Hoist Controller

While the form of controller shown was designed primarily to meet the requirements of rope-operated hoists, it is planned for other classes of service and can be arranged to be operated by a hand lever instead



UNIVERSAL HOIST CONTROLLER

Capacity, 5 hp.; maximum amperes, d.c. or primary a.c., 30; secondary a.c., 60; maximum volts, d.c. or primary and secondary a.c., 550.

of by sheaves and ropes. Practically the same controller can be used on any kind of alternating-current motor.

In the design lightness and compactness were of prime consideration. The resistance and switch gear are mounted in the same frame, and the entire mechanism, including terminals and all live parts, is inclosed with perforated steel covers. Ball bearings are used throughout. The resistance is of the graphite compression type.

The controller shown represents a line recently developed by the Allen-Bradley Co., Milwaukee, Wis.

Heavy Horizontal Turret Lathe

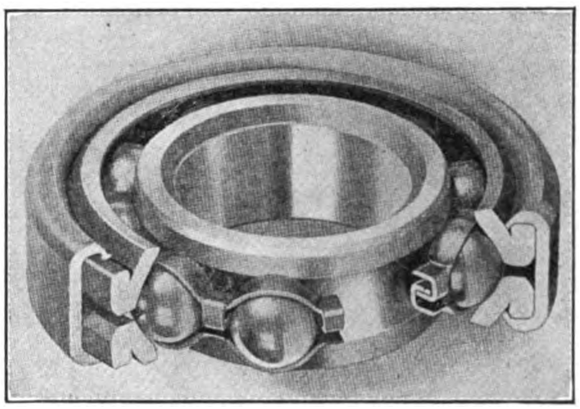
The turret lathe shown in the two views has been built especially for adapter and similar shell parts, but can be used equally well on other work.

The same rigid spindle construction is used as with the other lathes built by the T. H. Symington Co., Rochester, N. Y., the turret being arranged on a horizontal axis with stops in another turret or circular plate on the same shaft. The turret is located in its various positions by means of the long grooves on the turret periphery, the tools being swung into cutting position by the handles on the stop plate.

Undercutting and cutting off are secured by turning the turret after the tool is correctly located. Stops for controlling this movement are located on the periphery of the stop plate, the turning movement being accomplished by means of the handwheel at the right. The tools are fed into the work either by the hand pilot wheel or by power, the feed being tripped at any desired point.

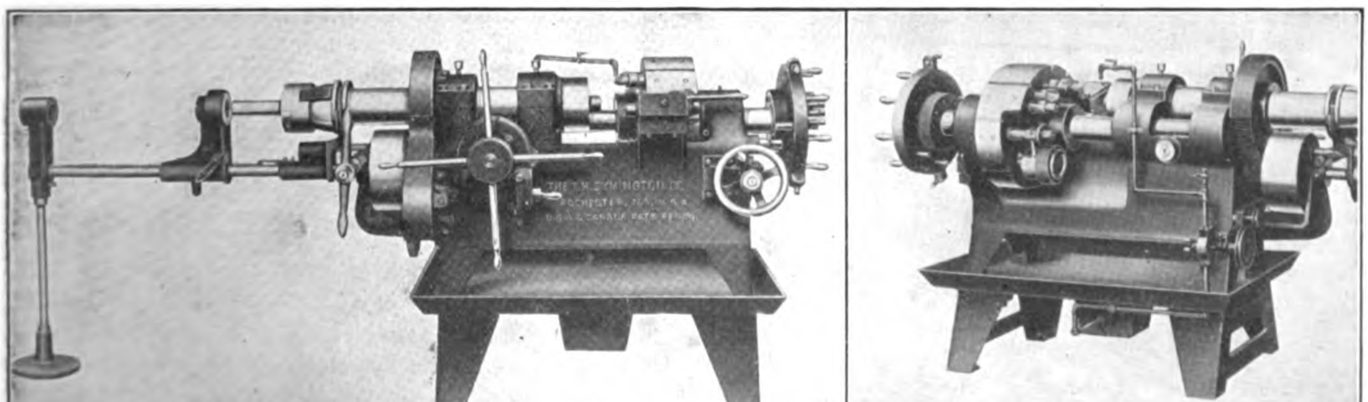
Annular Ball Bearing

The type of annular ball bearing shown, claimed to be capable of sustaining a thrust load of 50 per cent. of the rated radial load, without adjustment, is a recent product of the Schatz Manufacturing Co., Poughkeepsie, N. Y. The arrangement of the outer race, which provides two



ANNULAR BALL BEARING

points of contact, is designed to take care of the end thrust. By this arrangement, the balls have three points of contact, two points in the outer race rings, and the third located in the inner race ring as will be seen.



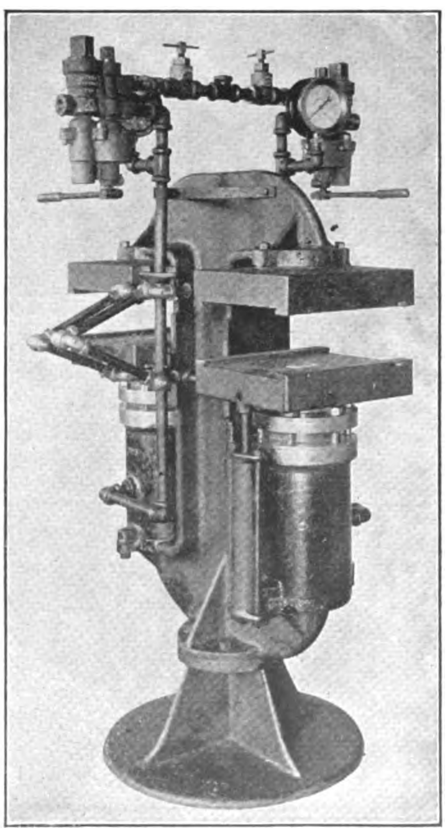
FIGS. 1 AND 2. TWO VIEWS OF A HEAVY HORIZONTAL TURRET

It will be observed that the outer race is in two parts, each of which has a curved recess generated on its inner periphery, thus forming a raceway for the balls. A curved ball track is generated on the outside of the cone or inner race ring and is designed to allow precise co-axial rotation. The curvatures of the raceways in the outer race rings and in the cone are 4 per cent. greater than that of the ball. The two point contact of the outer race is so arranged that the points are located at a given angle at either side of the center line of the bearing while the center line passes through the third point of contact at the inner race. Diagrammatically, the three point contact gives a triangular support designed to permit high end thrusts.

The cup rings are a press fit in the outer case and after assembling the case is closed over the cups, thus permanently fixing the interrelationship between the various parts of the bearing. The ball separator is made of pressed steel and is a self-locking design without rivets. All parts of the bearing are made of high-carbon chrome alloy steel except the case and ball separator and all the parts are heat-treated. Standard dimensions are used throughout.

Duplex Hydraulic Press

While the press shown was originally designed for vulcanizing purposes, other uses will readily suggest themselves to prospective buyers. With this type of press, the production may be practically doubled while holding labor cost down and using the floor space of a single press. It is built for 1,500 lb. accumulator pressure, which gives 15 tons on each side. Either side of the press is operated independently, the operations being controlled by means of Metalwood single-lever quick-acting operating valves. Plain flat platens can be furnished if desired.



DUPLEX HYDRAULIC PRESS

Pressure capacity, 15 tons on each side; rams, 5 in. diameter, with 4¼-in. stroke and with spring returns or "pull-backs"; platens, 12x14 in. and steam heated through swing joints; die space, 4½ in.; height from floor to lower platen, 3 ft.; height over all, 6 ft. 7 in.; diameter of base, 24 in.; weight, 1,450 lb.

This press is made by the Metalwood Manufacturing Co., Detroit, Mich.

Bench Taper Gage

In addition to regular toolroom requirements the form of taper gage shown is calculated to be adapted for manufacturing purposes.

The method of application is apparent. If desired, the head can be readily removed from the post and used in a horizontal position on the bench.

The gage plates are hardened and ground, and the clamping screws and nuts are hardened. The base and frame are finished in baked black enamel. In use, the gaging joint can be adjusted to the height of the eyes and the gage so placed that the operator may look through it toward the light. The plates are set to a master plug gage.

ADJUSTABLE BENCH TAPER GAGE

Capacity, from nothing to No. 14 B. & S. taper; greatest height to center line of gage, 30¼ in.; least, 23¼ in.; weight, 23 lb.

The gage shown is a recent product of the Hartford Special Machinery Co., Hartford, Conn.

Portable Radial Drilling Machine

A portable radial drilling machine, designed primarily for drilling, tapping and reaming holes in heavy pieces which cannot conveniently be brought to the regular type of radial, is the latest importation of the Wiener Machinery Co., 50 Church St., New York, N. Y. The machine is made in several styles.

Electric Welding High-Speed Steel Bits to Mild-Steel Shanks

By Ethan Viall

SYNOPSIS—This article briefly outlines the two methods of electric welding of high-speed to mild steel for the making of cutting tools. As the various applications at once suggest themselves to the practical shop man, no attempt is made to show other than the primary principles.

Until the recent scarcity and high price of the various makes of high-speed steel caused many manufacturers to look into methods of economy, few paid any attention to the saving possible by using a mild steel for all but the actual cutting parts of different shop tools. The electric welding of high-speed steel to mild steel is not new by any means, as a few shops have practiced it for several years. There are two methods employed in the electric process—butt welding and spot welding—each of which will be described with sufficient detail to give an idea of the saving involved by application of the welding process and how the work is actually done.

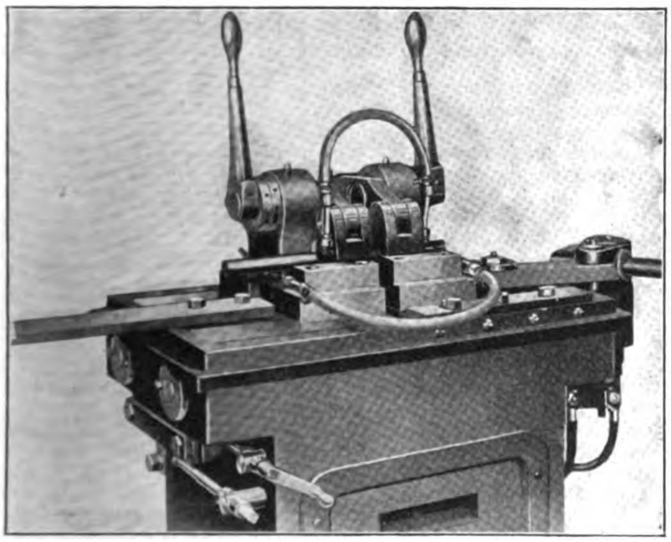


FIG. 1. BUTT WELDER WITH WORK IN PLACE

The electric butt-welding process is principally employed for welding such work as drill bits, reamers, boring tools and the like, made of either carbon or high-speed steel, to mild-steel shanks. The process is practically the same as for any ordinary butt welding. However, lathe, planer, shaping or other tools of that class may be easily made when suitably shaped pieces of high-speed steel are at hand. The judgment and commonsense of the shop man need only to be exercised according to the steel he has, the machine on which the work is to be done and the purpose of the tool. Very small or flat pieces, in general, lend themselves more readily to the spot-welding process. This, however, as just said, is a matter of good judgment, coupled with the machine available.

A Vollans butt-welding machine with two pieces of steel in the jaws is shown in Fig. 1, and a high-speed drill welded to a soft-steel shank is shown at A, Fig. 2. At B is a round piece of high-speed steel welded to a soft-steel piece of similar size. The flash left by the machine is easily ground off, and it is almost impossible to tell where a good weld has been made. The strength, too, is all that can be desired. In butt welding two pieces of round stock of the same size, a "take-up," or shortening, of approximately one-fourth of the diameter must be allowed for. The time required for welding together two pieces of ½-in. round-steel stock is about 10 sec., using between 15 and 20 kw.

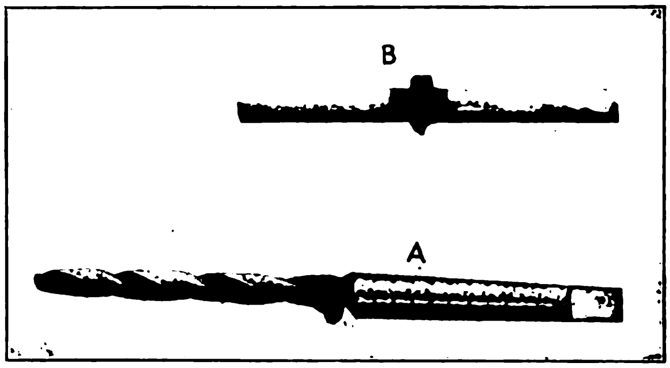


FIG. 2. BUTT WELDED HIGH TO MILD STEEL

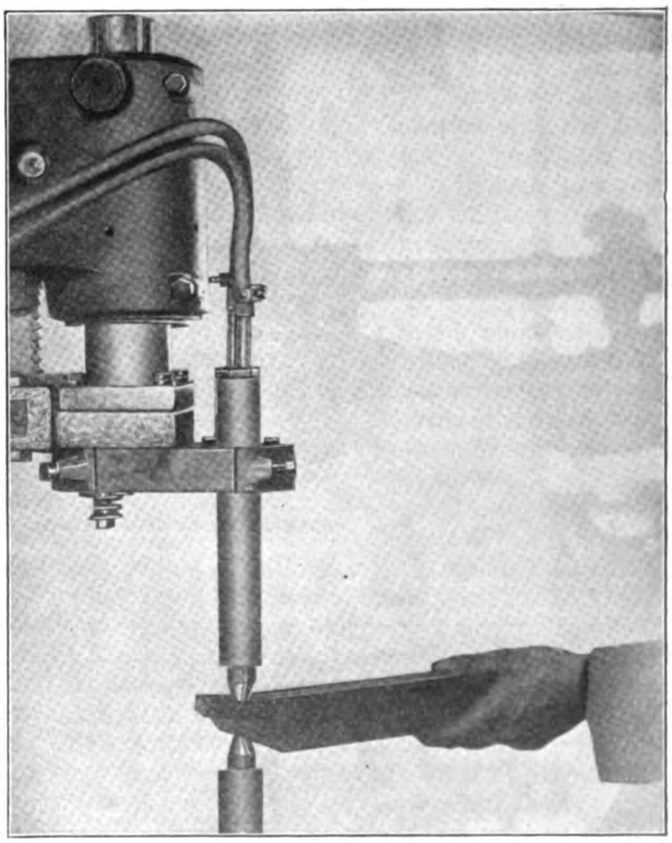


FIG. 3. SPOT-WELDING A LARGE TOOL

Larger stock, say 1½-in. diameter round or its equivalent in other shapes, requires more time in order to pre-

vent burning and to give time to heat up properly. The maximum time for 1½-in. stock under any circumstances should not be over 3 min., costing less than ½c. for current for the weld. The saving in the cost of the tool by this process of course varies with the proportion of high-speed steel to that of mild steel used. The work, however, is not difficult, and any standard electric welder may be used, provided it is of sufficient capacity for the sizes to be welded.

The tempering of the cutting part of the tool will vary somewhat with the kind of high-speed steel employed and the use to which it is to be put. In many cases the high-

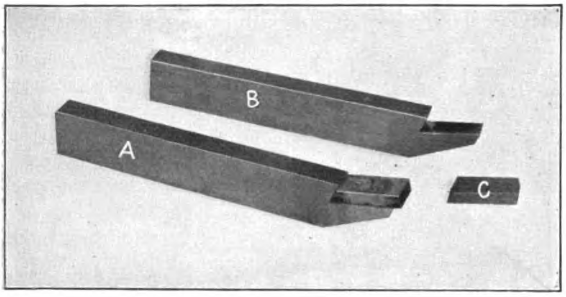


FIG. 4. A SPOT-WELDED TOOL AND ONE READY TO WELD

speed part may be placed in an air blast as soon as taken from the welder. In other cases the usual heating methods may be employed. Any man at all familiar with ordinary butt-welding methods will be able to make tools with but little experimenting. Even a novice can quickly get the "hang" of setting and clamping the pieces and watching the heat so as not to melt away part of the steel before the rest has time to heat up properly.

The same general rules that must be observed in regard to too rapid heating for butt welding must be applied to spot welding. Too rapid crowding down of the welding points may burn holes in the steel, cause it to shatter, or do other damage. Part of a Vollans spot-welding machine, made by the Detroit Electric Welding Co., Detroit, Mich., is shown in Fig. 3. Here the operator is shown holding a tool between the welding points, ready to apply the current. This same tool after welding is shown at *A*, Fig. 4. At *B* is shown a mild-steel shank and at *C* a high-speed steel cutter for the same kind of tool. The method of fitting in and shaping the high-speed steel bit is of course variable with the use to which it is to be put. Side-cutting tools, borings tools and others may be as readily made as the type shown, as the principle is the same in each case.

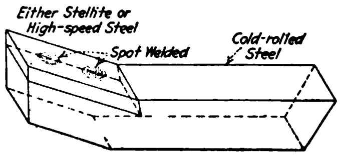


FIG. 5. METHOD OF SPOTTING THE HIGH-SPEED STEEL

On the particular tool shown, the high-speed steel bit is 1¼ in. wide, 2½ in. long and ½ in. thick. The shank is of 1x2-in. cold-rolled steel about 14 in. in length. Those so inclined can figure out the saving on this type of tool over one made of solid high-speed steel at the present prices!

There are two spot welds in this bit, and the actual time taken was less than 2 min. The locating of these two spot welds is indicated in the type of tool shown in Fig. 5. The beauty of this kind of weld is that very thin pieces can be used when properly supported from underneath. The kind of steel makes practically no difference, and Stellite may be welded in this way as successfully as high-speed steel.

Thin pieces can be welded quicker than thick ones. Stock ¼ in. thick may be welded under favorable conditions in about 4 sec., using 13-kw. current. Welds of this kind will vary in cost according to local conditions, but will average about 16 or 17c. per 1,000 welds. It was estimated at the time the spot welds were made on the tool just described that about 20 kw. of current was used, though no accurate method of measuring the current was at hand. In using a spot welder in this way, water should be connected to the machine, to keep the welding points as cool as possible and thus avoid burning. Finally, let it be repeated again—do not try to heat the work too rapidly, but allow it to come up slowly to welding heat. The larger the pieces the longer the time required.

NEW PUBLICATIONS

LOCATION OF CARBURETION-SYSTEM TROUBLES MADE EASY. A chart by Victor W. Page. Published by the Norman W. Henley Publishing Co., New York City. Price, 25c.

This book follows the work of the same author on gasoline motors and should help many automobilists to understand the anatomy of the gasoline system of their cars. If one's automobile happens to have the type of carburetor shown, together with a pressure feed, the information will have a more direct value than if these conditions are different. The troubles seem to include about everything but "flooding," which is an exasperating difficulty and one that is not always easy to remedy.

VALVE GEARS. By Charles H. Fessenden. One hundred and seventy 6x9-in. pages; 171 illustrations; cloth bound. Published by the McGraw-Hill Book Co., New York City. Price, $2.

This volume is intended to be used as a textbook rather than for reference purposes. The Zeuner and Bilgram diagrams are explained and used to illustrate typical valve-layout problems. An unusually complete discussion of port openings and passage areas is followed by a description of the construction and the method of laying out slide, riding-cutoff, Corliss and poppet valve gears. Chapters on direct-acting pump valves and on shaft governors are also included. A short chapter on valve setting gives directions for locating the valve by measurement and also a number of indicator cards illustrating faulty setting.

THE GASOLINE AUTOMOBILE—By George W. Hobbs, B.S., and Ben. G. Elliott, M.E. Two hundred and fifty-three pages, 6¼x9¼ in.; 253 illustrations. Published by McGraw-Hill Book Co., Inc., New York. Price, $2.

This book has been largely prepared from data given in a series of lectures in twenty-three cities in the State of Wisconsin during the winter of 1914. The purpose has been to give information on the subject of automobiles so that anyone, whether he operates a car or not, can understand the mechanical principles underlying automobile operation.

The contents of this volume are presented under the following well-illustrated chapters: General Construction, Engines, Power-Plant Groups and Transmission Systems, Fuels and Carbureting Systems, Lubrication and Cooling, Batteries and Battery Ignition, Magneto and Magneto Ignition, Starting and Lighting Systems, Automobile Troubles and Remedies, Operation and Care.

It will be thus seen from a résumé of the various subjects as given in the contents that the book takes up in detail the various elements used on the several types of automobiles, leading up to the concluding chapters on automobile troubles and their remedy and on the operation and care of the car. In the second chapter, under the title of Engines, the theory of the gasoline engine is briefly explained. Enough is given, however, to enable the reader to know the difference between two- and four-cycle motors and to what the names refer. But the purpose of the book is to teach not the theory of the automobile, but rather its practical side.

The volume is uptodate, containing good examples of eight and twelve-cylinder power plants. The chapters on ignition, both battery and magneto, also the chapters on various starting and lifting systems, are full of valuable information, filling a long-felt want in automobile textbooks.

In the last chapter, on the operation and care of the automobile, is given a fund of advice that should prove of great value to the reader. The volume as a whole should be of great service to anyone interested in automobiles, whether or not he operates one.

POWER, HEATING AND VENTILATION—By Charles L. Hubbard. Cloth; 6x9 in. Part I—Steam Power Plants. Two hundred and ninety-nine pages, 183 illustrations. Price, $2.50. Part II—Heating and Ventilating Plants. Three hundred and eight pages, 207 illustrations. Price, $2.50. Part III—Combined Power and Heating Plants. Four hundred and eight pages, 220 illustrations. Price, $3. Published by the McGraw-Hill Book Co., Inc., New York.

The three volumes of this treatise consider the design, construction and management of plants, as indicated by the titles given, and are a reprint of a set of three books by the same author and with the same general title, which was published in 1908 and 1909. The present edition has been rearranged to a considerable extent, and a few changes have been made. The section on electricity has been omitted and matter on steam turbines, power-plant design and economics added. Otherwise the original text and illustrations appear to have been retained.

Part I briefly describes boilers, engines and other auxiliary apparatus used in the power plant. Part II considers heating furnaces and boilers and heating and ventilating systems for all classes of buildings. Part III combines the material used in the first and second parts. The following review, while applying only to Part III, will therefore give an idea of the scope of the other two volumes.

The first chapter includes requirements for heating and ventilating office and loft, municipal and factory buildings, hotels, hospitals and theaters.

In succeeding chapters are discussed the relative merits of, and data needed to design, steam, hot-water and hot-blast heating systems. The methods of calculating and constructing systems for transmitting heat from a central station to a group of buildings are somewhat briefly explained. The last 200 pages of Part III are devoted to the uses of power and steam in various types of large buildings, the selection and operation of boiler plants, use of engines and turbines and to a general discussion of condensers, pumps and other auxiliary equipment. The book concludes with examples showing the methods of calculating operating costs for a technical high school, hotel, machine shop and a hospital.

DESIGN OF STEAM BOILERS AND PRESSURE VESSELS. By George B. Haven and George W. Swett. Four hundred and sixteen 6x9-in. pages; 197 illustrations; 54 tables; clothbound. Published by John Wiley & Sons, Inc., New York. Price, $2.50.

At least three-quarters of this treatise is generally applicable to boiler design, while the remainder relates to specific design of selected types. The design of water-tube boilers has not been included. According to the authors, their proportions can rarely be determined by calculation, but are largely the result of ripe experience and well-established precedent. The book opens with a brief review of the present status of the industry, considering boiler materials, construction, superheaters, grate setting and water circulation. This section concludes with a summary of the Massachusetts boiler rules directly affecting steam-boiler design. Next comes a discussion of the stresses in cylinders, spheres, flat plates, dished heads and spiral seams. The treatment is a summary rather than a derivation of the best-known methods of calculating stresses. The chapter on riveted joints outlines the calculation of efficiencies and concludes with tabulations showing maximum pitches, efficiencies and calking distances for the common joints. A chapter is devoted to such considerations as water consumption, fuel combustion, grate surface, tubes and furnaces and to the general dimensions and proportions of boilers. The principles laid down are used to work out complete designs of a horizontal return-tubular, a dry-back Scotch, a vertical multi-tubular and a locomotive-type boiler and a vulcanizer tank. In each case there are given: First, general specifications for the particular type; next, a complete solution of the problem based on the assumed data; and finally, the complete calculations and drawings of the actual apparatus. In addition to the examples of the designs of complete boilers, a number of problems are scattered through the text to show the use of the formulas and data given. A feature that should make the book valuable to those interested in boiler design is the large number of tabulations and plots. These are mostly calculated from the formulas, but the former comprise also properties of standard materials of boiler construction.

PERSONALS

Lorenzo S. Waite has been appointed general superintendent of the Becker Milling Machine Co., Hyde Park, Mass.

G. Janson representing Aktiebolagat Ryden & Bouthron, Stockholm, who has been in this country, sailed for Europe on Feb. 17.

W. Poesse, formerly foreman at the works of the Franz Premier Cleaner Co., has become superintendent of the newly organized Domestic Electric Co., Cleveland, Ohio.

Edward J. Muller, for over 30 years associated with the Fuchs & Lang Manufacturing Co., New York, N. Y., most recently as treasurer and general manager, has retired from active work and will be succeeded by Albert J. Ford, who has been associated with the Fuchs & Lang organization for a considerable time.

Emil Gairing, recently general superintendent of the Baker-Rauch-Lang Co., Cleveland, is now factory manager for the Eclipse Interchangeable Counterbore Co., Detroit, Mich. C. H. Michell is now office manager for the same concern, which recently bought out the Wiard Chuck Co., and has established a new shop.

OBITUARY

Christopher Columbus Bradley, president of C. C. Bradley & Son, Inc., Syracuse, N. Y., died on Jan. 29.

Clifford E. Lipe, for some years associated with the Brown-Lipe Gear Co. and the Brown-Lipe-Chapin Co., Syracuse, N. Y., died in that city on Feb. 7.

Walter F. Carr, who was formerly chief engineer of the Falk Co., Milwaukee, Wis., and for the past few years conducted a consulting practice in Seattle, Wash., died in that city on Feb. 2.

BUSINESS ITEMS

The International Acheson Graphite Co., of Niagara Falls, N. Y., has changed its name and will hereafter be known as the Acheson Graphite Co.

For the manufacture of fractional horsepower motors for light service a number of former employees of the Franz Premier Cleaner Co. have organized the Domestic Electric Co., Advance Building, Cleveland, Ohio. The officers are: C. A. Duffner, president; Victor C. Lynch, secretary; H. C. Kellogg, treasurer.

FORTHCOMING MEETINGS

A course of free lectures on military engineering will be given under the auspices of a committee representative of the four national engineering societies, by Captains Robins, Coiner and Ardery, Corps of Engineers, U. S. A. This course will be under the direction of Major-Gen. Leonard Wood and is designed to assist those who desire to enter the engineering battalion which will be formed at Plattsburg next summer. All engineers interested in preparedness will be welcome, but attendance at these lectures does not imply obligation to subsequent camp duty. Through the cordial attitude and coöperation of the United Engineering Society, the auditorium of the Engineering Societies Building has been placed at the disposal of the army officers. These lectures will be given weekly, having begun on Feb. 14, under the following divisions:

Feb. 28, 1916—Field fortifications, sieges and demolitions.

March 6, 1916—Seacoast defenses and battlefield illuminations.

March 13, 1916—The construction, maintenance and repair of roads, bridges and ferries; the selection and preparation of fords.

March 20, 1916—The selection, laying out and preparation of camps and cantonments; the service of general construction; and the special services, including all public work of an engineering nature which may be required in a territory under military control.

March 27, 1916—The construction, operation and maintenance of railways under military control and the construction and operation of armored trains.

American Society of Mechanical Engineers. Spring meeting. Apr. 11-14, New Orleans, La., Hotel Gruenwald. Calvin W. Rice, secretary, 29 West 39th St., New York City.

American Society for Testing Materials. Annual meeting June 27 to July 1, 1916, Hotel Traymore, Atlantic City, N. J. Edgar Warburg, secretary, University of Pennsylvania, Philadelphia, Penn.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	Feb. 17, 1916	Jan. 14, 1916	Feb. 19, 1915
No. 2 Southern foundry, Birmingham	$15.00	$15.00	$9.50
No. 2 X Northern foundry, New York	19.75	19.50	14.25
No. 2 Northern foundry, Chicago	18.50	18.50	13.00
Bessemer, Pittsburgh	21.45	21.45	14.55
Basic, Pittsburgh	18.70	18.70	13.55
No. 2 X, Philadelphia	20.00	20.00	14.25
No. 2, Valley	18.25	18.50	13.00
No. 2 Southern, Cincinnati	17.90	17.90	12.40
Basic, Eastern Pennsylvania	19.50	19.50	13.50
Gray forge, Pittsburgh	18.45	18.45	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger from jobbers' warehouse, New York:

	Feb. 17, 1916	Jan. 14, 1916	Feb. 19, 1915
Steel angles, base	2.70	2.50	1.85
Steel T's, base	2.75	2.55	1.90
Machinery steel (bessemer)	2.70	2.50	1.80

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse, New York:

	Feb. 17, 1916	Jan. 14, 1916	Feb. 19, 1915
No. 28 black	3.50	3.35	2.60
No. 26 black	3.40	3.25	2.50
Nos. 22 and 24 black	3.35	3.20	2.45
Nos. 18 and 20 black	3.30	3.15	2.40
No. 16 black	3.45	3.15	2.35
No. 14 black	3.35	3.05	2.25
No. 12 black	3.30	3.00	2.20
No. 28 galvanized	5.65	5.50	3.75
No. 26 galvanized	5.35	5.20	3.45
No. 24 galvanized	5.20	5.05	3.30

Standard Pipe—On carload lots f.o.b. Pittsburgh, the discounts follow:

	Black		Galvanized	
	Feb. 17, 1916	Feb. 17, 1915	Feb. 17, 1916	Feb. 17, 1915
¾- to 2-in. steel butt welded	75%	81%	59½%	72½%
2½- to 6-in. steel lap welded	74%	80%	58½%	72½%

At these discounts, the net prices in cents per ft. follow:

Diameter, In.				
¾	2.88	2.20	4.66	3.15
1	4.25	3.24	6.89	4.67
1¼	5.75	4.38	9.32	6.30
1½	6.88	5.25	11.14	7.55
2	9.25	7.05	14.99	10.15
2½	15.21	11.70	24.28	16.70
3	19.89	15.25	31.75	21.80
4	28.34	21.80	45.24	31.00
5	38.48	29.60	61.42	42.20
6	49.92	38.40	79.68	54.60

Swedish Drill Steel—The following prices are base in cents per pound to consumers f.o.b. warehouse, New York:

Carload lots and over	6.50
Over 10 tons, less than carload	7.00
Over 1 ton, less than 10	7.50
Over 500 lb., less than 1 ton	8.00
Less than 500 lb.	8.50
Hollow steel—	
Carload lots and over	10.50
Over 10 tons, less than carload	11.00
Over 1 ton, less than 10	12.00
Over 500 lb., less than 1 ton	13.00
Less than 500 lb.	14.00

Swedish Steel Sheets—To consumers requiring fair-size quantities tool steel sheets sell at 16c. base and spring steel sheets at 12c. base. These prices are f.o.b. warehouse, New York.

Swedish (Norway) Iron—This material sells at $4.50 base per 100 lb. f.o.b. New York. In coils an advance of 50c. is charged.

Bar Iron—Prices are as follows in cents per pound at the places named:

	Feb. 17, 1916	Jan. 20, 1916
Pittsburgh, mill	2.20@2.30	2.10
New York	2.40@2.45	2.20@2.25
From New York	2.70	2.50@2.60

Cold Drawn Steel Shafting—From New York warehouse to consumers requiring fair-sized lots the pri[illegible] off list.

METALS

Miscellaneous Metals—The present New York quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	Feb. 17, 1916	Jan. 14, 1916	Feb. 19, 1915
Copper, electrolytic (carload lots)	27.25*	24.00	14.75
Tin	42.00	41.00	36.25
Lead	6.30	5.90	3.85
Spelter	20.50	17.62½	8.75
Copper sheets, base	35.00	30.00	19.75
Copper wire (carload lots)	35.00	30.00	15.50
Brass rods, base	37.00	35.00	16.50
Brass pipe, base	40.00	38.00	17.50
Brass sheets	37.00	35.00	16.75
Solder ½ and ½ (case lots)	26.50	25.75	24.50
ST. LOUIS			
Lead	6.15	5.77½	...
Spelter	6.20	18.50	...

*This price prevails for deliveries required up to June.

Old Metals—In New York, the following are the dealers' purchasing prices in cents per pound:

	Feb. 17, 1916
Copper, heavy and crucible	23.00
Copper, heavy and wire	22.00
Copper, light and bottoms	20.00
Lead, heavy	5.25
Lead, tea	4.75
Brass, heavy	14.00
Brass, light	11.50
No. 1 yellow rod brass turnings	13.50
Zinc	13.50

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
$\frac{3}{16}$ to $\frac{7}{32}$	31.50	32.00	32.50	33.00	36.00
¼ to $\frac{5}{16}$	31.25	31.75	32.25	32.75	35.75
⅜ to 1⅞	31.00	31.50	32.00	32.50	35.50
1$\frac{15}{16}$ to 2⅞	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3$\frac{7}{16}$	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3½ to 3$\frac{15}{16}$	32.25	32.75	33.25	35.75	36.75
Squares					
3$\frac{1}{16}$ to 3$\frac{15}{16}$	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4$\frac{15}{16}$	33.00	33.50	36.00	36.50	37.50
5 to 6$\frac{15}{16}$	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Copper Bars from warehouse, New York, sell at 39.5c. per pound.

Babbitt Metal—In New York, quotations are as follows in cents per pound:

Best grade	55@60
Commercial grade	25@30

Antimony—For spot delivery on Chinese and Japanese brands the quotation is at 45c. per lb., duty paid.

Aluminum—Quotations were made in New York as follows in cents per pound:

No. 1 virgin, 98 to 99%	57@60
Pure 98 to 99%	56@58
Remelted No. 12 alloy	46@49

SHOP ACCESSORIES

Coach or Lag Screws—Quotations from New York warehouse are now 65% from list. This is for fair-sized orders.

Bolt Ends with hot pressed nuts now sell at the base price of 50% from list price. This is for fair-sized orders from New York warehouse.

Tap Bolts—The discount from New York warehouse now sell at 20% from list.

Machine Bolts—From New York warehouse, the base price for fair quantities are as follows: From ⅜ in. by 4 in. and smaller, 60% off list is discounted; for larger and longer sizes up to 1 in. by 30 in., 50% is allowed. At this rate prices per 100 are as follows:

Length, In.	Diameter ¼	⅜	⅝	¾	⅞	1 In.
1	$0.68	$0.96	$2.60	...	...	...
2	.71	1.02	2.79	$4.13	$5.60	...
2½	.74	1.09	2.98	4.40	5.95	...
3	.78	1.15	3.17	4.68	6.30	$8.90
3½	.81	1.22	3.36	4.95	6.65	9.35

Base prices on other sizes would be as follows: 1⅛ and 1¼ in. by 3 in. and up to 12 in. take 35% off list. On longer lengths a special pound price is quoted. For cold punched square nuts, 35% is discounted from list; for hot pressed hexagon nuts up to 1 in. by 30 in., 45%; up to 1 in. diameter, cold punched nuts, 35%. Buttonhead with hexagon nuts, 35% off list, as do hexagon head with hexagon nuts.

Wrought Washers—From New York warehouse, the base price on fair-sized orders is $4.50 from list price. At this rate the following prices per 100 lb. hold:

Diameter, In.		Diameter, In.	
9/16	$9.50	1½	$4.80
¾	7.70	1¾	4.70
⅞	6.90	2	4.60
1	6.00	2¼, 2½, 2¾	4.50
1¼	5.30	3¾, 4, 4¼, 4½	5.00
1⅜	4.90	3, 3¼, 3½	4.70

For cast-iron washers, the base price is $2.50 per 100 lb.

Carriage Bolts—On ⅜ by 6 in. and smaller 60% off list is allowed; for larger and longer sizes 50% off list is charged. For fair-sized orders from New York warehouse the following net prices at this rate would be charged:

Length, In.	Diameter ¼	5/16	⅜	7/16	½	⅝	¾
1½	$0.40	$0.56	$0.76	$1.10	....	....	....
2	.44	.61	.82	1.20	....	....	....
2½	.48	.66	.89	1.30	$1.125	$2.875	$4.25
3	.52	.70	.95	1.40	1.765	3.065	4.50
3½	.56	.75	1.02	1.50	1.955	3.255	4.75

Turnbuckles—From New York warehouse, on sizes smaller than 1¼ in. diameter, 40% off list is charged, and on 1¼ up to 2 in. diameter 30%. At this rate prices follow:

Size		Size		Size	
⅜	$0.24	⅞	$0.45	1½	$1.05
7/16	.25	1	.53	1⅝	1.225
½	.27	1⅛	.60	1¾	1.40
⅝	.30	1¼	.875	1⅞	1.575
¾	.38	1⅜	.97	2	1.855

These prices are for buckles having right and left stub ends and with openings between the heads measuring 5½ in.

Rivets—The following are the base quotations for fair quantities from New York warehouse:

	Discount from List
Steel 7/16 and smaller	65%
Tinned	65%

	Price per 100 Lb.
Button heads, ¾, ⅞, 1 in. diam. by 2 in. to 5 in.	$4.25
Cone heads, same sizes	4.35

	Extra per 100 Lb.
1⅛ to 1⅞ in. long, all diameters	$0.25
⅝ in. diameter	0.15
½ in. diameter	0.50
1 in. long and shorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

Nuts—On hot pressed square nuts $3 off list is allowed and on hexagon $3.20. At this rate the base price per 100 lb. for fair-sized orders from New York warehouse is as follows:

Short Diam.	Hot Pressed Square Blank	Hot Pressed Square Tapped	Hot Pressed Hexagon Blank	Hot Pressed Hexagon Tapped
½	$10.00	$12.00	$16.80	$19.30
9/16	9.00	10.50	14.80	16.80
11/16	7.50	8.60	10.80	12.40
⅞	6.00	6.70	8.00	9.00
1¼	5.50	5.90	6.80	7.40
1 7/16, 1⅝, 1 13/16, 2	5.40	5.80	6.70	7.30
2 3/16	5.50	6.00	6.80	7.50
2⅜	5.80	6.40	7.10	7.90

Semifinished nuts are sold at 70 % from list price.

From New York warehouse on cold punched square nuts $3 from list is deducted and on hexagon $3.75. The base price for fair-sized orders of case-hardened nuts is 70% from list price.

Nails—Wire nails f.o.b. Pittsburgh sell at $2.30, galvanized 1 in. and longer, $4.30, and shorter, $4.80. These prices are to regular customers and delivery is made at the mill's convenience. From New York warehouse, wire and cut nails sell at $2.70.

Copper Rivets from warehouse, New York, sell at 25% off list and burs at the net list price.

MISCELLANEOUS

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire

⅜, 11/32, 5/16, ¼, 7/32, 3/16	8.50
No. 8, 5/32 and No. 10	9.25
⅛	10.00
No. 12	11.00
3/32, No. 14 and 1/16	12.00
No. 18	14.00
No. 20	16.00

Special Welding Steel

⅛	33.00
5/32	30.00
3/16	28.00

Cast-Iron Welding Rods

¼ by 19 in. long	22.00
3/16 by 12 in. long	26.00
⅜ by 19 in. long	20.00
½ by 21 in. long	20.00

Vanadium Wire in Coils or Sticks

1/16	15.50
3/32	15.00
⅛	14.00
5/32	12.00
3/16 and larger	11.00

These prices are subject to change according to quantity and shipment desired.

Seamless Drawn Tubing—The base price per pound from New York warehouse is 40c. for brass and 41c. for copper. For immediate stock shipment 3c. is added, which gives the following quotations:

Diameter, In.	Copper Feb. 17, 1916	Copper Feb. 17, 1915	Brass Feb. 17, 1916	Brass Feb. 17, 1915
¾ to 2½	44.00	21.50	42.00	17.50
3	44.00	21.50	42.00	17.50
3½	45.00	22.50	43.50	19.00
4	46.00	23.00	44.50	19.50
4½	48.00	24.00	46.50	20.50
5	50.00	25.00	48.50	21.50
6	51.00	28.00	49.50	24.50
7	53.00	30.00	51.50	26.50
8	55.10	32.00	53.60	28.50

Tin Plates—The following prices are in effect from warehouse, New York:

Coke tin plate, 14x20:

100-lb.	$4.75
I. C. 107-lb.	4.90

Terne plate, 20x28:

Base Weight	Net Weight	Coating	Price	Base Weight	Net Weight	Coating	Price
100-lb.	200	8	$8.60	I. C.	226	20	$13.50
I. C.	214	8	8.90	I. C.	231	25	14.25
I. X.	270	8	10.90	I. C.	236	30	15.50
I. C.	218	12	12.00	I. C.	241	35	17.00
I. C.	221	15	13.00	I. C.	246	40	19.00

Zinc Sheets—The following prices in cents per pound prevail at New York:

Carload lots, f.o.b. mill	24.00
In casks, New York	24.50
Broken lots, New York	25.00

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Jan. 29	Feb. 5	Feb. 12	Feb. 19
Prompt furnace	$4.00@5.00	$3.00@3.25	$3.00@3.25	$3.25@3.75
Prompt foundry	3.50@4.00	4.00@4.50	3.75@4.25	3.75@4.25

Sal Soda—These quotations are per 100 lb. at the places named:

New York	$1.35
Philadelphia	1.10

Roll Sulphur in 360-lb. bbl. sells in New York at $2.25 per 100 lb.

Cotton Waste—In New York, the prices in cents per pound are as follows:

White	9.50@11.50
Colored mixed	6.50@ 9.00

Linseed Oil—Raw, in barrels sells at 77c. per gal. and in 5-gal. cans at 87c. Boiled, it is 1c. per gal. higher.

White Lead, dry and in oil, in cents per pound sells as follows:

100-lb. keg	8.75
25- and 50-lb. kegs	9.00
12½-lb. keg	9.25
1- to 5-lb. cans	10.75

Red Lead, dry, in cents per pound sells as follows:

100-lb. keg	8.75
25- and 50-lb. kegs	9.00
12½-lb. keg	9.25

In oil, the price in cents per pound is as follows:

100-lb. keg	9.25
25- and 50-lb. kegs	9.50
12½-lb. keg	9.75

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

Plans are being prepared for the construction of a 2-story garage at Auburndale, Mass., for F. W. Norris, 582 Massachusetts Ave., Auburndale.

W. H. Partridge, 60 Fenway St., Boston, Mass., is constructing a 1-story, 75x100-ft. garage at Boston. Estimated cost, $30,000.

The Keystone Stoker Co. will build a factory on Wells St., Greenfield, Mass.

Plans are being prepared for the construction of a plant for the Cowan Truck Co. at Holyoke, Mass.

The Holyoke Covered Wire Co. plans to construct an addition to its plant on Front St., Holyoke, Mass.

Frank W. Hodgdon will build a 2-story, 60x122-ft. garage on Mass Ave., Lexington, Mass. John G. Spofford, 15 Beacon St., Boston, Arch.

Plans have been prepared for the construction of a 4-story, 50x100-ft. factory at 17 Stewart St., Lynn, Mass., for the Campbell Electric Co., Dec. 23.

Plans have been prepared for the construction of a 1-story, 100x140-ft. garage at Methuen, Mass., for Daniel S. Smith, 30 Righ Lawn Ave., Lawrence. Estimated cost, $25,000.

The Turner Tanning Machinery Co. will build an addition to its plant at Peabody, Mass.

The contract has been awarded for the construction of a 1-story addition to the factory of the Potter Johnson Machine Co. at Pawtucket, R. I.

Work will soon be started on the construction of a 1-story, 50x100-ft. garage at Providence, R. I., for Daniel McLeod, 517 Hope St., Providence. Estimated cost, $15,000.

Plans have been prepared for the construction of a factory at Briston, Conn., for the C. G. Garrigus Machine Co.

Plans are being prepared for the construction of a garage at Hartford, Conn., for W. W. Walker, 749 Main St., and Russell P. Taber, 334 Pearl St., Hartford. Estimated cost, $60,000.

The contract has been awarded for the construction of an addition to the plant of the Blakeslee Forging Co. at Plantsville, Conn. Noted Dec. 2.

Bids have been received for the construction of a 1-story, 50x80-ft. forge shop at Southington, Conn., for the Blakeslee Forging Co., Plantsville, Conn. Estimated cost, $10,000. Noted Dec. 9.

MIDDLE ATLANTIC STATES

The Ward-Leonard Electric Co., Mt. Vernon, N. Y., has awarded the contract for a 2-story factory at Pearl and South St., Mt. Vernon.

Plans are being prepared by M. W. De Gaudio, Arch., 1910 Webster Ave., New York, N. Y. (Borough of Bronx), for a 1-story garage for William J. Howell Co., 3612 Olinville Ave. (Borough of Bronx). Estimated cost, $15,000.

Alfred Kurowski, care of Underwood Typewriter Co., 30 Vesey St., New York, N. Y. (Borough of Manhattan), is in the market for motor-driven machinery, such as milling machines, toolmakers' lathes, bench lathes, drill presses, grinders and shapers.

Plans are being prepared for the construction of a 2-story, 75x130-ft. garage for David Levine, 834 East 155th St., New York, N. Y. (Borough of Manhattan). Estimated cost, $30,000.

The Paterno Construction Co., 2255 Broadway, New York, N. Y. (Borough of Manhattan), contemplates the construction of a garage on 67th St. Estimated cost, $60,000. J. C. Watson, 271 West 125th St., Arch.

The Genesee Motor Car Co., Syracuse, N. Y., contemplates constructing a 3-story garage and showrooms. Estimated cost, $50,000. George H. Norris, 430 South Warren St., Syracuse, is Pres.

Plans will be prepared by Smith & Henderer, Arch., Sheen Bldg., Atlantic City, N. J., for the construction of a 1-story, 90x250-ft. garage at Atlantic City.

The Victor Talking Machine Co., Camden, N. J., has awarded the contract for a 7-story reinforced-concrete factory at Camden. Estimated cost, $175,000. Ballinger & Perrot, Philadelphia, Penn., is Arch. Noted Dec. 2.

The contract has been awarded for the construction of a 1-story factory for the manufacture of tools at Irvington, N. J., for the Irvington Manufacturing Co. Estimated cost, $10,000.

The Detroit Cadillac Co., Newark, N. J., will construct a new garage and showroom on Halsey St., Newark.

George J. Crosman, Newark, N. J., has purchased a site on Adams St., and will construct a plant for the manufacture of automatic machinery.

Bids will soon be received for the construction of a 1-story, 20x100-ft. factory at Franklin, Penn., for the Colburn Machine Tool Co. Estimated cost, $10,000. S. D. Brady, Franklin Trust Bldg., Franklin, Arch. Noted Jan. 13.

The Hamilton Watch Co., Lancaster, Penn., will construct an addition to its plant for the manufacture of speedometers. Charles F. Miller is Pres.

The Bronze Metal Co., Meadville, Penn., plans to build an addition to its plant. Estimated cost, $80,000.

The Keystone Forge Co. contemplates constructing a 2-story addition to its factory at Northumberland, Penn. Estimated cost, $15,000.

Bids have been received for the construction of a 4-story, 44x110-ft. factory for the Central Machine Co., 708 Cherry St., Philadelphia, Penn. Herman Miller, 1420 Chestnut St., Philadelphia, is Arch.

Bids will soon be received for the construction of a 1-story, 120x122-ft. garage at Philadelphia, Penn., for Thomas M. Seeds, Jr., 1207 Race St., Philadelphia. Estimated cost, $15,000.

The contract will soon be awarded for the construction of a 3-story, 60x135-ft. garage for the Shenley Farms Co., 5th Ave., Pittsburgh, Penn. Estimated cost, $50,000.

Fire, Feb. 12, destroyed the machine shop of the Jessop Steel Mill, Washington, Penn. Loss, $20,000.

Plans are being prepared by T. J. Litzleman, Arch., for the construction of a 2-story, 60x100-ft. garage for La France Garage Co. at Williamsport, Penn. Estimated cost, $25,000.

The Baltimore Tube Co., Baltimore, Md., has awarded the contract for an addition to its plant on Micomico St. Estimated cost, $100,000. Noted Sept. 3.

Bids have been received for the construction of a 1-story, 45x100-ft. garage at Baltimore, Md., for Edward Bauernschmidt, 1528 North Gay St., Baltimore. Estimated cost, $20,000.

Bids are being received for the construction of a 4-story, 86x188-ft. garage at Baltimore, Md., for the Mid-City Garage and Motor Supply Co. Estimated cost, $90,000. Noted Dec. 9.

The Overland Auto Co., Washington, D. C., plans to construct a garage and sales room.

SOUTHERN STATES

The Noreck Broiler Co., Richmond, Va., will not construct a plant at Hopewell, Va., as noted in Feb. 10 issue.

E. L. Johnson & Co., Berkeley Springs, W. Va., will build a garage.

The Board of Commerce has arranged for the building of a factory at Keyser, W. Va., for the manufacture of automobile parts.

E. E. Birch Son & Co., Inc., Newell, W. Va., will rebuild its garage and machine shop which was recently destroyed by fire. Noted Feb. 3.

The Parkersburg Iron & Steel Co., Parkersburg, W. Va., will enlarge its bar mill for the manufacture of black and galvanized sheets.

The Globe Automatic Fire Sprinkler Co., Cincinnati, Ohio, will build a plant at Wheeling, W. Va., for the manufacture of fire sprinklers.

The Seaboard Air Line Ry., Raleigh, N. C., has awarded the contract for shops at Raleigh. Estimated cost, $10,000.

The Automobile Sales Co., Waycross, Ga., will construct a brick fireproof automobile repair shop.

W. H. Irwin has awarded the contract for a 2-story garage and livery stable at Birmingham, Ala. Estimated cost, $15,000.

The Tennessee Stove Works, Chattanooga, Tenn., has awarded contract for 3 brick buildings to be equipped for foundry, nickel-plating and storage purposes. Noted Jan. 6.

The Ashland Steel, Iron and Mining Co., Ashland, Ky., has awarded the contract for the construction of an open hearth steel plant at Ashland, Ky. Estimated cost, $1,000,000. Noted Dec. 30.

T. W. Minton & Son, manufacturer of wagon and automobile parts and golf sticks, will enlarge its plant at Barbourville, Ky.

The American Metallic Packing Co., Lexington, Ky., is in the market for 2 large, iron-working planers and small iron-working lathes, all second-hand and in good condition.

MIDDLE WEST

The Twentieth Century Heating and Ventilating Co. will construct an addition to its plant at Akron, Ohio.

The city of Barberton, Ohio, is in the market for machinery equipment for manual training departments of the public schools as follows: 24-in. single cylinder surfacing machine with motor drive; oilstone grinding machine; 36-in. band sawing machine; universal saw bench and countershaft; 16-in. hand planing and jointing machine with motor drive; 6' under drive speed lathes with motor drive; 1 down draft forge.

Bids are being received by Guy Tilden Son, Arch., 34 Schaeffer Blk., Canton, Ohio, for the construction of a garage for S. Luntz, 1010 Walnut Ave., N. E., Canton, Ohio.

Plans are being prepared by William S. Epperson, Arch., 105 North Cleveland Ave., Canton, Ohio, for the construction of garage at Canton for W. J. Oby, 803 13th St., N. W.

The Upson Nut Co., 1976 Scranton Rd., Cleveland, Ohio, will construct a machine shop at Cleveland.

The Westinghouse Electric and Manufacturing Co. will construct a 1-story, 46x112-ft. addition to its plant at Cleveland, Ohio. Estimated cost, $6,500.

Plans are being prepared for the construction of a 2-story garage at Cleveland Heights, Ohio (Warrensville post office), for E. S. Well. Estimated cost, $15,000. H. E. Srimmin, 2031 Euclid Ave., Cleveland, is Arch.

The Capital Motor Car Co. is constructing a 2-story garage, service station and salesroom at Capital and 4th St., Columbus, Ohio. Estimated cost, $35,000.

The contract has been awarded for the construction of an addition to the assembling plant of the Ford Motor Co. at Cleveland and Buckingham Ave., Columbus, Ohio. Estimated cost, $150,000.

H. W. Kindig, 58 East Spring St., Columbus, Ohio, will establish a garage and repair shop at Columbus.

The Standard Motor Car Co., 25 North 4th St., Columbus, Ohio, has leased property at 4th and Broad St., Columbus, and will construct a plant.

Plans are being prepared for the construction of a 66x132-ft. garage on East 5th St., Covington, Ohio, for the Charles Schlear Motor Car Co.

The Dayton Metal Products Co. contemplates constructing an addition to its plant at Dayton, Ohio. Estimated cost, $75,000.

A. L. White and K. T. Agerter plan to construct a plant for the manufacture of mountain climbing engines at East Lima, Ohio (Lima post office).

The American Steel Grave Vault Co. will construct an addition to its plant at Church and Bloomer St., Galion, Ohio.

The O. S. Kelly Co., manufacturer of piano plates, is constructing an addition to plant at Springfield, Ohio.

The contract has been awarded for the construction of a garage at Steubenville, Ohio, for George Sampson.

We have been advised that the Warren Tool and Forge Co. has awarded the contract for the construction of several additions to its plant at Warren, Ohio. Noted Feb. 3.

The Vandalia Railroad Co. plans to construct shops and roundhouse at Bicknell, Ind. Estimated cost, $350,000. F. T. Hatch, St. Louis, Mo., is Ch. Engr.

Plans are being prepared by J. M. E. Riedel, Arch., for the construction of a 90x140-ft. garage at Ft. Wayne, Ind., for J. Poinsette, 1016 Maumee Ave.

Preliminary plans are being prepared by S. A. Craig, Arch., Interurban Station Bldg., Huntington, Ind., for the construction of a 2-story, 75x150-ft. factory at Huntington for the Sterling Metal Co. Estimated cost, $10,000. Noted Feb. 10.

The Oakes Co., manufacturer of automobile parts, will enlarge its plant at Indianapolis, Ind.

Bids have been received for the construction of shops Nos. 4, 5 and 6 at Detroit, Mich., for the Detroit Steel Products Co. Estimated cost, $60,000. Smith, Hinchman & Grylls, 710 Washington Arcade, Detroit, is Arch.

Bids are being received for the construction of a 1-story, 55x100-ft. heat-treating plant at Flint, Mich., for the Buick Motor Co. Estimated cost, $9,000.

Plans have been prepared for the construction of a 2-story, 70x540-ft. addition to the plant of the W. K. Prudden & Co., manufacturer of automobile wheels, at Lansing, Mich. Estimated cost, $50,000.

The Gile Tractor and Engine Co. contemplates constructing an addition to its plant at Ludington, Mich. W. L. Gile is Mgr.

The River Raisin Paper Co. contemplates the construction of a machine shop at Monroe, Mich. George Woods, East Elm St., Monroe, is Mgr.

Plans have been prepared for the construction of a 1-story, 60x200-ft. engine treating and assembly plant at Three Rivers, Mich., for the Sheffield Car Co. Noted Feb. 3.

The Colonial Manufacturing Co., manufacturer of clocks, is constructing a 2-story, 60x64-ft. addition to its plant at Zeeland, Mich. Noted Jan. 27.

The contract has been awarded for the construction of a 1-story, 75x125-ft. garage for Albert Hollander, 1616 Milwaukee Ave., Chicago, Ill. Estimated cost, $10,000.

Plans are being prepared for the construction of a 2-story garage at 761 Taylor St., Chicago, Ill., for Michael Iarassi. Estimated cost, $10,000.

The contract has been awarded for the construction of a 1- and 2-story garage at Chicago, Ill., for M. Larussi. Estimated cost, $10,000.

The contract has been awarded for the construction of a 1-story garage at 816 East 55th St., Chicago, Ill., for M. Neylon. Estimated cost, $16,000.

The Rockford Milling Machine Co. and the Rockford Tool Co. will construct additions to its plant at Rockford, Ill.

Plans are being prepared for the construction of a 2-story, 50x100-ft. garage and repair shop at Glenbeulah, Wis., for Louis Diehl.

The Heil Co., 26th and Montana Ave., Milwaukee, Wis., manufacturer of structural iron, sheet metal, etc., has increased its capital stock from $20,000 to $50,000 and plans to enlarge its plant at Milwaukee. Julius P. Heil is Pres. and Gen. Mgr.

Plans are being prepared for the construction of a 2-story garage and factory at Milwaukee, Wis., for the Milwaukee Dairy Supply Co., 934 13th St., Milwaukee. Estimated cost, $20,000. Noted Feb. 10.

Work will soon be started on the construction of a 72x124-ft. machine shop, public garage and factory building for the Carter Automobile and Machine Co. at 51st and National Ave., West Allis, Wis. Charles L. Lesser, 599 71st Ave., West Allis, Arch. Noted Jan. 13.

WEST OF THE MISSISSIPPI

The Fosstom Manufacturing Co. and Carpenter Wing Carrier Co., St. Paul, Minn., have been incorporated with a capital stock of $300,000 and will build a factory at 473 North Cleveland Ave., St. Paul, for the manufacture of farm implements.

Plans are being prepared by W. D. MacLeith, Arch., Summitt and Wabash St., St. Paul, Minn., for a 2-story garage and machine shop for Mueller Bros., Gaylord, Minn. Estimated cost, $12,000. Noted Feb. 10.

The Mathes Iron and Manufacturing Co., St. Louis, Mo., has awarded the contract for the construction of a 1-story foundry at 3100-02 North Broadway, St. Louis. Estimated cost, $10,000.

The Motor Instruction and Engineering Co., St. Louis, Mo., has been incorporated with a capital stock of $20,000, and will equip a plant for instruction and operation, also construction of automobile, aeroplane and other motors.

The Muldoon-Mertz Co., St. Louis, Mo., has acquired a site at 700 North 10th St., St. Louis, for constructing a factory for the manufacture of electric signs.

The Overland Automobile Co., St. Louis, Mo., will construct a new plant. Estimated cost, $250,000.

The Riefling Carriage and Wagon Co., 914-16 N. Broadway, St. Louis, Mo., has leased a 5-story building at 509 North Main St., St. Louis, and will remodel same for the manufacture of automobile delivery bodies.

The West Plains Motor Co., West Plains, Mo., will rebuild its garage which was destroyed by fire Jan. 15, at a loss of $12,000. William McBride is interested. Noted Jan. 27.

Barton Bros., Chickasha, Okla., will increase the capacity of its machine shop and garage.

Fire, Feb. 3, destroyed the shops of the Midland Valley R.R., Muskogee, Okla. Loss, $75,000.

The Carhart Motor Co., 218 West 1st St., Oklahoma, Okla., contemplates the construction of a plant. Estimated cost, $50,000.

The Mount Cooper Boiler Co., Tulsa, Okla., will construct a steel and corrugated iron building. Estimated cost, $5,000.

W. C. Byington, Tylertown, Miss., has purchased a building at Monticello, Ark., which he will equip as a machine shop.

WESTERN STATES

The Ford Automobile Co, Detroit, Mich., contemplates constructing an assembling plant at Pocatello, Idaho.

Fire, Feb. 4, destroyed the plant of the York Electric Steel Co. at 24th and York St., Portland, Ore. Loss, $30,000. Leonard Schad is Mgr.

Bids are being received for the construction of a plant at Los Angeles, Calif., for the American Can Co. Estimated cost, $500,000. Noted Sept. 30.

Plans are being prepared by Morgan, Walls & Morgan, Van Nuys Bldg., Los Angeles, Calif., for the construction of a garage at 11th and Hope St., Los Angeles, for N. H. Newmark.

A permit has been granted to the Moore & Scott Iron Works for the construction of a 2-story plant on Adeline St., Oakland, Calif.

The Rudgear-Merle Co. will construct an addition to its plant at Bay and Stockton St., San Francisco, Calif., for the manufacture of metal beds.

CANADA

Fire recently destroyed the plant of the Canadian Architectural Iron Works Co. at Montreal, Que.

Fire, Feb. 12, damaged the plant of the Canada Car and Foundry Co. at Montreal, Que. Loss, $50,000.

The Steel Co. of Canada, Hamilton, Ont., has taken over the plant of the Gananoque Bolt Co., at Gananoque, Ont., and will install drop forging equipment.

The Oneida Community, Ltd., Oneida, N. Y., will establish a plant at Niagara Falls, Ont., for the manufacture of silverware. A. Reeves is interested.

The Canada Pipe and Steel Co., Atlantic Ave., Toronto, Ont., plans to construct an addition to its machine shop at Toronto. Estimated cost, $3,000.

The Hamilton Carbureter Co., 535 Queen St., E., Toronto, Ont., will build an addition to its factory at Toronto.

The International Time Recorder Co. of Canada, recently organized, will build a plant at Toronto, Ont. F. E. Miller is Gen. Mgr.

The Maxwell Motor Co., Detroit, Mich., plans to establish a plant at Windsor, Ont.

Robert Reid, Broderick, Sask., is in the market for screw-cutting engine lathe, about 18-in. swing, gap bed.

The Kettle Valley R.R. will enlarge its machine shop at Penticton, B. C. J. J. Warren is Gen. Mgr.

GENERAL MANUFACTURING

NEW ENGLAND STATES

The Lewiston Concrete Co. will construct a factory at Lewiston, Maine, for the manufacture of concrete blocks. Chandler Barren is Pres.

George E. Kunhardt, manufacturer of woolens, will build a 2-story, 60x125-ft. mill at Lawrence, Mass.

Plans are being prepared for the construction of a 3-story, 50x100-ft. factory at Newburyport, Mass., for the N. D. Dodge Shoe Co. Edwin S. Dodge, 15 Exchange Pl., Boston, Arch.

L. B. Exeans Son Co. will enlarge its shoe factory at Wakefield, Mass.

The Motor Tire Reconstruction Co., New York, N. Y., will establish a factory at Wakefield, Mass. Thomas E. Dwyer is interested.

The Hope Mill will construct an addition to its weave shed at Providence, R. I.

The Stanley Bronze Co. will construct a 40x150-ft. factory on Holland Ave., Bridgeport, Conn.

The contract has been awarded for the construction of a 4-story, 55x60-ft. addition to the factory of the Glastonbury Knitting Co. at Glastonbury, Conn.

MIDDLE ATLANTIC STATES

The Hewett Rubber Co., Buffalo, N. Y., will construct a 1-story factory at 52 Pauline St., Buffalo. Estimated cost, $12,000.

The contract has been awarded for the construction of a 12-story, 106x114-ft. factory for the manufacture of paper for Robert Gair Co., 50 Washington St., New York, N. Y. (Borough of Brooklyn).

Preliminary plans have been prepared for the construction of a 6-story, 40x97-ft. silk mill for the Tremont Silk Mills, Park Ave. and Ittner Pl., New York, N. Y. (Borough of Manhattan). Estimated cost, $70,000. Buchman & Fox, 30 East 42nd St., Arch.

The Hammerschlag Manufacturing Co., Garfield, N. J., manufacturer of wax paper, will construct a new chemical building at Garfield.

The Alliance Button Co., Inc., Newark, N. J., has purchased property at Mechanic and Lawrence St., Newark, and will establish a factory for the manufacture of buttons. H. G. James is Pres.

A new factory building is being constructed by the Commercial Paper Box and Envelope Co., Front St., Chester, Penn.

The Business Men's Association plans to construct a mill at Christiana, Penn., for the manufacture of silks. Estimated cost, $50,000.

Fire, Feb. 7, destroyed the factory of the McCreary Manufacturing Co., 17 West 16th St., Erie, Penn., manufacturer of paper boxes. Loss, between $20,000 and $30,000. F. N. McCreary is Mgr.

The New Idea Hosiery Co., Harrisburg, Penn., has increased its capital stock $4,000 and will build an addition to its plant.

Bush & Terry, Philadelphia, Penn., will build a factory for the manufacture of rugs.

The Electric Hose and Rubber Co., Wilmington, Del., is building an addition to its cotton mill.

Nelson F. Brooks, Preston, Md., contemplates establishing a cannery at Hagerstown, Md.

The Sockett Fiske Co., Washington, D. C., has awarded the contract for its 3-story factory at 919 East St., N. W., Washington, for the manufacture of wholesale and retail paper and bookbinders. Estimated cost, $30,000.

SOUTHERN STATES

The Board of Commerce contemplates building a creosotal plant at Keyser, W. Va.

The Wheeling Tile Co., Wheeling, W. Va., has awarded the contract for a 2-story addition to its factory. Estimated cost, $12,000.

The Acme Hosiery Mills, Ashboro, N. C., will build an addition to its plant.

The plant of the Orangeburg Fertilizer Co., Orangeburg, S. C., recently destroyed by fire with a loss of $100,000, will be rebuilt. Noted Feb. 10.

MIDDLE WEST

The contract has been awarded for the construction of a 1-story addition to each of the 8 units of the plant at Akron, Ohio, of the Firestone Tire and Rubber Co. Estimated cost, $500,000.

G. M. Linthicum is interested in the organization of a company with a capital of $100,000 for the purpose of constructing a plant at Akron, Ohio, for the manufacture of rubber gloves.

The Norka Rubber Co., recently incorporated, plans to establish a factory at Akron, Ohio. W. C. Washburn is Pres.

The Kelly-Springfield Rubber Co., Akron, Ohio, has purchased a site at Barberton, Ohio, and plans to construct a plant.

The contract has been awarded for the construction of a plant at Cleveland, Ohio, for the German-American Portland Cement Co. Estimated cost $250,000.

Bids are being received by the Osborn Engineering Co., 740 Engineers' Bldg., Cleveland, Ohio, for the construction of a 4-story, 50x180-ft. addition to the factory of the Glidden Varnish Co. at Cleveland, Ohio.

The Cincinnati Rubber Co. plans several additions to its plant at Norwood, Ohio. Zettel & Rapp, Cincinnati, Arch.

The Salem Rubber Co., Salem, Ohio, is in the market for machinery. Estimated cost, $30,000.

The Ohio Chemical Co., recently organized, has purchased the plant of the W. H. Moores Lime Co. at Springfield, Ohio, and will construct 2 additions.

The Indianapolis Glove Co. contemplates building a factory on North Liberty St., Indianapolis, Ind.

The Solvay Process Co., manufacturer of chemicals, plans to build a 3-story factory on West Jefferson St., Detroit, Mich. Estimated cost, $12,000.

Plans are being prepared by C. A. Fairchild & Son, Arch., for the construction of an addition to the plant of the Kalamazoo Sled Co. at 3rd St., Kalamazoo, Mich. Estimated cost, $20,000. William E. Kidder, Secy.

The contract has been awarded for the construction of an addition to the plant of the Barrett Manufacturing Co., manufacturer of coal tar products, at Sacramento Ave. and 29th St., Chicago, Ill. Estimated cost, $35,000.

Plans are being prepared by Hilton & Sadler, Arch., 403 Jackman Bldg., Janesville, Wis., for the construction of a 4-story, 80x144-ft. factory at Sheboygan, Wis., for the John C. Nicholas Harness Co., Janesville. Estimated cost, $25,000.

Plans are being prepared for the construction of a 3-story, 50x120-ft. factory at Waupun, Wis., for the Paramount Knitting Co., Chicago, Ill.

WEST OF THE MISSISSIPPI

Work will be started on the factory for the Des Moines Hosiery Mills, Boone, Iowa, in about 60 days. Estimated cost, $20,000. Noted Jan. 27.

The International Shoe Co., St. Charles, Mo., plans to build an addition to its plant. Estimated cost, $30,000.

The American Manufacturing Co., St. Louis, Mo., has awarded the contract for a 1-story factory at 1032 South 11th St., St. Louis, for the manufacturing of bagging and cordage. Estimated cost, $13,500.

The Booth-St. Louis Fisheries Co., St. Louis, Mo., will build a 2-story addition to its cold-storage plant.

The Hamilton-Brown Shoe Co., St. Louis, Mo., contemplates constructing a branch factory.

The Lowell Bleacheries, 807 Laclede Ave., St. Louis, Mo., has increased its capital $400,000, and will build and equip a 3-story plant in St. Louis. Noted Dec. 16.

The Monsanto Chemical Works, St. Louis, Mo., plans additions to its plant. Estimated cost, $200,000.

The Southwestern Engineering Co., 525 Littlefield Bldg., Austin, Tex., contemplates installing machinery for the manufacture of ammunition and reloading shells.

The Pierce-Fordyce Oil Association will enlarge its refineries at Ft. Worth and Texas City, Tex. Estimated cost, $400,000.

The Consumers' Refining Co., Cushing, Okla., contemplates installing a lubricating plant in connection with its refinery. C. B. Shaffer is interested.

The Morris Co. will build an extension to its plant at Oklahoma, Okla., for the manufacture of oxygen.

WESTERN STATES

We have been advised that the contract has been awarded for the construction of a plant near Astoria, Ore., for the Warrenton Clay Co. Estimated cost, $85,000. Noted Feb. 3.

The contract has been awarded for the construction of additions to the plant of the Hawley Pulp and Paper Co. at Oregon City, Ore. Estimated cost, $750,000. Noted Dec. 30.

The California Door Co., San Francisco, Calif., plans to construct a plant at Diamond Springs, Calif., for the manufacture of box shooks, door stock, etc.

Plans have been prepared for the construction of a 3-story factory at Cheney St. and Santa Fe Ave., Los Angeles, Calif., for the Van Vorst & Berman Co., manufacturer of furniture, 1333 East 6th St., Los Angeles. Noted Dec. 30.

The Hercules Powder Co. plans to build a plant in the vicinity of San Diego, Calif.

Work has been started on the construction of an electro-chemical plant at Pittsburg, Calif. Estimated cost, $500,000. Mortimer Fleischacker, 2418 Pacific Ave., San Francisco, is interested.

CANADA

C. Decarie, of the Imperial Munitions Committee, is interested in the organization of a company for the construction of a factory at Notre Dame de Grace Ward, Montreal, Que., for the manufacture of fuses, etc.

The Dunlop Tire and Rubber Co. contemplates constructing an addition to its factory on Booth Ave., Toronto, Ont.

Classified Advertising

The Classified Advertising section appears on pages 157, 158, 160, *of this issue and will in future appear in the same relative position in the paper.*

American Machinist

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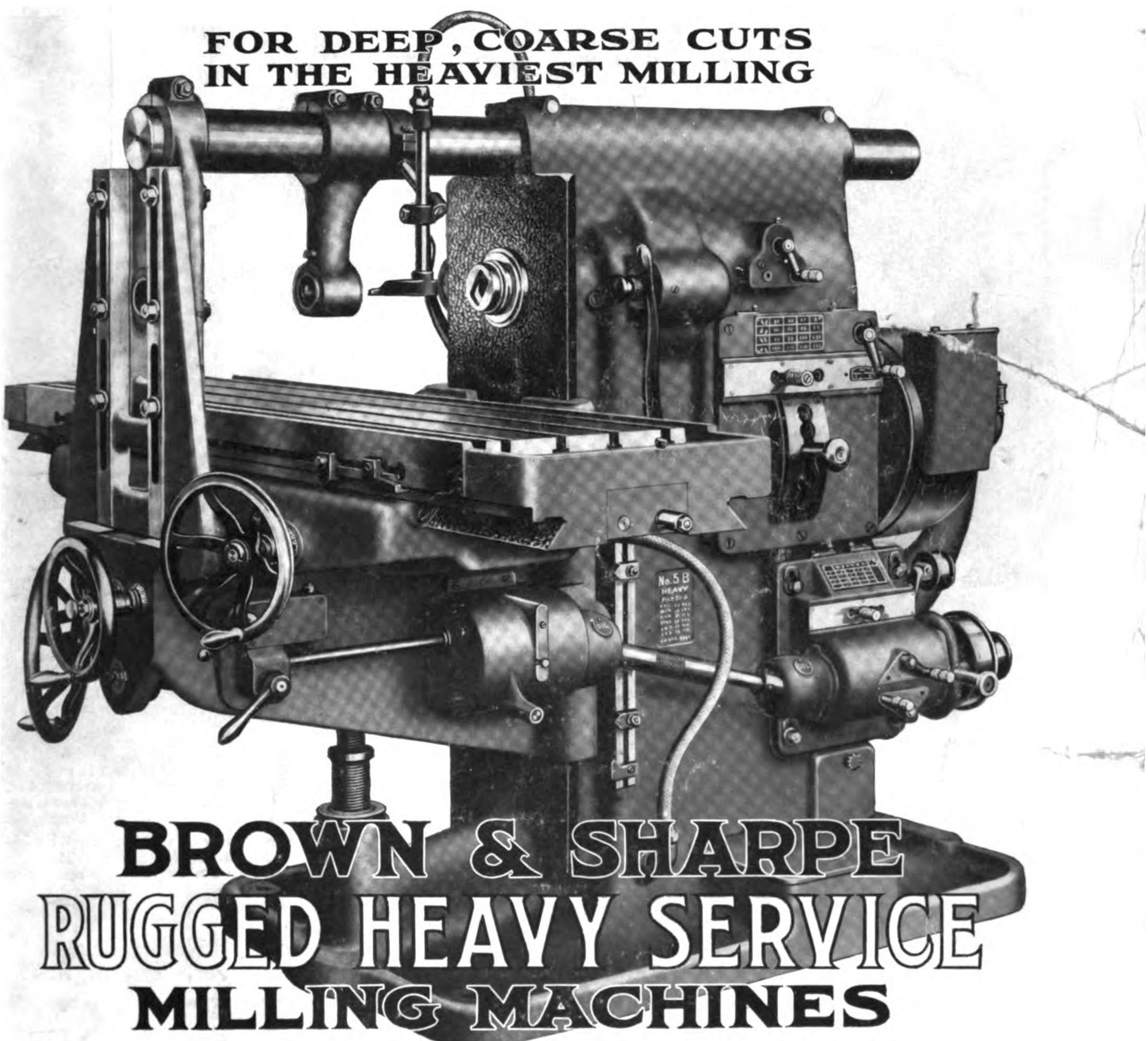
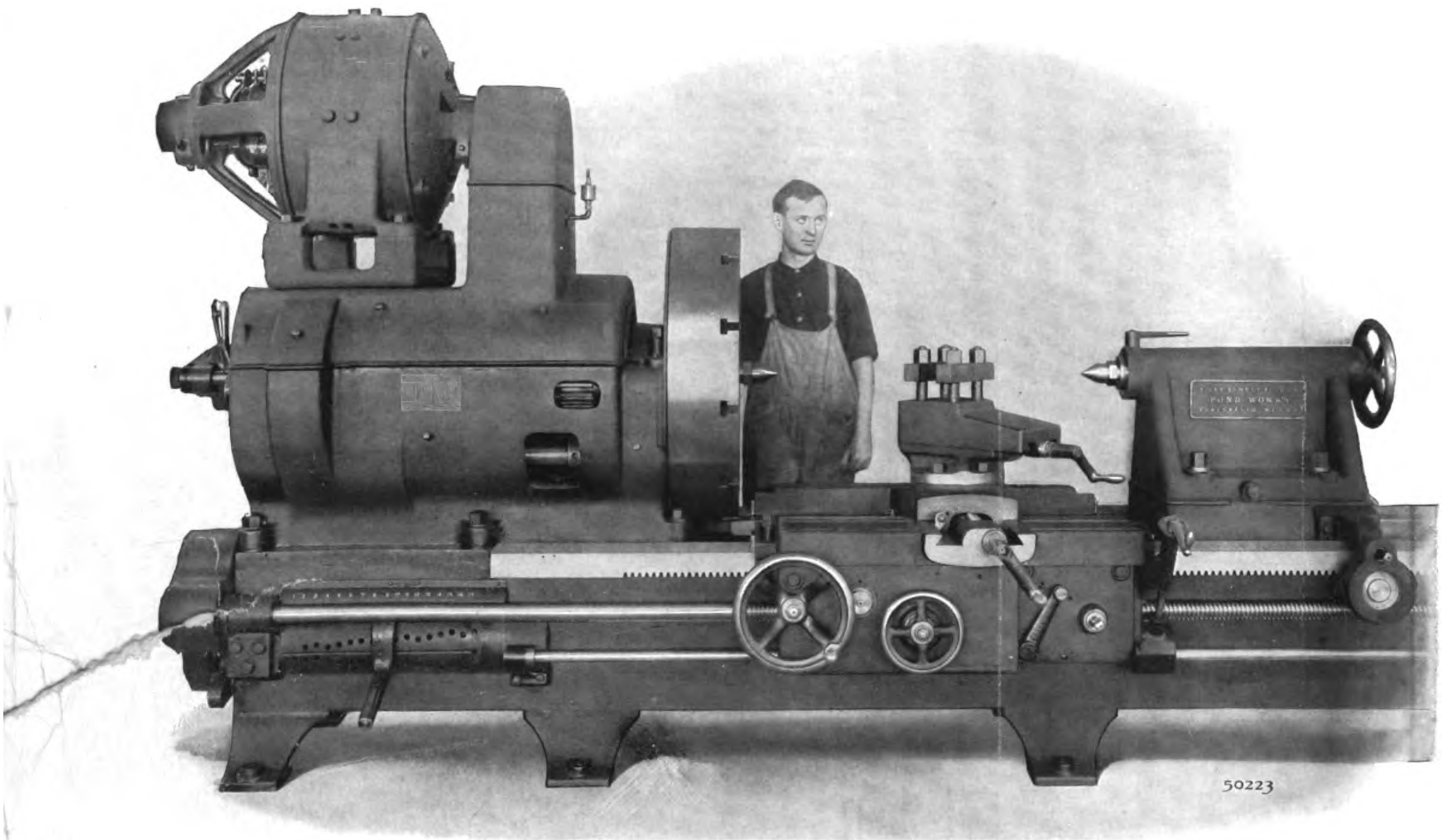


36" Heavy Lathes



Belt or Motor Driven. Equipped with quick-change gears. Bed-length to suit requirements.

Specifications, Delivery, Prices, Etc., Promptly Furnished on Request.

Pond Lathes possess all features required for efficient maximum output, without sacrificing simplicity of design. The weight is ample and carefully distributed, as our long experience has taught to be essential. The spindle bearings are large and bronze lined. The carriage has an exceptionally large bearing on the bed. As the tool does not overhang the bed the full driving power can be used in turning work of the maximum swing.

By simply tightening up the small hand-wheel in the proper direction, the cross or longitudinal feeds are thrown in and only one can be in operation at a time. The feeds can be reversed at the carriage. The feed and screw cutting mechanisms are interlocking so that both cannot be engaged at the same time.

On motor-driven lathes the speed may be varied through a wide range by the handle on the right side of the carriage. Thus the operator does not have to leave his work and is more apt to use the proper speed for his job.

Niles-Bement-Pond Co.

111 Broadway, New York City
25 Victoria Street, London, S. W.

SALES OFFICES AND AGENCIES—Boston: 93-95 Oliver St. **Philadelphia:** 405 N. 21st St. **Pittsburgh:** Frick Bldg. **Cleveland, O.:** The Niles Tool Works Co., Rockefeller Bldg. **Hamilton, O.:** The Niles Tool Works Co. **Cincinnati:** 336 West 4th St. **Detroit:** Kerr Machinery Bldg. **Chicago:** W. Washington and N. Jefferson Sts. **St. Louis:** 516 North Third St. **Birmingham, Ala.:** 2015 First Avenue. **For Colorado:** Hendrie & Bolthoff Mfg. & Supply Co., Denver. **For Seattle:** Hallidie Machinery Co. **For Canada:** The John Bertram & Sons Co., Ltd., Dundas, Montreal, Winnipeg, Vancouver. **Japan:** The F. W. Horne Co., 6 Takiyama-cho, Kyobashi-ku, Tokio. **Italy:** Ing. Ercole Vaghi, Milan. **Germany:** F. G. Kretschmer & Co., Frankfort, a.M. **France:** Glaenzer & Perreaud, 18 Faubourg du Temple, Paris. **Austria-Hungary:** E. Krause & Co., Vienna, Prague and Budapest. **Holland:** R. S. Stokvis & Zonen, Ltd., Rotterdam. **For Mexico:** The Railway Supply Co., S. A., Cinco de Mayo, 6 Mexico City. **Russia:** S. G. Martin & Co., Ltd., Petrograd and Moscow. **Brazil:** Comptoir Technique Bresclien, P. O. Box 802, Rio de Janeiro.

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CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormay processes, protected by United States patent issued June 22, 1915, and another pending

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Talks With Our Readers

By the Publisher

ONE of the most fascinating facts of zoology is that of Protective Coloration.

This is the principle by which the creatures of the wild are guarded from their enemies by their own color—the principle by which certain tropic treetoads are mottled like the bark on which they live; by which tropic butterflies in regions where butterflies have many enemies are splotched with the colors of the leaves among which they flit; by which the partridge and deer *turn* red in autumn, and the rabbit white in winter. This coloration is not only protective for *defense*, but also for *attack*—as with the tiger's perpendicular yellow and black stripes which conceal him among the upright reeds of the jungle.

The human animal, too, has seized hold of the idea. He paints his battle-ships gray to merge with the gray of the sea; he clothes his armies in yellow khaki which at a distance across a country-side becomes almost invisible in the sunlight.

Protective Coloration is a phase of things where the individual counts for nothing; where the mass counts for all.

But in modern commercial life the conditions are reversed. The individual counts for everything; not the man who most resembles his background, who is most like his neighbors, who survives; but the man who is most *different from* his neighbor.

The vital breath of commercial success is individuality.

The man who has something *different* to say, to sell, and who does it in a new way, is the man who wins. The man who disbelieves in *advertising* belongs to that former age where individuality was a handicap, not an asset. Whether he realizes it or not, that man believes in submerging himself in his background. Not a strikingly apt way to win success these days, is it?

Along with him, there is a type of business man who has another reason for not wanting to loom out from his neighbor. He's the fellow whose product wouldn't bear spotlight scrutiny. *He's* got good cause to fight shy of advertising.

And there's another non-advertiser who is worse even than he who sells an inferior product as a first-class product—this is he who leeches off of his neighbor's publicity; who, lying low and without spending a shekel, grabs a big share of the reward coming in from the other man's campaigns.

But the man who *advertises* plunges into the great every-wight-for-himself fight of today—determined, unafraid. He *knows* himself and his goods and has confidence therein. He is protected by individuality. And as he advertises, the advertising itself develops and intensifies his sense of and his need for still greater individuality in his product.

You can bank on the advertised product. The advertiser *must make good*.

Manufacturing British 18-Pounder High-Explosive Shells--V*

By E. A. Suverkrop

SYNOPSIS—After the bases have been faced off, the shells are trucked to the banding department, where the copper driving bands are assembled on the shell bodies and pressed into the driving-band recess. Then the bands are turned to correct diameter and shape with a formed tool. This work comprises the last real machining operation.

The machine equipment here consists of two triple-cylinder hydraulic pumps, an accumulator to give a pressure of 1,200 lb. per sq.in. and two banding presses—one built by Lymburner and the other by the West Tire Co. The Lymburner press is shown in Fig. 53, with a shell in place in the closing dies. Under normal conditions only one set of the pumps and one of the presses are in use at a time, the others being kept in reserve in case of a breakdown.

To the right in Fig. 53 is one corner of the assembling bench. This bench is about 4 ft. wide by 10 ft. long and accommodates the assembler, who prepares the work for the men who serve the banding press.

The shells, as previously stated, are trucked to the department. The copper bands come in boxes from the copper mills. Two sizes of boxes are used, holding 700 and 1,000 bands respectively. The dimensions of the copper bands are as shown in Fig. 54. The banding gang, when everything is going right, consists of three men. One man assembles the copper bands and the bodies of the shells, and two men handle the shells into and out of the banding press and operate it. When the gang is working, the operation is about as follows:

A number of copper bands from one of the boxes are dumped on the assembling bench. The truck boxes with

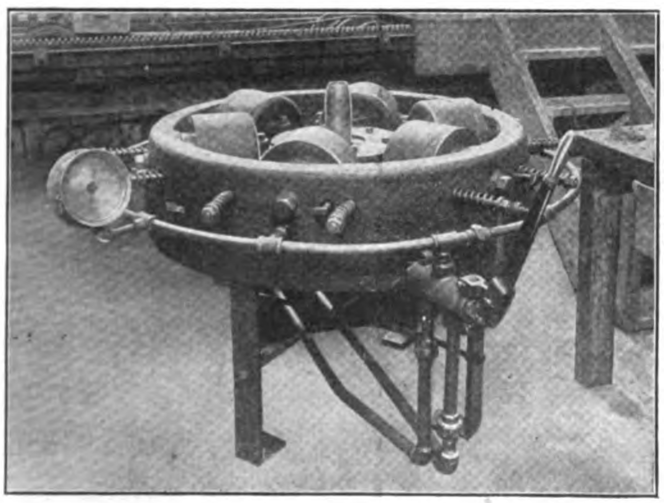


FIG. 53. THE COPPER-BANDING PRESS

the shell bodies are placed conveniently for the band assembler. He takes a shell from a truck box and a copper band from the pile on the bench. Laying the band on the bench, he enters the base of the shell into it. Owing to the way the copper bands are shipped and to the fact that they are annealed dead soft, they are usually enough out of round to cling to the shell. The assembler then raises the shell and the band, which clings to it. With the shell as a ram he bunts the band on the base of the shell, using the bench to bunt it against. When the band is as far on as it can be driven in this way, he lays the shell on its side and taps the band lightly with a hand hammer at several places on its perimeter, to expand it slightly so that it can be slipped along the body to its position over the driving-band groove. It is a fairly snug fit sidewise in the groove; but as it has been expanded sufficiently to pass over the body, it will not

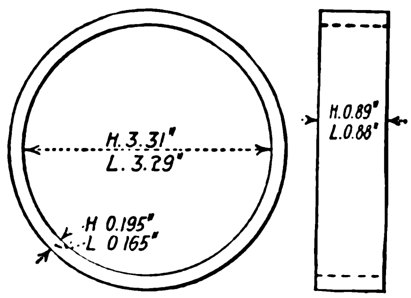


FIG. 54. ROUGH COPPER DRIVING BAND FOR 18-POUNDER HIGH-EXPLOSIVE SHELL

remain in position in the groove. To assure that it remains in place till it is compressed, the assembler closes it into the driving-band groove at two diametrically opposite places by blows with the hand hammer. He then stands the assembled shell and band on its base in a position convenient for the operator of the banding press.

The banding-press operator takes the shell and centers it base downward in the dies of the press. He then opens the operating valve, which causes the six dies, connected with the six cylinders of the press, to close on the driving band and force it into the driving-band groove. The operating valve is then reversed, and the dies open. As soon as the work is clear of the dies, the operator gives the shell a slight turn, approximately the twelfth part of a circle, so that the ridges formed on the compressed band between the dies in the first squeeze are about in the centers of the individual dies. The work is then given a second squeeze. After the second squeeze, the bands are given the hammer test, the work is credited, and the shells are trucked to the band-turning lathes, which are located near the banding presses. A banding gang has assembled and pressed copper bands on 3,300 shells in 10 hr. This production is much higher than I have seen mentioned in the literature on the subject. It is, however, correct.

One of the original band-turning lathes is shown in Figs. 55 and 56. The arrangement of the tool holder on the lathes now used is slightly different, as shown in Fig. 57. The taper of the jaws and the pitch of the thread on the chuck are such that it is self-closing. The operator places the base of a shell in the jaws of the chuck and brings the cup tail center up against the nose of the shell. The lathe is then started. The inertia of the shell and the friction cause the chuck jaws to tighten

*Previous installments appeared on pages 1, 45, 145 and 221.

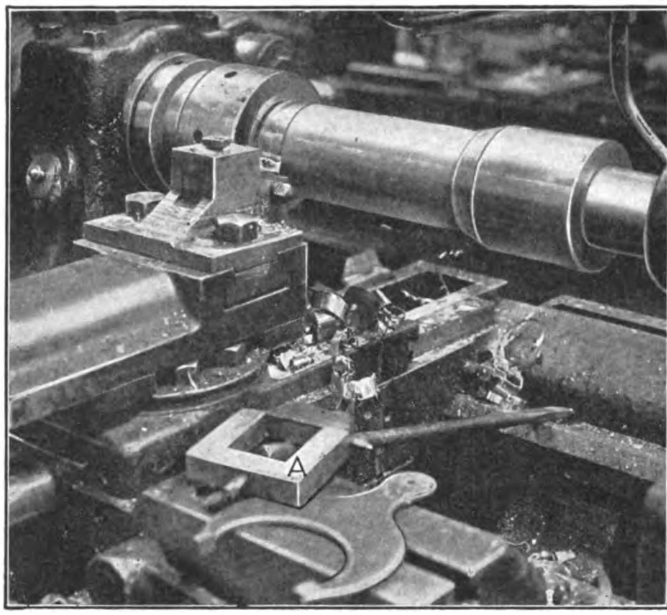


FIG. 55. TURNING THE COPPER-DRIVING BAND

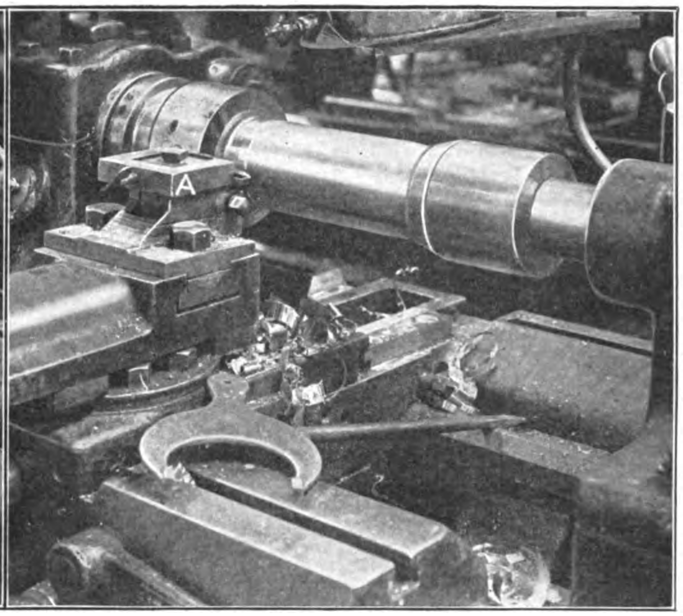


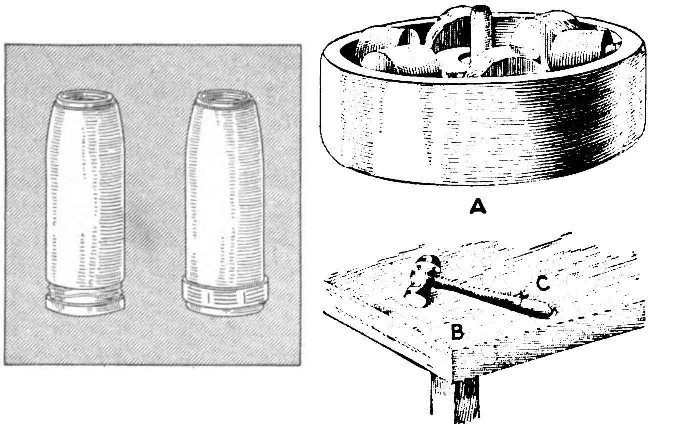
FIG. 56. SCRAPER REST READY TO REMOVE BURR

themselves automatically on the base of the shell. The operator feeds the tool in to the stop. As soon as the stop is encountered, the tool is withdrawn.

The tool leaves a slight burr on the edge of the copper driving band. This burr must be removed with a band scraper, shown at *B*, Figs. 55 and 56. In the old type of band-turning lathe the scraper rest was separate, as shown at *A* in Fig. 55. The operator placed it over the top of the tool post, as shown in Fig. 56, when he was ready to scrape the burr off the edge of the driving band. The present type of scraper rest is shown at *A*, Fig. 57. It is pivoted and remains on the tool post above the tool while the band is being turned.

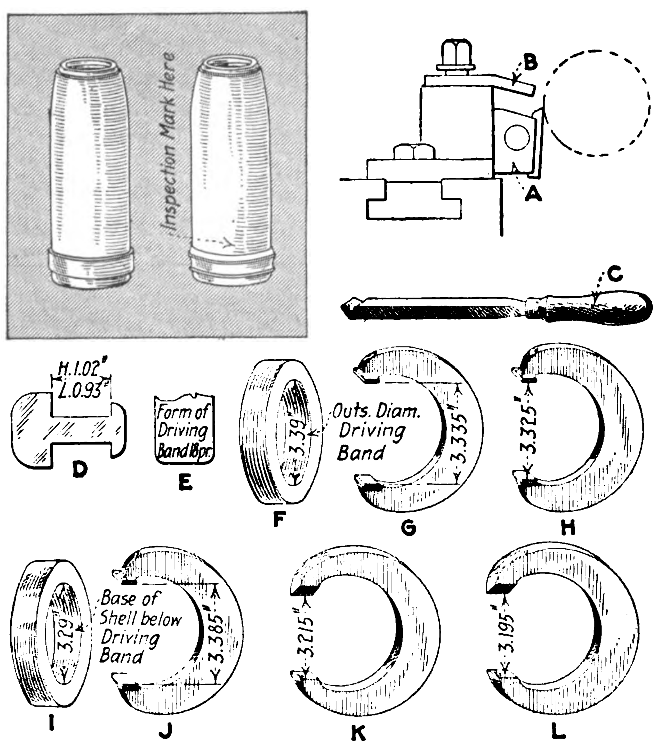
A mere touch on the edges of the copper band removes the burrs. Owing to the fact that the copper is turned at a much higher speed than would be possible with steel, the formed tool is made slightly narrower than the copper band, so that there will be no chance of the tool coming in contact with the steel body of the shell and thus destroying its edge. After scraping, the chuck is opened with a pin spanner, the shell taken out and the gage passed over the band by the operator for the only and final inspection.

The speed at which driving bands can be turned depends on the skill of the individual operator, and this varies between wide limits. On the day when the 3,300 shells were banded three workmen turned the bands of these shells at the rate of 1,100 each in 10 hr. This output means that besides turning the bands each man raised and lowered for a distance of approximately 4 ft. 16,500 lb. of shells in 10 hr. Those familiar with the difficulties of turning copper will appreciate this performance.



OPERATION 32: BANDING

Machines Used—Triple-cylinder hydraulic pumps; accumulator; banding press A.
Fixtures and Tools—Bench B; hand hammer C.
Gages—None. The hand-hammer test is used on the bands.
Production—From one banding press and three men, 330 per hr.
References—Figs. 53 and 54.



OPERATION 33: TURN COPPER BAND

Machines Used—Lathes.
Tools and Fixtures—Special collet chuck; cup center for tailstock; formed tool A; scraper rest B; scraper C.
Gages—Gage D from rib to base; E, form of driving band; F, outside diameter of driving band; high and low gages G and H for rib; ring gage I, base of shell; low snap gage J for driving band; K and L, high and low for groove in driving band.
Production—One machine and one man, 110 per hr.
Note—Soluble oil and water used as lubricant.
References—Figs. 55, 56, 57, 58; and for position of inspector's stamp see standard marking chart, Fig. 10.

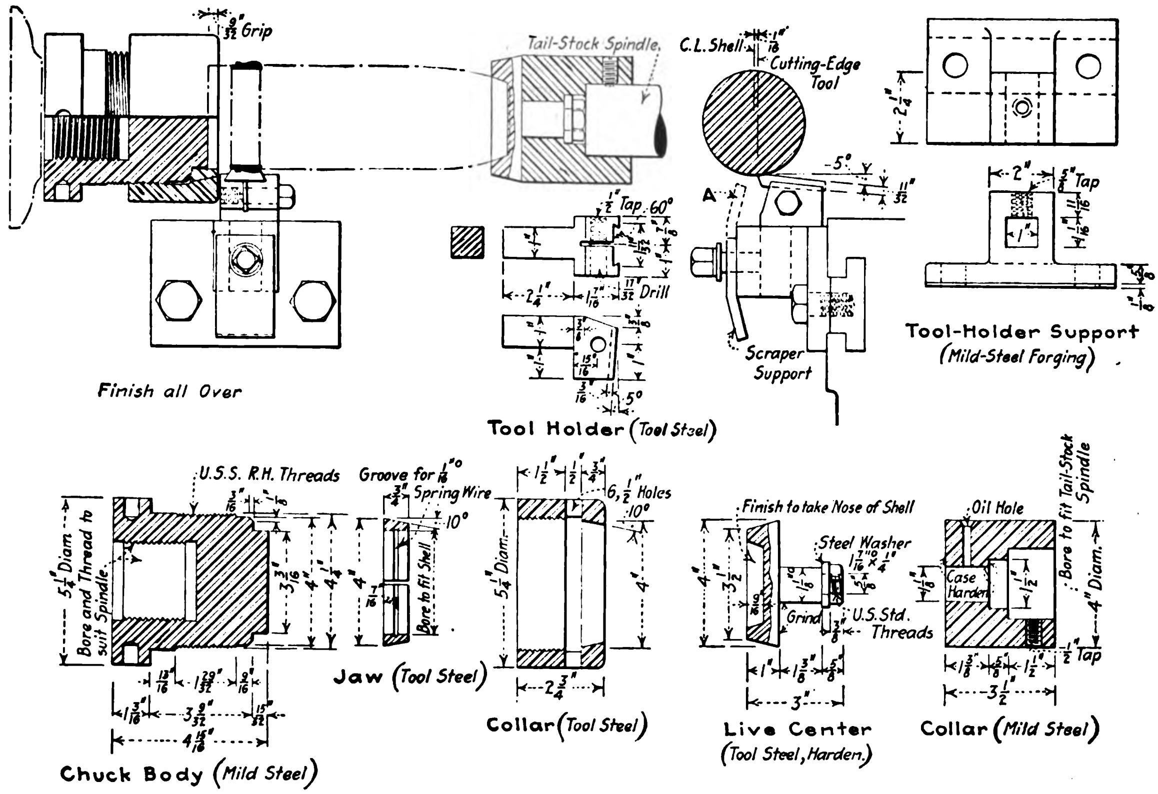
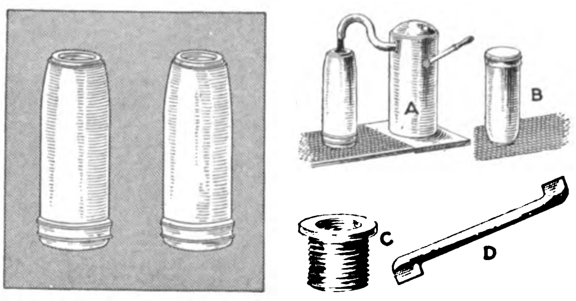


FIG. 57. DETAILS OF BAND-TURNING LATHE ACCESSORIES

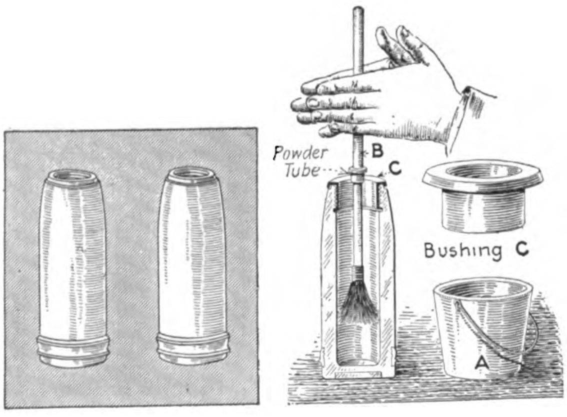
High-speed steel is used at the Dominion Bridge Works for the formed tools for turning copper driving bands. The contour of the form-turned driving band is shown in Fig. 58. The life of a tool is dependent on a number of factors and therefore varies greatly. From 100 to 430 copper bands have been turned by a tool at one grinding. As it must be kept very keen, the operator touches up the edge of the tool with an oil stone about every 30 bands. An emulsion of soluble oil and water is used to lubricate the cut. After turning, the shell is subjected to a rigid inspection in which nine gages are used. They are shown in operation sheet 33. In Fig. 59 is shown the latest drawing of the 18-pounder high-explosive shell, which is known as Mark III and supersedes Mark II. Having passed inspection and having been stamped and credited to the operator, the shells are trucked to the varnishing department.

Varnishing is done in a variety of ways, each shop differing from the others. In the No. 2 shell shop the first operation in the varnishing department consists in screwing bushings into the fuse hole in the shell. These bushings are made of cast brass and are very light. They have a hole entirely through them, and their object is to protect the threads in the nose from the varnish. Once screwed in they remain in the shells till after the baking. The operation of screwing in the bushings is a simple one. The men enter the bushings in the shells and screw them



OPERATION 34: VARNISHING

Machines Used—Bowser tank A.
Special Appliances—Draining screen B; thread-protecting bushings C; bushing wrench D.
Gages—None.
Production—Five men can screw in bushings and varnish 3,000 shells in 10 hr.
Note—Shells drain on B for 10 min.
Reference—Fig. 60.

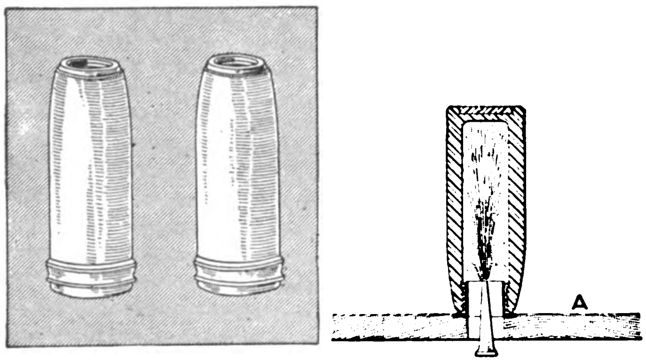


OPERATION 34 (ALTERNATIVE A): VARNISHING

Machines Used—None.
Appliances—Varnish pot A; special long-handled brush B; sheet-steel slip bushing C, to protect the fuse-hole threads.
Gages—None.
Production—One man, 100 per hr.
Reference—None.

down as far as they will go by hand. Then with a flat cranked key, which engages with the lugs projecting inwardly from the upper part of the bushing, the men screw the bushings down as far as they will go.

Varnishing at this works is done with a Bowser oil tank, as shown in Fig. 60. The tank is filled with varnish. The shells, with the bushings screwed in their noses, are placed conveniently for the operator who handles the Bowser tank. They are taken one at a time and placed as shown at *A* in Fig. 60. The operator then turns the crank *B*, filling the shell with varnish. The shell is then inverted over the screen *C* and left to drain, as shown at *D*, for 10 min. The capacity of the pump cylinder is such that a single stroke of the handle *B* just fills the shell. The most tedious part of this method is waiting for the shells to drain properly so that the film of varnish will not be too heavy in the bottom of the shell. An objection to this procedure is the excessive amount of cleaning necessary after baking. By this manner of varnishing,



OPERATION 34 (ALTERNATIVE B): VARNISHING
Machine Used—Varnish-spraying machine.
Special Appliances—None.
Production—One man, one machine and two helpers, 250 per hr.
Reference—Fig. 61.

five men can screw in the bushings and varnish 3,000 shells in 10 hr.; but the shells are left very dirty on the outside, and it takes 12 men 10 hr. to clean off the excess of varnish from the outsides of the 3,000 shells.

At another works the method is as follows: Each varnisher is provided with an ordinary round varnish brush. On the end of the brush is a brass powder tube from a shrapnel shell. The thread of the shell to be varnished is protected by a slip bushing that is instantly inserted. The varnisher, with the shell standing on its base on the bench, dips the brush in the varnish and inserts it in the fuse hole in the shell. He then holds the brass powder tube between the palms of his hands and, rubbing them back and forth, causes the brush to rotate at a fairly high speed. The centrifugal force thus set up causes the bristles of the brush to fly outward and deposit the varnish on the sides of the hole in the shell. At the same time that the brush is caused to rotate as described, the hands and brush are reciprocated up and down so that the varnish is evenly distributed all over the inner surface of the shell. When carefully done, no varnish is smeared on the outside of the shell, which of course eliminates the cleaning operation after the shells are baked. By this method three men can varnish 3,000 shells in 10 hr.

In one of the large factories in the United States the varnishing department is laid out as shown in Fig. 61 and run in the following manner: Just previous to varnishing, the shells are thoroughly washed in gasoline in the tank *A*. When taken from the tank, th[e]... placed on vertical tubes *D* projecting from the top of the sheet-iron box *B* to dry. The arrangement of the box *B* is as follows: It is made of sheet iron on an angle-iron frame and is inclosed on all sides. Inside the box is a series of steam-heating coils. Outside the box is a motor-driven

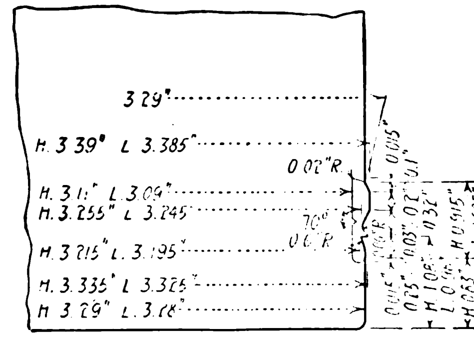


FIG. 58. FORM OF DRIVING BAND

blower *C*, which drives air in over the coils. The top of the box is perforated to receive the short pipes *D*. The lower ends of these pipes open to the hot-air space in the box; and the upper ends, to the atmosphere. All the air that passes into the box from the blower must pass out through these pipes.

At *E* is the varnishing machine made by the Spray Engineering Co., of Boston, Mass. The operation of varnishing with this outfit is as follows: By the time the pipes *D* are all filled with shells the first shell is not only dry, but has attained a temperature of approximately 150 deg. F. and is ready for varnishing. The operator of the varnishing machine has two helpers to assist him. A hot shell is taken by the first helper from a pipe *D* and placed nose down on the table of the varnishing machine. The varnisher lifts it and places it over the spraying nozzle. The mechanism that does the actual varnishing is an atomizer, the nozzle of which is vertically disposed. Surrounding the nozzle is a sheet-metal bushing that is small enough in diameter to enter the fuse hole in the shell. It is of sufficient length adequately to protect the thread in the fuse hole from the atomized varnish.

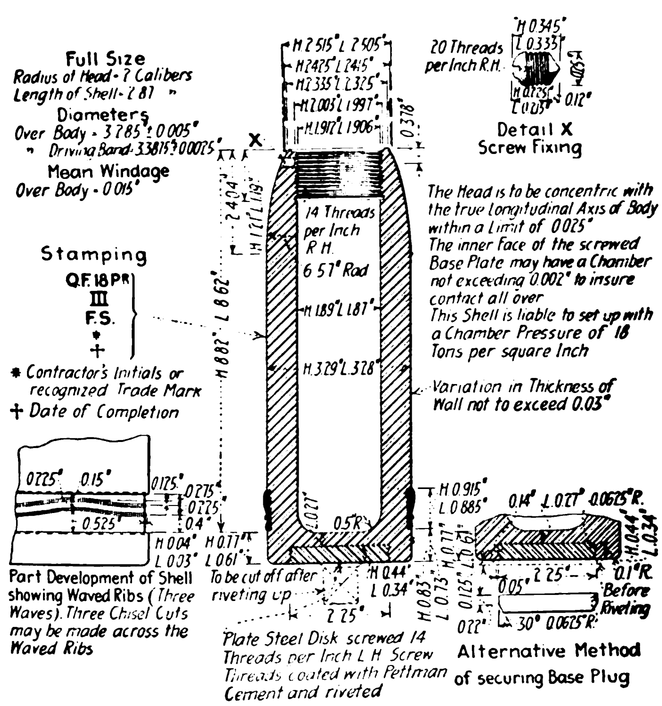
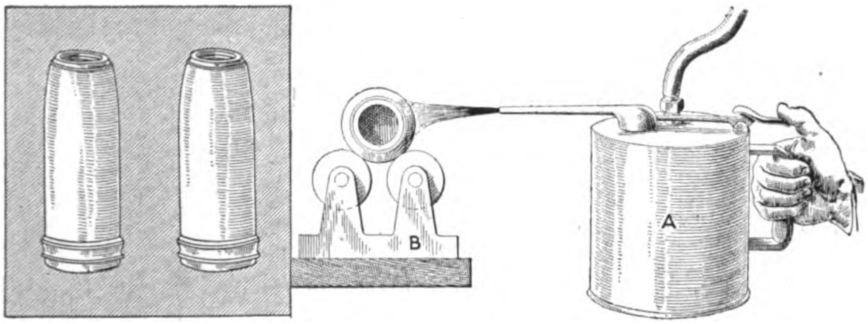


FIG. 59. HIGH-EXPLOSIVE 18-POUNDER MARK III SHELL

In some cases the weight of the shell opens the air valve of the atomizer; in others the valve is operated by a foot lever. In either case the time consumed is very short. The atomizing nozzle sprays the varnish over the inner surface of the shell so evenly and in such accurate quan-



OPERATION 34 (ALTERNATIVE C): VARNISHING
Machines Used—Hand-operated atomizer A connected to shop air service.
Special Appliances—Roller shell support B; gloves for handling the hot shells.
Production—One man and one atomizer, 100 per hr.
Reference—Fig. 62.

tity that, while the surface is entirely covered, there is no excess or dribbles of varnish. The shell is removed, and the second helper places it in the tray *F*, which takes the shells to the baking ovens. In the meantime the first helper has another shell ready. With this outfit one varnisher can varnish 2,500 shells in 10 hr.

Another method of varnishing, employed in one of the large shops in the United States, also uses an atomizer. The device was made at the works, where they have had a great deal of experience in varnishing and lacquering brass goods. Just before varnishing in this factory the shells are cleaned in hot caustic soda, after which they pass through two washings in boiling water to remove all traces of the caustic soda. They go direct from the last boiling-water bath to the varnishing operation and are so hot (approximately 150 deg. F.) that the varnisher has to protect his hands with gloves.

On the bench *G*, Fig. 62, is the fixture *H*, which has two rollers *I* about 3 in. in diameter and 6 in. long. The operator takes a shell with his right hand and lays it on the rollers *I*. In his left hand he holds the atomizer *J*. The atomizer has a long nozzle which the operator enters in the nose of the shell. The valve of the atomizer is controlled by the thumb of the left hand. The atomizer is operated by air at 90 lb., from the shop compressed-air service. While the varnish is being sprayed in the shell from the atomizer held in the left hand, the operator's right hand keeps the shell rotating on the rollers. As the work is in plain view of the operator and the atomizer valve is under control of his left thumb, no bushing is used or necessary to protect the thread. By this method one man can varnish 1,000 shells in 10 hr. The work is very good, the number of rejects for poor varnishing amounting to only 1 per cent.

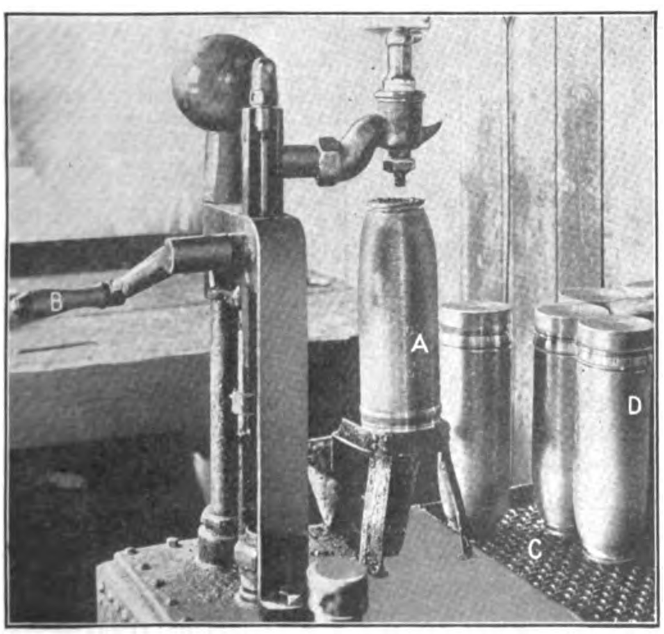
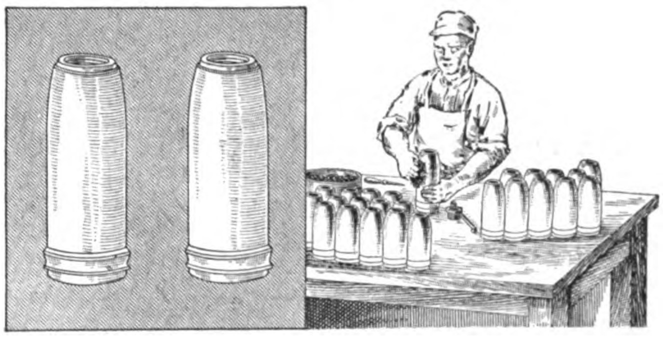


FIG. 60. OIL TANK USED FOR VARNISHING

After varnishing in the No. 2 shell shop, the shells are placed in steel racks, two of which are shown on a truck in Fig. 63. The main frame of the rack is of angle iron. The bottom is of flat steel strips and the partitions of $\frac{3}{8}$-in. round steel. The racks are 7 shells in width and 11 shells in length. They stack one on top of the other. The furnaces are at present two in number, as shown in Fig. 64. The small



OPERATION 36: CLEANING VARNISH OFF OUTSIDES
Machines Used—None.
Appliances Used—Benches; scrapers; waste; bushing wrench.
Production—One man, 25 shells per hr.
Reference—None.

furnace *A* is wide enough to take one truck and high enough to accommodate a truck with two racks superimposed, as shown in Fig. 63. The large furnace *B* is two trucks in width and will accommodate just twice the number of shells that the small one will.

Both furnaces are heated by Bunsen burners at the bottom, the hot gases from which are led upward through thin sheet-iron ducts that entirely cover the floor, sides and roof on the inside of the ovens. The shells are subjected to a temperature of 300 deg. F. for 6 hr. Superheated steam has been tried in some shops; but as one engineer put it, "The superheater should be in the oven to get results." In another shop the shells are heated to 350 deg. before the varnish is applied. This treatment gives fairly good results.

About 20 per cent. of the shells have the fuse-hole threads clogged with varnish, which is removed by retapping the fuse hole. Owing to this condition the method of handling the shells has been recently changed. By turning back over this series of articles it will be noticed that the shells were hand tapped in operation 19. This operation has now been entirely eliminated, and there is no plug thread gage used in the inspection on the thread of the nose at that stage of manufacture. The hand-

tapping operation now takes place after varnishing. This change not only results in the elimination of an operation, but assures that all the threads of all the shells shall be clean and of correct size.

After tapping, the shells are trucked to the Government inclosure to undergo the final Government inspection. As stated in the third article of this series, in the paragraph beginning just over operation sheet 22, "At the preliminary Government examination a shell may be selected for proof." When a proof shell has been thus selected, passed through the various manufacturing operations to rapid completion and submitted for proof, the final examination of the other shells in the lot is proceeded with in the usual way without waiting for the proof results from such shells; but they are not accepted by Government inspectors till after proof results have been received. The finished shells weigh 14 lb. 13 oz. 2½ dr., with an allowance of plus 1 oz. 3 dr. or minus 2 oz. 5 dr. The operations for the final Government inspection are enumerated in Table 3. Shells that are found correct are stamped with the inspectors' work marks in the following manner. These marks are also indicated in Fig. 37.

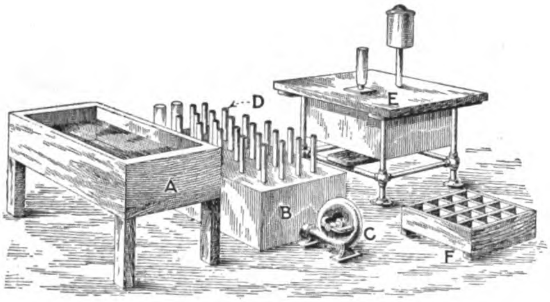


FIG. 61. LAYOUT OF SHOP USING VARNISH SPRAYER

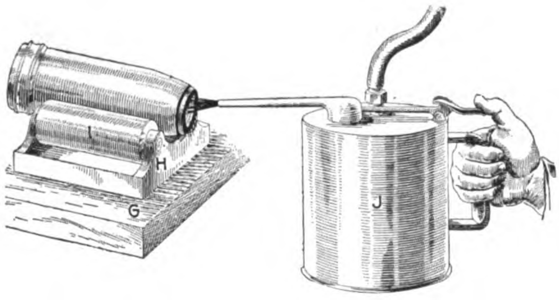
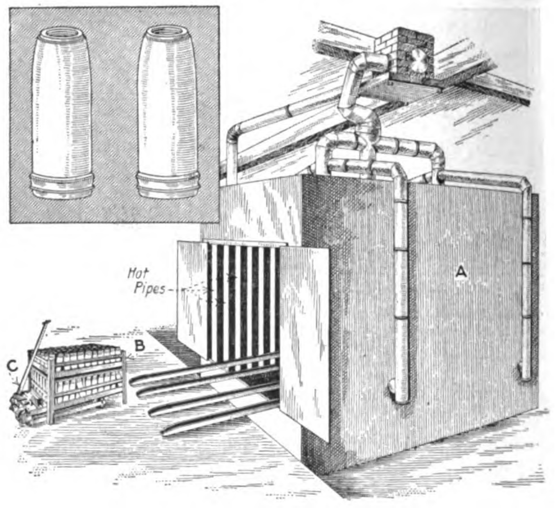


FIG. 62. VARNISH ATOMIZER FOR INSIDES OF SHELL

A work mark is placed immediately below the fuse hole to indicate correctness of the fuse-hole examination, gaging and external examination. The serviceable sign is stamped above it to signify the correctness of the final examination and external gaging. The serviceable sign, which is the British broad arrow with a *C*, will not, however, be stamped until results of the proof and varnish tests are received. While awaiting receipt of these, the shells may be painted. Reports on the preliminary and final inspections are kept on forms supplied by the Government.

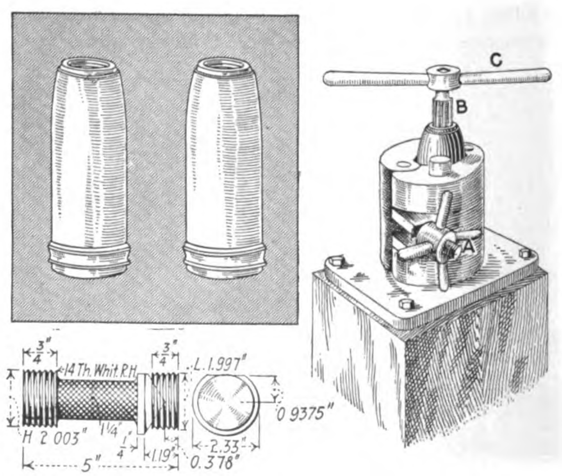
From each consignment of varnish and paint that the contractor proposes to use, one-quarter pint is taken by the inspector, put in bottles supplied for the purpose and forwarded by express to the Government analyst.

Varnish is also scraped from varnished shells. A sample at least ¼ oz. in weight must be obtained, and this governs five lots of shells. The contractor is not informed from which shells scrapings are to be taken. Formerly the inspectors were permitted to take varnish samples from proof and defective shells. When this was done, little time was lost. At that time also the contractor was kept in ignorance of the specific proof shells from which the samples were to be taken. He was also required to submit proof shells with as smooth and dry surfaces as were required for the general run of shells. Any failure on the part of the contractor to comply with these orders resulted in the withdrawal of the privilege of expediting the completion of the proof shells. The scrapings are



OPERATION 35: BAKING THE VARNISH

Machines Used—None.
Special Appliances—Two furnaces A holding two and four trays B respectively; thermometer; clock; trucks C.
Production—With both furnaces, 200 per hr.
References—Figs. 63 and 64.



OPERATION 37: HAND TAPPING THE FUSE HOLE TO FINISHED SIZE

Machines Used—None.
Special Tools and Fixtures—Hinged vise A; adjustable tap B; tap wrench C.
Gages—High and low plug gage with angular seat on one end.
Production—One man, 30 per hr.
References—Figs. 4 and 5 for details of vise; Fig. 34 for sizing tap.

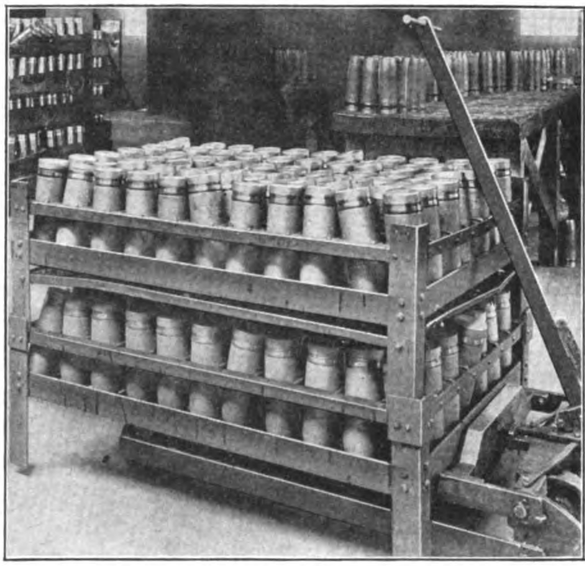


FIG. 63. TRUCK AND STEEL VARNISHING RACKS

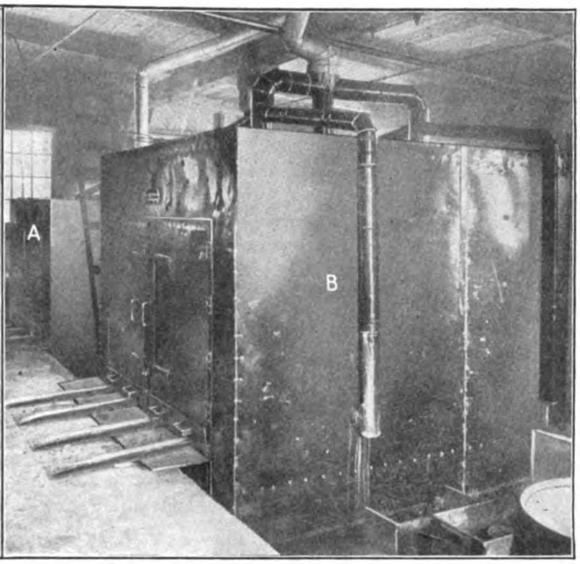


FIG. 64. THE SHELL-BAKING OVENS

forwarded by express, in the bottles supplied, to the Government analyst.

All samples—liquid varnish and scrapings—must be clearly labeled. The label for the liquid sample shows the firm which supplied the varnish, the firm which received it, the amount of the consignment and the date received. The bottles containing the scrapings are labeled to show the name of the firm, the lot or lots from which the sample is actually taken and the lots which will be governed by the sample.

TABLE 3. INSTRUCTIONS FOR FINAL INSPECTION OF 18-POUNDER HIGH-EXPLOSIVE SHELLS

No. of Opera-tion	Operation	Per Cent. To Be Done
13*	Testing base plate for looseness............	100
14	Screw-gage fuse hole, high and low........	100
15	Examination of screw threads in fuse hole.:	100
16†	Depth of recess in fuse hole................	Optional
17	Diameter and angle of recess..............	100
18	Internal examination for flaws and varnish	100
19	Weight	100
20	Width of driving band and distance from base.	100
21	Form of driving band......................	100
22	Distance of fixing screw hole..............	100
23	Hammer test, driving band................	100
24	Form and radius of head..................	100
25	Cylinder gage	100
26	Length over all............................	100
27	Examination of markings on body and base.	100
28	Examination of heat number...............	100
29‡	Diameter rear part of driving band.........	100
30	Diameter driving band, high and low........	100
31	Greasing and fixing plugs and setscrews....	100
32	Ring-gage diameter over paint.............	100

*This test will be made by the inspector in the open shop as soon as the base plate has been inserted and machined off. †The forming of the recess in the fuse hole is itself optional. ‡All shells that measure 3.286 in. or over are marked with a cross in green paint below the driving band. In the loading station these shells are fitted to cases that are large in the mouth.

The results of the analysis are reported to the inspection office at Quebec, which notifies the manufacturers when the lots successfully pass the final Government proof and varnish tests.

When scraping the varnish from the shells, the following points are to be strictly attended to:

1. The nose of the shell down to 2 in. from the fuse hole outside and also the threads are to be wiped clean with a clean piece of rag or waste.

2. The scraper is to be in a polished and bright condition and kept for this purpose only.

3. The examiner is to have clean hands.

4. The paper on which the scrapings of varnish are collected is to be clean and is not to have been previously handled.

5. There must be no steel in the scraped samples.

As it is practically impossible to scrape varnish off the surface of the shell without scraping some of the steel, the fifth requirement has given the inspectors some trouble. The steel can be readily removed from the scrapings with a bar magnet before sending them to the Government analyst. A small electromagnet, where direct current is available, could be easily rigged up, and it would do the work more thoroughly.

Machining a Brake Handle in a Turret Lathe

By F. P. Terry

The illustration, Fig. 1, shows a brake handle made of a mild steel stamping and used in munition work. The old-time foreman would have placed the machining of this handle under the heading of "All work." This term is fairly correct when we consider that handles *A* and *B* have to be bored and turned, the shank turned all over and threaded, a fine thread cut at *D*, an internal square thread at *E* and a clearance hole, as shown at *C*.

No doubt a good number of firms have been up against this job, and it may be of interest to give the methods we used to turn out a large number of these handles.

It was quite impossible to get them out in anything like the time desired, with the engine lathes we had to spare, and I decided to make it a six-operation job for the turret lathe. Two machines were used, and the result was very satisfactory.

In Fig. 2 is shown the handle *A* gripped in the ordinary toggle chuck for the first operation—boring the hole at *A*—with an extended socket to clear the shank of the handle. One drill only was put through, as the condition of the hole was not important, the only necessity being that it should be fairly true. This operation was completed very quickly, and no difficulty was experienced regarding the balance of the piece.

Fig. 3 shows the second operation. In turning handle *A* for this operation a piece of bar stock was turned, as shown at *B*, to act as a mandrel, the block *C* acting as a driver and a balancing piece combined. The mandrel was turned to a light push fit, so that the handles could be easily twisted off after turning.

The third operation is shown in Fig. 4. This bores the clearance hole *C* in the shank, which is gripped in the toggle chuck, and presents no unusual features, the turret stop being set to give the required depth of hole.

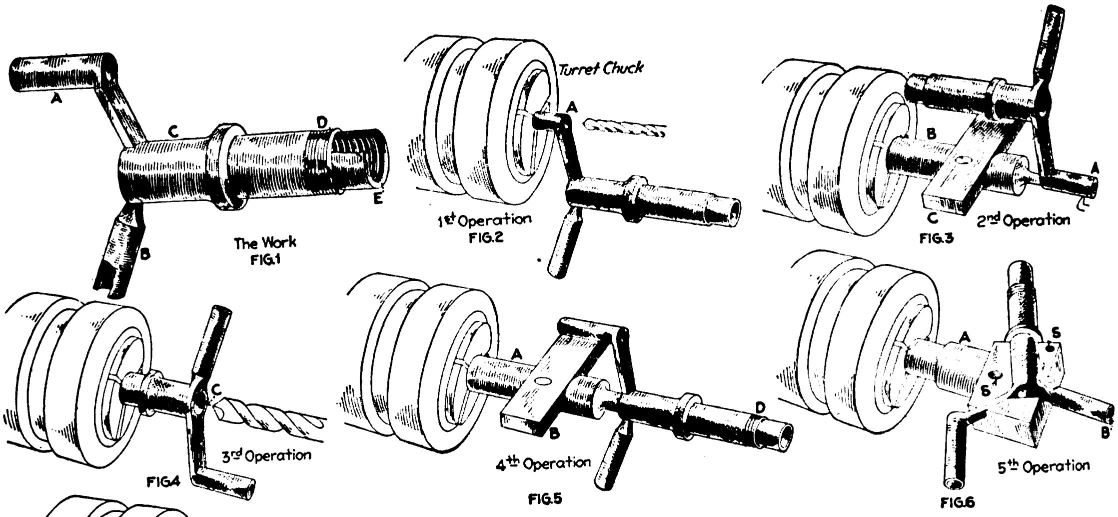
In Fig. 5 is the fourth operation, turning and threading the shank. A piece of bar stock was turned a light push fit as shown, for a mandrel, and a driver *B* was used. The fine thread at *D* was 1⅜ in. in diameter, 12 threads, and required special dies. It was quite impossible to buy these and equally as difficult to attempt to make them for the present-day die head, which is of course one of the improvements. Fortunately I had a very old geometric die head long since laid away for a well-earned rest, which had been made before we knew as much about dies as we now know, and it was a simple matter to make a special set of dies in the toolroom to do the job.

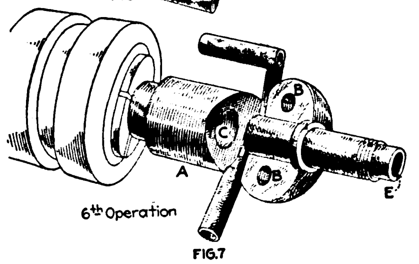
The fifth operation—turning and boring handle *B*—is shown in Fig. 6. For this operation a special fixture *A* was made. A pattern was made to suit the set of the handle, and a casting in gun metal was made from scrap cuttings from the shop. The handle is a snug fit in the fixture and is held in place by a slip plate (not shown) and setscrews in holes *S*.

The sixth and last operation—boring and tapping the square thread at *E*, as in the fifth operation—is shown in Fig. 7. A similar fixture *A* was made, a slip plate (not shown) securing the handle in place for tapping. Two long taps were made, the fixture *A* having a cored hole, as shown at *C*, to give clearance for the taps.

In carrying through these operations with two lathes, it was possible to vary the sequence of the operations, one turret getting ahead with operations one and two, and the other taking up operations three and four.

By putting this job on the turret lathes, we not only obtained good results as to output, but we also provided a very interesting change of work for the operators—a point that is very often overlooked, although it means more than is usually supposed when the day's output is considered.





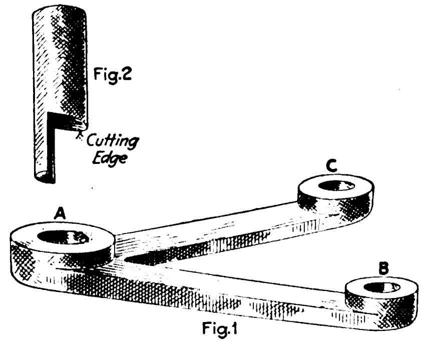
DETAILS OF OPERATION IN MACHINING A BRAKE HANDLE TURRET LATHE

Correcting Inaccurate Spacing

By Jacob Kirchmer

In making a piercing die in which the spacing of the holes required great accuracy, I found that the distance between *A* and *B*, Fig. 1, was out about 0.0002 in.

In order to correct this inaccuracy in a simple way I made a broach, as shown in Fig. 2, 0.0002 in. larger than the size of the holes I had bored in the punch holder.



CORRECTING INACCURATE SPACING

I then set the broach in hole *A* so that by forcing it through in a small press it would bring the centers of holes *A* and *B* the required distance apart, which it did to my satisfaction.

A Holiday in a Small Shop

BY JOHN H. VAN DEVENTER

SYNOPSIS—Salt-water sailors are supposed to be without equal in the art of "spinning yarns," but their laurels are in danger when small-shop men get together. This article recounts some conversations which took place in Dave Hope's office on a holiday.

Although it was a legal holiday, I took a chance at finding Dave Hope in his shop. Many shop men visit the plants on Sundays and holidays so they can look at all of the hard work lying about without having to dig in and do it. This and the plausible excuse it offers to the "missus" for the avoidance of a trip to church may explain many nine and ten o'clock Sunday morning shop gatherings.

Clouds of smoke coming from the partly open door of Dave's office made me think that something must be on fire, but it was only a combination of cigar clippings and Pittsburgh stogies. Dave himself was busily engaged in furnishing draft for a corncob pipe in which a charge of black clippings was being fried in its own juice. Sandy McPherson and Reddy Burke, dressed in their best, were at work on cigars so full of bends as to be beyond measuring except with a flexible rule.

It is not customary among men of the type gathered here to be profuse in their greeting—in fact, it is a great compliment if the smoker momentarily removes his pipe or cigar. So I was well satisfied to take the chair indicated by Dave's pipe stem and place my feet on the office table in the space made there for them.

The silence was broken by Sandy, who sat facing the glass outer door. "Here comes the largest builder of steam engines in the state," he remarked in an offhand way.

SETTLING A STRIKE BY PSYCHOLOGY

I wondered why such a prominent man was visiting Dave Hope's small shop, but saw Sandy's joke as the man entered. His amidships dimensions were so large that it looked as if he would stick in the doorway, but a skillful wiggle born of experience brought him safely through. He passed the vacant chair and seated himself on an unopened packing case, letting his weight come down gradually as a boy does when testing thin ice before venturing on it.

"Thought I'd find you fellows here," he remarked, after being introduced to me as Tom Dodge, foreman of the assembling department of the Apache Iron Works. "They won't let us fellows into the big shop on holidays except to work, and the wife's relations are visitin' us at the house, so I thought I'd come here for a little rest."

"Sort of locked out by both of your bosses—eh, Tom?" queried Dave.

"Say, speakin' of lockouts," remarked Tom; "did you hear how our foundry boss, Barney Olds, dodged a strike last week?"

No one present had heard, so Tom forthwith started to tell.

"Laborers are scarce now—so many of 'em havin' gone back to Italy to fight the Austrians. So when a guinea comes to the foundry yesterday Barney puts him to work at once.

"'Bout an hour later the molders' committee waits on Barney an' tells him that either the new guinea must go or they will. It seems he's a bad egg and has got into several stabbin' scrapes and is suspected of stickin' a three-cornered file between a molder's ribs some time back.

"Barney says, 'All right, boys; out he goes!' and makes a bee line for the cleanin' shed to can him. Five minutes afterward somebody tells him that the guineas are walkin' out, which brings him onto the scene in three jumps. 'Hold on there! Where're you goin'?' he asks. One of the guineas who can speak English says: 'Data man he belonga to da une; you canna heem, we queet.' That puts Barney in bad for sure, because he can't replace that bunch in a month. He gives a couple of quick thinks and says: 'All right, boys; get back to work; that fellow can stay here as long as he wants to.'

"Barney goes back to his office an' calls up the chief of police. 'Send a uniformed officer down right away,' he says, 'an' tell him to come in the cleaning-shed door and to walk through to the office and ask me what's wanted!'

"Inside of ten minutes along comes the officer, lookin' for trouble. As soon as he sticks his red nose and brass buttons inside the door, the new guinea remembers a business engagement and goes out through the window.

"Barney gives the officer a cigar and tells him it's a false alarm. The cop goes back satisfied, the molders are satisfied and the guineas are satisfied because their pal left of his own free will. Everybody's happy, all because of diplomacy and skychology."

DAVE HOPE AND HIS DIAMOND FOUNDRY

Tom Dodge, by relating this experience, had evidently started a train of recollections, for Dave Hope took four or five quick puffs on his pipe, cleared his throat and addressed the members of the holiday club.

"Speaking of foundries," he remarked, "reminds me of one of my foolish adventures, the object of which was to get diamonds out of molding sand. I don't blame you if you laugh," said Dave, in answer to a chuckle from the fat foreman, "but remember that this happened a good many years ago. I had a little foundry and machine shop in Massachusetts in those days and did quite a bit of work for the textile plants.

"A fellow walked into my place one morning who had me guessing. He didn't look hungry enough for an inventor, or crazy enough for a perpetual-motion originator, or prosperous enough for a mill man, or bold enough for an agent. I put him down for either a clergyman or a teacher, and came close to it at that, for his card read 'James W. Hemphill, B.A., Professor of Geology, State Normal School.' After I knew him a while I found that the letters B.A. after his name stood for 'big appetite.'

"He wanted to talk to me privately, so I stepped outside with him—there not being room enough inside the plant for a private conversation.

"'Mr. Hope,' he began, 'I have a plan worked out to get diamonds out of your foundry.'

"I saw which way the wind blew and figured it was best to humor him. 'If you can do that,' I said, 'you're a better planner than I am.'

"That fellow started in with a line of talk that was certainly convincing. He told me he had studied geology until he knew just how all the minerals of the earth had been made, and that diamonds were nothing more than bits of carbon like plain black coal that had been heated by volcanoes and then squeezed under enormous pressure in rock. I began to get interested at this and think there might be something in the scheme after all. 'I can see where there is plenty of heat in the foundry,' said I, 'but doggone if I can see where the pressure is coming from.'

"'That's the important part of my discovery,' he said, 'and before I disclose it we must sign a partnership contract.'

"The contract provided that he was to furnish the method of making diamonds out of graphite, and was to produce the real article inside of three weeks, during which time I was to pay him his board and lodging and advance him $10 a week. As soon as the process was successful I was to come across with $250, and after that it was to be share alike.

"We didn't want it noised around that we were operating a diamond foundry, so all of our work was done at night. The professor took chunks of graphite as big as the end of your thumb and had me set up a number of 14-in. snap flasks, using a block about 3 in. each way for a pattern. He stuck a nail dipped in clay wash into the nowel of each mold and set a chunk of graphite on the head of each nail. The molds were left to be poured in the next day's heat. The professor said that the melted iron would heat the graphite white hot and then the shrinkage of the iron in cooling would furnish the squeezing.

The Art of Making Diamonds Has Its Difficulties

"Next night we took the blocks and sawed them nearly to the center and split them. There wasn't anything to be found in any of them except a little dirt and a blowhole. The professor scratched his head and said the graphite we had used wasn't the right quality.

"We tried lumps of coal the next night, but with no better results. Then I suggested that the center of the mold was the wrong place to get any squeeze—that iron always shrinks *away* from the center in a solid chunk and that we should not put the graphite in the center, but halfway between the center line and the edge. The professor agreed and I rammed up three molds, the professor sticking in the graphite chunks.

"Next evening I was on hand ahead of the professor and decided not to wait for him. I split the first block, with the same result as the night before—nothing there except what remained of the nail, and a blowhole.

"I got a surprise in the second block. When the pieces fell apart I could see a small dark object sticking out of one of them. My first thought was that it was the original piece of graphite, but it proved too hard for that, for I couldn't touch it with a smooth file.

"The professor arrived just as I was getting a chisel undercut finished around the thing to pry it out. He wasn't half as excited as I. 'Try it on the window glass,' he said. It left a mark on the glass like a skate track.

"'Come on, professor,' I yelled, grabbing my hat, 'I'm going to take this to Davis the jeweler and see what we've got.'

"Davis took the thing into his back room and came out after a few minutes. 'Its a rough diamond, Mr. Hope.' he said, handing it back. 'Not much good for an ornament, as the color is poor, but all right for commercial use. It's worth about $35, I should say.'

"It took a pretty big flask to hold $35 worth of cast iron, and if a 3-in. hole in the sand could turn out a diamond of that value, I saw where Dave Hope would become a millionaire very shortly.

"The professor took the diamond to send it to the college laboratory and have it analyzed so we could tell what to do to make the next ones whiter in color. Then I paid him his $250.

"We waited anxiously to hear from the college before making any more diamonds. On the third day the professor thought it would be a good plan for him to go to the college and hurry the analysis along. I carried his grip to the station for him and bought his ticket, as he had no small bills where he could conveniently get at them. I guess that analysis must have been a hard one, for he hasn't been back since!"

Reddy Burke Clears His Decks for Action

After finishing this bit of history Dave loaded up afresh with cigar clippings; Reddy Burke, on the other hand, was going through a process of unloading, part of which consisted in discarding the butt of his cigar, the other part in getting rid of a surplus of Navy Plug.

"Shpakin' of doiminds," said Reddy, "remoinds me of what happened to a surveyor up in Maine. Worruk bein' slack, he was kapin' his hand in be drawin' a map of his back yarrud. He left the corruk out on his ink bottle one noight whan the job was nearly complate, an' a poor unforchunate fly fell into the bottle. Be good luck an' parsivairance the insickt managed to crawell out again, restin' his fate on terry-fimy wance more—or in other worruds on the map. Bein' slightly intoxykated be the smell of the ink the poor craythur wandered zig-zag over the pahper, lavin' mysterious tracks behind him. Whin he reached the lokashun of the auld apple tray his head began to clear a bit, so he buzzed the ink off of his wings an' away he flew.

"Next mornin' whin the surveyor looked at his map he let out out a whoop that ye could hear fur a block. ''Tis the spirrits have done it,' says he, 'an' be the same token they've come to the pahrty that will apprayshiate it!' With that he took a good squint at the big blot near the apple tray, so as to fix its lokashun in his head. grabbed a shovel and made for the shpot. He dug an' dug until the sweat ran down his back an' his hands was bhlistered. 'Begorry,' says he, 'I wish the spirrits had done the job right, an' wrote down the dipth as well as the locashun. Well, here goes another lick for luck,' says he, an' at that his shpade hit against somethin' that had a ring to it. The shpade was too slow for him thin, so down on all fours he wint and clawed up the dirrt wid both hands. It wuz a shmall iron box ——"

Reddy stopped abruptly, for his discarded cigar had set fire to the waste paper basket and there was a general rush to get to the door before the fat man could block the exit. Some day I mean to find out what was in that box.

IDEAL SPEEDS IN GEOMETRICAL PROGRESSION

	1.10	1.11	1.12	1.13	1.14	1.15	1.16	1.17	1.18	1.189	1.20	1.21
1	1	1	1	1	1	1	1	1	1	1	1	1
2	1.10	1.11	1.12	1.13	1.14	1.15	1.16	1.17	1.18	1.19	1.20	1.21
3	1.21	1.23	1.25	1.28	1.30	1.32	1.34	1.37	1.39	1.41	1.44	1.46
4	1.33	1.37	1.40	1.44	1.48	1.52	1.56	1.60	1.64	1.68	1.72	1.77
5	1.46	1.52	1.57	1.63	1.69	1.75	1.81	1.87	1.94	2.00	2.07	2.14
6	1.61	1.68	1.76	1.84	1.92	2.01	2.10	2.19	2.29	2.37	2.48	2.59
7	1.77	1.87	1.97	2.08	2.19	2.31	2.44	2.56	2.70	2.82	2.98	3.13
8	1.95	2.07	2.21	2.35	2.50	2.66	2.83	3.00	3.18	3.36	3.58	3.79
9	2.14	2.30	2.47	2.66	2.85	3.06	3.28	3.51	3.75	4.00	4.30	4.59
10	2.36	2.55	2.77	3.00	3.25	3.51	3.80	4.11	4.43	4.76	5.16	5.55
11	2.59	2.84	3.10	3.39	3.70	4.04	4.41	4.81	5.23	5.66	6.19	6.72
12	2.85	3.15	3.47	3.83	4.22	4.65	5.12	5.62	6.17	6.73	7.43	8.13
13	3.14	3.49	3.89	4.33	4.81	5.34	5.94	6.58	7.28	8.00	8.91	9.84
14	3.45	3.88	4.36	4.89	5.49	6.15	6.89	7.70	8.59	9.51	10.70	11.91
15	3.80	4.30	4.88	5.53	6.26	7.07	7.99	9.00	10.13	11.30	12.84	14.41
16	4.18	4.78	5.47	6.25	7.13	8.13	9.27	10.54	11.96	13.45	15.41	17.43
17	4.59	5.30	6.12	7.06	8.13	9.35	10.75	12.33	14.11	16.00	18.49	21.10
18	5.05	5.88	6.86	7.98	9.27	10.75	12.47	14.42	16.65	19.03	22.19	25.53
19	5.56	6.53	7.68	9.02	10.57	12.36	14.47	16.87	19.65	22.63	26.62	30.89
20	6.11	7.25	8.60	10.19	12.05	14.22	16.78	19.74	23.19	26.91	31.95	37.37
21	6.72	8.05	9.64	11.51	13.73	16.35	19.46	23.10	27.36	32.00	38.34	45.22
22	7.40	8.93	10.79	13.01	15.65	18.80	22.58	27.02	32.28	38.05	46.01	54.72
23	8.14	9.91	12.09	14.70	17.85	21.62	26.19	31.62	38.09	45.25	55.21	66.21
24	8.95	11.00	13.54	16.61	20.35	24.86	30.38	36.99	44.95	53.82	66.26	80.12
25	9.85	12.21	15.16	18.77	23.19	28.59	35.24	43.28	53.04	64.00	79.51	96.95
26	10.83	13.56	16.98	21.21	26.44	32.88	40.88	50.64	62.59	76.11	95.4	117.3
27	11.91	15.05	19.02	23.97	30.14	37.81	47.42	59.25	73.86	90.51	114.4	141.9
28	13.10	16.70	21.30	27.08	34.36	43.48	55.01	69.32	87.15	107.6	137.3	171.7
29	14.41	18.54	23.86	30.60	39.17	50.01	63.81	81.11	102.8	128.0	164.8	207.8
30	15.86	20.58	26.72	34.58	44.66	57.51	74.02	94.89	121.3	152.0	197.8	251.4
31	17.44	22.84	29.92	39.07	50.91	66.13	85.87	111.0	143.1	181.0	237.4	304.2
32	19.19	25.36	33.52	44.15	58.04	76.05	99.61	129.9	168.9	215.3	284.9	368.1
33	21.10	28.14	37.54	49.89	66.16	87.46	115.5	151.9	199.3	256.0	341.8	445.4
34	23.21	31.24	42.04	56.38	75.43	100.5	134.0	177.8	235.2	304.4	410.2	539.0
35	25.54	34.68	47.09	63.70	85.99	115.6	155.5	208.0	277.6	362.0	492.3	652.2
36	28.09	38.49	52.74	71.99	98.02	133.0	180.3	243.4	327.5	430.5	590.7	789.1
37	30.90	42.72	59.06	81.35	111.7	152.9	209.2	284.8	386.5	512.0	708.9	954.9
38	33.99	47.42	66.15	91.92	127.4	175.9	242.7	333.2	456.1	608.9	850.7	1155.0
39	37.39	52.64	74.09	103.8	145.2	202.3	281.5	389.8	538.2	724.0	1020.0	1398.0
40	41.13	58.43	82.98	117.3	165.5	232.6	326.5	456.1	635.1	861.1	1225.0	

	1.22	1.23	1.24	1.25	1.26	1.27	1.28	1.30	1.32	1.34	1.36	1.38	1.414	1.45	1.50	1.55	1.60
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1.22	1.23	1.24	1.25	1.26	1.27	1.28	1.30	1.32	1.34	1.36	1.38	1.41	1.45	1.50	1.55	1.60
3	1.48	1.51	1.53	1.56	1.58	1.61	1.63	1.69	1.74	1.79	1.85	1.90	2.00	2.10	2.25	2.40	2.50
4	1.81	1.86	1.90	1.95	2.00	2.04	2.09	2.19	2.29	2.40	2.51	2.62	2.83	3.04	3.37	3.72	4.09
5	2.21	2.28	2.36	2.44	2.52	2.60	2.68	2.85	3.03	3.22	3.42	3.62	4.00	4.42	5.06	5.77	6.55
6	2.70	2.81	2.93	3.05	3.17	3.30	3.43	3.71	4.00	4.32	4.65	5.00	5.66	6.40	7.59	8.94	10.48
7	3.29	3.46	3.63	3.81	4.00	4.19	4.39	4.82	5.28	5.79	6.32	6.90	8.00	9.29	11.38	13.86	16.77
8	4.02	4.25	4.51	4.76	5.04	5.32	5.62	6.27	6.98	7.75	8.60	9.52	11.31	13.47	17.08	21.49	26.84
9	4.90	5.23	5.59	5.95	6.35	6.76	7.20	8.15	9.21	10.39	11.70	13.14	16.00	19.53	25.62	33.31	42.95
10	5.98	6.44	6.93	7.44	8.00	8.59	9.22	10.60	12.16	13.93	15.91	18.14	22.63	28.33	38.43	51.63	68.72
11	7.29	7.92	8.59	9.30	10.08	10.91	11.80	13.78	16.05	18.66	21.65	25.03	32.00	41.08	57.65	80.03	109.9
12	8.90	9.74	10.66	11.63	12.70	13.85	15.10	17.92	21.19	25.01	29.44	34.54	45.25	59.56	86.48	124.0	175.9
13	10.86	11.98	13.22	14.54	16.01	17.60	19.33	23.29	27.97	33.52	40.04	47.67	64.00	86.37	129.7	192.2	281.4
14	13.25	14.74	16.39	18.17	20.17	22.35	24.75	30.28	36.92	44.91	54.46	65.79	90.51	125.2	194.5	298.0	450.3
15	16.17	18.13	20.32	22.71	25.42	28.38	31.68	39.37	48.73	60.19	74.06	90.79	128.0	181.5	291.8	461.9	720.6
16	19.72	22.30	25.20	28.39	32.02	36.05	40.55	51.18	64.33	80.65	100.7	125.2	181.0	263.3	437.8	715.9	1152.0
17	24.06	27.43	31.25	35.49	40.35	45.78	51.91	66.53	84.92	108.0	136.9	172.9	256.0	381.8	656.7	1109.0	1844.0
18	29.36	33.73	38.75	44.37	50.84	58.14	66.44	86.49	112.0	144.8	186.3	238.6	362.0	553.6	985.0	1720.0	
19	35.82	41.49	48.05	55.46	64.06	73.84	85.05	112.4	147.9	194.0	253.3	329.2	512.0	802.7	1477.0		
20	43.70	51.04	59.58	69.33	80.72	93.78	108.8	146.1	195.3	260.0	344.5	454.3	724.0	1163.0			
21	53.31	62.78	73.89	86.66	101.7	119.1	139.3	190.0	257.8	348.4	468.6	627.0	1024.0	1687.0			
22	65.04	77.22	91.62	108.3	128.1	151.2	178.3	247.0	340.3	466.9	637.3	865.3	1444.0				
23	79.35	94.98	113.6	135.4	161.4	192.1	228.3	321.1	449.2	625.6	866.8	1194.0					
24	96.81	116.8	140.8	169.2	203.4	243.9	292.2	417.4	592.9	838.4	1178.0	1647.0					
25	118.1	143.7	174.6	211.5	256.3	309.8	374.0	542.7	782.7	1123.0	1603.0						
26	144.1	176.7	216.6	264.4	323.0	393.5	478.7	705.5	1033.0	1505.0							
27	175.8	217.4	268.6	330.6	407.0	499.7	612.8	917.2	1363.0								
28	214.4	267.4	333.0	413.2	512.8	634.7	784.4	1192.0									
29	261.6	328.9	413.0	516.5	646.1	806.0	1004.0	1550.0									
30	319.2	404.5	512.1	645.7	814.1	1023.0	1285.0										
31	389.4	497.6	635.0	807.1	1025.0	1300.0											
32	475.1	612.0	787.4	1008.0	1292.0												
33	579.6	752.8	976.4	1261.0													
34	707.2	925.9	1210.0	1576.0													
35	862.8	1138.0	1501.0														
36	1052.0	1400.0															
37	1284.0																
38	1566.0																
39																	
40																	

Cone-Pulley Speed Table*

In the accompanying table are shown ideal speeds arranged in geometric progression. They will be found useful in designing machine tools or in similar work. However, as only a small part of the table will be used for this purpose in any one case, no doubt its greater usefulness will be in checking up old machine tools made with odd gear-speed ratios. The geometric ratios compiled are from 1.10 to 1.60 inclusive; in the lower ratios each is applied to 40 speeds and in the higher up to a speed of about 1,200 r.p.m.

The table is somewhat similar to one compiled by P. V. Vernon and published on page 80 of the "Handbook for Machine Designers and Draftsmen," by F. A. Halsey.

The chief difference is that in this table the ratios are expressed as multipliers, while in the former they are given as percentages. The other difference is that the speeds increase, reading down the column, instead of decrease. The arrangement given in the table shown here, it is believed, will be handier than the one referred to.

To use this table, proceed as follows: Find the desired ratio of the progression at the top of one of the columns. The numbers in this column are multipliers that, multiplied by the lowest speed in revolutions per minute, give the other speeds of the series, the multiplier for the highest speed being the overall ratio of the set.

More often the problem must be worked in the opposite direction, in which case divide the highest by the lowest desired speed, thus finding the overall ratio of the set. In the left-hand column find the number of speeds desired and follow its line to the right until the value nearest the desired overall ratio is found. At the top of this column will be found the ratio of the progression, the numbers in the columns forming, as before, multipliers that, multiplied by the lowest speed, give the other speeds of the set as accurately as is possible without smaller ratio increments, those given being small enough for all practical requirements.

A column based on Mr. Barth's ratio $(\sqrt[4]{2} = 1.189)$ is included. In this series each speed is exactly twice that of the fourth one above it. This relation is most convenient, and the low value of the ratio of the progression permits close adjustment of the speed to the requirements. However, it introduces more speeds than many designers will admit. In such cases the modified ratio $(\sqrt{2} = 1.41)$, which is also included in the table, may be used if it not considered too large, though it should always be so considered. In this series each speed is twice that of the second one above it.

Definite Boiling Points of Metals

All metals have definite boiling points under atmospheric pressure, lower boiling points at lower pressures, and can evaporate at any temperatures down even to their freezing points, if the pressure is sufficiently reduced, according to Prof. J. W. Richards.

The metals will also vaporize at low temperatures in the presence of an indifferent gas, if the latter is renewed as fast as it becomes saturated with the vapor of the metal. It is even true that metals, like ice, have some vapor tension in the solid state, quite sufficient to cause their vaporization, especially in indifferent gas.

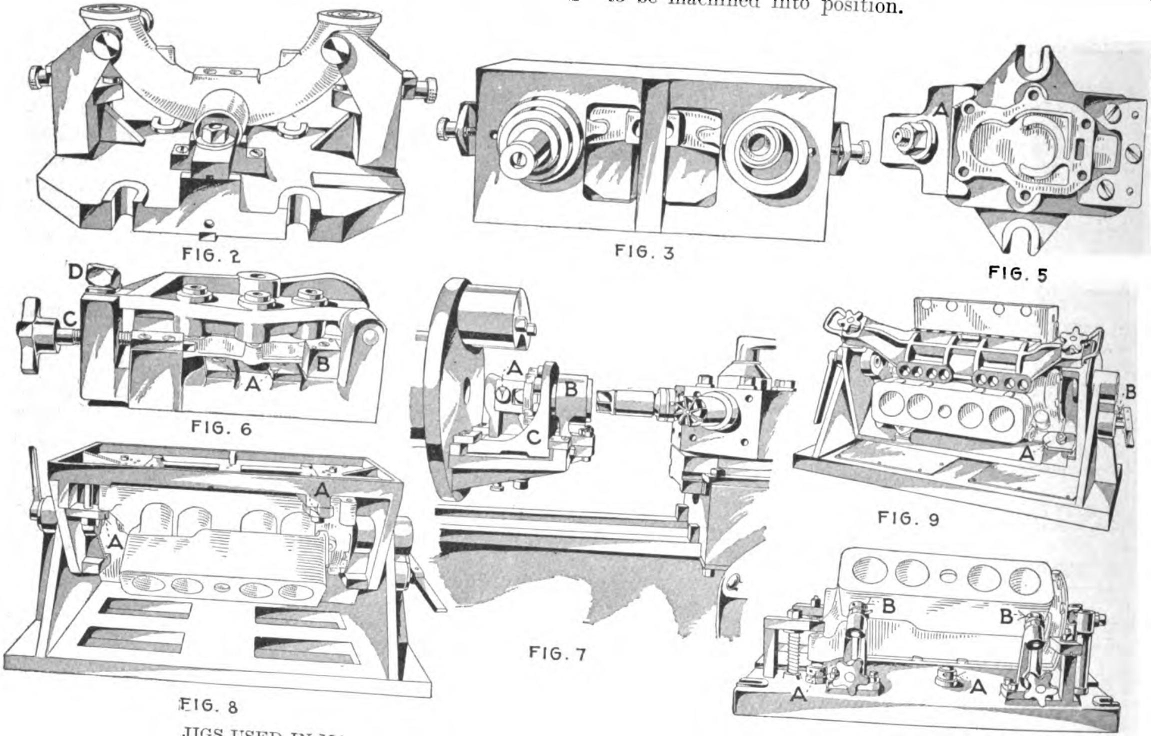
Jigs for V-Motor Parts

By Robert Mawson

SYNOPSIS—In this article are shown jigs used in machining some of the detail parts used on an 8 V-motor. When machining the intake manifold, V-blocks are used to locate the casting in position.

On page 19 was described the 8 V-motor manufactured by the Ferro Machine and Foundry Co., Cleveland, Ohio. Articles illustrating various jigs, fixtures and methods used in machining different parts used on this motor appeared on pages 14, 98, 186 and 272. In this article other parts are discussed in a similar manner and the same high-grade small-tool construction will be observed.

The operations on the oil-pump gear housing are milling, drilling and boring, the tools used being shown. It will be observed that on the tools employed for performing machining operations on the cylinder an index pin fitting into the correct location brings the surface to be machined into position.



JIGS USED IN MACHINING DETAILS OF 8 V-MOTOR WITH WORK IN POSITION

FIGS. 2 AND 2-A

Operation—Milling manifold. The rough casting is located by V-blocks at each end and held by a strap at the lower end. Knurled-head screws are tightened against the upper end.

Surfaces Machined—Joint surfaces on pipe, using a 4-in. mill at 75 r.p.m. with a feed of 0.083 in. per revolution.

FIGS. 3 AND 3-A

Operations—Drilling and counterboring gas and water inlet flanges in manifold. The casting is located by a V-block at each end and held down by two knob-operated screws.

Holes Machined—Two 1$\frac{3}{16}$-in. drilled and an annular recess counterbored 1$\frac{13}{16}$x2$\frac{7}{16}$ in.

FIGS. 5 AND 5-A

Operation—Milling gear housing. The rough casting is placed on four adjustable pins and held by the clamp A.

Surface Machined—Milling joint surface, using a 6-in. mill at 62 r.p.m. with a feed of 0.015 in. per revolution.

FIGS. 6 AND 6-A

Operation—Drilling gear housing. The milled casting is placed on hardened-steel blocks A and forced against the V-block B with the knob-headed screw C. The cover is then dropped dcwn and held with the thumb-screw D.

Holes Machined—Six $\frac{11}{32}$-in. drilled.

FIGS. 7 AND 7-A

Operation—Boring gear housing. The milled and drilled casting is located on dowels that fit into drilled holes. The open-sided clamp A is tightened against the casting with a knob-headed screw.

Holes Machined—Tools in the turret are fed through bushing B and the first hole bored, reamed and faced. The casting and fixture C are then slid to the second position, against a stop pin, and the second hole machined.

FIGS. 8 AND 8-A

Operation—Drilling bearing-cap bolt holes in cylinder, page —. The casting is located by dowels in reamed holes. Four straps, as A, are then tightened to hold it in position.

Holes Machined—Six $\frac{7}{16}$-in. drilled, which are later tapped with ½-in. U.S.S. threads.

FIGS. 9 AND 9-A

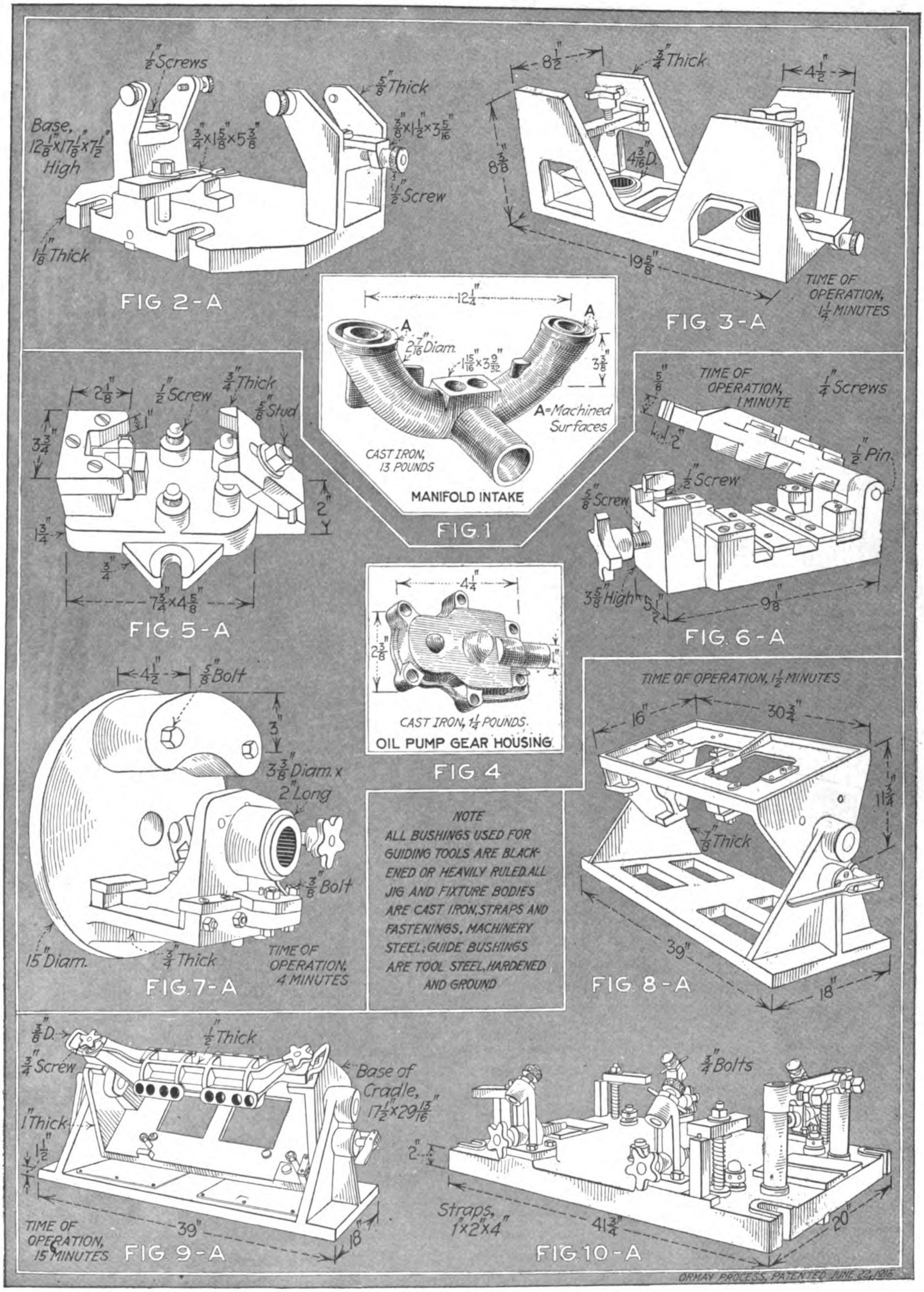
Operations—Milling head-joint surfaces on cylinder. The casting is placed on adjustable poppets A, and held with straps at each end. The adjustable poppets B are then tightened against the side to resist the cutting stresses.

Surfaces Machined—Cylinder-head joints, using two 16-in. cutters at 16 r.p.m., feed of 0.190 in. per revolution.

FIGS. 10 AND 10-A

Operations—Drilling and reaming valve holes in cylinder. The casting is located by dowels in reamed holes and held by straps A.

Holes Machined—Sixteen 1$\frac{15}{64}$-in. drilled and reamed 1¼ in. The jig is indexed on its axis, the positions obtained by the pin B.



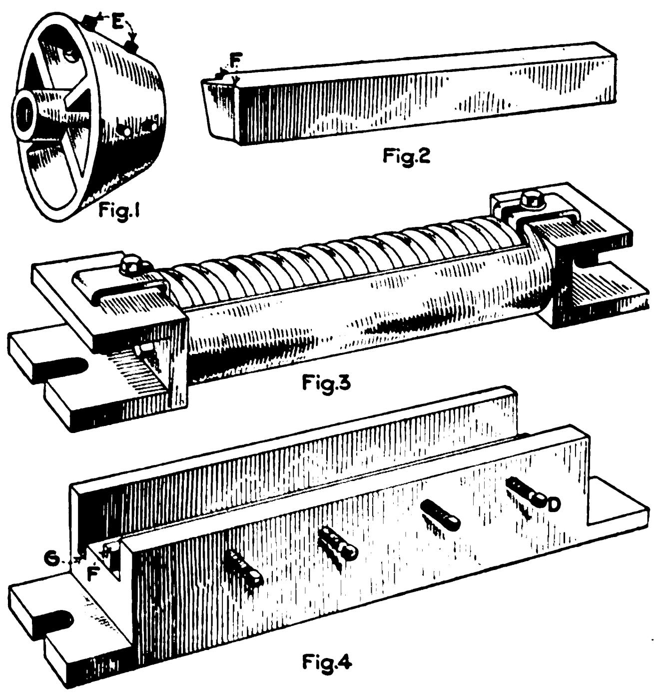
DETAILS OF JIGS USED IN MACHINING 8 V-MOTOR PARTS

Making Gear Racks from Pipe

By J. A. DeTurk and Gustav H. Radebaugh

The method of gear-rack cutting explained herewith has produced parts used in special thermometer-plate engraving machinery with satisfaction in every respect. In the manufacture of these thermometer plates accuracy in all machined parts of the engraving machine is essential to produce the proper calibration of the scale. The gear racks perform important time operations in relation to other parts of the machine, and the machine is governed entirely by the forces acting through the racks. In choosing stock, steel pipe of extra-heavy strength, of a diameter not smaller than 12 in., is selected. The thickness is governed by the thickness of the finished rack, and extra-heavy strength pipe finishes nicely to $\frac{5}{16}$ in. Standard thickness will finish to $\frac{1}{4}$ in.

The pipe is placed in the lathe by chucking one end and supporting the other by a tailstock pipe center. This method, however, allows it to be finished to within only 2 or 3 in. of the chuck end. Probably a more efficient way would be to place it between pipe centers, the head-



FIGS. 1 TO 4. FIXTURES AND TOOLS FOR MAKING RACKS FROM PIPE

stock center being the driver. This arrangement would permit the full length of the pipe to be machined. By referring to Fig. 1, it will be noticed that such a headstock center is made to screw on the nose of the lathe spindle, the pipe being adjusted concentric and driven by the setscrews *E*.

In cutting the gear-tooth thread in the lathe it is necessary to cut the pitch of the thread equal to the desired pitch of rack. The threading tool is carefully ground to the finished form of the desired tooth. Two tools are used conforming with the shape of the tooth—one for roughing, the other a specially formed tool, Fig. 2, for the finishing and gaging cut. Referring to Fig. 2, the faces *F* act as a stop or depth gage, the depth of the tooth being accurately governed by the tool. To obtain the best results the finishing tool should not remove more than 0.001 in. of stock. A good supply of soa[illegible] lubricant gives a satisfactory finish. After the gear-tooth form of thread is cut on the pipe, it is clamped on the platen of the miller by two finger clamps, precaution being taken to protect the finish thread by placing cardboard strips between the platen and pipe before clamping the latter in place. The rack is sawed out $\frac{1}{16}$ in. wider than the finished rack, using a good stiff milling saw to give a straight cut.

This method of clamping is used until about half of the stock is cut up in this manner. Then it becomes necessary to clamp the pipe on a special fixture consisting of a pipe of about the same outside diameter as the inside of the work. This special fixture may be clamped to the platen of a miller and the work held to it by means of two clamps, as shown by Fig. 3.

After sawing up, a rack is unfinished on the bottom. Fig. 4 shows a clamping block, which after removing all burrs from the rack, is clamped by tightening the screws *D*. The rack so held is then faced down to thickness with a slab miller. It is next placed in the slot *G*, a liner of proper thickness placed between *F* and the rack, the setscrews *D* tightened and $\frac{1}{32}$ in. milled from one side. It is then changed to the opposite side and milled.

Upon close inspection of the rack a small burr is found in the space of each tooth. This is easily removed by brushing the teeth with a small flexible wire brush.

A rack produced by this method should never be coarser than 20 diametral pitch.

Figuring Turning Speeds

By Henry M. Wood

A short-cut rule for quick mental calculation of turning speeds on a lathe or boring mill is: Multiply one-half the revolutions (per minute) by half the diameter (in inches). Add 1 for every 25 in the product. The result is the cutting speed in feet per minute.

Example: What is the cutting speed on a $1\frac{1}{2}$-in. diameter at 400 revolutions per minute?

Solution: $200 \times \frac{3}{4} = 150$; $150 \div 25 = 6$; $150 + 6 = 156$ ft. per min.

Frequently the following statement of the same formula is more convenient, as it avoids dividing the diameter, which sometimes makes a troublesome fraction: Multiply one-quarter the revolutions (per minute) by the diameter (in inches). Add 1 for every 25 in the product. The result is the cutting speed in feet per minute.

Example: What is the cutting speed on a $1\frac{1}{8}$-in. diameter at 440 ft. per min.?

Solution: $110 \times \frac{9}{8} = 124$; $124 \div 25 = 5$; $124 + 5 = 129$ ft. per min.

To see how closely this "rule of thumb" formula approximates the theoretical formula in accuracy, reduce both to similar terms in the latter example:

Practical formula: $\frac{1}{4} \times 440 \times \frac{9}{8} \times 1\frac{1}{25}$, or 440 (revolutions) $\times \frac{9}{8}$ (diameter) $\times$ 0.260.

Theoretical formula: $3.1416 \times 440 \times \frac{9}{8} \times \frac{1}{12}$, or 440 (revolutions) $\times \frac{9}{8}$ (diameter) $\times$ 0.262.

This comparison shows that, when both formulas are reduced to similar terms, the discrepancy between the "constants" is only the difference between 0.260 and 0.262. This difference represents the amount of error, which is usually so much less than the error in roughly measuring the diameter or the revolutions per minute that it is entirely negligible.

How To Set Machine-Hour Rates

By A. G. Popcke*

SYNOPSIS—A complete outline of the method used to set machine-hour rates in a shop department having four subdivisions, occupying 83,000 sq.ft. of floor area and having 61 machine tools. The determined rates for each machine are given. These range from $5.69 per hour for a 14-ft. planer to $0.04 per hour for a 12-in. lathe.

Every shop superintendent before hiring a machinist determines very carefully what rate he is willing to pay him. When purchasing a machine tool, does he inquire what its cost per hour will be? The tendency at the present time is to install labor-saving machinery and employ unskilled labor. The ratio of hourly cost of operating machinery to the workman's wages is therefore increasing and is in most cases equal to and often two or three times the workmen's hourly rate. To have the shop superintendent know the cost of operating each tool per hour is therefore fully as important as the question of wages.

In addition to the workmen's wages, every shop has the following expenses: (1) Interest and depreciation on cost of buildings and accessories; (2) repairs and renewals to existing equipment; (3) general operating expenses, including losses due to defective workmanship, design and material; (4) salaries of supervisors, engineering staff and clerks.

These overhead charges must be included in the cost of any manufactured article. A method frequently employed is to determine from time to time the percentage which the total overhead charge bears to the cost of total actual or productive labor. This ratio in large shops reaches from 100 to 200 per cent., or even more. The total labor charge is then obtained by multiplying the actual labor cost by one, plus the per cent. to be added for the overhead charge.

This is an easy way to take care of the overhead charge, but the method is inaccurate and does not show the relative importance of different types and sizes of machines. This statement is especially true where a great variety of materials is manufactured, in shops using a large number of different types and sizes of tools. Under such conditions the percentage obviously varies within wide limits for different kinds of work.

A satisfactory method of distribution is to set off against each machine its proportion of the total overhead charges. The portion chargeable to each depends entirely on local conditions, and thorough familiarity with the conditions is needed in order to apportion these charges equitably. In this way the relative importance of each machine is taken care of.

In a shop where only one type of article is manufactured and the castings are passed from one machine directly to the next, a simple and logical plan is to divide the total overhead charge among the machines in proportion to the floor space charged to each. In the majority of shops, however, the above simple condition does not exist; several sizes and kinds of articles are usually turned out, and various sizes and types of machines, differing greatly in their operating characteristics, are employed. In such cases not only must the floor space be considered, but also the time each machine is actually in operation, the nature of the work and the amount of supervision and engineering attention needed.

Large shops handling different classes of materials are in most cases divided into various departments or sections, and each section may be considered as a separate smaller factory. The overhead charges against each department may thus be apportioned among its tools in proportion to the floor space occupied, making proper allowance for special local conditions, or special supervision or engineering attention. Here again is required thorough familiarity with both the engineering and shop features of the materials manufactured.

The following analysis outlines a method of determining the hourly overhead charges per machine tool, which

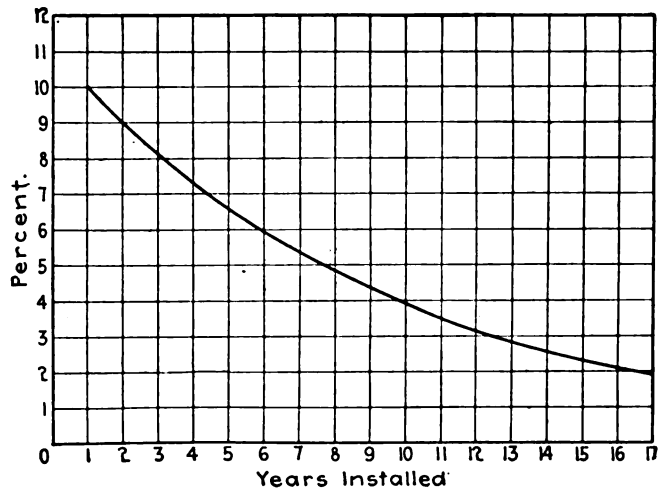


FIG. 1. DEPRECIATION CURVE AT 10 PER CENT. REDUCING BALANCE

will be called the machine-hour rates. Overhead charges can be grouped in three main classes as follows:

1. Charges Against the Entire Factory—(a) Fixed charges; these include interest and depreciation, taxes and insurance on buildings, grounds and accessories. (b) Variable charges; these include repairs and renewals on buildings and accessories, omitting all charges which can be set off directly to a particular section of the factory; charges against the storeroom and toolroom; defective design, material or workmanship; printing and stationery; lubricants and general manufacturing supplies. (c) Salaries (not chargeable to a definite section); these include cost of superintendence (manager, superintendent, foreman); engineering and drawing; clerical force, including office boys and general laborers.

2. Charges Against Each Section of the Factory—(a) Fixed charges, including an equitable portion of the total factory fixed charge and interest, and depreciation on auxiliary apparatus located in the section (except machine tools). (b) Variable charges; these include a portion of the variable charges as well as similar charges belonging to the section, such as repairs and renewals, storeroom and toolroom charges, defective design, material and workmanship, lubricants and manufacturing supplies. (c) Salaries, including a portion of the total salaries as

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well as those belonging exclusively to the section; that is, foremen, clerks, errand boys, laborers, cranemen, etc.

3. Charges Against Each Machine Tool—(a) Portion of fixed charge; (b) portion of variable charge; (c) portion of salaries charge; (d) interest on cost of machine tool, fairly taken at 6 per cent.; (e) depreciation of value of tool (see following explanation); (f) cost of power to operate tool, including also lighting and crane service.

A method frequently used in calculating the depreciation in value of a machine tool is to allow 10 per cent. of a reducing balance; that is, 10 per cent. of the first cost the second year, and 10 per cent. of the second remainder the third year, etc. This method is based upon the fact that the apparatus actually decreases in value year by year. Allowance for depreciation in any given year can be made easily by the aid of the curve in Fig. 1. This curve gives the percentage of the first cost corresponding each year to 10 per cent. on the reduced balance. For example, the curve shows that the depreciation on a tool that has been in service five years will be 6.6 per cent. of the original cost. If this cost was $4,500, the allowance for depreciation during the sixth year according to the 10 per cent. reducing-balance method is $4,500 × 0.066 = $297. Since this is 10 per cent. of the reduced cost, the value of the machine at the end of the fifth year is $2,970.

Machine tools designed for special work will be discontinued after a comparatively limited period and therefore depreciate in value much more rapidly than is indicated by the foregoing method; a special allowance frequently made for such tools is known as utility depreciation.

An example will follow showing how the machine-hour rates were determined in a section of a large manufacturing organization. The total floor space of this section consisted of the following divisions:

	Sq.Ft.	Per Cent. of Total Floor Space
Machine tool	35,900	43
Assembling and winding	15,700	19
Testing	15,700	19
Assembled to ship	15,700	19
		100

The 35,900 sq.ft. of floor space occupied by the machine-tool department was divided among the machines in the following manner: The actual floor space occupied by each machine tool was determined. This is given in Table 1, column 4. The sum of these actual floor spaces was 17,350 sq.ft. The remaining 18,550 sq.ft. was divided proportionately among the various machines.

Suppose m equals the actual floor space occupied by a certain machine tool and M equals the sum of all actual floor spaces of all machines (in this case 17,350 sq.ft.); then the ratio of m to M is the percentage of the remaining floor space charged to the machine under consideration. This ratio is given in Table 1, column 5.

Column 6 gives the supplementary floor space charged to each machine tool. This is obtained by taking an m of M percentage of the remaining 18,550 sq.ft. The total floor space charged to each machine tool is indicated in column 7. This is the sum of the actual and the supplementary floor spaces. The sum of all the total floor spaces in this table is equal to the floor space of the machine-tool division, 35,900 sq.ft.

The division made, as just explained, is based on the fact that the larger tools work upon larger castings, which occupy a greater amount of storage space while waiting to be machined.

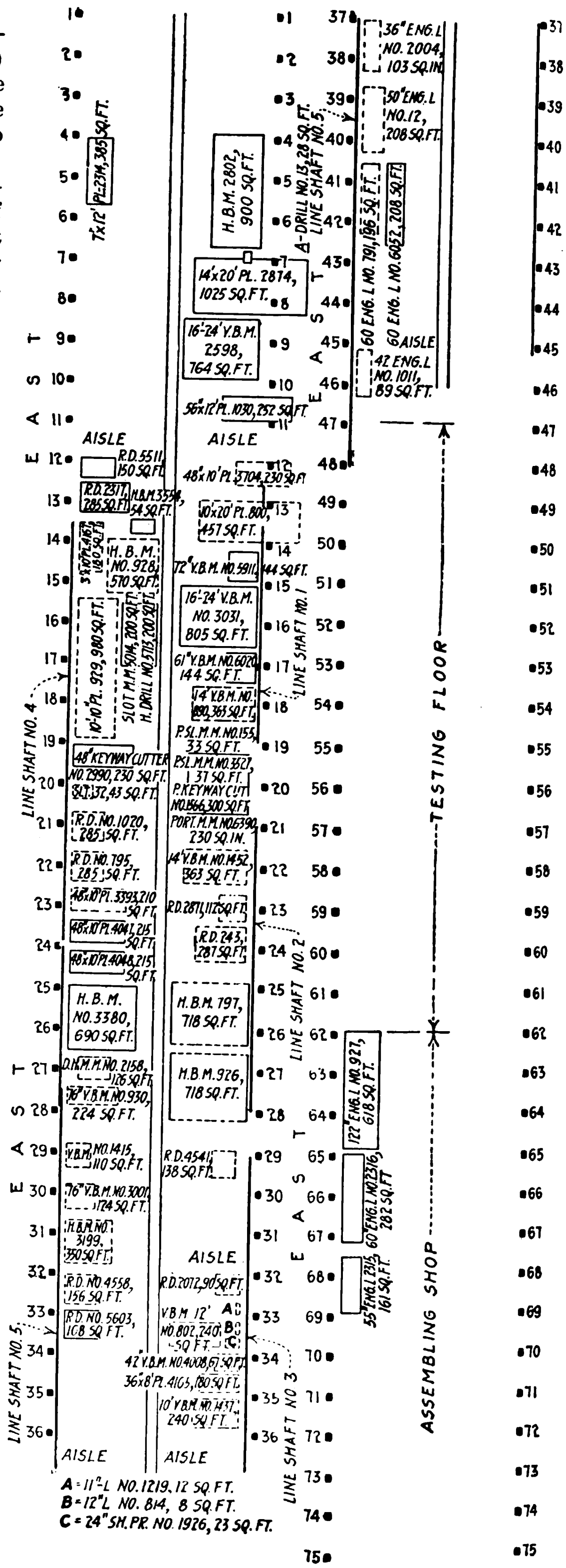


FIG. 2. LOCATION AND SPACE OCCUPIED BY THE VARIOUS MACHINE TOOLS

The plan shown in Fig. 2 shows the location of all the machine tools. Each rectangle represents the tool thereon designated. The area of the rectangle is proportionate to the actual floor space occupied. The symbols in Table 1, column 3, give the location of all the tools. The letters *E* and *W* refer to the east and west sides of the building. The numbers refer to the columns at the sides of the building. Thus vertical boring mill No. 2598 is located by *W*-9—column 9 on the west side of the building; planer No. 2314 is located at column 5 on the east side, designated by *E*-5.

The charges against the machine-tool department are divided as follows: (1) Variable charges; (2) fixed charges—(a) salaries, (b) interest and depreciation on auxiliary apparatus; (3) interest and depreciation on machine tools; (4) cost of power; (5) shipping charge.

Variable charges consist of the items given in Table 2. The amount of each of these charges is given for the total building. This value is divided among the machine-tool, assembling and testing departments as indicated by the percentages next to the amount in dollars.

Wherever the percentage 43, 38 or 19 is used, the division is made according to the percentage of total floor space. Other percentages are used where this division is not suitable. For example, patterns are charged 50 per cent. to machine tool and 50 per cent to assembling, none being charged to test. New dies and formers are charged entirely to assembling or winding. Repairs to tools are charged 90 per cent. to machine tool and 10 per cent. to assembling and winding.

All the charges in Table 2 cover six months' operation. The number of working hours per year, based on 54 hours per week, is 52 × 54 = 2,808 hours per year. From this table the variable charge per hour per square foot is derived as follows:

Total variable charges (six months)	$63,920
Number of hours (six months)	1,404
Number of square feet (machine-tool department)	35,900
Charge per hour ($63,920 ÷ 1,404)	$45.50
Charge per hour per square foot ($45.50 ÷ 35,900)	$0.00127

The variable charges are divided among the following items as indicated by the percentages:

	Per Cent.
Repairs and renewals to tools	26.0
Nonproductive sections	20.0
Defective workmanship	14.0
Defective design	12.2
Stores	7.4
Defective material	5.3
Miscellaneous	3.5
Repairs to electrical plant	3.0
Repairs to mechanical plant	2.8
Patterns	2.7
Repairs and renewals to buildings, etc	2.5
Lost material	0.6
	100.0

TABLE 1. SUMMARY OF CHARGES INCLUDED IN MACHINE-HOUR RATES FOR THE VARIOUS MACHINE TOOLS*

1	2	3	4	5	6	7	8	9	10	12	13	14	15	16
								Fixed Charges						
Tag No.	Machine Tool	Location	Actual Floor Space (M.)	Per Cent. m : M	Supplementary Floor Space	Total Floor Space	Variable Charges	Salaries	Interest and Depreciation Aux. Apparatus	Machine Tool Interest	Machine Tool Depreciation	Power	Shipping	Total Charge
4,008	42-in. VBM	W-34	67	0.39	73	140	0.18	0.10	....	0.04	0.04	0.01	0.06	0.43
1,415	48-in.	E-29	110	0.64	119	229	0.29	0.15	0.01	0.05	0.02	0.01	0.09	0.62
3,001	60-in.	E-30	124	0.72	133	256	0.33	0.17	0.01	0.07	0.06	0.01	0.10	0.75
6,020	61-in.	W-17	144	0.83	155	299	0.38	0.20	0.01	0.06	0.09	0.01	0.12	0.87
5,911	72-in.	W-15	144	0.83	155	299	0.38	0.20	0.01	0.08	0.09	0.01	0.12	0.89
930	76-in.	E-29	224	1.30	242	466	0.59	0.31	0.02	0.08	0.04	0.01	0.19	1.24
1,437	10-ft.	W-35	240	1.39	258	498	0.63	0.31	0.02	0.08	0.04	0.02	0.20	1.32
802	12-ft.	W-33	240	1.39	258	498	0.63	0.33	0.02	0.13	0.07	0.02	0.20	1.40
890	14-ft.	W-18	363	2.10	390	753	0.96	0.49	0.03	0.20	0.07	0.02	0.30	2.07
1,452	14-ft.	W-22	363	2.10	390	753	0.96	0.49	0.03	0.18	0.09	0.02	0.30	2.07
2,598	16- to 24-ft.	W-9	764	4.40	817	1,581	2.01	1.04	0.06	0.23	0.17	0.03	0.63	4.17
3,031	16- to 24-ft.	W-16	805	4.66	865	1,670	2.12	1.10	0.06	0.37	0.30	0.03	0.67	4.65
13	3-ft., 6 DR	W-7	60	0.35	65	125	0.16	0.08	....	0.005	0.002	0.01	0.05	0.31
2,072	5-ft. RD	W-32	90	0.52	97	187	0.24	0.12	....	0.005	0.002	0.01	0.07	0.45
2,871	5-ft. RD	W-23	112	0.65	121	233	0.30	0.15	0.01	0.02	0.02	0.01	0.09	0.60
4,541	6-ft. RD	W-29	138	0.80	149	287	0.36	0.19	0.01	0.02	0.03	0.01	0.12	0.74
5,511	5-ft. RD	E-12	150	0.87	162	312	0.40	0.21	0.01	0.03	0.01	0.01	0.13	0.80
5,603	5-ft. RD	E-33	168	0.97	181	349	0.44	0.23	0.01	0.03	0.04	0.01	0.14	0.90
5,713	Hor. DR	E-17	200	1.16	216	416	0.53	0.27	0.01	0.08	0.13	0.01	0.17	1.20
4,558	6-ft., 6-in. RD	E-32	256	1.48	275	531	0.67	0.35	0.02	0.01	0.01	0.01	0.21	1.28
2,317	6-ft., 6-in. RD	E-13	285	1.65	306	591	0.75	0.39	0.02	0.08	0.06	0.01	0.24	1.55
1,020	6-ft., 6-in. RD	E-21	285	1.65	306	591	0.75	0.39	0.02	0.03	0.01	0.01	0.24	1.43
795	6-ft., 6-in. RD	E-22	285	1.65	306	591	0.75	0.39	0.02	0.03	0.02	0.01	0.24	1.48
243	7-ft. RD	W-24	287	1.66	310	597	0.76	0.39	0.02	0.07	0.04	0.01	0.24	1.53
3,554	HBM	E-14	54	0.31	58	112	0.14	0.07	....	0.06	0.05	0.01	0.04	0.37
3,199		E-31	350	2.03	378	728	0.93	0.48	0.03	0.08	0.06	0.01	0.29	1.88
928		E-15	570	3.30	615	1,185	1.50	0.78	0.04	0.15	0.07	0.01	0.48	3.03
3,380		E-26	690	4.00	746	1,436	1.82	0.95	0.05	0.25	0.22	0.01	0.58	3.88
797		W-25	720	4.17	776	1,496	1.90	0.99	0.05	0.21	0.11	0.01	0.60	3.87
926		W-27	720	4.17	776	1,496	1.90	0.99	0.05	0.16	0.08	0.01	0.60	3.79
2,802		W-5	900	5.20	970	1,870	2.38	1.23	0.07	0.46	0.36	0.01	0.75	5.26
	Lathes													
814	12-in.	W-33	8	0.04	7	15	0.02	0.01	....	....	....	....	0.006	0.04
1,219	11-in.	W-33	12	0.07	13	25	0.03	0.02	....	....	....	....	0.01	0.06
1,011	42-in.	E-45	89	0.52	97	186	0.24	0.13	....	0.04	0.02	0.01	0.08	0.52
2,004	36-in.	E-37	103	0.60	102	205	0.26	0.14	....	0.04	0.02	0.01	0.08	0.55
2,315	55-in.	E-68	161	0.93	175	336	0.43	0.22	0.01	0.06	0.04	0.01	0.13	0.90
791	60-in.	E-41	196	1.13	211	407	0.52	0.27	0.01	0.06	0.03	0.01	0.16	1.06
12	50-in.	E-39	208	1.20	225	433	0.55	0.29	0.02	0.05	0.02	0.01	0.17	1.11
6,052	60-in.	E-41	208	1.20	225	433	0.55	0.29	0.02	0.12	0.08	0.01	0.17	1.24
2,316	60-in.	E-66	282	1.63	305	586	0.75	0.39	0.02	0.08	0.06	0.01	0.23	1.54
927	122-in.	E-63	618	3.58	667	1,285	1.63	0.84	0.04	0.39	0.16	0.02	0.49	3.57
	Planers													
4,165	36-in.	W-35	180	1.00	195	375	0.48	0.25	0.01	0.02	0.02	0.01	0.15	0.94
4,167	36-in.	E-14	180	1.00	195	375	0.48	0.25	0.01	0.02	0.02	0.01	0.15	0.94
3,393	48-in.	E-23	215	1.25	233	448	0.57	0.30	0.02	0.06	0.03	0.01	0.18	1.17
4,047	48-in.	E-24	215	1.25	233	448	0.57	0.30	0.02	0.06	0.06	0.01	0.18	1.20
4,048	48-in.	E-24	215	1.25	233	448	0.57	0.30	0.02	0.06	0.06	0.01	0.18	1.20
3,704	48-in.	W-12	231	1.34	250	481	0.61	0.32	0.02	0.06	0.05	0.01	0.19	1.26
1,030	56-in.	W-10	252	1.46	272	524	0.67	0.35	0.02	0.06	0.03	0.02	0.21	1.36
2,314	7-ft.	E-5	385	2.23	415	800	1.02	0.53	0.03	0.11	0.08	0.02	0.32	2.11
800	10-ft.	W-14	457	2.75	510	967	1.23	0.64	0.03	0.19	0.09	0.02	0.39	2.59
929	130-in.	E-17	980	5.69	1,060	2,040	2.59	1.35	0.07	0.15	0.07	0.03	0.82	5.08
2,874	14-ft.	W-7	1,025	5.94	1,110	2,135	2.71	1.42	0.08	0.34	0.26	0.03	0.85	5.69
32	SLTR	E-20	43	0.25	47	90	0.11	0.06	....	0.04	0.02	0.01	0.04	0.28
1,926	24-in. SHPR	W-34	23	0.13	24	47	0.06	0.03	....	0.01	0.01	0.01	0.02	0.14
5,014	SLMM	E-16	200	1.16	216	416	0.53	0.27	0.01	0.11	0.05	0.01	0.17	1.15
2,990	48-in. MM	E-19	230	1.33	248	478	0.61	0.32	0.02	0.11	0.09	0.01	0.19	1.34
2,158	DHMM	E-27	126	0.73	136	262	0.33	0.17	0.01	0.03	0.02	0.01	0.10	0.67
	Portable	W-19												
155	SLMM	W-19	33	0.19	35	68	0.09	0.05	....	0.05	0.03	0.01	0.03	0.26
3,527	SLMM	W-19	37	0.21	39	76	0.10	0.05	....	0.05	0.04	0.01	0.03	0.28
6,390	SLMM	W-20	230	1.33	248	478	0.61	0.32	0.02	0.08	0.13	0.01	0.19	1.36
1,566	SLTR	W-19	300	1.74	324	624	0.80	0.41	0.02	0.10	0.05	0.01	0.25	1.64

* Designation used for machine tools is as follows—VBM., vertical boring mill; DR, drilling machine; RD, radial drilling machine; HBM, horizontal boring mill; SLTR, slotter; SLMM, slot-milling machine; DHMM, double-head milling machine.

The variable charge per hour of a machine tool is obtained by multiplying $0.00127 by the total floor space of the machine in question. This value is given in Table 1, column 8.

Fixed charges are divided into two parts—(1) wages and salaries and (2) interest and depreciation on auxiliary apparatus.

TABLE 2. SUMMARY SHOWING DISTRIBUTION OF VARIABLE CHARGES

	Total	Machine Tool	Per Cent.	Assembling and Winding	Per Cent.	Test	Per Cent.
Repairs and Renewals:							
Office buildings, factory, heaters and ventilators, sanitary plants, fire appliances, miscellaneous apparatus, bench and shelving, fences, gates, guards, roadway and tracks, other....	$3,431	$1,480	43	$1,300	38	$650	19
Tools....	18,489	16,640	90	1,849	10	....	....
Electric plant....	3,296	1,976	60	330	10	990	30
Mechanical plant....	3,967	1,710	43	1,510	38	755	19
Patterns:							
New, repairs to, change in....	3,498	1,749	50	1,749	50	....	....
New dies and forms....	143	....	..	143	....	....	....
Metals, polish and plate....	83	....	..	83	....	....	....
From nonproductive section....	29,950	12,900	43	11,460	38	5,700	19
Stores....	8,890	4,890	55	4,000	45	....	....
Defective design....	18,200	7,850	43	6,900	38	3,450	19
Defective material....	6,140	3,380	55	2,760	45	....	....
Defective workmanship....	16,270	8,950	55	7,320	45	....	....
Lost material....	80	45	55	35	45	....	....
Undistributed freight and haulage; demurrage; insurance; sick and injured employees; relief department; printing and stationery; lubricants; other manufacturing supplies; coke, gas, except plant; water, except power house use; undistributed factory expense; miscellaneous travel expense..	5,470	2,350	43	2,080	38	1,040	19
Total....	117,907	63,920		41,459		12,585	
Shipping....	47,054	20,200	43	17,900	38	8,950	19

Table 3 contains a summary of the salaries for six months' operation, amounting to $33,032, from which the charge per hour per square foot is obtained as follows:

Total salaries (six months)....	$33,032
Number of hours....	1,404
Number of square feet....	35,900
Charge per hour ($33,032 ÷ 1,404)....	$23.60
Charge per hour per square foot ($23.60 ÷ 35,900)....	$0.00066

This value multiplied by the total floor space per machine tool gives the charges listed under "Salaries," Table 1, column 9. The salaries are divided as follows:

	Per Cent.
Foremen....	20.5
Engineering....	18.4
Handling material....	17.6
Factory clerks....	13.6
Crane and elevator men....	7.0
Boiler and engine room....	7.0
Timekeepers....	6.3
Janitors and watchmen....	4.1
Operating heads and superintendents....	3.0
Inspection....	2.5
	100.0

Interest and depreciation on auxiliary apparatus include interest and depreciation on cranes, heating system, wiring, etc., listed in Table 4. The interest is taken at 6 per cent. and depreciation at 10 per cent. of a reducing balance, as explained previously.

Since most of the apparatus has been installed from 10 to 15 years, the depreciation will be from 3 to 4 per cent. on the original value (see the curve of Fig. 1); hence if we take 10 per cent of the original investment, we cover both interest and depreciation. The method of figuring the charge per hour per square foot for interest and depreciation is as follows:

Total investment in auxiliary apparatus....	$36,555
10 per cent. of investment ($36,555)....	3,655
Number of hours per year....	2,808
Square feet of floor space....	35,900
Charge per hour ($3,655 ÷ 2,808)....	$1.30
Charge per hour per square foot ($1.30 ÷ 35,900)....	$0.000036

This value multiplied by the total floor space is listed in Table 1, column 10.

Interest on a machine tool is taken at 6 per cent. The investment includes the cost of the machine and all accessories. Depreciation is taken at 10 per cent. of a reducing balance, as already explained. A method of keeping a record of the details of each machine tool will be outlined later. The power required to run each machine tool is based upon tests made with a recording meter on both motor-driven and line-shaft-driven machines. An average kilowatt per hour consumption of power was determined. The charge per kilowatt hour was one cent. The cost of power is a small percentage of the other charges. Table 1, column 4, gives this charge.

The shipping charge is also a variable charge, given in Table 2, and is divided according to floor space. The charge per hour per square foot is figured out in the following manner:

Total shipping charge (six months)....	$20,200
Charge per hour ($20,200 ÷ 1,404)....	14.40
Charge per hour per square foot ($14.40 ÷ 35,900)....	$0.0004

This charge multiplied by the total floor space of a machine tool is listed under "Shipping," Table 1, column 15.

The charges have been separated, as explained, to show their relative importance. It is also possible to work out easily the total charges against any machine during any period of time by finding the charge per square foot per hour and multiplying this by the total floor space occupied by the machine in question. The following percentages show the relative importance of the charges given in Table 1:

	Vertical Boring Mills	Drilling Machines	Horizontal Boring Mills	Lathes	Planers	Miscellaneous	Portable
Variable....	45.5	48.7	47.0	46.0	48.0	44.5	44.5
Salaries....	25.0	27.3	26.3	25.9	27.0	26.0	24.5
Shipping....	14.3	15.5	14.8	14.2	15.0	14.1	14.0
Interest....	7.6	3.3	6.1	7.8	4.6	8.1	7.8
Depreciation....	5.2	3.0	4.2	4.0	3.2	5.2	7.0
Auxiliary apparatus	1.4	1.2	1.3	1.1	1.4	1.0	1.1
Power....	1.0	1.0	0.3	1.0	0.8	1.1	1.1
	100.0	100.0	100.0	100.0	100.0	100.0	100.0

The total charge against the machine-tool department per hour is $96.06.

For convenience and ready reference the following record kept for each machine tool has been found convenient:

1. Type of tool—Niles vertical boring mill N-1415.
2. Location—E-29.
3. Size—60 in.
4. Date installed—1900.
5. Floor space—Occupied by tool, 110 sq.ft.; supplemental space, 119 sq.ft.; total chargeable to tool, 229 sq.ft.
6. Cost of tool—$2,100.
7. Cost of accessories—foundation, $175; motor; control; attachments, $179; line shaft, $88.
8. Motor, horsepower.
9. Average load—1 kw. per hour.
10. Hourly charges—variable charges, 29c.; shipping charges, 9c.; fixed charges, salaries, 15c.; auxiliary apparatus, 1c.; interest on tool, 5c.; depreciation on tool, 2c.; power, 1c.; total, 62c.

Just as the charges have been divided in the machine-tool department among the various tools, the charges in the assembly section can be divided among the various workmen employed in this department. If one does benchwork, the space occupied by his bench is directly chargeable to him; if he does laying-out work on a surface plate, the space occupied by the surface plate is directly chargeable to him. A gang working on a bedplate assembling large machinery should be charged with the space occupied by the bedplate. The basis of obtaining these charges can be obtained from the charge per hour per square foot. These charges are as follows for the assembly and winding department adjoining the machine-tool department previously discussed: (1) Variable charges;

(2) salaries; (3) shipping; (4) interest and depreciation on auxiliary apparatus.

TABLE 3. SUMMARY OF NONPRODUCTIVE WAGES AND SALARIES

	Total	Machine Tool	Per Cent.	Assembling and Winding	Per Cent.	Test	Per Cent.
Wages:							
Time keepers	$3,222	$1,777	55	$1,445	45	....	....
Manager works, office clerks, factory clerks, errand boys	10,520	4,520	43	4,000	38	$2,000	19
General foreman, assistant foreman, foremen	12,400	6,800	55	5,600	45	....	....
Fire brigade	43	19	43	15	38	8	19
Watchmen, janitors, porters	3,236	1,390	43	1,230	38	616	19
Crane and elevator men and heaters	5,450	2,340	43	2,070	38	1,040	19
Inspection and test	3,615	904	25	904	25	1,808	50
Tool, mold, die and pattern rooms	29	17	55	12	45	....	....
Handling material in factory not otherwise specified	13,610	5,850	43	5,170	38	2,580	19
Superintendent salaries	1,805	905	50	720	40	180	10
Drafting salaries and expenses, engineering salaries and expenses	14,330	6,150	43	5,450	38	2,730	19
Boiler and engine-room, wages	5,900	2,360	40	1,180	20	2,360	40
Total	74,160	33,032		27,796		13,322	

These items are similar to those given under the machine-tool section and are also listed in Table 2. The charge per hour is found in a like manner, as follows:

Variable charges (six months)	$41,459
Salaries	27,796
Shipping	17,900
Total	$87,155
Number of hours (6 months)	1,404
Charge per hour ($87,155 ÷ 1,404)	$62

For auxiliary apparatus (see Table 4) the charges are found as here shown:

Investment	$53,072
10 per cent. of investment (interest and depreciation)	5,307
Hours per year	2,808
Charge per hour ($5,307 ÷ 2,808)	1.79
Total charge per hour	63.90
Charge per hour per square foot ($63.90 ÷ 15,700)	$0.004
Square feet of floor space	31,400

The assembly section should be divided among the various workmen or gangs just as the machine-tool department was divided among the various tools. Both the space actually required by the workman to do his work and his share of space required for storage, aisles, etc., should be charged to him as supplemental floor space, as was done in dividing total space among the various tools in the previous discussion. Thus if a winder requires a space 10x10 ft., or 100 sq.ft., to do his work, and supplemental space chargeable to him is 75 sq.ft., the hourly charge to be added to his wages will be $0.002 × 175 = $0.35. A gang assembling large machinery, or a bedplate 25x50 ft., or 1,250 sq.ft. and chargeable with 1,000 sq.ft. supplemental space should be charged $0.002 × 2,250 = $4.50 per hour.

TABLE 4. CHARGES FOR AUXILIARY APPARATUS

Portion of power-house cost	$19,000
Fans and heating	7,985
Electric wiring	7,200
Lamps: Arc	750
Incandescent	250
Cranes	40,888
Total	$76,073
Divided as follows:	
Machine tool	$32,600
Assembly	28,900
Test	14,500
Charges Against Machine-Tool Division:	
Portion of total	$32,600
Dividing tables	2,283
Grinders	500
Miscellaneous	1,172
Total	$36,555
Charges Against Assembly Division:	
Portion of total	$28,900
Jib cranes	2,187
Dividing tables	2,283
Grinders	500
Testing devices	700
Hydraulic press	8,700
Scales	576
Surface plates	6,960
Miscellaneous	2,266
Total	$53,072

The testing department can be divided into sections laid out for testing various types of machines. Space can be definitely allotted to each individual section, as was done in subdividing space among the various machine tools. As before, the total charge consists of the following variable, shipping and salary charges divided per square foot of floor space, in addition to the interest and depreciation on the cost of testing equipment installed for each individual section:

Variable charges (six months)	$12,585
Shipping charges	8,950
Salaries	13,322
Total	$34,857
Number of hours (six months)	1,404
Charge per hour ($34,857 ÷ 1,404)	$24.80
Auxiliary apparatus:	
Investment (see Table 4)	14,500
10 per cent. of investment (interest and depreciation	1,450
Charge per hour ($1,450 ÷ 2,808)	$0.52
Total charge per hour	$25.32
Total floor space	15,700
Charge per hour per square foot of floor space	$0.0016

The charge against a testing section occupying a space 30x60 ft. and charged with a supplemental space of 2,000 sq.ft., or a total of 3,800 sq.ft., will be $0.0016 × 3,800 =$6.10 per hour for the total charges. If investment in testing equipment is $2,500, interest and depreciation will be at 10 per cent., $250 per year, or $250 ÷ 2,808 = $0.089. Average power required for testing is 5 kw. per hour, so the cost of power is $0.05 per hour. The total charge against this individual testing section is therefore $6.10 + $0.089 + $0.05 = $6.24 per hour, outside of the wages of those conducting the test.

The previous analysis shows how the charges against the different departments of a large manufacturing organization can be divided among the various machine tools as machine-hour rates or among the various workmen in an assembly or testing section. In addition to giving accurate costs, figures of this kind are extremely valuable to the shop superintendent, since they show what each element of his organization is costing him per hour. They show in dollars and cents what even a small delay to any one man means, show where efficiency of operation is mostly needed to avoid greatest loss by delays, and show the great importance of economy in space.

In deciding whether or not certain tools shall be made to reduce the setting-up time on machine tools, or whether tools shall be made to facilitate and reduce assembly time, the hourly rates as here figured will be the determining factor.

Over-Safetyized Machines

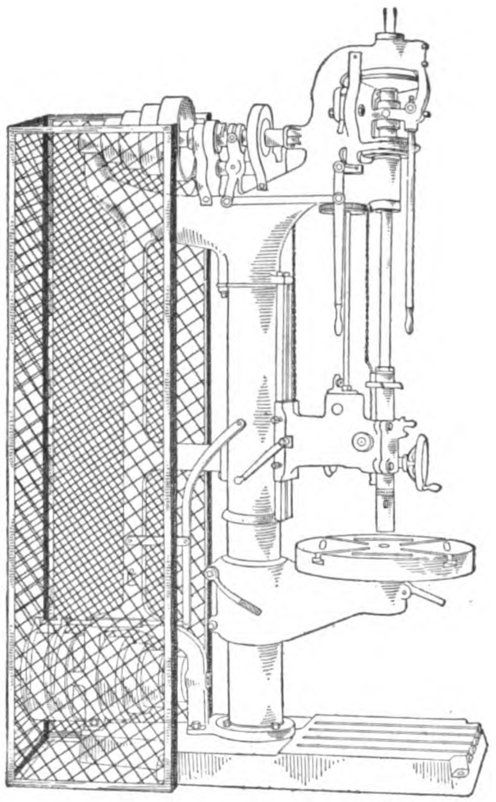
By H. B. McDermid

"Safety First" has become a national slogan, but like many other reforms, initiated because of a real need for a change for the better and so taken up in a wave of popularity, the movement is in danger of going too far and so perhaps defeating its legitimate object. It seems to have become a habit to see how much can be put upon a machine in the way of devices to protect the operator from the results of his own gross carelessness, in some instances; and too often the safeguards (?) serve no real purpose, but are instead a menace to the man running the machine.

An instance of this sort was noticed recently in a small machine shop and power plant in an oil-storage yard. The place contained two high-speed vertical engines each

direct connected to a generator of about 25 kw., a small unit, familiar to everyone nowadays. These engines had previously been amply protected by a heavy pipe railing around the moving parts. There were also a pipe machine and a drill press of a standard type; another small engine belted to an overhead line shaft, for driving the last two machines, completed the equipment.

It was said that a state factory inspector's visit caused the changes; if so, he ought to be ashamed of himself,



OVER-SAFETYIZED MACHINE

or the state which demanded such provisions. The engines, already protected by a railing so designed that a careless man could not injure himself, were further covered by a netting made of $\frac{1}{8}$-in. wire, with a mesh about 1 in. square, to such an extent that a man intentionally seeking to injure himself could not get near the moving parts. The belts of the pipe machine were thoroughly covered with similar cages of like netting, but it remained for the drilling machine to take the prize. Its belts were covered, as shown by the illustration, in a manner that was foolhardy dangerous.

The cone-pulley belt was a 3-in. double-ply belt, difficult at best to throw off the pulleys while not running, as any mechanic knows. Yet a cage had been built covering the full length along the shafts of the pulleys, as least 7 ft. high and clearing the large diameters by less than 2 in. No opening had been left anywhere on three sides, the frame was solid and bolted to the floor, making the changing of the belt a very difficult operation when not running, and several times more dangerous when running, than ever before. Just enough opening had been left on the side toward the table to encourage a reckless man to try to change the belt while running. The whole device was merely a trap to a man of ordinary ability, and a valid excuse for quantities of lost time to a timid or lazy operator.

It would seem that there ought to be a quick-acting remedy for such cases. If state laws are responsible, they should be repealed or modified till a better condition can be secured. If the personal equation of the state's inspection is responsible, then care should be used to secure sensible and experienced men. If the condition is the result of a safety-first fad by some company officer, the case is even worse, because the cure is harder to find.

Whatever the cause, it should be removed and methods adopted which make for real safety for an ordinarily careful and skillful man, instead of those which make a machine safe in the hands of a recklessly ignorant or otherwise unreliable man.

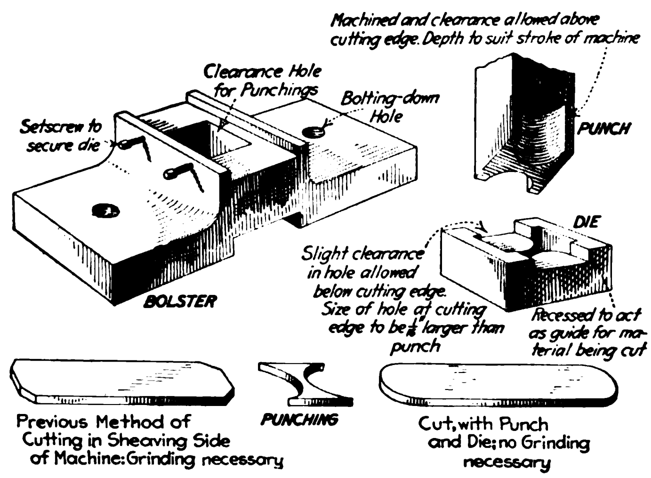
Saving Costs in Shearing and Punching Flat Bars

By A. Patterson

I recently had occasion to be in a shop cutting flat bars into short lengths and trimming the ends in the shearing side of a punch and shearing machine. The ends were finally ground circular in shape on a grinding machine. The cost involved was $2.86 per 100. The material was $2\frac{1}{4}$x$\frac{1}{2}$ flat mild steel.

To reduce the cost, I had a punch and die made with a bolster to fit the punching side of the machine. The illustration gives an idea of the arrangement.

A gage was afterward attached to the bolster so that the bar could be cut accurately into lengths without



SAVING COSTS IN SHEARING AND PUNCHING

marking off. The ends were nicely rounded off when cut and required no dressing. The price of the job was reduced to 12c. per 100, a saving of 2.74 per 100.

The die was recessed to the depth and width of the flat bar to insure the material being fed square into the machine. The punch was made wider than the material, as it was feared that the corners at the extreme points of the radius would be difficult to temper and likely to chip and break.

The recess in the bottom of the bolster was to permit raking out the punchings; but the machine the bolster was used on, the hole for the punchings was large enough to allow the $2\frac{1}{4}$-in. section to pass through.

As a large number of this article is made in the course of a year, the tool has been a profitable one. A number of dies similar to the one shown have been made from old shear blades for square punches, as I find the square-section die shows no tendency to break, whereas the round dies usually supplied with punching machines break very frequently.

Alignment Charts for Design of Flat Plates--I

By Axel K. Pedersen

SYNOPSIS—A series of nine charts simplifying the usually complex problem of the design of flat plates. Seven take up common cases of circular, elliptical, square and rectangular plates for different conditions of loading and supporting. Another covers the ideal case of a stayed surface, and the last a surface stayed according to the recommendation of the A. S. M. E. boiler code.

The application of mathematical analysis in developing the theory of flat plates forms one of the most interesting chapters in the history of the theory of elasticity. From a mathematical point of view, the results obtained are quite satisfactory; the hypothesis adopted for developing the theory, however, circumscribes the problem too closely, not taking into account all the factors which, from a practical point of view, enter into the subject. Also the application of the mathematical theory results in formulas far too complicated for practical use.

The state of stress of a flat plate is a very complicated one, and in order to obtain practical formulas in close agreement with experiments the method of research seems to be the only one possible. The experiments conducted by Professor Bach continuously over a long period of years form the fundamentals upon which the practical design of flat plates confidently may be based. All the experiments conclusively prove that the strength of a flat plate is directly proportional to the square of the thickness of the plate and a more or less complex function of the other dimensions of the plate. Certain coefficients introduced bring the formulas in accordance with the experimental data.

In the *American Machinist,* Vol. 43, page 21, in my article "The Graphical Design of Shear and Press Frames," the different behavior of ductile and brittle materials relative to Hooke's law—the law of proportionality between stresses and strains—was discussed. While the bending stress for a plate made of steel may be definitely determined at any load, the bending stress for cast-iron plates is an apparent one only, and the factor of safety in this case must be determined by taking the dimensions of the section into account, the ultimate bending stress not being a constant figure but depending upon the dimensions of the section.

For detailed information the article in the *American Machinist* on the design of shear and press frames is referred to, the relation, experimentally determined, between the apparent ultimate strength and the tensile strength of the material only being given here in the following formula:

$$S_u = \sqrt{\frac{E_1}{E_0}}\, S_t$$

S_u = Apparent ultimate bending stress in pounds per square inch;

S_t = Tensile strength of the cast iron in pounds per square inch;

E_1 = Distance in inches from the "neutral axis," or center of gravity of the whole section, to the extreme fibers in tension;

E_0 = Distance in inches from the neutral axis to the center of gravity of that portion of the section which is located between the neutral axis and the extreme fibers in tension.

In the case of flat plates

$$E_0 = \tfrac{1}{2}\, E_1$$

Introducing this value in the formula, we obtain

$$S_u = S_t \sqrt{2}$$

or

$$S_u = 1.41\ S_t$$

The experimental coefficients vary according to the material used. It is interesting to observe that in each case the ratio of the experimental coefficients for cast iron to that of steel is approximately 1.41. If therefore in all cases for cast iron the ultimate tensile strength instead of the ultimate bending strength is used, the same formulas may be employed both for steel and for cast iron, because the ultimate bending stress is reduced in the same ratio as the coefficient is reduced.

The method of support is of great importance when calculating the strength of flat plates; in each case the conditions of support must be carefully analyzed, and the result obtained by assuming ideal conditions relative to support must be accordingly modified.

The charts accompanying this article cover all the important cases likely to be met with in practice. Eight practical cases and one ideal case are covered by the charts: Chart 1, elliptical plate, uniformly loaded, supported or fixed; Chart 2, elliptical plate, concentrated load W at the center, plate supported at edge; Chart 3, circular plate, total load W uniformly distributed on circular area of diameter D, plate supported at edge; Chart 4, rectangular plate, uniformly loaded, supported or fixed; Chart 5, rectangular plate, uniformly loaded, fixed along edges A and supported along edges B; Chart 6, rectangualr plate, concentrated load W at center, plate supported at edge; Chart 7, square plate, uniformly loaded, plate supported at four corners; Chart 8, flat stayed surface, uniformly loaded, ideal case; Chart 9, flat stayed surface, uniformly loaded, according to recommendation of the A. S. M. E. Boiler Code Committee.

As to Chart 9, it is interesting to compare the results obtained from this chart with the results obtained from Chart 8, which gives the ideal case of a flat stayed surface. The influence of the circumstances in regard to the method in which the stays are fitted to the plates is evident.

The formulas for developing Charts 1 to 8 are of the general form

$$S = CF\frac{P}{T^2}$$

where

P = Load in pounds per square inch;

T = Thickness of the plate in inches;

Explanation. This chart connects five variables and may be used in various ways. Any three scales or axes when used together must have consecutive subscripts. The method of using the chart to determine the thickness of the plate is as follows: From the point on the M_1 scale representing the unit pressure, trace to the point on the M_2 scale representing the allowable unit stress and note the intersection of the line so traced on the M_3 axis. Connect this intersection with the point on the M_4 scale representing the width of the plate and note the intersection of this line on the M_5 axis. Through this point trace a line from the point on the M_6 scale representing the proper ratio K to the M_7 scale. At the point of intersection on the M_7 scale read the required thickness of the plate.

The example indicated on the key diagram has given: A = 10", B = 11.1", P = 2000 lb. per sq.in., material cast iron of ultimate strength of 20,000 lb. per sq.in. Factor of safety is 5. The plate is fixed along the edges. The allowable stress is $\frac{20000}{5}$ = 4000 lb. per sq.in. The ratio $K = \frac{A}{B} = 0.9$. Solving on the chart as indicated above gives the thickness of the plate T, as 3.35"

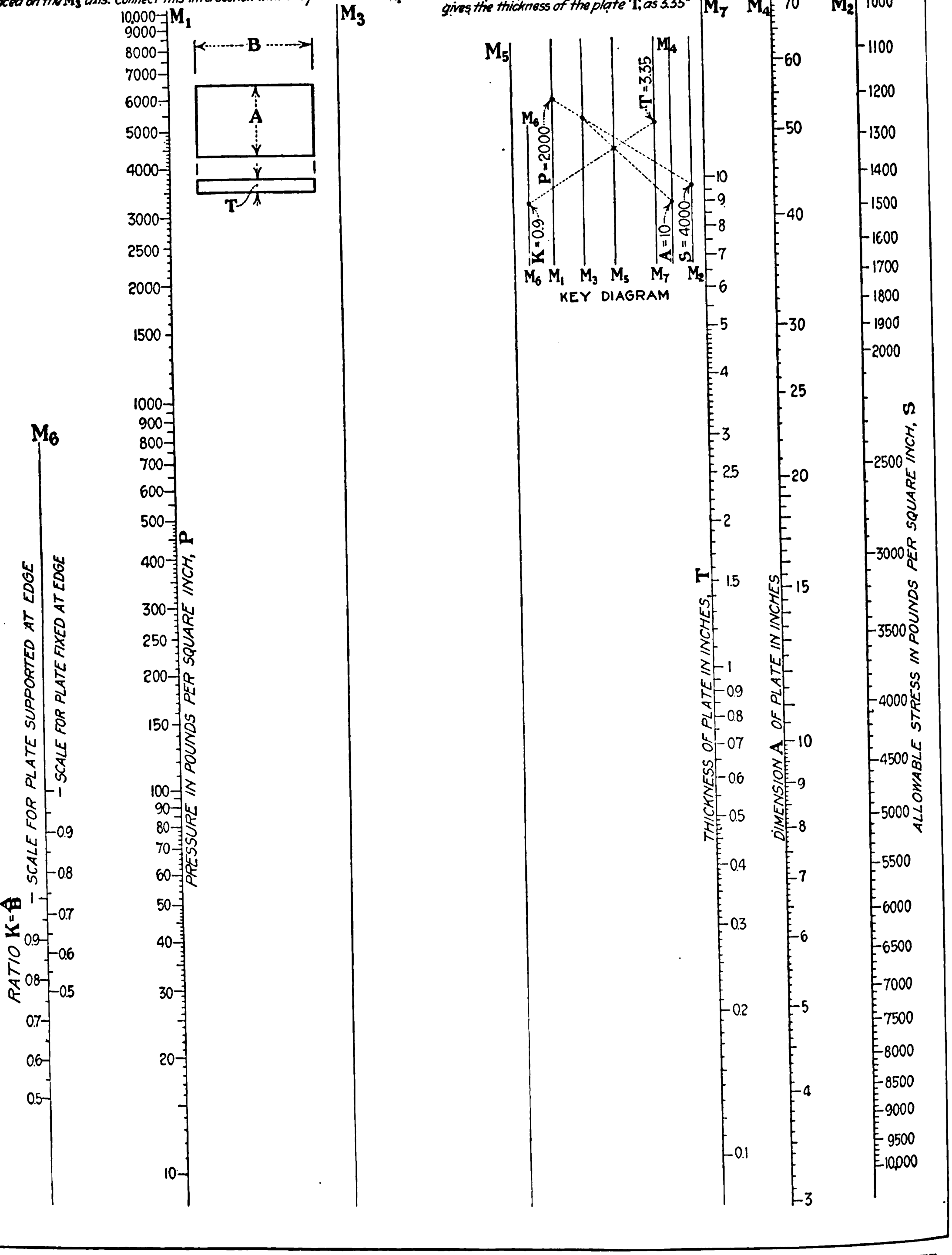
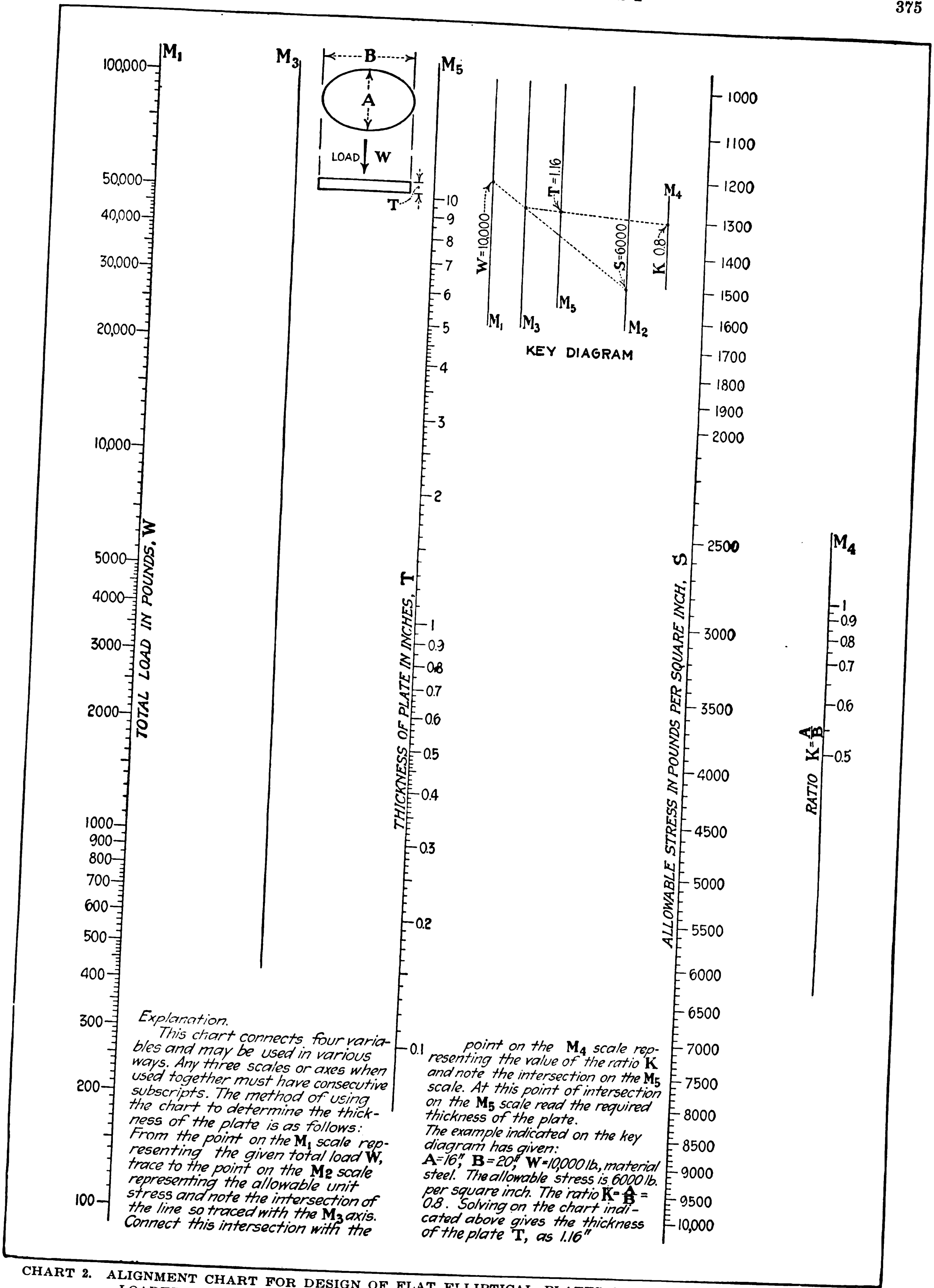


CHART 1. ALIGNMENT CHART FOR DESIGN OF FLAT ELLIPTICAL PLATES, UNIFORMLY LOADED AND EITHER SUPPORTED OR FIXED AT THE EDGE—BY AXEL K. PEDERSEN



Explanation.

This chart connects four variables and may be used in various ways. Any three scales or axes when used together must have consecutive subscripts. The method of using the chart to determine the thickness of the plate is as follows: From the point on the M_1 scale representing the given total load W, trace to the point on the M_2 scale representing the allowable unit stress and note the intersection of the line so traced with the M_3 axis. Connect this intersection with the point on the M_4 scale representing the value of the ratio K and note the intersection on the M_5 scale. At this point of intersection on the M_5 scale read the required thickness of the plate.

The example indicated on the key diagram has given: A=16", B=20", W=10,000 lb., material steel. The allowable stress is 6000 lb. per square inch. The ratio $K=\frac{A}{B}=0.8$. Solving on the chart indicated above gives the thickness of the plate T, as 1.16"

CHART 2. ALIGNMENT CHART FOR DESIGN OF FLAT ELLIPTICAL PLATES SUPPORTED AT THE EDGE AND LOADED WITH A CONCENTRATED LOAD AT THE CENTER—BY AXEL K. PEDERSEN

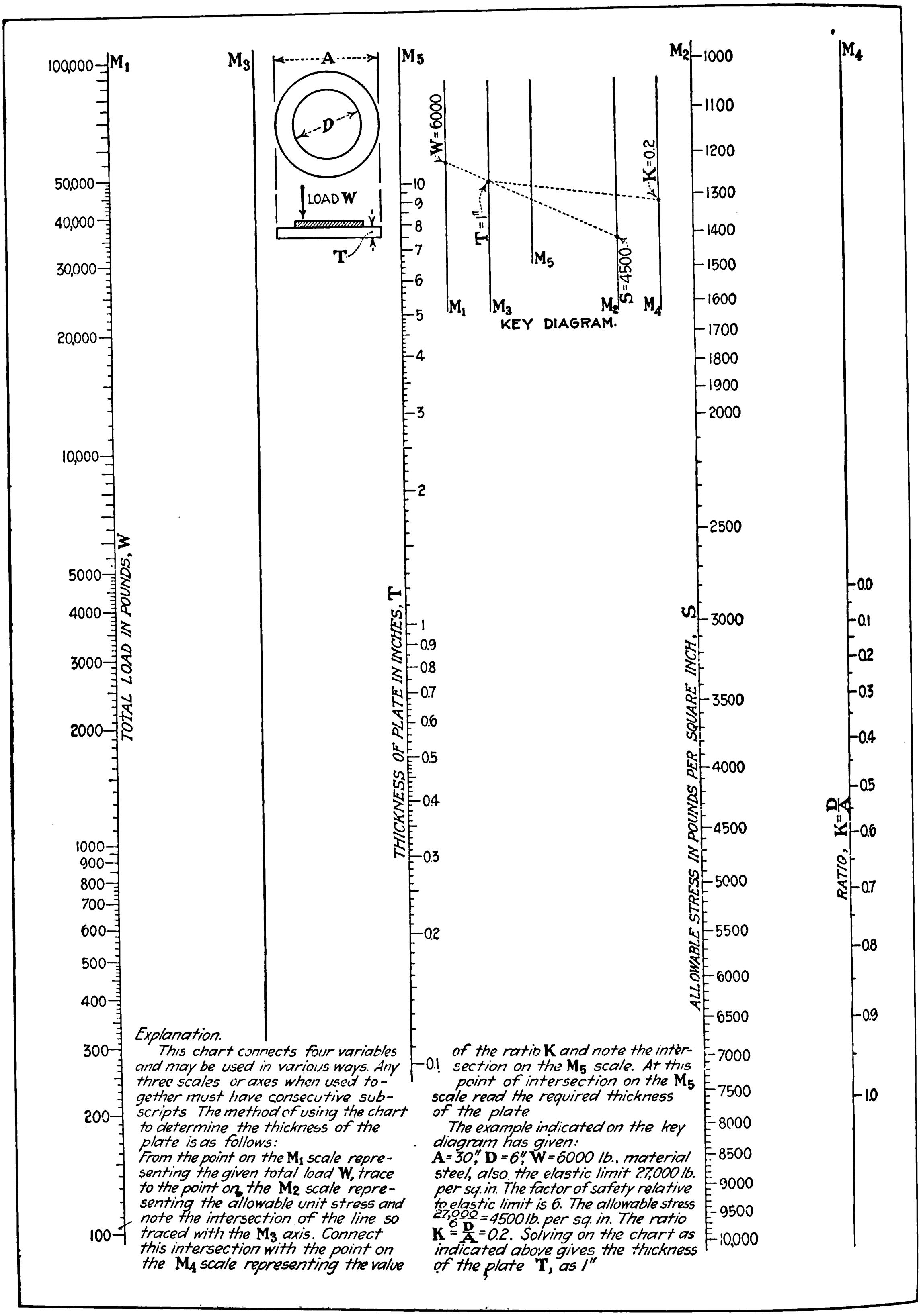


CHART 8. ALIGNMENT CHART FOR DESIGN OF FLAT CIRCULAR PLATE SUPPORTED AT EDGE WITH TOTAL LOAD UNIFORMLY DISTRIBUTED ON A CONCENTRIC, CIRCULAR AREA—BY AXEL K. PEDERSEN

Explanation. This chart connects five variables and may be used in various ways. Any three scales or axes when used together must have consecutive subscripts. The method of using the chart to determine the thickness of the plate is as follows:

From the point on the M_1 scale representing the given unit pressure, trace to the point on the M_2 scale representing the allowable unit stress and note the intersection of the line so traced with the M_3 axis. Connect this intersection with the point on the M_4 scale representing the short diameter of the plate and note the intersection on the M_5 axis. Through this intersection trace from the point on the M_6 scale representing the ratio K to the M_7 scale. At this point of intersection on the M_7 scale read the required thickness of the plate. — The example indicated on the key diagram has given: A = 12"; B = 17"; P = 150 lb. per sq. in.; material, cast iron of an ultimate strength of 20,000 lb. per sq. in.; factor of safety 10. The allowable stress $= \frac{20000}{10} = 2000$ lb. per sq. in. The ratio $K = \frac{A}{B} = 0.706$. Solving on the chart as previously indicated, gives the thickness of the plate T as 1.6"

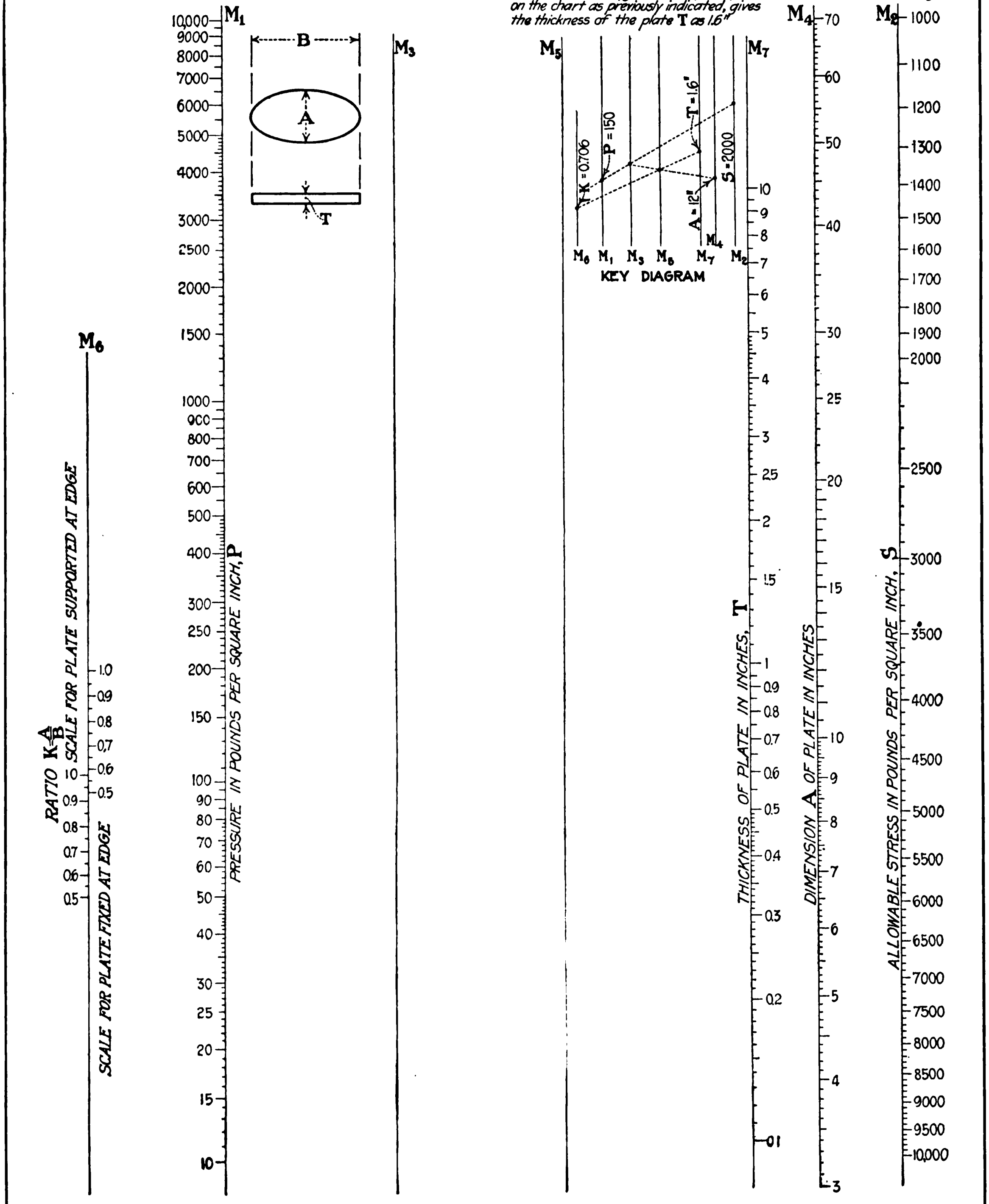


CHART 4. ALIGNMENT CHART FOR DESIGN OF FLAT RECTANGULAR PLATES UNIFORMLY LOADED AND EITHER SUPPORTED OR FIXED AT THE EDGES—BY AXEL K. PEDERSEN

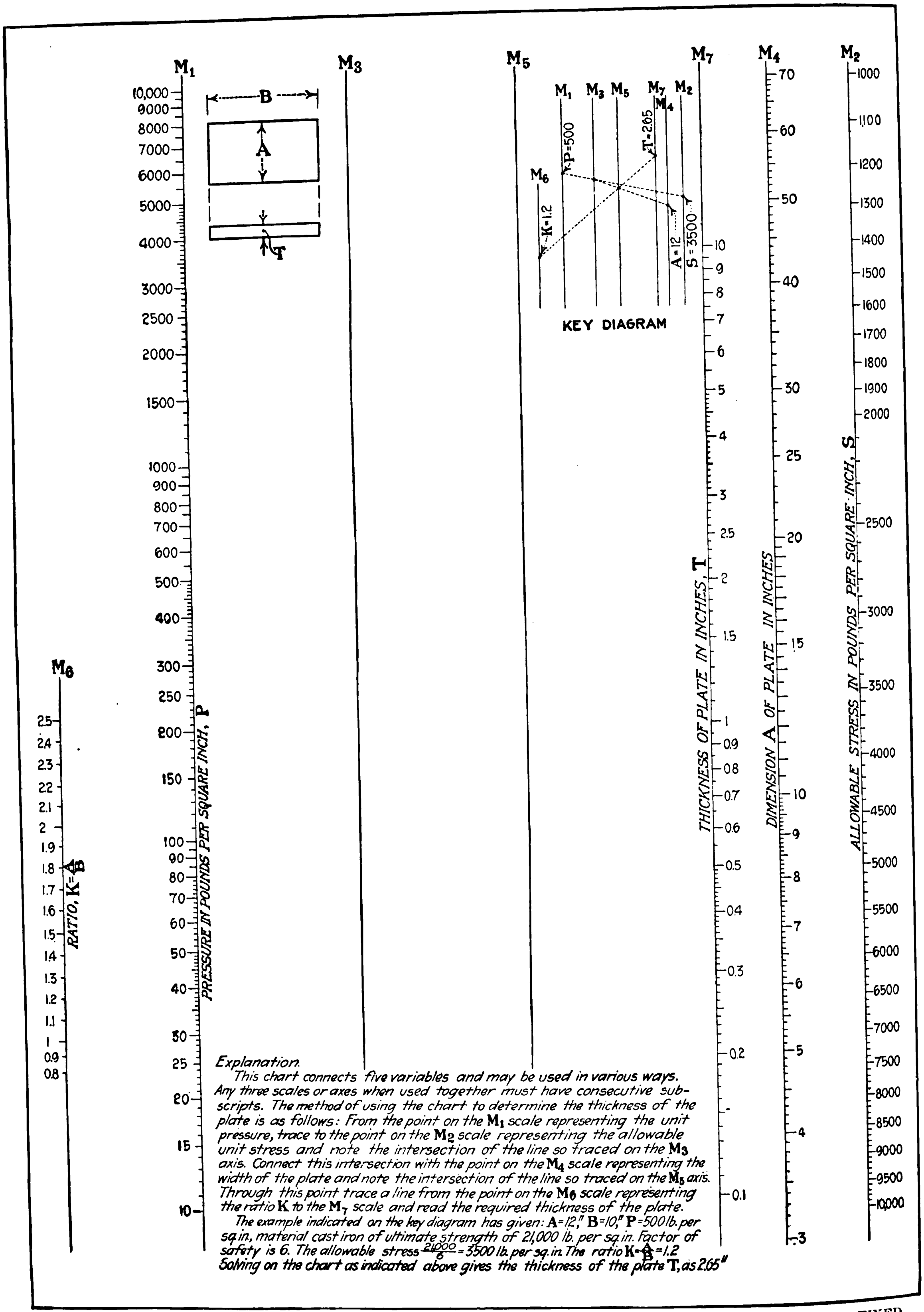


CHART 5. ALIGNMENT CHART FOR DESIGN OF FLAT RECTANGULAR PLATES UNIFORMLY LOADED, FIXED ALONG SHORTER EDGES, SUPPORTED ALONG LONGER EDGES—BY AXEL K. PEDERSEN

F = Function of the dimensions of the plate and can be determined as a function of the ratio K;

K = Ratio between certain dimensions of the plate as explained on the charts in each case;

C = Experimentally determined coefficients;

S = Allowable stress in pounds per square inch.

The factor of safety is determined for steel as follows:

$$f = \frac{S_e}{S}$$

and for cast iron

$$f = \frac{S_t}{S}$$

S_e is the elastic limit of steel, and S_t the ultimate tensile strength of cast iron in accordance with the fact that for brittle materials the factor of safety must be determined by taking the ultimate strength into account.

The formula for developing Chart 9 is as follows:

$$P = \frac{M\,(T+1)^2}{A^2 - 6}$$

where

T = Thickness of the plate in sixteenths of an inch;

A = Pitch of the stays, in inches;

M = Constant according to circumstances as given in instructions for using M_2 axis on Chart 9;

P = Working pressure in pounds per square inch.

The procedure is rendered very easy by numbering the various scales consecutively M_1, M_2, M_3, etc., straight lines being drawn from proper points between two consecutive scales locating a point on the third consecutive scale or axis, which then again is used in connection with the two next consecutive scales. It will be noticed that the charts may be used in various ways according to data given; care, however, must be taken always to use any three sets of scales simultaneously, only if they bear consecutive numbers.

Several of the charts contain a double scale for the ratio K, which must be used in accordance with the conditions as to support, as especially noted in each case on the charts.

(To be continued)

Reducing Cost of Chain

By Dan Patch

Back in 1909, when the estimating division was formed at the Boston Navy Yard, one of the first things noticed was the extremely high prices at which standard stud-link chain cables were issued to the ships. An investigation was made of the three subdivisions of cost—namely, material, labor and overhead—and the curves of Fig. 1 were plotted. The thing which first caught the eye was the high cost of the material entering into the manufacture of the chain.

On looking into this it was found that the Navy Yard was buying the best of iron in sizes other than that for the chain wanted, blooming these bars and rerolling in a not too modern rolling plant and charging all this labor and expense to the material cost. When this practice was objected to, the estimating division was informed that this treatment was necessary to get the "superior quality" of Government-made cables. This sounded like the reason for soap floating given by a guide when he was showing a party through a big soap works: "It floats, madam, because of its superior quality."

At the time there was no answer to this statement, but a little later a neighboring shipyard received permission to have a chain cable which was to be installed in a recently completed merchant vessel tested in our

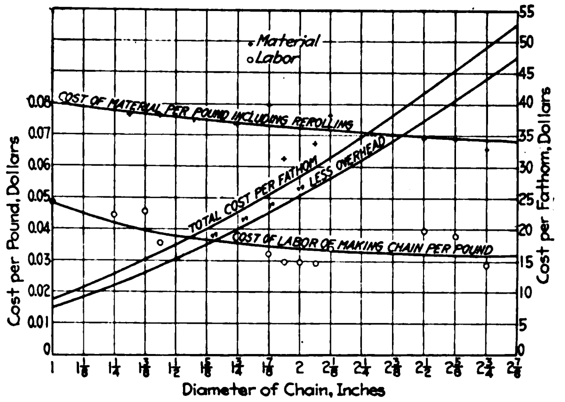


FIG. 1. TOTAL AND MATERIAL COST OF STUD-LINK CHAIN PRIOR TO 1909

pit. A representative of the estimating division was detailed to be present at the test and found that the results were very close to those of our "superior-quality" chain.

To make a long story short, in spite of opposition, officers having the efficiency of the service at heart finally abolished the rolling mill and eliminated one unnecessary operation in the manufacture of the chain.

The next item in the chain cost which was noted was the manufacture of the studs. These studs were shaped somewhat as in Fig. 2 and were drop-forged. The dot-and-dash lines indicate the location of the link with regard to the studs. After leaving the drop-forge shop the studs were sent to a machine shop in another building, where they were first planed, set up in gangs and

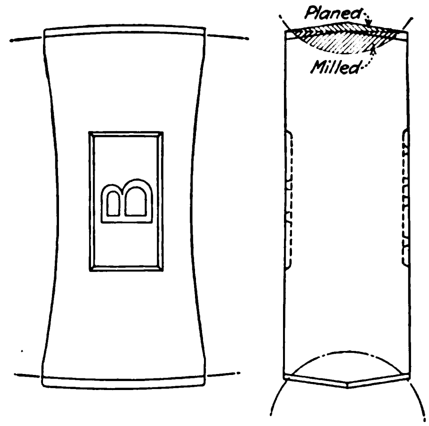


FIG. 2. DETAIL OF A STUD FOR STUD-LINK CHAIN

then milled in a miller with a revolving table, on which they were so dogged as to give the proper longitudinal radius for the particular chain with which they were destined to be used. After the machining process was completed they were sent to a third building to be put into the chain.

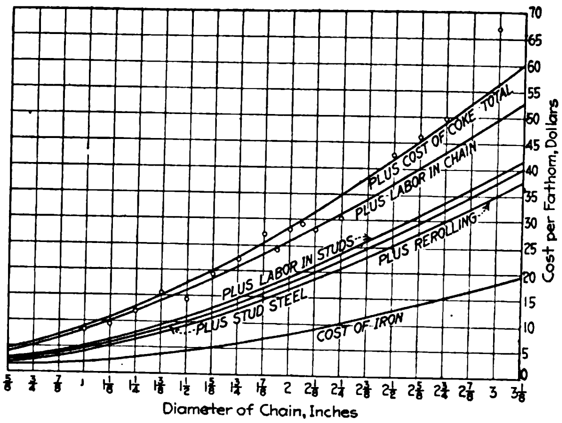


FIG. 3. ANALYSIS OF STUD-LINK CHAIN COST PER FATHOM PRIOR TO 1909

It was suggested that the studs be drop-forged on edge, so that the draft of the die would give the proper radius. The objections raised to this were that the dies would be apt to crack on account of the fine corners and that the letters "U S" and "B" would not appear on the sides of the link. The first objection was believed to be overestimated and the second groundless, as the "U S" and "B" could just as well come on the edges as on the sides. The stunt was tried on one of the smaller sizes. It worked all right, so that this method was extended to the other sizes, eliminating a process which, though a delight to the eye and apparently very efficiently carried on due to the gang set-up, was nevertheless unnecessary.

Along with this reduction in the number of operations was an increase in output due to a study of rest and work periods and shop methods which reduced the direct-labor cost on the making operation.

The costs are shown graphically analyzed in Figs. 3 and 4. Approximately the material had advanced about 4 per cent. of its value, or about 1 per cent. on the cost of chain. The labor costs, direct and indirect, had been reduced 40 per cent. by the elimination of processes and 13 per cent. by increased output. These percentages are based on labor costs of 27 per cent. and 9 per cent. respectively on the total costs of the chain. This reduction in costs brought work to the yard which undoubtedly would otherwise have gone to outside plants or abroad—namely, the manufacture of the fender chains for the Panama Canal.

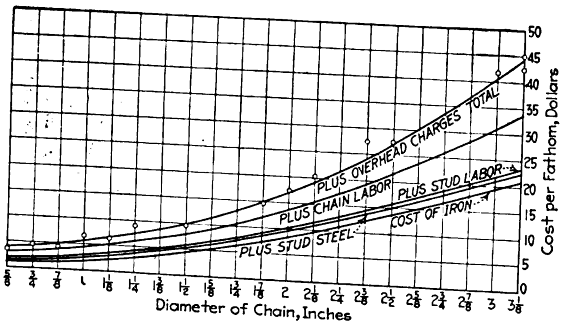


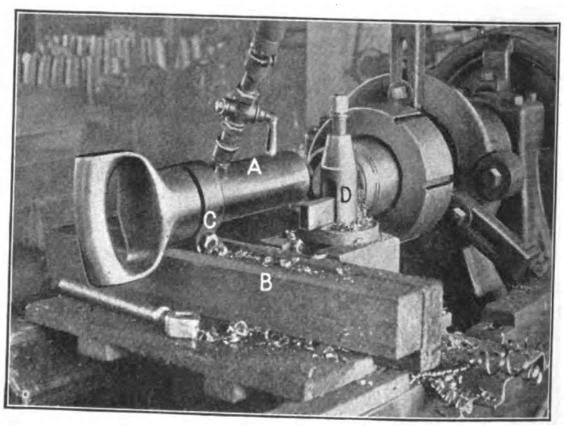
FIG. 4. ANALYSIS OF STUD-LINK CHAIN COST PER FATHOM, 1912

The credit for these changes is largely due to the younger officers of the Construction Corps, who have received special technical training. Such industrial officers should serve long terms without change of yard in order that they may formulate and build up a managing policy. On the contrary, they are constantly shifted, and political interference from without and friction within the service make their lives anything but pleasant. It will be surprising if there are not many resignations from the Construction Corps to take up more congenial positions in civil life.

Turning Bases of Shells and Riveting Base Plates

The illustration shows a method (employed in one of the Canadian shell shops where 4.5-in. high-explosive shells are manufactured) of riveting in the base plates of the shells at the same time that a cut is being run across the base of the shell. An ordinary air hammer *A* is used to close the metal around the base plate, which is of the threaded type.

The wooden blocking *B* on the carriage is of such height that the air hammer can be rested on it, the clamp *C* acting as a pivot. The threaded type of base plate is



RIVETING AND TURNING BASE PLATES

of a thickness that makes it project beyond the surface of the base of the shell. While the tool in the tool post *D*, at the back of the lathe, is facing off the extra metal on the base plate, the air hammer at the front rivets the base plate in.

This method of doing the job combines what would otherwise be two distinct operations. Running the two concurrently saves considerable time.

While on the subject of base-plate riveting, it may be mentioned that in another works, where they are making 18-pounder high-explosive shells with the new type of riveted base plate, an ordinary air hammer closes the base of the shell over on to the base plate in ½ min. from floor to floor.

The outfit used consists of a 12x12 timber set, end up, in the concrete floor. It is of such height as to be convenient for the operator holding and operating the hammer. The end of the timber has a hole in it large enough to take the shell and deep enough to allow the shell to go down about three-fourths of its length. A steel ring fits over the base end of the shell, to act as a guide for the riveting tool in the air hammer.

Letters from Practical Men

Irregular Grinding Jobs

There are four factors to be considered in "getting by" on operations of the irregular type, where there is no machine or jig well suited for the work. These factors are, first, the piece itself; second, the machine that is to handle the work; third, a good supply of ingenuity; and, fourth and by no means least, a man with an appetite for the irregular job—an "optimo-mechanic."

Mr. Van Deventer in his recent eulogy of the drill press as a *multum in parvo* machine for general shop work took a shy at the drafting-room force and suggested the use of a mallet as a useful antidote for a certain obstinacy peculiar to the profession. It might also be said of some operatives that, when the knock-down-and-drag-out method seems imprudent, a clever word-sponging will animate the fellow on the job until he says, "I'll do it, or my name is McGinnis."

Four jobs are here described, all grinding operations. The machine is a small universal tool grinder—a Norton No. 2. A careful study of the illustrations will help one understand these various jobs, and a few words in connection will insure a good idea of the methods used.

In Fig. 1 is shown an extraordinary set-up. Four square-end mandrels were required to be ground clean to a shoulder and perfectly true with the cylindrical portion. It will be seen from the shape of the mandrels that it was impossible to use the cup-wheel method. The top (false) platen of the grinder was lifted off and clamped at right angles to the table, the overhanging end of the platen being supported by an ironwork table conveniently placed, with a steel plate leveled for the traverse and $\frac{5}{16}$ steel balls for the platen to ride upon. All this material was within easy reach of the machine, and it was only a few minutes before this grinding job was put on a manufacturing basis. The arbors in question were for holding automobile transmission gears in which the holes were broached.

The second task was to grind four sections of a circle, with two center points for rotating. The radii were to be exactly alike—or in other words, two sections of two circles of exact diameters, with their centers offset from each other and with the piece itself, when assembled to operate upon a third center. Despite all this description the only way to grasp the idea is to look at the piece as it was arranged for grinding.

It will be observed that the piece, which was a hardened-steel plate, had a relatively large hole in which a bushing was inserted with a small hole carefully drilled and reamed for position on the milling machine. The bushing was also splined, and a key was set in, which located it in the plate. Thus arranged, the plate was placed on the surface plate, which in turn was held in the universal head and properly set for the grinding operation against the cup wheel. The radius grinding was accomplished by rotating the work by hand about the small stud in the surface plate, which served as an arbor. The opposite sections were ground to the required diameter, the plate simply reversed with the bushing, and the other two sections then ground.

The third operation was to grind a radius (inside) many times larger than the wheel used. This was accomplished simply by setting the table traverse at an angle from the wheel spindle, so that a position was reached in which by passing the work across the corner of the wheel the required curve was obtained. This method will serve for curves of limited arc. A curve 5 in. long with a 30-in. radius can be ground with a 7-in. wheel—a curve so nearly a perfect circle that it would be difficult to detect any error. The illustration, Fig. 3, shows a former for shrapnel turning being thus ground.

The fourth case illustrates how the inconvenience of not having a regular form-grinding attachment for circular formed cutters may be overcome. All that was needed besides the regular equipment was a sufficiently large faceplate attached to a spindle, and this in turn held in a bronze quill with an adjustable nut on the end of the spindle for the end thrust. The faceplate was notched lightly on the quarters, a flat strip of spring-tempered steel attached to the regular tooth support and set for tension against the rim of the faceplate. Simple holders, as shown, adapted to the specially shaped cutters were made, and the cutters were then ground mechanically correct—exactly "like the cutters you buy."

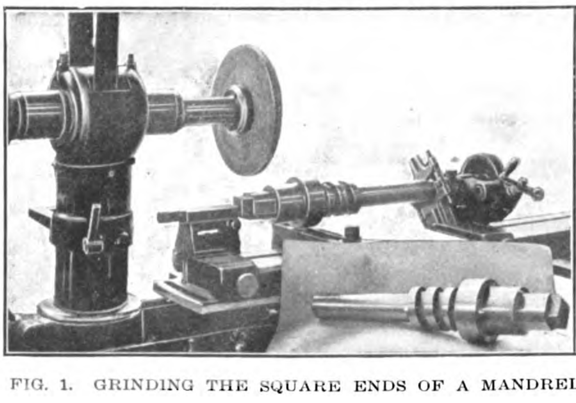


FIG. 1. GRINDING THE SQUARE ENDS OF A MANDREL

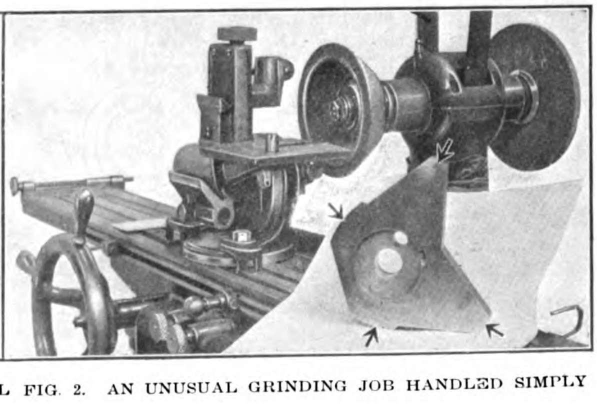


FIG. 2. AN UNUSUAL GRINDING JOB HANDLED SIMPLY

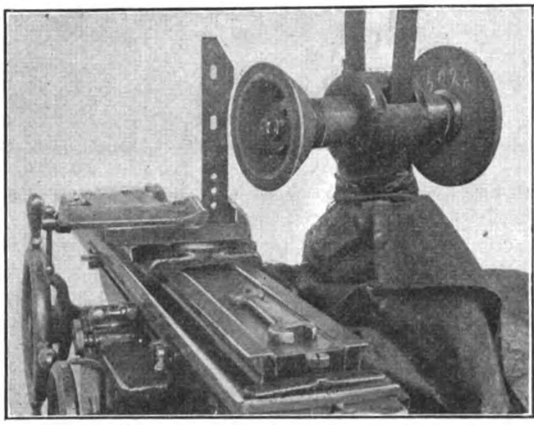


FIG. 3. GRINDING A LARGE RADIUS WITH A SMALL WHEEL

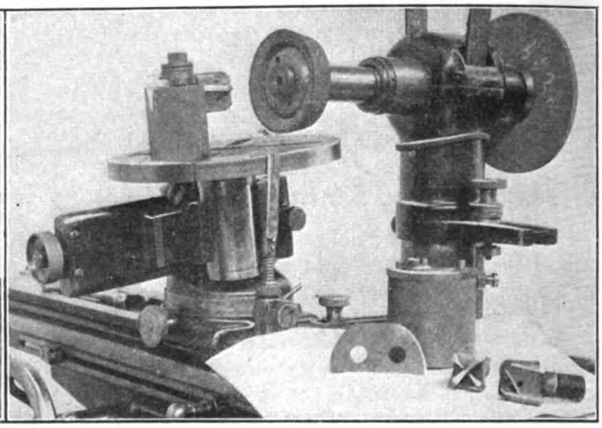


FIG. 4. GRINDING FORMED CUTTERS WITH SIMPLE FIXTURES

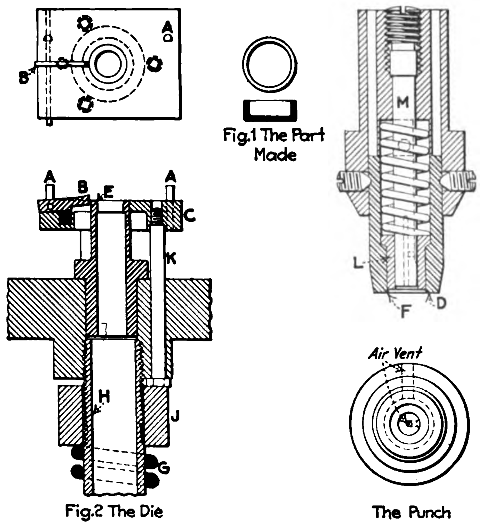
Incidentally, the new type of four-lip drill, shown in Fig. 4, is stocky and a great cutter. Two lips are carried across it, the same as in an ordinary drill, and the other two cut nearly to the center. This particular drill is flat on the end, with a 0.4-in. radius on the corners. The ends, sides and corners were accurately ground on the fixture shown, including the relieving. The finger support for the lip is removed to give an unobstructed view of the cutter.

These operations are not shown as presenting the last word in manufacturing the particular parts, but hint how to get along until the proper machine arrives.

Springfield, Vt. O. S. MARSHALL.

Blanking and Forming Die

The die in Fig. 2 was designed for blanking and forming the cup shown in Fig. 1 and has proved satisfactory for small work. The dimensions of the cup are as follows:



BLANKING AND FORMING DIE

lows: Inside diameter, $\frac{3}{8}$ in.; depth, $\frac{1}{8}$ in.; thickness of metal, $\frac{1}{32}$ in.

The stock used for making the part is $\frac{3}{4}$ in. in width. It is guided by the pins *A*, while the spring lever *B* acts as a pilot. The spring pad *C* holds the metal firmly against the lower surface of the punch *D* while the shearing is being done. The outside diameter of the piece *E* and the corresponding hole at *F* in the punch act as cutting surfaces.

The spring *G*, for supporting the pad, is located beneath the die bed, as shown, and is placed around the pipe *H*, which is screwed into the die bed. At the lower end of the pipe is a nut for adjusting the tension of the spring.

The sleeve *J* acts as a bearing surface for the pins *K*. There are three of these pins used in this die. The piece *E* is of tool steel, hardened and ground, and acts as a punch in shearing, while the inside diameter acts as a die in the forming.

The punch is designed to fit a standard press. The sleeve *L* fits into the piece *F*, which is of tool steel hardened and ground. This sleeve locates the blank and holds it firmly until the descent of the forming punch *M*, which is held in position by means of a shoulder on the upper end and by a setscrew. On the return stroke the sleeve releases the finished cup so that the work falls through the clearance hole in *E*.

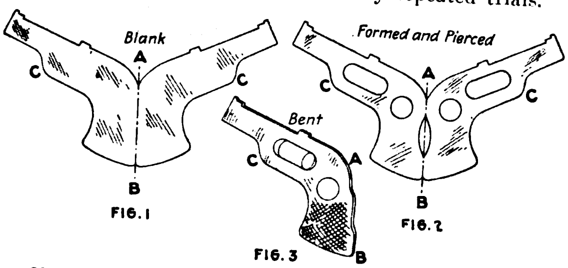
Bridgeport, Conn. MALCOLM PETERSON.

Overcoming a Difficulty in Forming Dies

In making the dies for a sheet-metal toy pistol, we ran against several snags, and the solution of our problems may be of interest and value to other readers. The pistol is modeled after the Smith & Wesson hammerless, with the case made in one piece. It is blanked, formed and pierced, the sides spread open and then bent through the handle on the line *AB*, shown in the illustrations, Figs. 1 and 2.

The trouble arose from the fact that the line *AB* is straight in the flat but forms a double curve in the finished case. There is an open space from *B* to *C* in the finished case for the works, but it is only $\frac{1}{2}$ in. wide, while the grips are $\frac{7}{8}$ in. This leaves only room for a bending punch $\frac{1}{2}$ in. thick in the fourth operation, which operation must be a simple bend, for any drawing of the metal would distort the sides, which are already formed.

It was necessary in the first forming operation to put enough metal along the line AB to make the double curve covering a space ½ in. wide. This result was accomplished by putting a hump in the forming die, between the handles. The right height to give just the proper amount of metal was found by repeated trials.



OVERCOMING A DIFFICULTY IN FORMING DIES

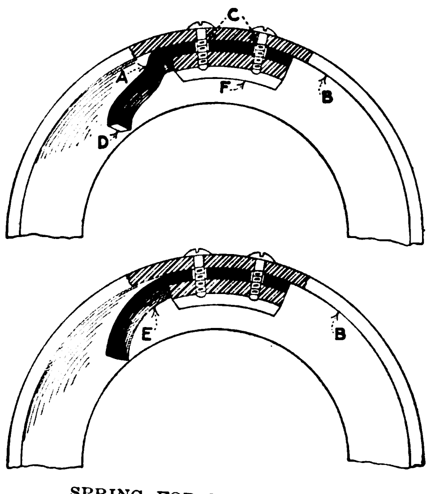
The bending operation reverses this hump and gives the proper curve to AB without affecting the shape of the grips.

The metal tears down somewhat at A in the first forming, and the two edges fold over one another in the bend. We could not avoid this without a long thin point in the blanking die, which would not give any service. As the lap is ironed down smooth in the fifth operation, it is not objectionable.

Bridgeport, Conn. W. B. GREENLEAF.

Designing Small Springs To Avoid Breakage

The spring shown full size is made of steel 0.020 in. thick, ⅛ in. wide and about ⅞ in. long. There are three springs in each multiple lens piece for microscopes and they are continually breaking, causing much annoyance



SPRING FOR MICROSCOPES

and expense where a number of instruments are in constant use.

The point D snaps into a notch and serves to hold one of the lenses in position for use. The spring is secured to the surface B by two screws through the holes C threading into the plate F. The strain is thrown into a very short section at A, which is the weakest part of the whole spring.

If the spring is formed as shown at E, then the movement of the point D, will cause the spring to bear against the surface B, which will remove the strain from A and distribute it along between the binding screws and the working point D.

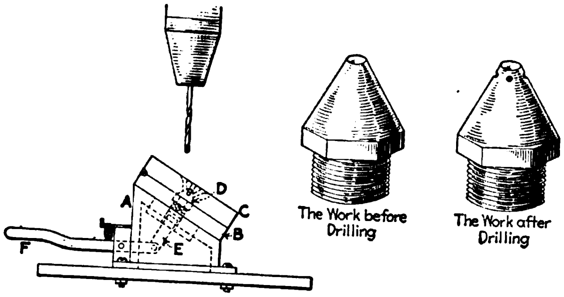
There is nothing about the lens piece or the adjustment of the spring that really calls for the offset at A, and a spring like E will be a decided improvement. The principle involved can be applied to similar cases and to any size of spring.

Rochester, Minn. GEORGE G. LITTLE.

Drilling Holes in Gas Burner

The accompanying sketch shows a revolving jig for drilling the four holes in a gas-stove spud, for an adjustable orifice. The spud is made of brass and finished in one operation on an automatic machine, except for the four holes, which are drilled in the jig.

The jig consists of a cast-iron base A upon which the parts B and C turn. Parts B and C are hinged at G, the



REVOLVING JIG FOR DRILLING HOLES AT AN ANGLE

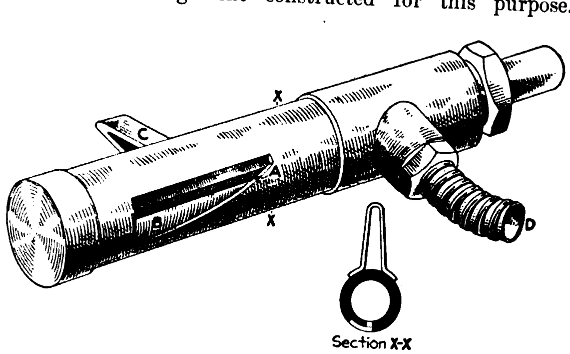
cover C being lifted up to place and remove the work at D. The lever F works the plunger E to kick the spud out after it is drilled.

The drilling is done through the hardened cover C through the holes in the top of the cover, a No. 50 Morse twist drill being used. With this jig the four holes can be drilled at the rate of 325 spuds per hour.

Rockford, Ill. H. J. McCLAFFERTY.

Combined Feed Pipe and Valve

In cases where it is advisable to flow cutting solution in the form of a sheet, it is desirable to control the width of stream and flow at the same point. The illustration shows an arrangement constructed for this purpose.



COMBINED FEED PIPE AND VALVE

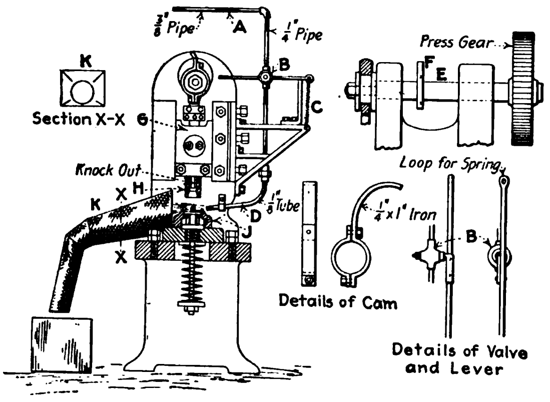
The solution is delivered through a narrow slot *A* in a brass tube, and the flow is regulated by a taper opening *B* in a sleeve that fits over the tube. As the sleeve is rotated by means of the handle *C* soldered to it, the taper side of the opening cuts down the length of the slot in the tube and hence the width of the lubricant stream. This sleeve must be carefully fitted over the tube so that it will not leak.

The whole device is supported by the customary rod, which is threaded into the tee of a pipe. The solution is fed through the flexible metal hose *D* into the side of the T-pipe. This arrangement allows considerable flexibility in flowing the cutting solution on the right place.

Bridgeport, Conn. W. BURR BENNETT.

Blowing Work Out of Dies

Some months ago we had occasion to manufacture quite a number of small copper and other metal caps ranging from ½ to 1 in. in diameter and from ½ to 1⅛ in. long. They were made on a single-action vertical punch press



BLOWING WORK OUT OF DIES

with combination blanking and drawing dies. The action of these dies was perfectly satisfactory, but the problem arose as to a more economical and safer method of removing the finished cap from the die without running the risk of having the ram come down meanwhile. We also wished to prevent the waste of time taken in removing chips of metal and occasionally such dust and dirt as might accidentally adhere to the oiled sheets of stock, as it was our idea to keep the press running continuously.

The air compressor used was a small 3x3-in. single action of vertical type belted directly from the line shaft and running at a speed of 350 r.p.m. The tank was only a little larger than the ordinary commercial household hot-water tank. This gave us a very limited supply of air, especially as it was already being used to clean off chips from drill presses and other machines, and to force oil up from a tank on the ground floor to the floor above to be used at the different assembling benches.

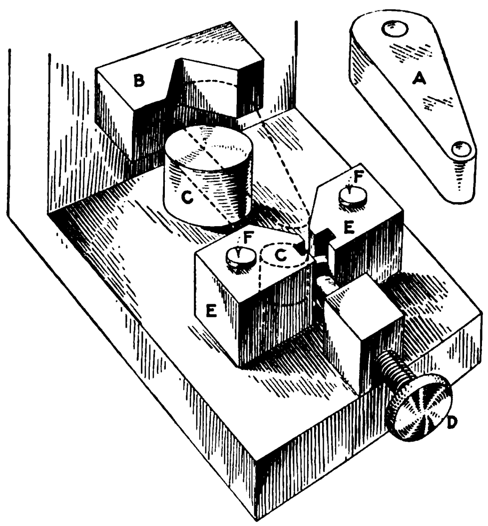
We at first rigged up the press with a continuous flow of air at about 80 lb. pressure through a ⅛-in. pipe. That soon exhausted the supply, so we planned and rigged up an intermittent air supply in the following manner: On the press used, the main shaft rotated between two bearings with the cam on the outside of the front housing, exposing about 8 in. of the shaft. On this section a trip was placed and so timed that at each revolution of the shaft, just as the punch was ascending from the die, a valve was opened letting the full pressure of the air blow across the die for a second or two only, the valve being closed again by a spring after the high part of the trip passed the handle on the valve. On the other side of the die was placed a funnel-shaped chute to catch the caps as they were formed and blown from the die. Passing through this, they were carried through a pipe to a barrel or box placed on the floor by the side of the press.

The illustration fully explains the device. The air line *A* comes from the tank; *B* is the valve; *C* a spring to close the valve; *D* a copper tube to be bent as required to bring air in proper relation to the die; *E* the main shaft of the press; *F* represents the cam for opening the valve; *G* is the press ram; *H* the punch; *J* the die and *K* the funnel-shaped carrier and pipe leading to the box.

Buffalo, N. Y. HERBERT J. RANDALL.

Locating Round Ends of Levers

The illustration shows a good device for locating in a drill jig work similar to *A*. The holes are located concentric with the rounded ends, which is always desirable. The work is set on one end in a suitable fixed V-block,



LOCATING ROUNDED ENDS OF LEVERS

as *B*, and upon the bottom on studs *C*. The screw *D* is then tightened, which in turn forces the movable V-blocks *EE*. These V-blocks pivot on studs *FF*. B. MACK.

Dayton, Ohio.

Tinning Tempered Steel

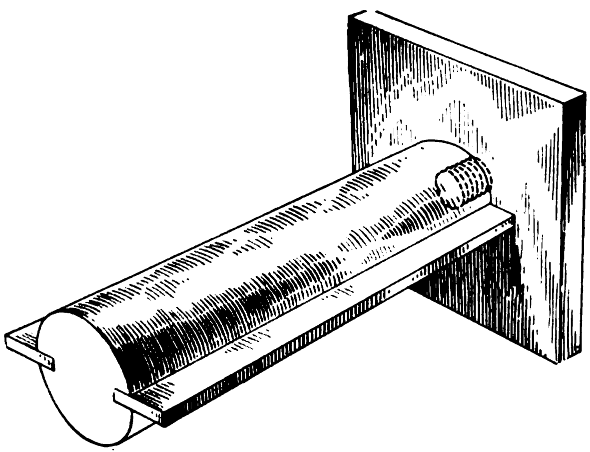
Steel articles that have been tempered or blued and show a light color, either straw or blue, cannot be tinned without first removing the thin film of oxide which gives color to the hardened and tempered steel. A bath of dilute hydrochloric acid is necessary to remove this thin film of oxide. It will require only a few seconds' immersion to do so, after which the object should be dipped into the lead and tin bath while wet; lace it immediately in the melted bath, as quick as it comes from the acid, and the lead and tin alloy will immediately coat the surface and form a foundation for soldering.—"Brass World."

Discussion of Previous Question

Around Small-Shop Babbitt Fires

I read your article in Vol. 43, on page 1017, dealing with babbitting and was particularly interested, because that is an important part of the work in our repair shop. We have a cheap and easy way of babbitting our standard bearings. While not new, it may be of interest to those having similar work to do.

Having a number of bearings running from 1 15/16 in. to 4 15/16 in. in size, to be babbitted regularly, we made a mandrel, as shown in the sketch. The scrap pile was appealed to, and a piece of cast iron about 8 in. square and 1 in. thick was found. A 1¾-in. hole was bored out



MANDREL FOR BABBITTING STANDARD BEARINGS

and threaded in its center. Mandrels for each size of bearing were then turned, leaving them about 2 in. longer than the bearings and, as we did not want to do much scraping, a few thousandths oversize in diameter.

One end was turned and threaded to screw down flush into the cast-iron plate. The mandrels were then put into the shaper and slotted along two opposite sides, and flat pieces were tightly driven in, as shown. The thickness of the pieces varied according to the amount of liners wanted for that size of bearing.

In babbitting, the base plate is laid flat, the proper-sized mandrel is screwed into it, and the bearing and cap are bolted on with their regular bolts, the side strips fitting into the planed-out part of the bearing and automatically centering it around the mandrel. A little of the asbestos and cylinder-oil mixture is put around the bottom and in the oil holes, to prevent leaking, and also around the top, so that a riser can be poured. The babbitt is then poured into the open end. As soon as it sets, the bearing and cap are taken off, and the surplus metal is removed with a piece of iron heated in the forge. The resulting bearing is smooth; and as the bearings are always planed the same, they are always in line and the same height from the sole plate, without any measuring on the part of the man doing the pouring.

We use this hot-iron method to remove surplus babbitt from nearly all our babbitting jobs. It is quicker and safer, for unless extreme care is taken, the babbitt in the bearing is likely to be loosened by chipping. In melting off the babbitt, care must be taken to hold the bearing in such a position that the melting metal will run away from, and not into, the bearing proper.

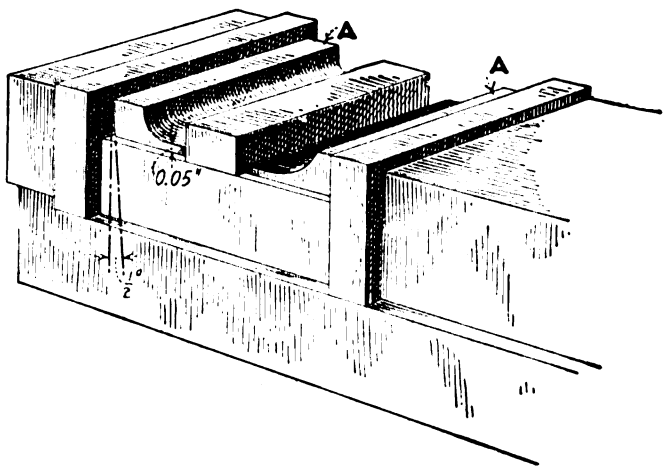
It has been our experience that sometimes a little more care and thought in cutting the oil grooves in a bearing are more important than the grade of babbitt used. In a number of instances, after a few experiments with different ways of cutting the grooves and finding the most suitable lubricant, we were able to get as good, or even better, results with a much cheaper grade of babbitt, which is quite an item in these days of high-priced copper and tin.

E. W. Wrigley.

Seattle, Wash.

Milling Attachment for Thin Cutter Blades

On page 1175, Vol. 43, Mr. Fruhner describes a fixture which looks very good. I have been up against the same proposition and find that two simple strips shown at *A*



MILLING ATTACHMENT FOR THIN CUTTER BLADES

answer the same purpose very satisfactorily when used in an ordinary milling vise. Blades as thin as 1/16 in. thick may be milled with them.

The strips may be made of ¼ or 3/16 in. thick tool steel, spring tempered, with the edges which come in contact with the vise jaws made on a slight angle. This arrangement tends to force the work solidly against the parallel.

Harold E. Greene.

Ilion, N. Y.

Chart To Determine Maximum Unit Repeated Stresses

We have noticed with much interest Professor Kommers' diagram for use with the exponential formula for strength of metals under repeated stress. Professor Kommers' diagram is, in many respects, a decided improvement over the diagram given by us in the paper on

"The Failure of Materials Under Repeated Stress" (American Society for Testing Materials, 1915).

In this connection it seems proper to call attention to the fact that the values of B given in that paper and quoted by Professor Kommers were given as tentative values. Recently the writers have discovered an error in the derivation of the value of B from the test data.[1] Having corrected this error and having given further consideration to available test data, we now suggest the following values for B:

Material	Values of B
Structural steel and soft machinery steel....	250,000
Cold-rolled steel shafting....................	400,000
Steel, 0.45% carbon..........................	350,000
Wrought iron	250,000
Spring steel	400,000 to 600,000
Hard steel wire................................	600,000
Cast iron (gray)...............................	100,000
Cast aluminum	80,000
Hard-drawn copper wire.........................	140,000

In view of the small number of test data available for some of the materials the values herewith should be regarded as tentative. It is our opinion that in no case should working stresses be taken as greater than one-half the stresses for fatigue failure as given by the exponential formulas, using the foregoing values of the constant B, while in many cases the working stresses should be lower than one-half the fatigue-failure stress. Of course, in no case should working stress be taken greater than the safe static stress.

H. F. MOORE,
F. B. SEELY.
University of Illinois, Urbana, Ill.

Two Small-Shop Items

The contributions of John H. Van Deventer are most interesting reading for me and must be more so to the owner of the small shop, who is too often looked upon as a sort of "stick in the mud" by all of us who "know something."

Quite recently I visited a small shop. The whole of its machinery consisted of two old engine lathes, a milling machine, made when milling machines were young, and a drill press of the same period.

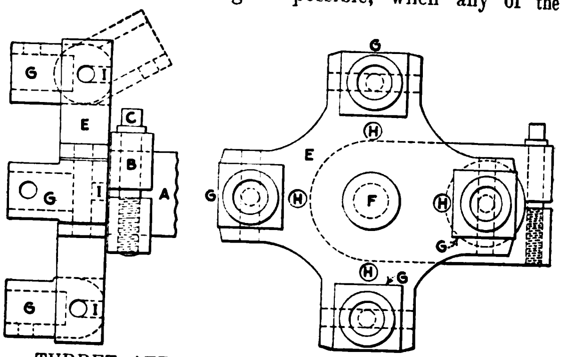
This shop was exceptionally busy on munitions—small details for aëroplanes. The work was ideal stuff for the automatic. Many of us, I fear, if similarly placed, would have started in by getting into communication with some makers of automatics. After telling them what we thought of their delivery dates, we should probably have finished up by not getting the automatics and by making no attempt to get on with the details. The proprietor of this little shop had no time to waste. He just went ahead, and the way those old engine lathes were eating up the bars would have surprised the automatic and its maker.

The illustration shows the home-made turret attachment used on the engine lathes. The turret is attached to the sleeve A of the tailstock by means of the bar B and the screw C. To this bar the swing plate E is attached by means of the pin F. On plate E the four tool holders G are pinned and arranged, as the proprietor said, to swing "clear of everything."

The tools are located by means of a pin carried on bar B, engaging with the holes H. In the center hole of the sleeve is a spring plunger that engages with the hole I at the back of the tool holder, keeping this in position while in use.

For the work on hand, a drill, a reamer, a recessing tool and a tap were in use, while in the tool post a forming tool and parting tool were carried. While I could not help but admire the speed with which these methods produced the small parts, I think what appealed to me most was the "swinging clear of everything" of the tools not in use.

The proprietor of this same shop had recently installed electricity for lighting purposes. He had placed an old barrel in the loft, to which the disused gas pipe was attached, thus making it possible, when any of the machines required lubricant for their cutting tools, just to "turn on the gas."



TURRET ATTACHMENT FOR LATHE TAILSTOCK

No trouble was experienced with this system, the boy at the drill press taking a sort of delight in looking after the supply to the barrel. The only untoward incident occurred when someone "turned on the gas" in the proprietor's little office, which unfortunately for some of his correspondence and drawings, still had its gas jet. One accident of this sort was quite enough to convince the proprietor that it was advisable to make a second one impossible by blanking off the pipe entirely.

Somehow, while admiring these methods, the thought passed through my mind that one of the boys of this shop might one day make his way to a modern shop, with its drip cans and pans. Perhaps he will compare it with the old man's gas-pipe system and think how terribly the modern shop is out of it. Possibly he might go into a really modern shop, with its lubricant system complete with pipes and pumps and with costs worked out to the fraction of a cent; but even then it would not cause him any surprise, as quite naturally he would think someone had stolen the old man's ideas and also his system of bringing lubricant to the cutting tools.

Belfast, Ireland. G. P. TERRY.

Best Way To Do Certain Things

On page 165 Mr. Jacker has commented on the method proposed by Professor Sweet for attaching a lever to a shaft. Mr. Jacker suggests replacing with a taper pin the nut originally recommended by Professor Sweet.

To my mind the nut is much easier to fit up in the first place. On interchangeable work especially, the taper pin calls for expensive jigs and extremely careful work. The lever and shaft may be assembled and drilled in place, but then they are no longer interchangeable. After the thing has been fitted up once and taken apart a few

[1]In the paper before the American Society for Testing Materials the last sentence on page 452 (1915 Proceedings, Part II) should read: "It (B) is twice the value of the ordinate," etc. The mistake was ours, not the editor's. The values of B given in the illustrative problems solved in that article will be affected by this error, but the methods of solution will not be affected.

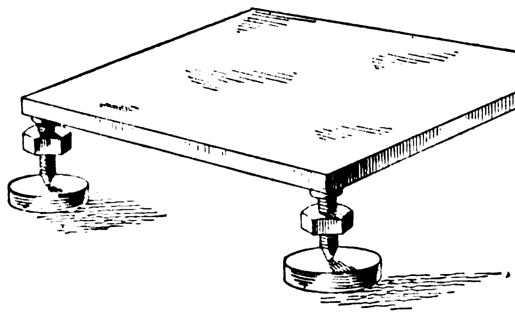
times, the crank will be worn or stretched enough so that the pin holes will not match when the crank is driven on snugly.

When it comes to a job such as a gasoline-engine flywheel, great is my respect for the designer who bolts his wheel to a flange on the crankshaft. Especially on boat engines this job of removing a flywheel has to be done under unfavorable circumstances with limited tools, and no system of keying on either a straight or a taper shaft will let go so promptly as a flanged, bolted joint. It will even defy sea water, which converts the fixing of any other joint I ever saw into one of the meanest jobs the repair man has to handle. H. W. JOHNSON.

Poughkeepsie, N. Y.

A Bench Plate with Legs

A. E. Holaday, on page 1130, Vol. 43, illustrates a bench plate with legs, in which the threaded holes pass right through the plate and the bolt heads of the adjusting screws serve as the surfaces in contact with the bench. The plate here shown corrects these two seeming disad-



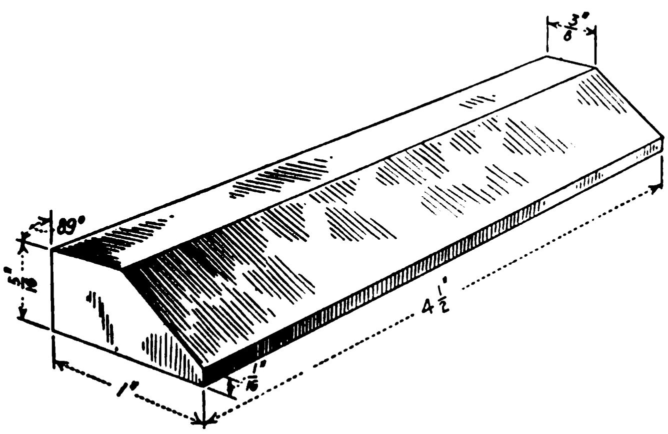
A BENCH PLATE WITH LEGS

vantages. Chips and dirt will find their way into holes that run wholly through the plate, and the adjustment will be more readily made when the hexagons on the adjusting screws are raised somewhat from the table.

London, England. G. S. BOWLING.

The Small-Shop Planer

On page 841 of Vol. 43 Mr. Van Deventer mentions a kink used in holding work against the solid jaw in the milling, planer and the shaper chuck with a piece



CENTERS FOR HOLDING THIN WORK IN A VISE

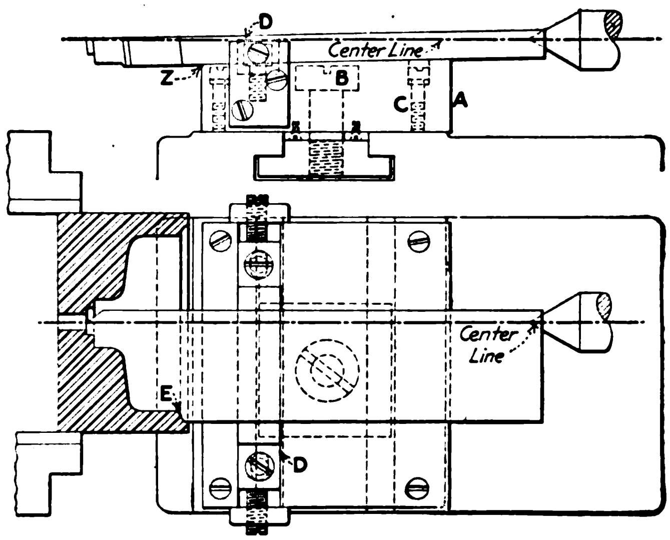
of round stock. Pieces like the one illustrated, called "centers," are a great improvement over the round pieces. They are made of tool steel hardened and ground.

I am doing a good deal of shaper work in making dies and don't see how I could get along without the pair I have, not alone for holding work against the solid jaw, but on lots of other work, particularly thin pieces. One on each side of the work fills the bill here and in many other places. Grinding the face which goes against the jaw, a little past square tends to force the work against the parallels. AXEL HALVORSEN.

Albany, Ind.

Face-Forming Tool for a Lathe

With reference to Gustave A. Remacle's article, page 1127, Vol. 43, I think this is purely a technical idea. If put to a practical test, it would be likely to fall down.



FACE-FORMING TOOL FOR A LATHE

After the tool has been made and hardened, the tempering would have to be carefully studied, as *Z* in the reproduced illustration would be subjected to a great pressure and would probably break or bend. Owing to the great cutting surface, the tool would be found to spring and chatter. This class of tool is all right for roughing out; but for finishing, it is nearly useless.

If your contributor requires a tool for such a die, it would be advisable to make a reamer or D-bit, which could be done without much trouble.

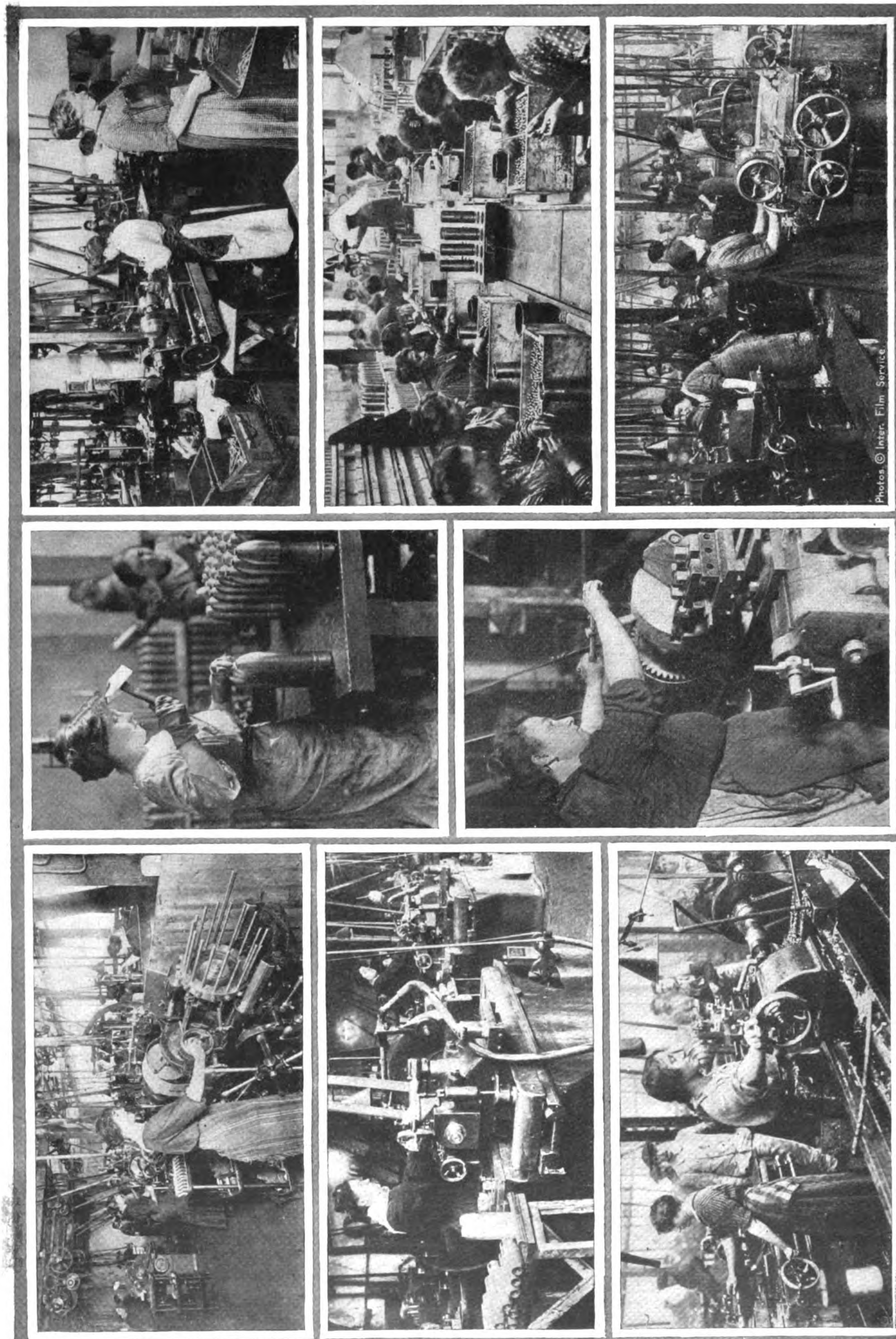
Chingford, England. W. H. HUTCHINS.

Humoring a Small Lathe

Your correspondent, A. S. Day, on page 912 brought up an interesting subject. I believe that the cutoff tool is one of the most unsuccessful tools which the engine-lathe operator has, unless it is used upside down and the lathe reversed.

I have seen a lathe operator cutting up in a 14-in lathe a steel bar $1\frac{1}{2}$ in. in diameter by 18 in. long into disks about 1 in. thick. One end of the bar was held in the chuck; the other end ran on the center. I doubt if the ordinary cutoff tool could have been made to go right along the bar without some digging in and some broken tools. It seems to be the general practice in motor shops around London to cut off with upside-down tools. What would they do with a lathe having only forward speeds?

Wembly, England. J. H. DAVIS.



Women Machine-Tool Operators and Bench Workers in a French Munition Plant.

Editorials

Women Munition Workers in French Shops

The illustrations reproduced on the opposite page show conclusively how universal the employment of women has become in French munition shops. It will be noticed that their employment is not restricted to machines and operations that in the past have been considered suitable for women. Here they are shown operating cutting-off machines, rough-turning lathes, wet grinders and screw machines, as well as performing a number of manual operations such as loading, inspecting and stamping.

One point is emphasized by an inspection of the costumes worn by these operators. Apparently standardization in this matter has not yet been attempted, although it will probably come with time.

The shop from which these illustrations are reproduced is a part of the celebrated Panhard-Levasser works.

Racial Traits and Feelings in South America

"Pardon me, but I cannot give you anything." This expression, or its close equivalent, is the courteous everyday refusal to beggars in South America. Not only are the words polite, but the sentiment that they convey is genuine. Through this everyday occurrence is exhibited the strongest racial trait of South Americans. In contrast the brusque, "Beat it," hurled over one's shoulder at a northern panhandler exhibits a racial trait of the Anglo-Saxon.

To North Americans such extreme courtesy may appear hypocritical, but it is not. It springs from an inborn sense of the rights and privileges of others, and in its gracious thoughtfulness for another's feelings is a fine practical application of the Golden Rule. In South America there is no such thing as "cussing out" a subordinate; there is no discourtesy on the part of servants. Short-changing in the transactions of daily life is unknown. As a rule, financial obligations are scrupulously met. In this respect the subscription records of the *American Machinist* show that South American accounts are uniformly paid. Would that the same could be said of domestic accounts!

These things, while perhaps small in themselves, are traits and characteristics that every northern business man should understand and value at their true worth, if he hopes to do business in the great markets that are opening to the south of the Panama Canal.

It is more than likely that the average North American forms his opinions of South Americans by his knowledge of Mexicans. This twisted viewpoint is aided and abetted by our magazines and daily newspapers, which one often believes are deliberately fed with misrepresentations. Racially the Mexican is a mixture of Spanish and vicious Indian. In contrast Brazil, the largest country of South America, is racially Portuguese, Negro and Indian, but Indian of a far different type than that met with in Mexico. The rest of South America is racially Spanish and Indian. The population, taken as a whole, is far different from that in Mexico in almost every way that is touched in business connections.

Broadly speaking, there is no color line in South America. In Brazil, where the negro blood is most plentiful, many of the most important positions are held by pure negroes. For illustration, the president of the Bahia Water-Works Co., an able engineer and a man of affairs, is a negro—and he is no exception.

This population, which is just on the eve of tremendous advancement in the use of manufactured products, occupies the richest section of the entire world. The Amazon River basin has twice the area, and La Plata basin one and one-third times the area, of the Mississippi. The national resources are untouched and are magnificent in extent.

An Argentine statesman recently said that his country today is in the same position that the United States was in 1805. What tremendous things will happen there in the next 50 years!

Life is easier in South America than here, because of the great fertility and productiveness of the land, because wants are simpler and because of racial habits. But this leisure is not misused. The average man who would be approached by a salesman from North America is better educated than his caller. Not only would he have a thorough knowledge of his own business, but he would have accomplishments in languages, literature, art and music that would far outshine and outdistance the man from the north, with his purely business viewpoint. Such facts are well worth consideration whenever plans are being formed to enter South American markets.

The feelings of South Americans toward the United States have been as much misjudged as their racial traits have been misrepresented. It is true that, in the past, South American countries believed that the United States was a huge aggressor, interested mainly in stretching her boundaries and absorbing portions of the weaker countries to the southward. The latest incident to foster this feeling was the landing of the naval contingent at Vera Cruz. But when these troops were withdrawn and President Wilson affirmed and reaffirmed the position of the United States—that not one square foot of Mexican soil was wanted or would be taken—the sentiment in South America changed again. Today the feeling for us is one of extreme cordiality. Our much discussed Monroe doctrine is looked upon as the great safeguard of the entire western hemisphere and a principle that should be supported by the nations of the south as well as by the United States. In fact, in Rio de Janeiro there is a beautifully constructed building known as the "Monroe Palace." It was built to honor President Monroe and commemorate the establishment of the American doctrine that bears his name. At the present time there are running in South America serial novels in which Brazil, Argentina and Chile are pictured as joining with the United States in defending this doctrine against European aggression.

The business men of South America now realize that they have made a mistake in past years by not establishing closer business relations with their northern neighbors. This feeling has been accentuated by the situation developed from the European War. Without doubt, at no previous time in our history has the feeling in South America been so cordial and favorable toward the United States as it is today. Obviously, this is the time to lay the foundation for foreign trade that shall endure for decades to come.

Another source of misrepresentation has been in regard to the quality of goods demanded by South Americans. It has often been thought that they would purchase only cheaply made, inferiorly finished products. This is not true. It is an interesting fact that very little plated jewelry is sold in South America. However, people buy plentifully, within the limit of their means, genuine jewelry of excellent design and superior workmanship. In the region of more practical things—up to 20 years ago a Connecticut firm had practically a monopoly of the cutlery trade of the rubber districts of the upper Amazon. At about that time German goods began to enter, selling for a much lower price than the North American, but inferior in quality. In a short time the American products were driven out. But about 10 years ago the tide turned, and within another 5 years the German products had disappeared. The trade of the Connecticut firm is now firmly reëstablished. The turnover was due entirely to the superior quality of the Yankee products.

The lack of real information in regard to South America, her people, their traits, feelings and business likings, is perhaps due partly to the provincialism of North America. This is a well-worn statement, but it has not lost the force of truth. Now, if ever, is the time when facts, not beliefs, and plans, not schemes, must be relied upon if American manufacturers are to obtain and retain their proper share of the business in South American markets.

Preparedness for Manufacture Instead of for War Itself

We hear much in some quarters about the raising and equipping of a huge army at short notice, should we be threatened with an invasion. But those who talk in this way know nothing of the problem of securing arms and accouterments for such an army; they do not realize the time required to manufacture arms and ammunition.

They read of the huge order for munitions that have been placed in this country and read of different shops that are turning out from 3,000 to 10,000 shells per day and of cartridges by the million. They think of our large automobile and other shops and fondly imagine them turned into huge munition factories, and a sense of security comes over them. They say we are the greatest country on earth, with the greatest resources; why worry?

But they do not know that in reality we are supplying only a small percentage of the ammunition being used by the warring nations. They do not know the time required to begin turning out rifles, fuses and other munitions.

We are informed that very few rifles have yet been delivered of the millions which are under contract. And this in spite of the fact that some of the contractors were already in the business and large manufacturers of arms. Even mechanics do not realize the immense amount of preparation required to manufacture rifles; they do not appreciate the hundreds of operations that go to make up a modern rifle, the hundreds of jigs and of gages and the training of men or women for inspection and assembly.

Fixtures and gages play an important part in the making of rifles, and unfortunately they require a long time to design and manufacture. And even with the design made and blueprints to work from, it is no easy task to secure enough tool makers capable of this sort of work to turn these pieces out accurately and quickly, as mechanics of this class are none too plentiful in ordinary times.

As we have pointed out before, an excellent form of preparedness is in the making of as many sets of fixtures and gages as may be necessary to enable rifles to be turned out quickly in a dozen or more shops. Preparedness of this kind could hardly be used for offensive purposes and would yet be extremely effective in the effect on possible invaders.

With enough rifles on hand for the first few weeks—and although another 250,000 would do no harm—we are not as deficient in that respect as some would have us believe. And with fixtures and gages, not overlooking drop-forging dies and similar tools, additional arms could be quickly manufactured, preferably in interior towns and cities.

Preparedness to manufacture quickly is not only cheaper, but is more effective than many of the plans proposed. Such action, coupled with world-wide publicity that all preparations have been made, will do much to prevent invasion and also nullify even the most elaborate spy system in existence. Playing the game with the cards in the open is always the best in the long run.

The Cup That Energizes

In practically all the shell shops of Canada work goes on day after day and night after night with no let-up. The hungry guns on the battle front must be fed, and those who make the fodder must not rest. In many of the shops Christmas and New Year's day were the only holidays in the twelvemonth past. Night work for even a single night is trying. How much more so is it when carried on night after night, week after week and month after month!

In one of the larger Canadian shell shops the management has set up coffee stalls at convenient points throughout the plant. Here the men can get a hot cup of good coffee for two cents. There is only one restriction—a man can go and get a cup whenever he likes, day or night, except at four o'clock in the morning. This is the hour, so the doctors tell us, when a man's vitality is at its lowest. In the works referred to it is compulsory for the men to drink, at the firm's expense, a cup of hot coffee at this hour. The scheme has been in operation but a short time, but the results have justified the expense. A tired man, after drinking a cup of hot coffee, returns to his work with renewed vigor.

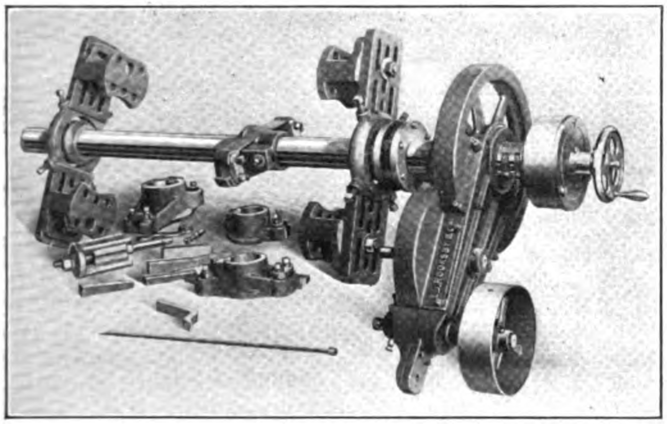
The increase in production after 4 a.m., since the coffee stands were started, has not yet been tabulated and compared with the production previous to their installation, but it is sufficiently marked to be noticeable.

Shop Equipment News

Cylinder Boring Bar

In the construction of the portable locomotive-cylinder boring bar shown, designed for reboring locomotive cylinders and valve-chamber bushings, special attention has been given to the safeguarding of all gears and moving parts.

The tool can be used with one or both cylinder heads removed. The crosshead blocks are bolted to the cylinder with the cylinder-head studs; and the bar revolves in the sleeves, supported and centered by setscrews in the crossheads.



CYLINDER BORING BAR

When boring with only one head removed, the expanding chuck and pin, having five sets of taper gibs to fit in stuffing-boxes of various diameters, are used to support the crank end of the bar.

The power is applied to the bar by means of a back-geared driving power having a two-speed quick-change gear drive. This form of drive is calculated to be of particular advantage where the same bar is used to rebore cylinders and valve-chamber bushings of various sizes. The quick-change is accomplished by simply pulling out a slip pin, shifting the primary pinion out of gear and driving by the intermediate shaft.

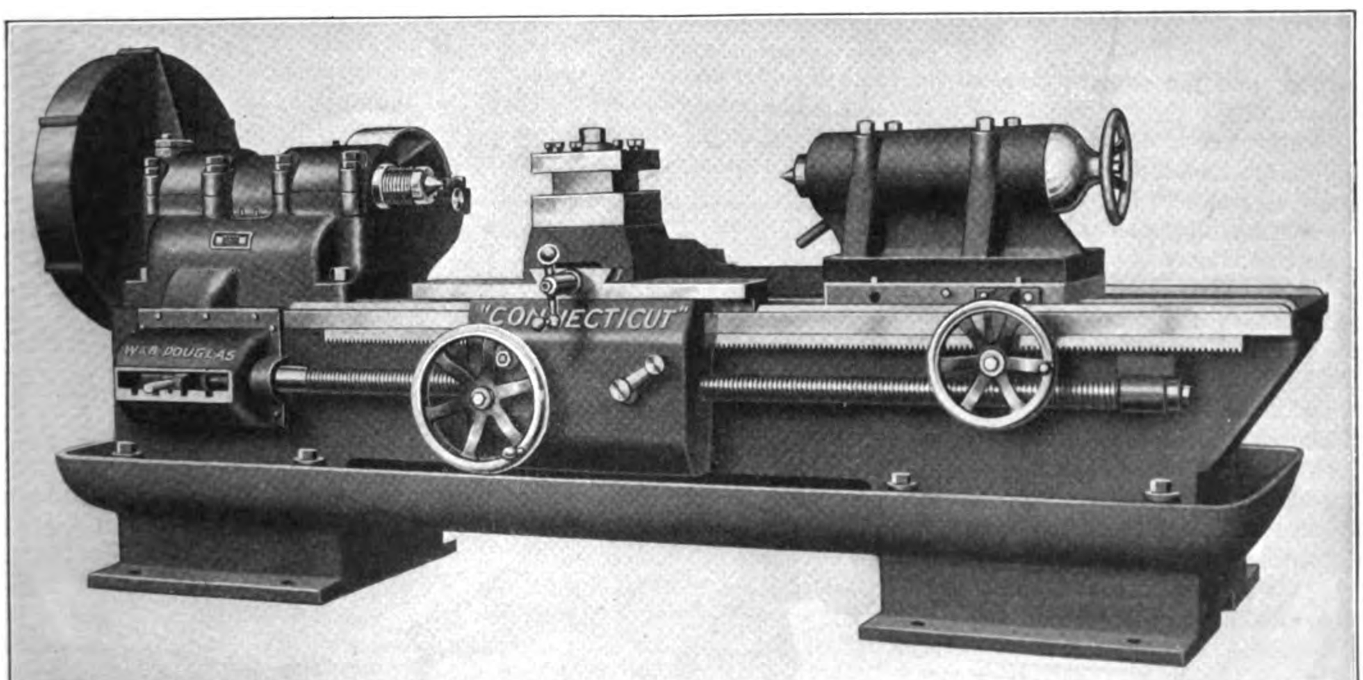
The cutter head is fed by means of an automatic feed case having two changes of feed controlled by a slip pin. For setting the bar up in valve-chamber bushings a novel device is used, enabling the operation to be quickly and accurately performed. This consists of a set of taper cone sleeves in halves, fitting in the counterbore, supporting the bar central while bolting up the blocks and crossheads, after which the cones are removed and the bar is ready for reboring. The sleeves being taper, one set can be used in bushings of various sizes.

These portable boring bars are manufactured by E. J. Rooksby & Co., Philadelphia, Penn.

Heavy Single-Purpose Lathe

It will be observed that the lathe shown is of the single-purpose type, designed primarily for turning or boring high-carbon steel forgings at maximum speeds.

As will be seen, the machine is heavily proportioned and follows more or less conventional design. All the



HEAVY-DUTY SINGLE-PURPOSE MANUFACTURING LATHE

Swing over ways, 26½ in.; swing over carriage, 15 in.; floor space, 11 ft. 6 in. by 4 ft. 8 in.; height to center, 42 in.; distance between centers, 60 in.; length of bed, 10 ft. 8 in.; cone diameters, 12 in., 15 in., 18 in.; speed of countershaft, 240 to 500 r.p.m.; diameter of countershaft pulleys, 18 in. for 6-in. belt; length of tool carriage, 36 in.; shipping weight, boxed for export, 16,000 lb.

bearings are fitted with removable bronze bushings, and the gears and pinions are made of steel, with the exception of the large spindle driving gear, which is made of semi-steel with 4-in. face.

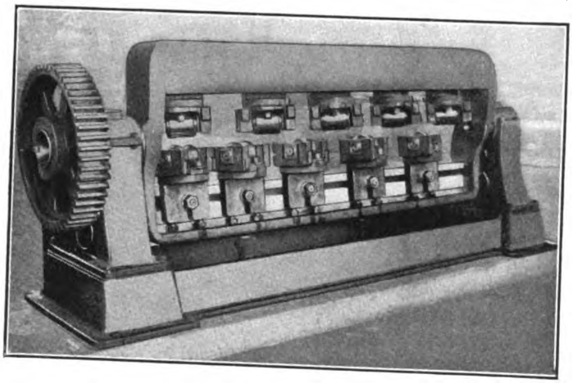
Three speeds and four feeds are provided. The turret tool post is of steel and arranged to lock in four positions. The bed is cross-ribbed with heavy box-shaped girts 15 in. apart. The central rack, which takes the end thrust of the tailstock, forms an additional rib. The feeds are all positive, transmitted through the lead screw. The main journals are provided with ring oilers, while all internal moving parts are lubricated by gravity feed.

The machine is a recent product of W. & B. Douglas, Middletown, Conn.

Roll Straightening Machine

In addition to its regular function of straightening, the machine shown puts on a high finish in one pass.

The straightener consists of a bed with upright pedestal bearings, which support a revolving frame that has hollow



ROLL STRAIGHTENING MACHINE
Capacity, 1- to 2½-in. rounds; speed, 30 to 40 ft. per min.

journals and the straightening mechanism. The latter consists of six rolls having concave surfaces. The rolls are supported by bearing blocks having a swivel and screw adjustment. The roll supports are secured to the revolving frame so as to project alternately from opposite sides, excepting at the receiving end of the frame, where two rolls are directly opposite. At each end of the straightener, tracks are provided, traversed by a gripping device that keeps the material to be straightened from revolving.

The contact of the concave rolls in the revolving frame produces varying speeds, according to the amount of concave surface put on the rolls. A certain degree of slipping that is done by the rolls will put on a fine finish. The rolls are adjusted at an angle to the shaft according to the diameter, each roll having a segmental line of contact with the shaft. This prevents gouging out or breaking of edges of flaws or cracks that might be found in the surface of the material.

The machine shown is the latest addition to the line made by the Brightman Manufacturing Co., Columbus, Ohio.

Adjustable Sizing Tap

The tap shown is an adjustable tap that may be kept accurately to size, and yet it has the advantages of a solid tap. It is made in various sizes and threads on

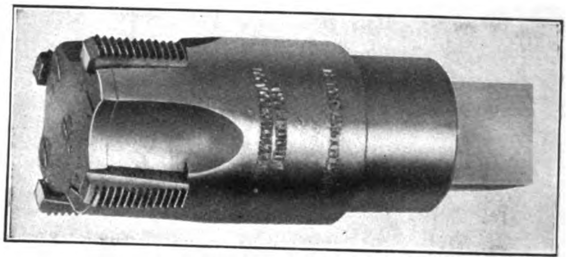


FIG. 1. ADJUSTABLE SIZING TAP
All sizes from 1¼ in. to 12 in.

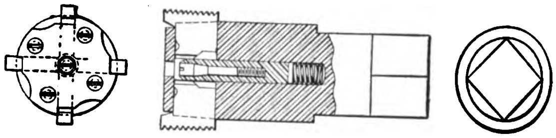


FIG. 2. CONSTRUCTION OF SIZING TAP

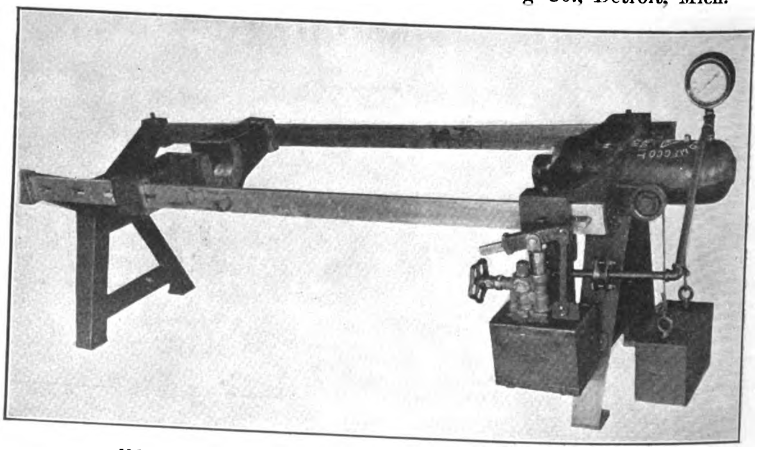
order, and additional sets of chasers may be easily obtained. Its construction is shown in detail in Fig. 2.

It is made by the Murchey Machine and Tool Co., Detroit, Mich.

Horizontal Hydraulic Press

The press shown has been designed to fill the need of a machine capable of powerful pressure, where speed and rapid production are not essential or under circumstances where power drive is not available.

The distance between the ram and the resistance head can be varied to suit the work by adjusting the head on the slotted and keyed bars. This press is a late product of the Metalwood Manufacturing Co., Detroit, Mich.

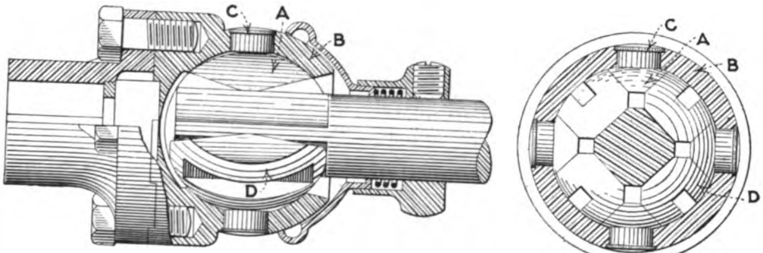


HORIZONTAL HAND-OPERATED HYDRAULIC PRESS
Twenty-ton size: Ram, 4½ in.; stroke, 12 in.; between bars, c. to c., 36 in.; length of bars, 9 ft.; ram to resistance head, extreme, 8 ft.; weight, 2,225 lb. Fifty-ton size: Ram, 4½ in.; stroke, 18 in.; between bars, c. to c., 36 in.; length of bars, 24 ft.; ram to resistance head, extreme, 22 ft.; weight, 2,930 lb.

Universal Joint

The illustration shows a new form of universal joint, which it is claimed gives a uniform motion at all parts of its revolution. It consists of four spherical driving segments *A*, held in the hollow driving case *B* by means of the pivots *C*. Between these driving segments are the floating segments *D*, which engage the squared end of the driving shaft. These floating segments fit the shaft. As they are free to move between the driving segments, they can assume any angle within the driving range, which is about 30 deg.

As will be seen, this joint has large bearing surfaces and is provided with large lubricating channels, so that it can be packed with enough grease for a year's run. The joint is compact and is provided with grease and dust covers. It is made by the Cooper Flexible Transmission Co., Inc., Brooklyn, N. Y.



FLEXIBLE SHAFT COUPLING OR UNIVERSAL JOINT

Machine Tools in France

By William D. Fitts

Recently I visited some of the important machinery houses in Paris that have connections in the United States and are the selling agents of many of the large factories there. Unusual activity was found everywhere, but the officers of the different companies found time to discuss the interesting question of the past, present and future of American machine tools in Europe. A considerable amount of information was obtained—in some instances of a disconcerting nature. One imagines that if there is a thing which Americans do really know something about it is organization and that they are wonderfully endowed with efficient methods for carrying out the details, big or little, of their business. But is seems that American business men still have two or three things to learn before Europe is quite willing to admit their supremacy in small details.

A member of one firm asked me to beg American manufacturers to put their office boys through a course of instruction in the postal rates between the United States and Europe. He said that it is not unusual for excess postage to be paid at this end by his firm, amounting in a month to 30 or 40 francs. Sometimes 20 or more invoices arrive in one cover, stamped with the minimum postage for the United States. This practice has been going on for years, notwithstanding a long and heated correspondence on the subject. Threats of fines are of no avail, and the habits of the American office boy are incorrigible, for even today the practice of putting a 2c. stamp on a letter to France prevails in many American offices.

Another firm has been writing weekly letters for the past 18 months to a New England factory, in an endeavor to persuade the manager to have the shipping cases marked with a stencil plate and in ink, rather than with a lead pencil. This kind of marking is obliterated by the time the case is on the docks at Havre, where it has to be opened and an inventory made of the goods it contains. A leather stencil and a brush were sent out to New England to be used in marking this firm's cases, and yet—alas!—the old pencil habit was too strong, and a weekly hunt has to be made upon the Havre docks for odd cases containing valuable shipments of machine tools. Delays and countless vexations are the result. Even when a stencil and ink are used, one steamer may bring three different invoices for the same firm, among which are found three No. 1's. In fact, I was begged to ask the manufacturers to take the time to perfect their markings, so that consignees will have less trouble in checking up their cases and knowing to a certainty what they contain. And too, will not the American manufacturer employ some system of checking the American Express Co. so as to be sure that cases are really shipped by it upon certain dates and upon specified steamers?

In general, the impression seems to be that the American has still many things to learn about the export business. As all the companies interviewed are anxious that the present exportation of American tools to Europe should be maintained, even after the war comes to an end, it is suggested that now is the time to study and perfect the details of the business, so as to be better prepared for the competition that is bound to come when European peace has been reëstablished.

The hazard of life has forced all foreign nations to turn to the United States for their present supply of machine tools. One estimate of the increase of American business with France in this line alone was 600 per cent.; with Russia, about the same; England, 300 per cent.; and Italy, 300 per cent. This latter country joined in the war after her allies had already made their contracts with American manufacturers, and factories were unable to make deliveries to her rapidly. Moreover, Italian methods of business are somewhat dilatory, and contracts are not so easily signed there as in France and Russia. There are always a certain hesitation and a lack of confidence on the part of the Italian buyer, which often loses him the chance of acquiring the articles he is most in need of.

Thousands of American lathes are now set up in factories all over France, turning out thousands of projectiles daily. One estimate is that France alone has bought anywhere from 5,000 to 10,000 lathes and from 1,000 to 3,000 automatic screw machines for making fuse parts. Millers and grinders have come over in great numbers and at the present moment cannot be had at any price. The French demand is in a measure beginning to fall off, although this is not so much due to the lessening in the needs of the country as to the inability of American factories to deliver or to make promises to furnish in any near future the quantity of machines required. And perhaps it is just here that, as a result, may be found the most interesting evolution which this war has brought

about in France. The great necessity for munitions of war has awakened in the French people a new conception of their own powers as an industrial nation.

Manufacturing Lathes in France

Before the war, France manufactured lathes, and those I have seen are good examples of design and workmanship. But they were turned out slowly, and it was a great event when one or more were sold. The firms who did this business were old and solid concerns, taking more pride in their well-earned prestige and the quality of the machines built than in the number sold. The war came, and it must be acknowledged that if the United States had not been there to furnish the myriads of machine tools necessary to equip the factories that sprang up all over France, the chances are that the present impregnable position of this country's army along its entire front would not have been so secure as all military authorities now admit it to be. But the country's demand for munitions of war has become insatiable, and as factories in the United States are temporarily exhausted, France itself has decided to make a superhuman effort to supply the necessary machines. Lathes are now being built in fairly large numbers. A simple type of machine has been chosen for a model; celerity in manufacture and utility for the one purpose—the making of projectiles—for which it is to be used are the only things that matter.

Future of France as an Industrial Nation

France easily acquires habits, and having made a beginning in the intensive supply of war material, it would not be surprising to find her, after peace is signed, entering upon a period of industrial expansion of great dimensions. Even now nothing is being left to chance, for finance and industry are banding together to an extent hitherto unknown. For the first time in the history of France the conception of vast schemes in business affairs is in process of formation. Until now it has never seemed possible for financiers to grasp the meaning or the value of great masses of figures, nor for the manufacturer to believe it possible that factories built and organized on any larger scale than might be necessary to supply in a measure the needs of the country itself were more than dreams of fancy. But all this has changed, and today France is talking in large figures and showing practically that no undertaking is too great for her comprehension. All this is happening while the flower and strength of the country are in the trenches. When this fighting generation of men, hardened by exposure and molded by life's forces in this giant contest now going on, returns to resume the material struggle for existence, it is safe to predict that whatever they do will bear the impress of their new-born conception of greatness.

In talking with the machine-tool companies here it was observed that all were guarded in making any prediction as to the future prospects of American manufactured articles in this market. All were convinced, however, that in order to hold the greater part of the business American firms must change many of their methods and show more willingness to conform to the habits of the different European countries.

The idea prevailing in America—that French firms are not worthy of credit—was spoken of as absurd by a member of an English firm which has done business in France for several generations. This gentleman said:

"There are no better contracts than those entered into in France. Possibly Americans who have little experience here may find the negotiations leading up to the signing of a contract somewhat tedious; but as a matter of fact, we do not mind this, and one is so completely protected by the laws of the country that losses are almost unknown. One case came up recently where the purchaser of lathes, who had already made an advance payment, finally received the machines and then upon various pretexts put off the final payment of the remainder from week to week. We waited four weeks and then made our complaint to the judge at the tribunal. Two days afterward the judge ordered the delinquent firm to pay in full, and we received our money the very same day. How long do you think the New York courts would have taken to decide a simple question of business of this kind? The fact is that, in spite of the war, French credits still remain as good as any in the world.

"The Germans beat the Americans before the war, not because their machine tools were better, or as good, but simply because they understood and were willing to cater to the prejudices of the people and arranged the matter of payments in a satisfactory manner."

Bitter Feeling Against Some American Firms

A member of another firm spoke about the very bitter feeling that has been aroused here by the manner in which American manufacturers had ignored many of their French contracts. He said:

"If it is true, and there seems to be little doubt of it, that American manufacturers, who have signed contracts for delivery in France upon certain dates, deliberately sold the promised machines to Americans or others at higher prices, I can only stigmatize this mode of business as immoral. At all events the manner in which some of the French companies have been treated has left a painful impression which cannot be easily effaced. And to add to the indignity, the Americans who have broken their contracts refuse to answer all letters, simply ignoring their undertaking.

"On the other hand, all really first-class American firms with whom we have been doing business have treated us very fairly and have kept us constantly informed of conditions at the factories and stated frankly how late they would be in making deliveries.

"Americans have become spoiled by too many orders. Before the war they were all crying out for business, and now that they have everything their own way they have become independent and arrogant. With the ending of the war, all this must change, for the French are not likely to forget the bitter lessons they have learned, and this time they will probably profit by them."

The director of one of the most important companies here had the same tale of woe to relate concerning the lasting harm that is bound to result from the smashing of many of the army contracts by American manufacturers. He said: "The army officers in charge of the factories know quite well what has been the cause of the delay in delivering machine tools contracted for. Promises had been broken time after time, and the general dissatisfaction that has been aroused will do great harm to American business prestige. France certainly will not soon forget the bitterness of this experience. America, on the other hand, does not seem to realize how serious the matter is."

Charles Churchill and Son, Charles Henry, Dead

The American machine-tool building industry will be shocked by the news of the death of Charles Churchill and his son, Charles Henry Churchill, founder and managing director respectively of Charles Churchill & Co., Limited, London, England. The death of the senior Churchill was not unexpected, inasmuch as he had been in failing health for the past few years, although it was not until last year that he relinquished active directorship of the business and his son became the managing head. Charles Churchill, the founder of the business, died on Feb. 14, following his son, Charles Henry, by only six days.

The story of the founding and growth of the giant machine-importing business built up in England by the Churchills dates back to 1861 and envelops the vision and faith of one of the first Americans to realize the future of the then infant American machinery-building industry.

Charles Churchill was born in Hamden, Conn., just outside of New Haven, on July 8, 1837. Upon completion of his early education he entered his father's business, which was that of auger manufacturer. In the early sixties his father became associated with the firm of Thompson, Langdon & Co., New York City, for which he went to London in 1861, to supervise the installation of some wire-covering machinery exported by that firm. In connection with the same work, the son Charles followed the next year, and the interest that this machinery aroused and the impressions he gained concerning the possibilities of other classes of machinery decided the young man in the choice of a career—American machinery importing. The business took hold almost immediately, and before many years it became a large one.

In 1864 Charles Henry Churchill was born in London. He received his early education in that city and joining the business when a young man, was associated with his father continuously.

With headquarters in London the firm established branches in Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. The latest development was a manufacturing plant in Manchester.

Two sons survive, one of whom, Arthur, is at the head of the small-tool division of the business.

TRADE CATALOGS

D & W Fuse Co., Providence, R. I. Catalog. Deltabeston wires and insulating materials. Illustrated, 24 pp., 4x7 in.

The Hartford Special Machinery Co., Woodland St. and Homestead Ave., Hartford, Conn. Circular. Bench taper gage. Illustrated.

Union Caliper Co., Orange, Mass. Catalog. Callipers, dividers, tap wrenches, steel rules, hack saw frames, tool holders, etc. Illustrated, 56 pp., 5x7 in.

Julius King Optical Co., 10-12 Maiden Lane, New York. Booklet. "Let Us Save Your Workmen's Eyes." Safety goggles. Illustrated, 18 pp., 6x9 in.

BUSINESS ITEM

To provide additional manufacturing facilities to meet increased demands for their line of sheet-metal working machinery, the V. & O. Press Co., Glendale, L. I., has added to its plant a one-story saw-tooth building of mill construction. The addition will more than double the capacity of the plant and will be in full operation by March 1.

PERSONALS

Maurice Stanley, for sometime past in charge of the foreign department of the Russell & Erwin Co., New Britain, Conn., has become secretary of the Fafnir Bearing Co.

R. S. Coe has been appointed assistant manager of the Norton Company's publicity department. Mr. Coe was formerly advertising manager of Landers, Frary & Clark, New Britain, Conn.

Frederick A. Robinson, Jr., has been appointed assistant manager of the Becker Milling Machine Co., Hyde Park, Mass. Until recently Mr. Robinson was associated with the Pennsylvania Steel Co.

Charles E. Thomas, who some years ago was general manager and treasurer of the Cleveland Punch and Shear Works Co., has joined the sales organization of the Hilles & Jones Co., Wilmington, Del.

Walter Knapp, formerly superintendent of the Lea-Courtenay Co., Newark, N. J., has become connected with the Fore River Shipbuilding Corp., Quincy, Mass., where he will be in charge of the brass machine-shop division.

E. L. Cushman, president of the Cushman Chuck Co., Hartford, Conn., has assumed the treasurership of the company, succeeding Richard Cushman in that capacity, who has resigned to devote his time to outside interests. Charles G. H. Schomacher has become assistant treasurer.

J. E. MacArthur, who was recently superintendent of the Robinson Fire Apparatus Mfg. Co., St. Louis, Mo., and formerly connected with the Pierce-Arrow Co., and the Brown & Sharpe Co., has accepted the position of superintendent of the No. 1 plant of the Russell Motor Car Co., Toronto, Can.

OBITUARY

V. P. Buck, president, Shawmut Machinery Co., Boston, Mass., died in that city on Feb. 15.

J. S. Peacock, president of the Carbon Steel Casting Co., Lancaster, Penn., died in Miami, Fla., on Feb. 15.

John W. Hill, mechanical engineer and sales manager in charge of the Detroit Office of the Bantam Anti-Friction Co., died suddenly in that cley on Feb. 12.

Thomas J. Moore, for the past eight years sales manager of the Philadelphia branch of the Halcomb Steel Company, died at Atlantic City on Feb. 6, after a brief illness.

FORTHCOMING MEETINGS

A course of free lectures on military engineering will be given under the auspices of a committee representative of the four national engineering societies, by Captains Robins, Colner and Ardery, Corps of Engineers, U. S. A. This course will be under the direction of Major-Gen. Leonard Wood and is designed to assist those who desire to enter the engineering battalion which will be formed at Plattsburg next summer. All engineers interested in preparedness will be welcome, but attendance at these lectures does not imply obligation to subsequent camp duty. Through the cordial attitude and coöperation of the United Engineering Society, the auditorium of the Engineering Societies Building has been placed at the disposal of the army officers. These lectures will be given weekly, having begun on Feb. 14, under the following divisions:

March 6, 1916—Seacoast defenses and battlefield illuminations.

March 13, 1916—The construction, maintenance and repair of roads, bridges and ferries; the selection and preparation of fords.

March 20, 1916—The selection, laying out and preparation of camps and cantonments; the service of general construction; and the special services, including all public work of an engineering nature which may be required in a territory under military control.

March 27, 1916—The construction, operation and maintenance of railways under military control and the construction and operation of armored trains.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth St., New York City.

American Society for Testing Materials. Annual meeting June 27 to July 1, 1916, Hotel Traymore, Atlantic City, N. J. Edgar Warburg, secretary, University of Pennsylvania, Philadelphia, Penn.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	Feb. 25, 1916	Jan. 28, 1916	Feb. 19, 1915
No. 2 Southern foundry, Birmingham	$15.00	$15.00	$9.50
No. 2 X Northern foundry, New York	19.75	19.75	14.25
No. 2 Northern foundry, Chicago	18.50	18.50	13.00
Bessemer, Pittsburgh	20.70	21.45	14.55
Basic, Pittsburgh	18.70	18.70	13.55
No. 2 X, Philadelphia	20.00	20.00	14.25
No. 2, Valley	18.25	18.50	13.00
No. 2 Southern, Cincinnati	17.90	17.90	12.40
Basic, Eastern Pennsylvania	19.50	19.50	13.50
Gray forge, Pittsburgh	18.45	18.45	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by 1/4 in. and larger and tees 3 in. and larger from jobbers' warehouse, New York:

	Feb. 25, 1916	Jan. 28, 1916	Feb. 19, 1915
Steel angles, base	2.95	2.60	1.85
Steel T's, base	3.00	2.65	1.90
Machinery steel (bessemer)	2.95	2.60	1.80

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse, New York:

	Feb. 25, 1916	Jan. 28, 1916	Feb. 19, 1915
No. 28 black	3.50	3.50	2.60
No. 26 black	3.40	3.40	2.50
Nos. 22 and 24 black	3.35	3.35	2.45
Nos. 18 and 20 black	3.30	3.30	2.40
No. 16 black	3.75	3.45	2.35
No. 14 blue annealed	3.70	3.35	2.25
No. 12 blue annealed	3.65	3.30	2.20
No. 28 galvanized	5.65	5.50	3.75
No. 26 galvanized	5.35	5.20	3.45
No. 24 galvanized	5.20	5.05	3.30

Standard Pipe—On carload lots f.o.b. Pittsburgh, the discounts follow:

	Black		Galvanized	
	Feb. 25, 1916	Feb. 25, 1915	Feb. 25, 1916	Feb. 25, 1915
3/4- to 2-in. steel butt welded	75%	81%	59 1/2%	72 1/2%
2 1/2- to 6-in. steel lap welded	74%	80%	58 1/2%	72 1/2%

At these discounts, the net prices in cents per ft. follow:

Diameter, In.				
3/4	2.88	2.20	4.66	3.15
1	4.25	3.24	6.89	4.67
1 1/4	5.75	4.38	9.32	6.30
1 1/2	6.88	5.25	11.14	7.55
2	9.25	7.05	14.99	10.15
2 1/2	15.21	11.70	24.28	16.70
3	19.89	15.25	31.75	21.80
4	28.34	21.80	45.24	31.00
5	38.48	29.60	61.42	42.20
6	49.92	38.40	79.68	54.60

Swedish Steel Sheets—To consumers requiring fair-size quantities tool steel sheets sell at 16c. base and spring steel sheets at 12c. base. These prices are f.o.b. warehouse, New York.

Swedish (Norway) Iron—This material sells at $4.50 base per 100 lb. f.o.b. New York. In coils an advance of 50c. is charged.

Swedish Drill Steel—The following prices are base in cents per pound to consumers f.o.b. warehouse, New York:

Carload lots and over	6.50
Over 10 tons, less than carload	7.00
Over 1 ton, less than 10	7.50
Over 500 lb., less than 1 ton	8.00
Less than 500 lb.	8.50
Hollow steel—	
Carload lots and over	10.50
Over 10 tons, less than carload	11.00
Over 1 ton, less than 10	12.00
Over 500 lb., less than 1 ton	13.00
Less than 500 lb.	14.00

Bar Iron—Prices are as follows in cents per pound at the places named:

	Feb. 25, 1916	Jan. 28, 1916
Pittsburgh, mill	2.20@2.30	2.10
New York	2.45	2.20@2.25
From New York	2.60	2.50@2.60

Cold Drawn Steel Shafting—From New York warehouse to consumers requiring fair-sized lots the price is 10% off list.

METALS

Miscellaneous Metals—The present New York quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	Feb. 25, 1916	Jan. 28, 1916	Feb. 19, 1915
Copper, electrolytic (carload lots)	27.25*	25.50	14.75
Tin	44.00	41.75	36.25
Lead	6.30	6.10	3.85
Spelter	21.65	19.50	8.75
Copper sheets, base	35.00	31.00	19.75
Copper wire (carload lots)	35.00	31.00	15.50
Brass rods, base	37.00	37.00	16.50
Brass pipe, base	41.00	42.00	17.50
Brass sheets	37.00	37.00	16.75
Solder 1/2 and 1/2 (case lots)	27.00	26.12 1/2	24.50
ST. LOUIS			
Lead	6.20	5.95	...
Spelter	21.50	19.50	...

*This quotation covers delivery for last half of year.

Old Metals—In New York, the following are the dealers' purchasing prices in cents per pound:

	Feb. 25, 1916
Copper, heavy and crucible	24.00
Copper, heavy and wire	23.00
Copper, light and bottoms	20.00
Lead, heavy	5.25
Lead, tea	4.75
Brass, heavy	14.50
Brass, light	12.00
No. 1 yellow rod brass turnings	14.00
Zinc	14.00

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	31.50	32.00	32.50	33.00	36.00
1/4 to 5/16	31.25	31.75	32.25	32.75	35.75
3/8 to 1 7/8	31.00	31.50	32.00	32.50	35.50
1 15/16 to 2 7/8	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3 7/16	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3 1/2 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Squares					
3 1/16 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4 15/16	33.00	33.50	36.00	36.50	37.50
5 to 6 15/16	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than 1/8 in. thick.

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Babbitt Metal—In New York, quotations are as follows in cents per pound:

Best grade	55@60
Commercial grade	25@30

Copper Bars from New York warehouse sell at 39.5c. per lb.

Antimony—For spot delivery on Chinese and Japanese brands the quotation is at 45c. per lb., duty paid.

Aluminum—Quotations were made in New York as follows in cents per pound:

No. 1 virgin, 98 to 99%	57@60
Pure 98 to 99%	56@58
Remelted No. 12 alloy	46@49

SHOP ACCESSORIES

Bolt Ends with hot pressed nuts sell at the base price of 50% from list price. This is for fair-sized orders from New York warehouse.

Tap Bolts—The discount from New York warehouse is 20% from list.

Coach or Lag Screws—Quotations from New York warehouse are now 65% from list. This is for fair-sized orders.

Turnbuckles—From New York warehouse, on sizes smaller than 1¼ in. diameter, 40% off list is charged, and on 1¼ up to 2 in. diameter 30%. At this rate prices follow:

Size		Size		Size	
⅜	$0.24	⅞	$0.45	1½	$1.05
7/16	.25	1	.53	1⅝	1.23
½	.27	1⅛	.60	1¾	1.40
⅝	.30	1¼	.88	1⅞	7.58
¾	.38	1⅜	.97	2	1.86

These prices are for buckles having right and left stub ends and with openings between the heads measuring 5½ in.

Wrought Washers—From New York warehouse, the base price on fair-sized orders is $4.50 from list price. At this rate the following prices per 100 lb. hold:

Diameter, In.		Diameter, In.	
5/16	$9.50	1½	$4.80
¾	7.70	1¾	4.70
⅞	6.90	2	4.60
1	6.00	2¼, 2½, 2¾	4.50
1¼	5.30	3¾, 4, 4¼, 4½	5.00
1⅜	4.90	3, 3¼, 3½	4.70

For cast-iron washers, the base price is $2.50 per 100 lb.

Carriage Bolts—On ⅜ by 6 in. and smaller 60% off list is allowed; for larger and longer sizes 50% off list is charged. For fair-sized orders from New York warehouse the following net prices at this rate would be charged:

	Diameter						
Length, In.	¼	5/16	⅜	7/16	½	⅝	¾
1½	$0.40	$0.56	$0.76	$1.10	....	....	....
2	.44	.61	.82	1.20	....	....	....
2½	.48	.66	.89	1.30	$1.13	$2.88	$4.25
3	.52	.70	.95	1.40	1.77	3.07	4.50
3½	.56	.75	1.02	1.50	1.96	3.26	4.75

Machine Bolts—From New York warehouse, the base price for fair quantities are as follows: From ⅜ in. by 4 in. and smaller, 60% off list is discounted; for larger and longer sizes up to 1 in. by 30 in., 50% is allowed. At this rate prices per 100 are as follows:

	Diameter					
Length, In.	¼	⅜	⅝	¾	⅞	1 In.
1	$0.68	$0.96	$2.60	...	...	...
2	.71	1.02	2.79	$4.13	$5.60	...
2½	.74	1.09	2.98	4.40	5.95	...
3	.78	1.15	3.17	4.68	6.30	$8.90
3½	.81	1.22	3.36	4.95	6.65	9.35

Base prices on other sizes would be as follows: 1⅛ and 1¼ in. by 3 in. and up to 12 in. take 35% off list. On longer lengths a special pound price is quoted. For cold punched square nuts, 35% is discounted from list; for hot pressed hexagon nuts up to 1 in. by 30 in., 45%; up to 1 in. diameter, cold punched nuts, 35%. Buttonhead with hexagon nuts, 35% off list, as do hexagon head with hexagon nuts.

Nuts—On hot pressed square nuts $3 off list is allowed and on hexagon $3.20. At this rate the base price per 100 lb. for fair-sized orders from New York warehouse is as follows:

	Hot Pressed Square		Hot Pressed Hexagon	
Short Diam.	Blank	Tapped	Blank	Tapped
½	$10.00	$12.00	$16.80	$19.30
9/16	9.00	10.50	14.80	16.80
11/16	7.50	8.60	10.80	12.40
⅞	6.00	6.70	8.00	9.00
1¼	5.50	5.90	6.80	7.40
1 7/16, 1⅝, 1 13/16, 2	5.40	5.80	6.70	7.30
2 3/16	5.50	6.00	6.80	7.50
2⅜	5.80	6.40	7.10	7.90

Semifinished nuts are sold at 70% from list price.

From New York warehouse on cold punched square nuts $3 from list is deducted and on hexagon $3.75. The base price for fair-sized orders of case-hardened nuts is 70% from list price.

Rivets—The following are the base quotations for fair quantities from New York warehouse:

	Discount from List
Steel 7/16 and smaller	65%
Tinned	65%

	Price per 100 Lb.
Button heads, ¾, ⅞, 1 in. diam. by 2 in. to 5 in.	$4.50
Cone heads, same sizes	4.60

	Extra per 100 Lb.
1¼ to 1⅞ in. long, all diameters	$0.25
⅝ in. diameter	0.15
½ in. diameter	0.50
1 in. long and shorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

Nails—Wire nails f.o.b. Pittsburgh sell at $2.30, galvanized 1 in. and longer, $4.30, and shorter, $4.80. These prices are to regular customers and delivery is made at the mill's convenience. From New York warehouse, wire and cut nails sell at $2.70.

Copper Rivets from warehouse, New York, sell at 25% off list and burs at the net list price.

MISCELLANEOUS

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire

⅜, 11/32, 5/16, ¼, 7/32, 3/16	8.50
No. 8, 5/32 and No. 10	9.25
⅛	10.00
No. 12	11.00
3/32, No. 14 and 1/16	12.00
No. 18	14.00
No. 20	16.00

Special Welding Steel

⅛	33.00
5/32	30.00
3/16	28.00

Cast-Iron Welding Rods

¼ by 19 in. long	22.00
3/16 by 12 in. long	26.00
⅜ by 19 in. long	20.00
½ by 21 in. long	20.00

Vanadium Wire in Coils or Sticks

1/16	15.50
3/32	15.00
⅛	14.00
5/32	12.00
3/16 and larger	11.00

These prices are subject to change according to quantity and shipment desired.

Seamless Drawn Tubing—The base price per pound from New York warehouse is 41c. for brass and 42c. for copper. For immediate stock shipment 3c. is added, which gives the following quotations:

	Copper		Brass	
Diameter, In.	Feb. 25, 1916	Feb. 25, 1915	Feb. 25, 1916	Feb. 25, 1915
¾ to 2½	45.00	21.50	43.00	17.50
3	45.00	21.50	43.00	17.50
3½	46.00	22.50	44.50	19.00
4	47.00	23.00	45.50	19.50
4½	49.00	24.00	47.50	20.50
5	51.00	25.00	49.50	21.50
6	52.00	28.00	50.50	24.50
7	54.00	30.00	52.50	26.50
8	56.00	32.00	54.60	28.50

Tin Plates—The following prices are in effect from warehouse, New York:

Coke tin plate, 14x20:

100-lb.	$4.75
I. C. 107-lb.	4.90

Terne plate, 20x28:

Base Weight	Net Weight	Coating	Price	Base Weight	Net Weight	Coating	Price
100-lb.	200	8	$8.60	I. C.	226	20	$13.50
I. C.	214	8	8.90	I. C.	231	25	14.25
I. X.	270	8	10.90	I. C.	236	30	15.50
I. C.	218	12	12.00	I. C.	241	35	17.00
I. C.	221	15	13.00	I. C.	246	40	19.00

Zinc Sheets—The following prices in cents per pound prevail at New York:

Carload lots, f.o.b. mill	25.00
In casks, New York	25.50
Broken lots, New York	26.00

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Feb. 5	Feb. 12	Feb. 19	Feb. 26
Prompt furnace	$3.00@3.25	$3.00@3.25	$3.25@3.75	$3.00@3.50
Prompt foundry	4.00@4.50	3.75@4.25	3.75@4.25	3.75@4.25

Cotton Waste—In New York, the prices in cents per pound are as follows:

White	10.00@11.50
Colored mixed	7.00@ 9.00

Sal Soda—These quotations are per 100 lb. at the places named:

New York	$1.35
Philadelphia	1.10

Roll Sulphur in 360-lb. bbl. sells in New York at $2.25 per 100 lb.

Linseed Oil—Raw, in barrels sells at 79c. per gal. and in 5-gal. cans at 89c. Boiled, it is 1c. per gal. higher.

White Lead, dry and in oil, in cents per pound sells as follows:

100-lb. keg	8.75
25- and 50-lb. kegs	9.00
12½-lb. keg	9.25
1- to 5-lb. cans	10.75

Red Lead, dry, in cents per pound sells as follows:

100-lb. keg	8.75
25- and 50-lb. kegs	9.00
12½-lb. keg	9.25

In oil, the price in cents per pound is as follows:

100-lb. keg	9.25
25- and 50-lb. kegs	9.50
12½-lb. keg	9.75

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

The Commercial Machine Co., Boston, Mass., recently incorporated with $300,000 stock, has taken over the factory on Webster St., Franklin, N. H., formerly occupied by the Arthur N. Ames Knitting Machine and Needle Co. and will construct an addition, also install new machinery. Arthur N. Ames is Pres.

The Three Fields Garage, 1356 Commonwealth Ave., Boston, Mass. (Allston), will construct a 55x140-ft. addition to its garage at Allston.

O. A. Sylvester plans to construct a garage at Oak and West St., Gardner, Mass.

The G. Haarman Co., manufacturer of structural iron, will construct a 1-story, 48x72-ft. addition to its plant on Commercial St., Holyoke, Mass.

The contract has been awarded for the construction of a garage on Park St., Springfield, Mass., for the W. H. Smith Estate.

The plant of the Franklin Machine Co., Providence, R. I., has changed hands. An expenditure of $50,000 for new machinery is contemplated by the new company.

The contract has been awarded for the construction of an addition to the plant of the Ansonia C. & C. Co., manufacturer of electrical supplies, at Ansonia, Conn.

Fire, Feb. 15 destroyed the plant of the Farist Steel Co. at Bridgeport, Conn. Loss, $450,000.

M. J. Gibbud, State and Trumbul St., New Haven, Conn., is constructing a 1-story, 70x124-ft. garage at New Haven.

The contract has been awarded for the construction of a steel rolling mill at New London, Conn., for George I. Stanford. Estimated cost, $10,000.

Plans have been prepared for the construction of an addition to the plant of the D. E. Whiton Machine Co. at New London, Conn.

Plans have been prepared for the construction of an addition to the plant of the Eagle Lock Co. at Terryville, Conn.

MIDDLE ATLANTIC STATES

The Western Twist Drill Co. will build a factory on James St., Eastwood, N. Y.

The contract has been awarded for the construction of a garage on Douglas St., New York, N. Y. (Borough of Brooklyn), for Richard E. Bridgette. Estimated cost, $10,000.

D. L. Dean will construct a 2-story reinforced-concrete garage on 152d St., west of Broadway, New York, N. Y., (Borough of Manhattan). Homer A. Reid, 345 5th Ave., Consult. Engr.

The Bossert Co., Utica, N. Y., manufacturer of electrical supplies and auto trucks, has awarded the contract for the construction of an addition to its plant on Hickory St. Estimated cost, $27,000. Noted Oct. 21.

The Hollow Steel Tool Co., Asbury Park, N. J., recently organized, will establish a plant for the manufacture of tools William A. Berry is interested.

The Bayonne Crucible Steel Co., South 5th St., Bayonne, N. J., will build a plant. Estimated cost, $80,000.

The Art Metal Works, Newark, N. J., manufacturer of metal novelties, will build an addition to its plant on Mulberry St. L. V. Aronson is Pres.

The French Manufacturing Co., Newark, N. J., will establish a plant on Jackson St. for the manufacture of steel umbrella rods.

Plans are being prepared by Lockwood, Greene & Co., 101 Park Ave., New York, N. Y., for the construction of a 4-story factory at Irvington, N. J., for Gould & Eberhardt, Newark, N. J., manufacturer of machine tools. Estimated cost, $50,000.

J. W. Mason, Newark, N. J., local representative for the Velie and Briscoe automobiles, will establish a garage and service station at Broad and West Kinney St.

A steel workshop will be constructed by the Newark Spring Mattress Co., Newark, N. J.

An addition will be built to the plant of John A. Roebling Sons Co., Trenton, N. J., manufacturer of wire rope. Noted Nov. 25.

The Independent Lamp and Wire Co., Weehawken, N. J., will improve its factory on Gregory Ave.

The United States Steel Corporation, Clairton, Penn., plans to construct 1,500 by-product coke ovens. Estimated cost, $15,000,000.

The Baldwin Locomotive Works has awarded the contract for the construction of an 8-story, 100x160-ft. addition to its shop at 18th and Hamilton St., Philadelphia, Penn. Estimated cost, $500,000.

The Philadelphia Coppersmithing Co., 322 North Front St., Philadelphia, Penn., has been granted a permit for the construction of an addition to its machine shop. Estimated cost, $6,000.

The Baltimore Drydock and Shipbuilding Co., Baltimore, Md., plans to improve its plant. Estimated cost, $500,000.

SOUTHERN STATES

The National Steel Castings Co. will construct a plant on the Ward Estate, New Cumberland, W. Va. Estimated cost, $200,000. E. E. Kramer, Pittsburgh, Penn., is interested.

The contract has been awarded for the construction of a garage at Wheeling, W. Va., for Cole Bros., Baltimore, Md. Estimated cost, $28,000. Noted Oct. 28.

Hoby & Read contemplates the construction of a garage at Scottsville, Ky.

MIDDLE WEST

Bids have been received for the construction of a 2-story, 32x31-ft. addition to the plant at Colerain and Alabama St., Cincinnati, Ohio, of the M. L. Andrews & Co., manufacturer of woodworking machinery. Estimated cost, $5,000.

Plans are being prepared by Paul A. Jones, Arch., for 2-story, 65x112-ft. garage for Belvins Auto Sales Co. at Cincinnati, Ohio. Estimated cost, $25,000.

Plans are being prepared for the construction of a garage at Reading Rd. and South Crescent Ave., Cincinnati, Ohio (Avondale) for Van Duttonhofer.

Plans are being prepared by Samuel Hannaford & Sons, Arch., for the construction of a 1- and 2-story plant on McMichen Ave., Cincinnati, Ohio, for the Rapid Electrotype Co. Estimated cost, $50,000.

The contract will soon be awarded for the construction of a 2-story, 65x85-ft. addition to the factory of the John Steptoe Shaper Co. on Colerain Ave., Cincinnati, Ohio. Estimated cost, $20,000. Noted Jan. 20.

The Wray-Chase Motor Service Co., recently incorporated with a capital of $100,000, plans to construct a garage and repair shop in the downtown district of Cincinnati, Ohio. J. Morris Wray and Wilson Chase, interested.

The Adams Express Co., 333 Superior Ave., N. W., Cleveland, Ohio, plans to build a garage at Cleveland. Estimated cost, $50,000.

The American Stove Co. plans to construct a 60x120-ft. factory at Cleveland, Ohio. Estimated cost, $50,000.

The Cleveland Automatic Machine Co., 2269 East 65th St., Cleveland, Ohio, is in the market for tools. Noted Jan. 20.

The Cleveland Twist Drill Co., Hamilton Ave. and East 49th St., Cleveland, Ohio, will rebuild its plant at Cleveland which was recently destroyed by fire.

Tentative plans have been prepared for the construction of a 1-story, 50x138-ft. addition to the plant of the Crescent Brass Manufacturing Co. on West 110th St., Cleveland, Ohio. Estimated cost, $15,000.

The Metal Products Co., Taylor St., Dayton, Ohio, plans to construct a reinforced-concrete addition to its plant at Dayton. Estimated cost, $75,000.

The Champion Hardware Co. will build an addition to its plant at Geneva, Ohio. John Hasenpflug is Pres.

The contract has been awarded for the construction of a 2-story, 45x55-ft. addition to the plant of C. R. Patterson & Sons, manufacturer of carriages, at Greenfield, Ohio.

The contract has been awarded for the construction of a 1-story, 81x90-ft. machine shop at Lima, Ohio, for the East Iron and Machine Co., 352 East Market St. Noted Feb. 10.

Plans are being prepared for the construction of an addition to the shops for the Baltimore & Ohio Railroad Co. at Lorain, Ohio. F. L. Stuart, Baltimore, Md., is Ch. Engr.

The Niles Forge and Manufacturing Co. is constructing a 25x100-ft. machine shop at Niles, Ohio.

The United States Can Co. contemplates constructing an addition to its plant at Norwood, Ohio.

The Eagle-Macomber Motor Car Co. will establish a plant at Sandusky, Ohio.

The National Malleable Casting Co. will construct an addition to its plant at Michigan and Holmes Ave., Indianapolis, Ind. Estimated cost, $5,000.

The Chevrolet Motor Co. will construct an addition to its factory at Flint, Mich.

The Chicago File and Rasp Co., Chicago, Ill., has acquired a plant at Grand Haven, Mich., and will install new equipment.

It is reported that the Steel Furniture Co. plans to construct an addition to its plant at Grand Rapids, Mich.

The Light Car Axle Co., successor to the Clark Delivery Car Co., 1835 East 76th St., Chicago, Ill., will move its plant to Kalamazoo, Mich., and will install new machinery

G. P. Barker, 7956 South Chicago Ave., Chicago, Ill., will build a 1-story, 50x100-ft. machine shop at Chicago. Estimated cost, $5,000.

J. H. Rosberg, 2028 Rice St., Chicago, Ill., will construct a 2-story, 100x150-ft. factory at 642 North Kedzie Ave., Chicago, for the manufacture of metal specialties. Estimated cost, $30,000.

Plans have been prepared for the construction of a 96x 100-ft. factory at Chicago, Ill., for the Snyder Electric Furnace Co. Estimated cost, $12,500.

WEST OF THE MISSISSIPPI

The Graham Valve Co., Detroit, Mich., contemplates constructing a factory at St. Paul, Minn., for the manufacture of valves. Estimated cost, $100,000.

B. W. Harris, will build a factory at St. Paul, Minn., for the manufacture of gas engines. Estimated cost, $350,000.

H. D. Lee of Lee Hardware Co., Salina, Kan., contemplates constructing a new building. Estimated cost, $150,000.

The Coleman Lamp Co., Wichita, Kan., will construct a 2-story factory at North St. and Francis Ave. for the manufacture of lamps.

The Willys-Overland Co., Toledo, Ohio, will construct a building at Kansas City, Mo., for sales and service quarters. Estimated cost, $500,000.

Bids will soon be received for a 2-story distributing plant at Dallas, Tex., for the Studebaker Corporation. Estimated cost, $150,000. Noted Feb. 10.

S. W. Snider and J. J. Perkins have awarded the contract for a 2-story garage at 8th and Scott St., Wichita Falls, Tex. Noted Feb. 17.

Barton Bros., Chickasha, Okla., has awarded the contract for its new machine shop and garage at Chickasha. Noted Feb. 24.

B. Johnson has awarded the contract for a garage at Chickasha, Okla. Estimated cost, $13,000.

W. L. Perry and B. F. Lewis contemplate building a garage at Guymon, Okla.

The Midland Valley Railroad Co. will rebuild its machine shops at Muskogee, Okla., which were recently destroyed by fire with a loss of $45,000. Noted Feb. 24.

The Baker Steel Corporation, Oklahoma, Okla., contemplates building a plant.

The Farm Engineering Co., will build a 1-story factory at Sand Springs, Okla. Estimated cost, $70,000. Noted Dec. 28.

WESTERN STATES

J. R. Carman, Seattle, Wash., is back of a movement to construct a plant at Everett, Wash., for the manufacture of fireplace radiators. Estimated cost, $25,000.

The American Can Co. plans to construct a plant at Seattle, Wash. Estimated cost, $350,000.

The name of the Ferris Auto and Repair Works, 101 North Broadway, Seattle, Wash., has been changed to the Ferris Motor and Machine Co. The plant will be improved and enlarged.

Plans are being prepared for the reconstruction of the plant of the Spokane Ornamental Iron Works at Spokane, Wash., which was recently destroyed by fire. Noted Feb. 3.

M. M. Shooshian will construct a commercial garage and machine shop on Van Ness Blvd., Fresno, Calif.

The Valley Garage, recently incorporated, will construct a 60x150-ft. garage and machine shop at Lancaster, Calif. Curt E. Henderson is interested.

Plans are being prepared by Eisen & Son, Arch., for the construction of a garage and machine shop on New Hampshire St., Los Angeles, Calif.

The Knox Auto and Wagon Manufacturing Co. plans to construct an addition to its plant at 680 San Fernando St., Los Angeles, Calif.

The Self-Oiling Wheel and Bearing Co., Walla Walla, Wash., contemplates constructing a plant at Los Angeles, Calif. Estimated cost, $50,000. J. Williams is interested.

The Union Iron Works, San Francisco, Calif., has purchased the plant of the United Engineering Works, Oakland, Calif., and will improve the plant. Estimated cost, $250,000.

The contract will soon be awarded for the construction of a 1-story, 100x175-ft. garage, salesroom and service building for Willys-Overland Co. at Pasadena, Calif. Noted Dec. 2.

The Pacific Sanitary Manufacturing Co. will construct an addition to its plant at 15th St. and Barrett Ave., Richmond, Calif.

The contract has been awarded for the construction of a garage on Valencia St., San Francisco, Calif., for Edwin O'Donnell, Monadnock Bldg. Estimated cost, $12,000.

CANADA

The Metal Drawing Co., Race St., St. Catherines, Ont., is constructing a plant at St. Catherines.

The Algoma Steel Corporation has awarded the contract for the construction of a plant at Sault Ste. Marie, Ont. Estimated cost, $50,000.

John Pirson, Stevensville, Ont., is in the market for tight barrel machinery, drum saw, 36-in. stave joiner, etc.

The contract has been awarded for the construction of a plant at Windsor, Ont., for the Maxwell Motor Co., Detroit, Mich. Estimated cost, $45,000. Noted Feb. 24.

The Ford Motor Co. will construct 4-story, 130x200-ft. assembling plant at 8th St., W., and 11th St., Calgary, Alta. Estimated cost, $200,000.

The contract has been awarded for the construction of a plant at North Vancouver, B. C., for the Drydock and Engineering Co., Ltd. Estimated cost, $5,500,000.

GENERAL MANUFACTURING

NEW ENGLAND STATES

A dynamite plant is being constructed near the Westbrook line, South Gorham, Maine (Gorham post office), by T. M. Block.

Plans are being prepared for the construction of a 4-story, 45x150-ft. factory at Manchester, N. H., for Willar H. Griffen Shoe Co. Estimated cost, $30,000.

Fire, Feb. 14 destroyed the barrel factory of Proctor Bros. at Rochester, N. H. Loss, $45,000.

Fire, Feb. 12 damaged the plant of the American Linen Co. at Fall River, Mass. Loss, $18,000.

Plans have been prepared for the construction of a 1- and 2-story, 30x200-ft. addition to the plant of the Falulah Paper Co. at Fitchburg, Mass.

The contract has been awarded for the construction of a 4-story, 72x159-ft. addition to the plant of the Converse Rubber Co., Pearl St., Malden, Mass. Estimated cost, $100,000. Noted Feb. 17.

Bids will soon be received for the construction of a 2-story, 60x160-ft. mill on Prairie Ave., Pawtucket, R. I., for the Railroad Island Textile Co.

Plans are being prepared for the construction of an addition to the plant of the Central Worsted Co., at Central Village, Conn.

Plans are being prepared for the construction of an addition to the plant of the Morley Button Co. at New Haven, Conn. Estimated cost, $100,000.

MIDDLE ATLANTIC STATES

The Clifton Manufacturing Co., Buffalo, N. Y., manufacturer of electric tape and rubber heels, will build an addition to its plant for the manufacture of metal tubes and conduit.

Plans are being prepared for the construction of a 4-story, 24x146-ft. factory at Buffalo, N. Y., for the Mentholatum Co. Estimated cost, $15,000.

The Stephen Jerry Co., 436 Manhattan Ave., New York, N. Y. (Borough of Brooklyn), will construct a 2-story, 50x 100-ft. cooperage shop at Parker St. and Vandervoort Ave., (Borough of Brooklyn). Estimated cost, $5,000.

The Avalon Knitwear Co., Broad St., Utica, N. Y., has awarded the contract for a 4-story addition to its plant. Estimated cost, $30,000. Noted Feb. 10.

Fire, Feb. 10, damaged the chemical plant of the Midvale Chemical Co., Elizabeth, N. J. Loss, $25,000. Stephen S. Krayer is Supt.

Plans are being prepared for an addition to the plant of the Grasselli Chemical Co., Grasselli, N. J. Estimated cost, $75,000.

The Henbert Silk Co. and the Harrison Textile Co., Harrison, N. J., will construct a plant on Elm St., Kearney, N. J.

The Aryl Chemical Co., New York, N. Y., has purchased the plant of the American Chemical Co., Keyport, N. J., and will expend about $60,000 for improving same and installing new machinery.

Plans have been prepared for the construction of a 1-story brick factory on Berlin St., Newark, N. J., for Frank Euler, manufacturer of paper specialties.

The Martin Dennis Co., manufacturer of tanners supplies, will construct a plant at Newark, N. J. Estimated cost, $75,-000.

Plans have been prepared for the construction of a 50x 75-ft. factory at Newark, N. J., for Levy & Charlon, 675 South 10th St., manufacturer of woolen goods. Estimated cost, $5,000.

Maas & Waldstein, manufacturer of chemicals, Ave. R and Central R.R., Newark, N. J., is building an addition to its plant to be used as an acid concentration plant. Noted Sept. 30.

The Howe Rubber Co. will construct an addition to its plant at New Brunswick, N. J. John Tenney, Jr., is Pres. Noted Feb. 24.

The German Artistic Weaving Co., Paterson, N. J., will construct an addition to its plant at Pompton Lakes, N. J., for the manufacture of silk ribbons, labels and shoe lacings.

The Jericho Silk Co., Phillipsburg, N. J., recently organized, has acquired the property of the Mauchline-Firth Silk Co. and will enlarge the plant and install new machinery.

The William F. Taubel Hosiery Co., Trenton, N. J., will rebuild its plant which was recently destroyed by fire at Chestnut and Grand St., Trenton.

The C. H. Masland & Co., Philadelphia, Penn., manufacturer of carpets, has awarded the contract for its 4-story manufacturing building at Westmoreland and Collins St., Philadelphia. Estimated cost, $24,000.

The Philadelphia Textile Co., Philadelphia, Penn., has awarded the contract for a new factory at 6th and Tabor Rd. Day & Zimmerman, Philadelphia, is Engr.

Bids will soon be received for the construction of a 1-story, 50x50-ft. and 50x200-ft. welt factory for the Eberly Tannery Co. at Westfield, Penn. Estimated cost, $30,000. Noted Nov. 18.

The Duplan Silk Co., Wilkes-Barre, Penn., will construct a factory at Philadelphia for the manufacture of piece dyed silk and mixed goods.

The Mutual Manifold Co., Baltimore, Md., recently organized with a capital stock of $100,000, plans to construct a factory for the manufacture of sales books. Charles F. Macklin, 408 Maryland Trust Bldg., Baltimore, is Pres.

Plans being prepared by George F. Sansbury for an addition to the plant of the Parker Hosiery Mill, Frostburg, Md.

SOUTHERN STATES

H. W. Kirby, Williamson, and associates contemplates constructing a 2-story hosiery mill at Spartanburg, S. C. Estimated cost, $50,000.

L. H. Oden, Blackshear, Ga., is interested in a project to construct a cold-storage plant.

Plans are being prepared by Westinghouse-Church-Kerr Co., Arch., 30 Church St., New York, N. Y., for the construction of a refinery at Savannah, Ga., for the Savannah Refining Co. Estimated cost, $50,000.

A cottonseed oil mill will be constructed at Douglas, Ga.

The Newport Rosin and Turpentine Co., Pensacola, Fla., has awarded the contract for its new turpentine and oil distillation plant. Estimated cost, $250,000.

Asher P. Gluck, Chicago, Ill., plans to establish a canning plant at Lawtey, Fla.

The Florida Packing and Provision Co., Tampa, Fla., is having plans prepared for a plant.

A. P. Fuquay, Secy., Alexander City Commercial Club, Alexander City, Ala., is interested in a project to establish a factory at Alexander City for the manufacture of corn brooms.

J. Sanders Gordon of the North American Fire Works Display Co., St. Louis, Mo., is interested in a project to construct a plant at Birmingham, Ala., for the manufacture of fireworks.

The Linde Air Products Co., New York, N. Y., will build a plant at Birmingham, Ala., for the manufacture of oxygen gas.

The Gadsden Fertilizer Co., Gadsden, Ala., will build a cotton gin.

George Terry & Son, Biloxi, Miss., will build a cannery. Estimated cost, $10,000.

The Granada Cotton Compress Co., Falls Bldg., Memphis, Tenn., will rebuild its plant at Holly Springs, Miss., and will install new equipment.

The Independent Compress and Warehouse Co., Tupelo, Miss., has increased its capital stock and plans to rebuild its cotton compress. H. H. Womble is Pres.

R. B. Embree, Philadelphia, Penn., plans to construct a large paper-making plant at Kingsport, Tenn.

R. W. White and A. B. du Pont, New York, N. Y., plan to construct a chlorine plant at Kingsport, Tenn.

G. H. Miller, Chattanooga, Tenn., will establish a hosiery mill at Spring City, Tenn. Estimated cost, $50,000.

The Business Men's Club of Memphis, Tenn., has appointed H. W. Benner as chairman of a committee to arrange for the financing and construction of a cotton mill at Memphis. Estimated cost, $500,000.

MIDDLE WEST

The Barrett Manufacturing Co., 17 Battery Pl., New York, N. Y., manufacturer of coal tar products, will establish a 200x400-ft. plant in Ironville, Ohio (Toledo post office).

The Gerke Chemical Co. plans to construct a factory at Marietta, Ohio. Robert H. Gerke is Gen. Mgr.

The Lindley Box Co. will construct a factory at Marion, Ind.

The Mandel Bros. Manufacturing Co., manufacturer of phonographs, cameras, etc., will establish a plant at Benton Harbor, Mich.

The Dryden Rubber Co. purchased a site at Chicago, Ill., and will construct a factory in the spring.

A 1-story, 120x200-ft. building is being constructed at 57th Ave. and 65th St., Chicago, Ill., and will be leased by the Hydro-Stone Products Co.

The Appleton Wood Products Co., manufacturer of butchers' blocks, contemplates constructing a 1-story, 40x200-ft. factory at Appleton, Wis. R. Miller, 428 John St., Appleton, is Pres.

The Fox River Valley Envelope Co. contemplates the construction of a 3-story, 48x250-ft. factory at Menasha, Wis. Thomas J. Taylor is Pres.

WEST OF THE MISSISSIPPI

The Marshall Oil Co., Marshalltown, Iowa, will soon award contract for improving its plant. Estimated cost, $20,000.

The Farmers Terminal Packing Co., St. Paul, Minn., will build a packing plant at Newport, Minn. Estimated cost, $400,000.

The American Manufacturing Co., St. Louis, Mo., will build a 1-story factory at 1026 South 11th St., St. Louis, for the manufacture of bagging and cordage. Estimated cost, $11,500.

Plans being prepared for 4-story addition to the plant of the Krey Packing Co., St. Louis, Mo. Estimated cost, $150,000. Noted Feb. 10.

F. H. Mitchell, Fordyce, Ark., will build a factory at Benton, Ark., for the manufacture of handles.

The Phillips County Farmers' Exchange is interested in a plan to organize the company with a capital stock of $50,000 to construct a cotton compress at Helena, Ark.

The Texas City Compress and Concentration Co., Texas City, Tex., has been organized with a capital of $30,000 to build and operate a cotton compress. J. H. W. Steele is interested.

The Bohnefeld Cleaning Works, Tulsa, Okla., has awarded the contract for a 3-story factory at Tulsa.

WESTERN STATES

F. S. Brandon, Medford, Ore., has purchased the grist milling plant at Eagle Point, Ore., and will install new machinery.

Fire recently damaged the glove factory of Liebreich & Gold, 1321 Kelley St., Portland, Ore. Loss, $8,000.

CANADA

The Bird Woolen Co. is constructing an addition to its factory at Bracenbridge, Ont., and will be in the market for new machinery.

Edwards & Edwards, 762 Dupont St., Toronto, Ont., has leased a building at Bridgeburg, Ont., and will equip it for the manufacture of leather goods.

Fire, Feb. 13 destroyed the plant of the Northumberland Paper and Electric Co. at Campbellford, Ont.

The Gutta Percha and Rubber Co., Ltd., 47 Younge St., Toronto, Ont., will construct an addition to its plant on West Lodge Ave., Toronto.

Murphy, Stedman & Co., Ltd., 180 Gray's Inn Rd., Holborn, London, W. C., England, has an inquiry for machine tools both for British use and for export to countries outside as follows: 526 lathes, all sizes and types; 51 grinders, all sizes and types; 20 millers, all sizes and types; 4 sawing and cutting-off machines; 11 screw machines; 9 boring machines; 92 power hammers; 16 bar cutters; 19 punching and shearing machines; 10 gear-cutting machines; 66 drilling machines; 4 forging machines; 12 planing machines; 3 boring mills; 6 presses; 4 rifling machines; 24 shaping machines; 40 slotting machines; foundry equipment, machinery, etc.; eight 6½-in. by 6-ft. surfacing, sliding and crew-cutting lathes; ten 7½-in. by 8-ft. surfacing, sliding and screw-cutting lathes for chasing threads in 3'3, H. E. shells, at least 7-in. centers; 3 screw-cutting lathes; 45 lathes, No. 4 Warner & Swasey, or similar, chuck and bar feed, cutoff overhead chasing attachment, geared friction head; 13 No. 2 Warner & Swasey, or similar, chuck and bar feed, cutoff overhead chasing attachment, lathes, plain head; No. 1 Warner & Swasey, or similar, chuck and bar feed, cutoff overhead chasing attachment lathes, plain head; 20 capstan lathes, ¼- or ¾-in. capacity; 6 lathes, 1½-in. through wire feed, chasing arm and cross-slide; ten 2-spindle sensitive drilling machines to drill up to about ⅝-in., cheap simple type; ten 3-spindle sensitive drilling machines, to drill up to about ⅝-in., cheap simple type; 60 plain horizontal milling machines for power, table about 34x10 in., cheap and simple; 3 sensitive drilling machines to drill up to 20 mm., cheap, simple type; 3 multiple drilling machines, 3 spindles, to drill up to 20 mm., cheap, simple type; 64 milling machines, vertical, Brown & Sharpe No. 1, or alternative; 40 milling machines, vertical, Brown & Sharpe No. 2 Y or alternative; 1 planning machine, 2 tools, admit 3M 500x1M250; 1 slotting machine, 450 mm. stroke; 1 slotting machine, 450-mm. stroke, largest size available; 2 planning machines, single tool, circular motion, admit 2 m. 400 long by 1 m. 250 wide by 1 m. to 1 m. 500 high; 1 horizontal boring machine, 100 mm. through spindle, length of table capable of being used 3 m. 500; 1 radial drilling machine, drilling capacity 800 mm.; 1 vertical drilling machine, drilling capacity 25 mm.; 2 electric drilling machines, drilling capacity 15 mm., continuous current 110 volts; 30 gold-sawing machines capable of sawing up to 170 mm.; 2 center machines for 60 mm. shafts; 1 slotting machine, preferably with inclined top, 300 mm. stroke; 1 slotting machine, preferably with inclined top, 300 mm. stroke; 1 slotting machine, preferably with inclined top, with 200 mm. stroke; 2 shaping machines, 16-in. stroke; 2 purifying or filtering machines, for filtering oils after use with automatic lathes; 4 twist drill grinding machines, take drills 5 mm. to 500 mm.; 2 twist drill grinding machines, take drills 5 mm. to 80 mm.; 5 universal grinders, capacity 5 to 200 mm.; 1 grinding machine to sharpen saw teeth; 4 multiple-spindle drilling machines to drill up to 7 mm.; 4 multiple-spindle drilling machines, reversible, to drill up to 7 mm.; 9 drilling machines up to 15 mm.; 7 drilling machines, reversible, to drill up to 15 mm.; 7 drilling machines, reversible, to drill mm. in steel; 2 drilling machines to drill up to 30 mm. in steel; 2 drilling machines to drill up to 30 mm. in steel; 1 shaping machine, 10-in. to 20-in. stroke; 1 shaping machine, 20-in. to 24-in. stroke; 1,000 plumbago crucibles of an equivalent size to Morgan's D. 60; crucibles in following sizes: 150 lb., 440 lb. and 1,120 lb. capacity.

Classified Advertising

The Classified Advertising section appears on pages 220, 221, 222, of this issue and will in future appear in the same relative position in the paper.

American Machinist

Volume 44, No. 10
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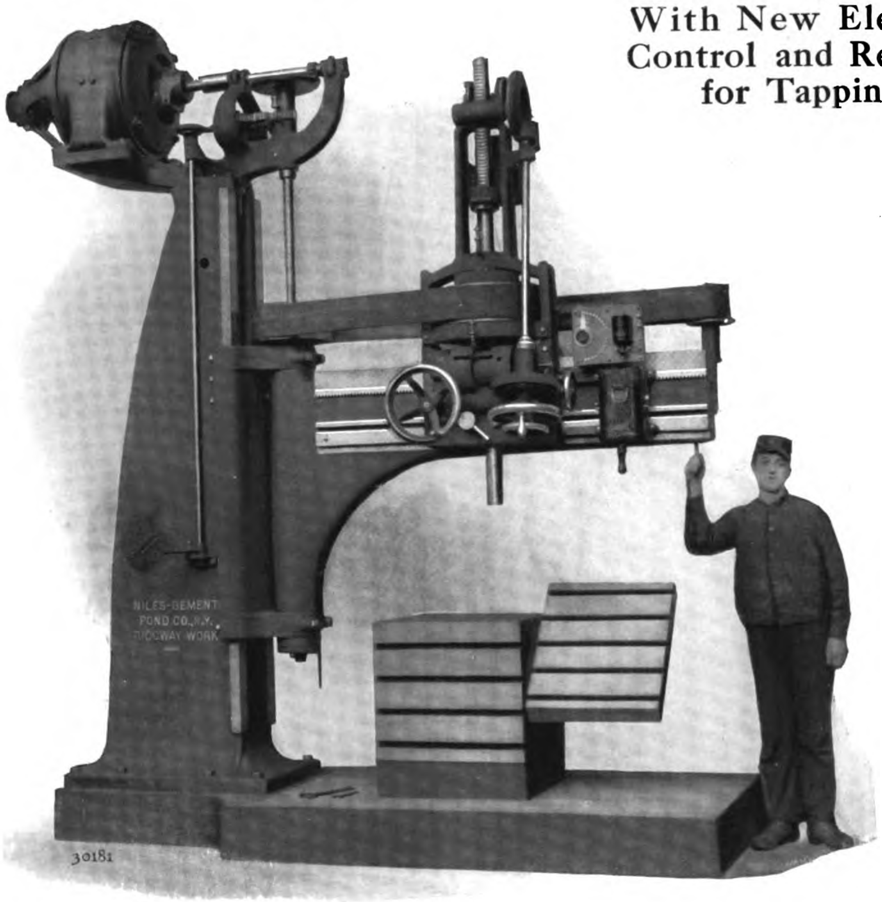
Hill Publishing Company

NEW YORK, MARCH 9, 1916

Price, 15 Cents
Contents, First Page
Advertising Index, Last Page

Heavy-Duty Radial Drills

With New Electric Control and Reverse for Tapping



ABOVE illustration shows one of our radials for heavy drilling. It is equipped with direct-connected reversing motor drive through 6-in. belt. Although of heavy construction throughout, it is easily and quickly handled, and the entire control is very conveniently arranged for the operator. For reversing the spindle when tapping there is provided a controller by which the motor is stopped instantly by dynamic braking and then reversed in direction. This controller, and also the rheostat for varying the speed of the motor, are attached to the drill head, where they are always within easy reach from the operator's working position.

After setting the rheostat for any given speed the controller handle can be thrown into the starting position and the motor will automatically pick up to that speed.

The arm is easily swung, as it is supported by ball bearings at both top and bottom trunnions.

This drill can be furnished in sizes ranging from 5 to 10 feet.

Write for Circular No. 30181.

Niles-Bement-Pond Co.,

111 Broadway, New York City
25 Victoria St., London, S. W.

SALES OFFICES AND AGENCIES—Boston: 93-95 Oliver St. **Philadelphia:** 405 N. 21st St. **Pittsburgh:** Frick Bldg. **Cleveland, O.:** The Niles Tool Works Co., Rockefeller Bldg. **Hamilton, O.:** The Niles Tool Works Co. **Cincinnati:** 336 West 4th St. **Detroit:** Kerr Machinery Bldg. **Chicago:** Washington and Jefferson Sts. **St. Louis:** 516 North Third St. **Birmingham, Ala.:** 2015 First Avenue. **For Colorado:** Hendrie & Bolthoff Mfg. & Supply Co., Denver. **For Seattle:** Hallidie Machinery Co. **For Canada:** The John Bertram & Sons Co., Ltd., Dundas, Montreal, Winnipeg, Vancouver. **Japan:** The F. W. Horne Co., 6 Takiyama-cho, Kyobashi-ku, Tokio. **Italy:** Ing. Ercole Vaghi, Milan. **France:** Glaenzer & Perreaud, 18 Faubourg du Temple, Paris. **Austria-Hungary:** E. Krause & Co., Vienna, Prague and Budapest. **Holland:** R. S. Stokvis & Zonen, Ltd., Rotterdam. **For Mexico:** The Railway Supply Co., S. A., Cinco de Mayo 6 Mexoci City. **Russia:** S. G. Martin & Co., Ltd., Petrograd and Moscow. **Brazil:** Comptoir Technique Breselien, P. O. Box 802, Rio de Janeiro.

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L. P. ALFORD, *Editor*

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WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormsay processes, protected by United States patent issued June 22, 1915, and another pending

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"His Master's Voice"

"THE great fault with manufacturers and merchants," declared H. C. Brown, of the Victor Talking Machine Company, to a group of Camden business men on January 27, as reported in Printer's Ink, "is the fact that they are satisfied to plug along at the same rate of speed without looking to the future. If that were the policy of the Victor company we should worry ourselves to our graves."

"You here to-day," he continued, "remember the great holiday advertising of the Victor company in the newspapers and magazines. But you don't know that *we invest* $250,000 *in Christmas advertising in newspapers alone, for a product that was greatly oversold long before our advertising began.* I want to be frank, and tell you that we would not be satisfied if we did not have orders on hand sufficient to run our plant for several years without taking another order. But *we must keep this condition going,* and we succeed only by the fact that we are continuing to advertise and will continue to do so as long as newspapers and magazines are published."

Another manufacturer said:

"I would just about as soon take the fire insurance off our million-dollar plant as I would take the advertising off our million-dollar trade-mark. I am not sure which we value the most highly.

"If all my competitors would stop advertising too, if no new competitor entered the field, if nobody discovered a substitute for my product, if the trade failed to notice that I am no longer pushing the goods, and if the public would stop dying and being born and forgetting until I am ready to advertise again — everything might be lovely. But since the rest of the world is not likely to be so accommodating, there are a number of things to be taken into consideration before deciding to cut off the advertising because the factory happens to be oversold.

The effects of a discontinuance of advertising upon the trade and the sales force are the more obvious because they are more immediately apparent. But they are far from representing the most serious effects of such a policy.

The most disastrous results are not quite so apparent, perhaps, but they are all the more serious on that account. *Loss of prestige* cannot be definitely located, perhaps cannot even be detected until months, and maybe years, have elapsed, but for all that it comes pretty close to being the worst thing that can happen to a concern.

A concern which deals with the public—directly or indirectly—can as little afford to permit its trade-mark or name to be forgotten, as it can afford to let doubts be cast upon its credit."

Manufacturing 120-Millimeter Serbian Shells--I*

By Fred H. Colvin

SYNOPSIS—One of the most difficult problems for the shop manager is the economical production of pieces in comparatively small lots and in a variety of sizes. The compensation comes in the developing of ways and means to overcome the difficulties presented. These articles on the manufacture of Serbian shells show how a shop of moderate size handles shells from 70 mm. to 150 mm. in diameter and of different types, making nine different shells altogether. The methods and times are interesting as showing what can be done under adverse conditions.

The shop of the Providence Engineering Works, Providence, R. I., affords an example of the way in which a plant of moderate size can be transformed from heavy engine work to the making of shrapnel and high-explosive shells from 70 to 150 mm. in diameter. True, a portion of the shop had been accustomed to the making of the Providence shaper, while another department had made automobile parts; but even these are considerably removed from the work of turning out shells in large quantities, and the way in which regular machine equipment has been utilized has many interesting phases. The shells are all made from forgings and in four diameters—70, 75, 120 and 150 mm. They are again divided into shrapnel and high-explosive shells, while the 120- and 150-mm. sizes are also made in two lengths. All of this goes to make the manufacturing problem more difficult, but adds interest to the final solution.

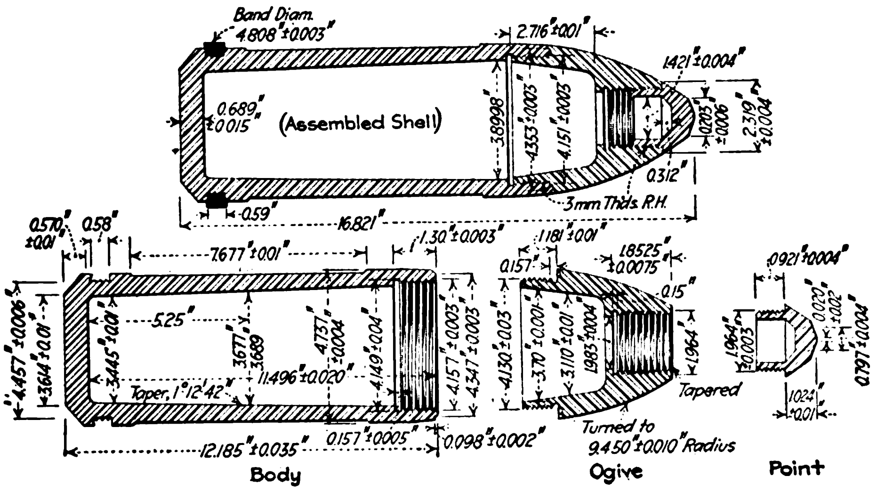


FIG. 1. SERBIAN HIGH-EXPLOSIVE 120-MM. SHORT SHELL

Taking the 120-mm. short high-explosive shell as the subject, the manufacturing operations will be followed through, and the methods used on the other sizes will be shown. Fig. 1 gives a general view of the complete shell, with the protecting point screwed in place.

The rough forgings weigh about 55 lb. and are approximately $5\frac{1}{4}$ in. in outside diameter, $3\frac{1}{4}$ in. in the bore and probably average $11\frac{1}{2}$ in. long. The first operation is cutting off the open end to length on the Espen-Lucas saw. The forgings are clamped in the holders at each side of the saw, being handled in pairs, as shown in Fig. 2. They are gaged from the bottom of the forged hole by means of simple stops, shown on the machine and also in detail in Fig. 3. There is a varying amount to be cut off, owing to the difference in the depth of the forged hole, but all operations are gaged from the bottom of the pocket. The back end of the shell is also faced off by a large milling cutter suitably spaced on the same arbor as the cutting saw, so that the face of the shell is given an approximately equal thickness in each case for all future operations.

The device for setting these shells in the cutting-off machine, as shown in Fig. 3, has several points of interest. It consists primarily of the arm *A*, which swings on a stud screwed into the bed and carries the gages *B* and *C*. These are a good sliding fit through the arm *A*, have the inner point tapered and the outer end knurled for easy handling. They also have two $\frac{3}{8}$-in. grooves, one near each end, for locking them in either the in or the out position.

This locking is done by the latch handles *D* and *E*, which are pivoted so that the weight of the hooked end will keep them in place in the notch unless they are lifted out by the other end. The latches hold them in either position, and the whole arm can be easily swung out of the way except when the blanks are being gaged for location in the machine. Next comes the centering of the back end. This operation is done in the fixture shown in Fig. 4, which is mounted on a 24-in. Snyder vertical drilling machine, that carries a centering pintle mounted on trunnions in the side of the fixture and is fitted with two sets of three centering fingers, so as to insure the hole being drilled central with the bore of the shell. This fixture is shown in two positions in Fig. 4, while Fig. 5 gives the details of its construction. The action of the centering fingers can be easily seen from the sectional view in Fig. 5, these fingers *A* and *B* being forced out by adjusting the nuts *C* and *D* on the rod *E*. The nuts carry right and left threads, and the rod *E* is easily controlled by the handwheel *F*, beneath.

In operation the shell is placed over the spindle while in the horizontal position shown. The shell is then thrown into the vertical position and locked by the index pin *G*, on the side. The handwheel *F* is turned until the locking fingers grip the bore of the shell, centering it for the drill, which comes through the bushing at the top. Details of this pintle are also shown in Fig. 5. The fingers *A* and *B* are held in a closed position.

Although it might appear that a shell of this size would be hard to handle in such a device, the trunnions are so placed that the long lever carrying the index pin makes it very easy to swing the shell from one position to the other.

Rough-Turning the Back End

The third operation brings the shell blanks to the lathe for rough-facing the back end and turning the bevel, which is considerably larger on these shells than on some others. Several old 21-in. lathes are utilized for this purpose, and also some new LeBlond lathes of the same size. The difference in production is very noticeable, varying from 2½ per hr. on the old lathe to 4 per hr. on the new. This operation removes a large amount of metal, as can be seen from the operation sheet, which, together with the time required for handling, makes up the total operations.

The shell is held on a three-jawed mandrel, or pintle *A*, these jaws being expanded by a taper draw-in plug oper-

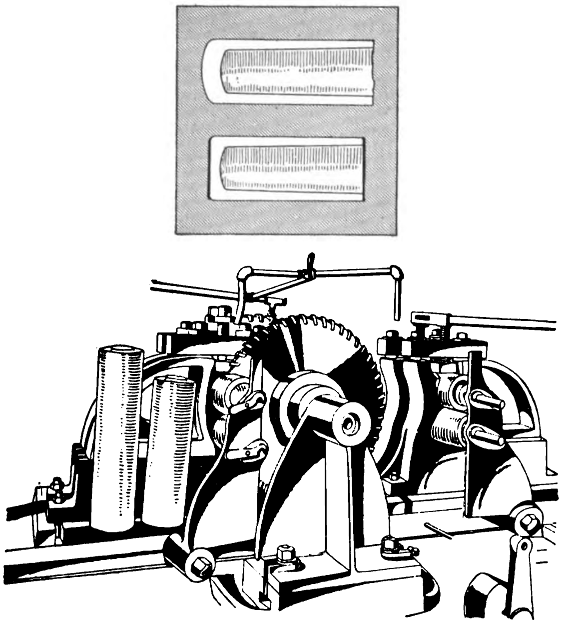


FIG. 2. OPERATION 1: CUTTING OFF END

Machine Used—Espen-Lucas.
Special Fixtures and Tools—Milling cutter face back end.
Gages—Special depth gages on machine, see Fig. 3.
Production—10 per hr.

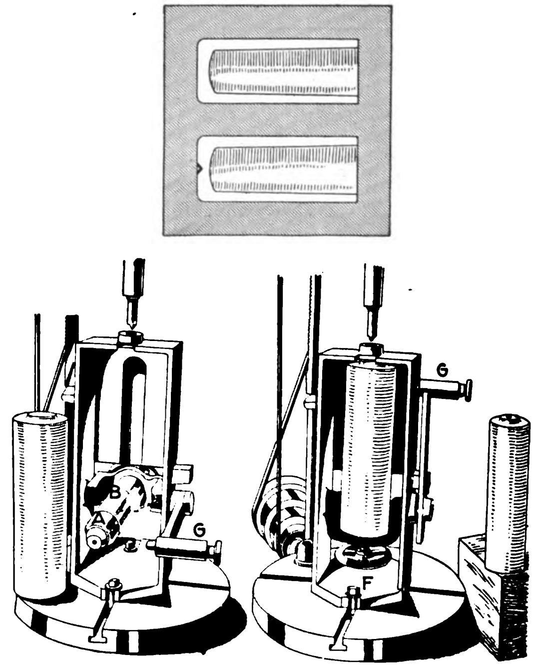


FIG. 4. OPERATION 2: CENTERING BACK END

Machine Used—Snyder 24-in. vertical drilling machine.
Special Fixtures—Swinging drill jig.
Gages—None; use stop on center drill.
Production—50 per hr.

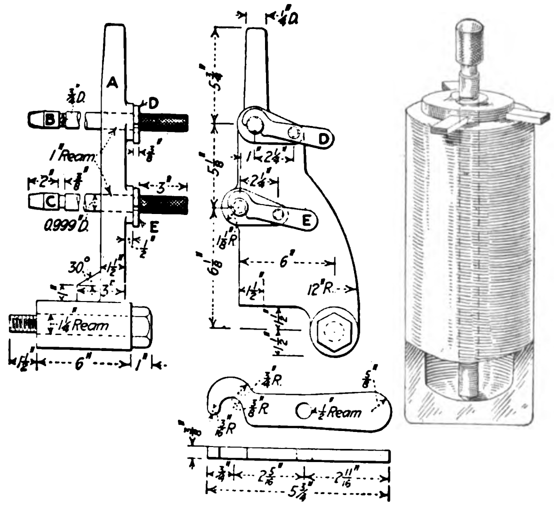


FIG. 3. DETAILS OF DEPTH STOP

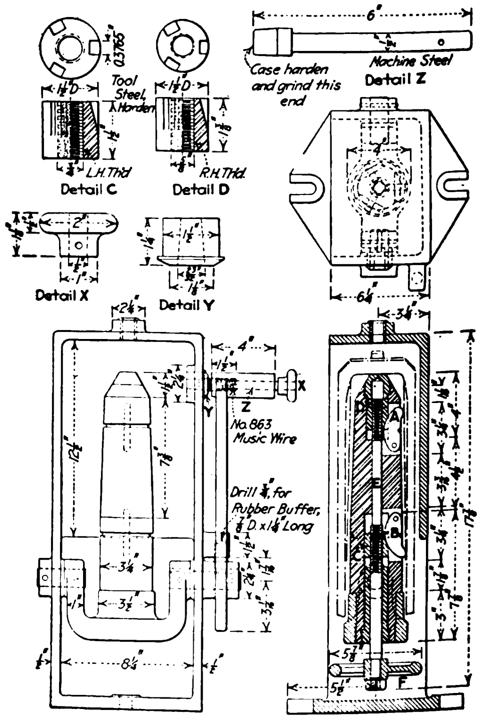


FIG. 5. DETAILS OF DRILLING JIG

ated by a handwheel on the rod that goes through the hollow spindle. The three jaws are of hardened steel and are curved on the bottom to insure even seating on the inside forged surface of the shell.

Fig. 6 gives a view of the tool layout, with the squaring tool *C* and beveling tool *D* shown in position in the turret tool post. This picture also shows how the face of the firer is set into a recess in the faceplate and is then bolted to it. Fig. 7 shows all details of the holding mechanism. It is set into the faceplate, as shown at *B*.

A similar holding device is used for the fourth operation of rough-turning the outside diameter of the shell. This work is in reality split into two suboperations, the first lathe leaving about $\frac{1}{16}$ in. to be removed by a second lathe, as this method has been found more satisfactory in maintaining the desired allowance for finishing on the last cut. No particular lathe set-up is required, except as represented in Fig. 8, the only difference between this and the layout in Fig. 6 being in the tool used. The production on the first lathe is 4 per hr.; and on the second roughing cut, a production of 8 per hr. is easily reached.

The work has now progressed to the boring of the shell, which is done in a LeBlond turret lathe equipped with a special chuck, shown in Fig. 12. The tool layout is shown in Fig. 9, while Fig. 12 gives a general view of the lathe set-up for this operation.

Details of the special chuck are shown in Fig. 10 and contain several interesting features. It consists of the cylindrical body, which is bolted to the faceplate by the flange *A* and turned on the outside at *B* to run in the steadyrest shown. The chuck carries two adjusting collars *C* and *D*. The front collar carries the split taper bushing *E*, which is forced inward by the front plate *F*, and closes on the shell by means of the saw cuts on the comparatively thin taper section. The other end of the shell is screwed up by the collar *C* forcing three equally spaced pins *F* down against the shell.

The boring tool, shown in Fig. 11 at *A*, is for rough-boring the inside of the shell and consists of a heavy steel shank carrying a ½-in. square high-speed steel cutter. This is hollow and has a brass tube that carries the lubricant direct to the cutting point. The construction of the other boring bars can be readily seen from the details and require little explanation. Another reamer is shown at *B*, carrying two long blades, that lap by each other so that each can present its cutting edge on the center line. Each also has adjusting and clamping screws.

Behind the cutter blade is the pilot bushing *A*, which is pressed forward by the helical spring *B*. This pilot enters the shell body in the space bored for the thread and assists in guiding the bar so that the whole will be reamed true to the correct taper of 1° 12′ 42″. The finishing reamers are shown at *E* and *F*, also the tool for recessing

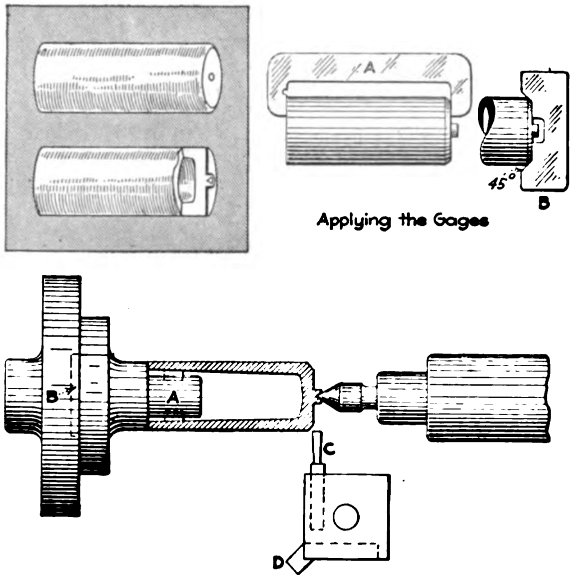


FIG. 6. OPERATION 3: FACING BACK END

Machines Used—Blaisdell and LeBlond 21-in. lathes.
Special Fixtures—Driving mandrel, multiple tool block.
Gages—Flat former A, length; B, form of bevel.
Production—2½ to 4 per hr., depending on lathe.

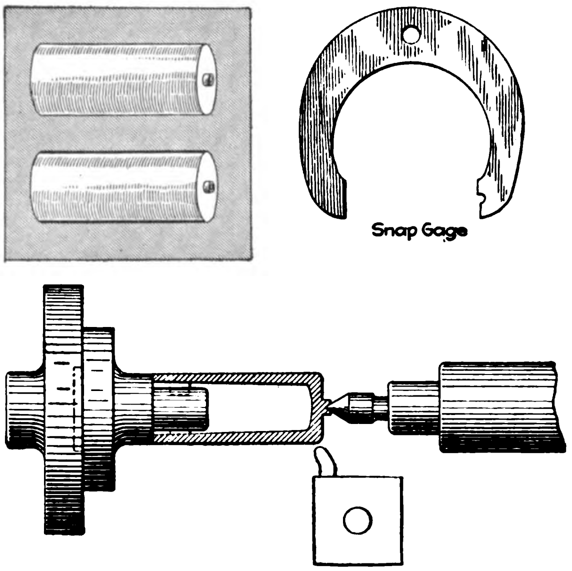


FIG. 8. OPERATION 4: ROUGH TURN

Machine Used—LeBlond 21-in. lathe.
Special Fixture—Same driving mandrel as operation 3.
Gages—A, diameter.
Production—4 per hr. first cut, 8 per hr. for second cut.

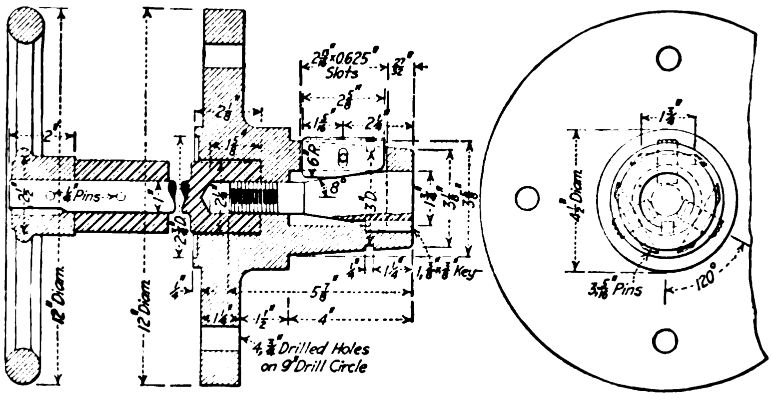


FIG. 7. DETAILS OF DRIVING MANDREL

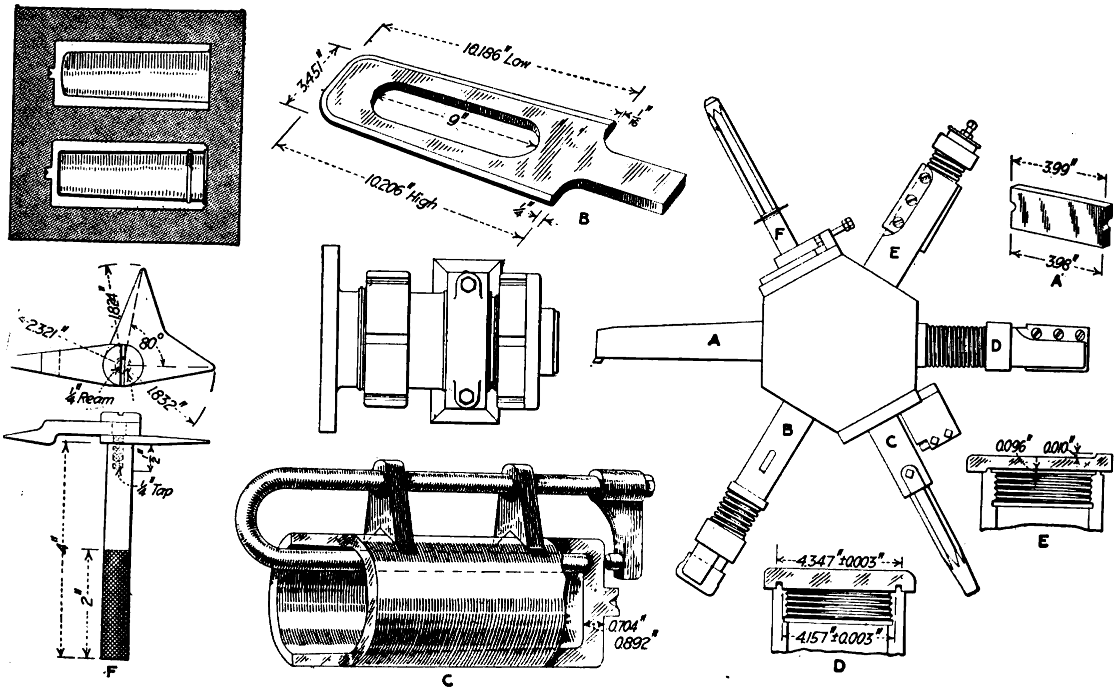


FIG. 9. OPERATION 5: BORING SHELL

Machine Used—LeBlond 21-in. turret lathe.
Special Fixtures—Stops, position index—special chuck.
Gages—A, bore for thread; B, form of bore; C, thickness of bottom; D, width of tongue; E, length of tongue; F, recess for thread.
Production—40 min. each.

at the bottom of the thread. This carries a central stud, or distance piece A, which locates the recess with reference to the bottom of the bore. The necessary side movement is obtained by means of the lever B.

Fig. 12 shows the carriage stops at C, a separate stop being provided for each turret position. A large multiplying lever A has also been added on the front of the lathe carriage to aid in quickly setting the turret central at any time. The short end of this, at the left of the capscrew B that forms the pivot, is in the form of a bell crank, having a curved surface presented to the end of the turret slide.

The upper surface of the cross-slide way is graduated so as to make it easy for the operator to bring the turret to the desired position quickly. This view also gives a good idea of the construction of some of the tools shown in Fig. 11. It shows the roughing reamers, the tool for trimming the end of the shell, and the circular recessing tool, which cuts the groove at the bottom of the thread in the shell nose.

The boring is divided into six suboperations, the first being to rough-bore by using the taper attachment at the back of the carriage, which has been fitted with a form of the proper shape. This is then released by means of a special nut, and the turret is brought to its central position by using the pointer already referred to.

The second suboperation rough-faces the bottom of the hole and rough-bores the thread diameter. The third suboperation finishes the taper at the bottom of the shell with a two-bladed reamer, shown at E in Fig. 11 and also in the turret-tool layout. The fourth suboperation finishes the taper reaming and also finishes the thread

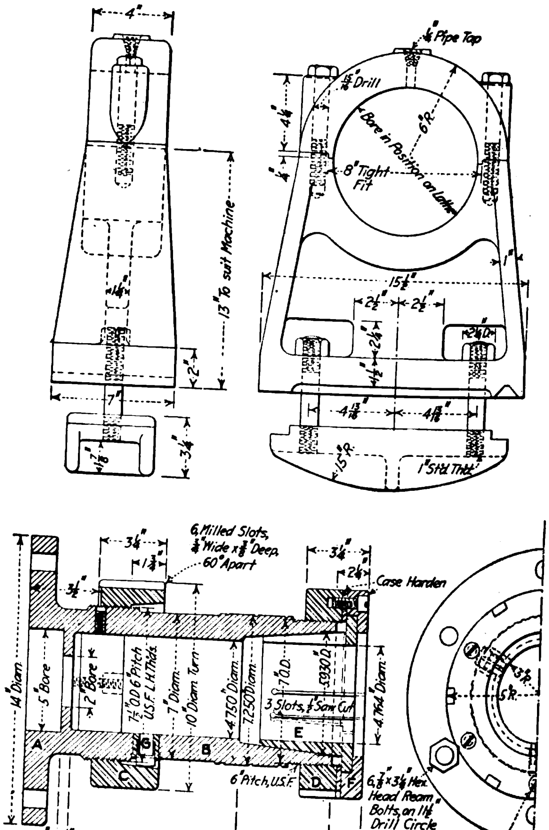


FIG. 10. DETAILS OF CHUCK AND REST

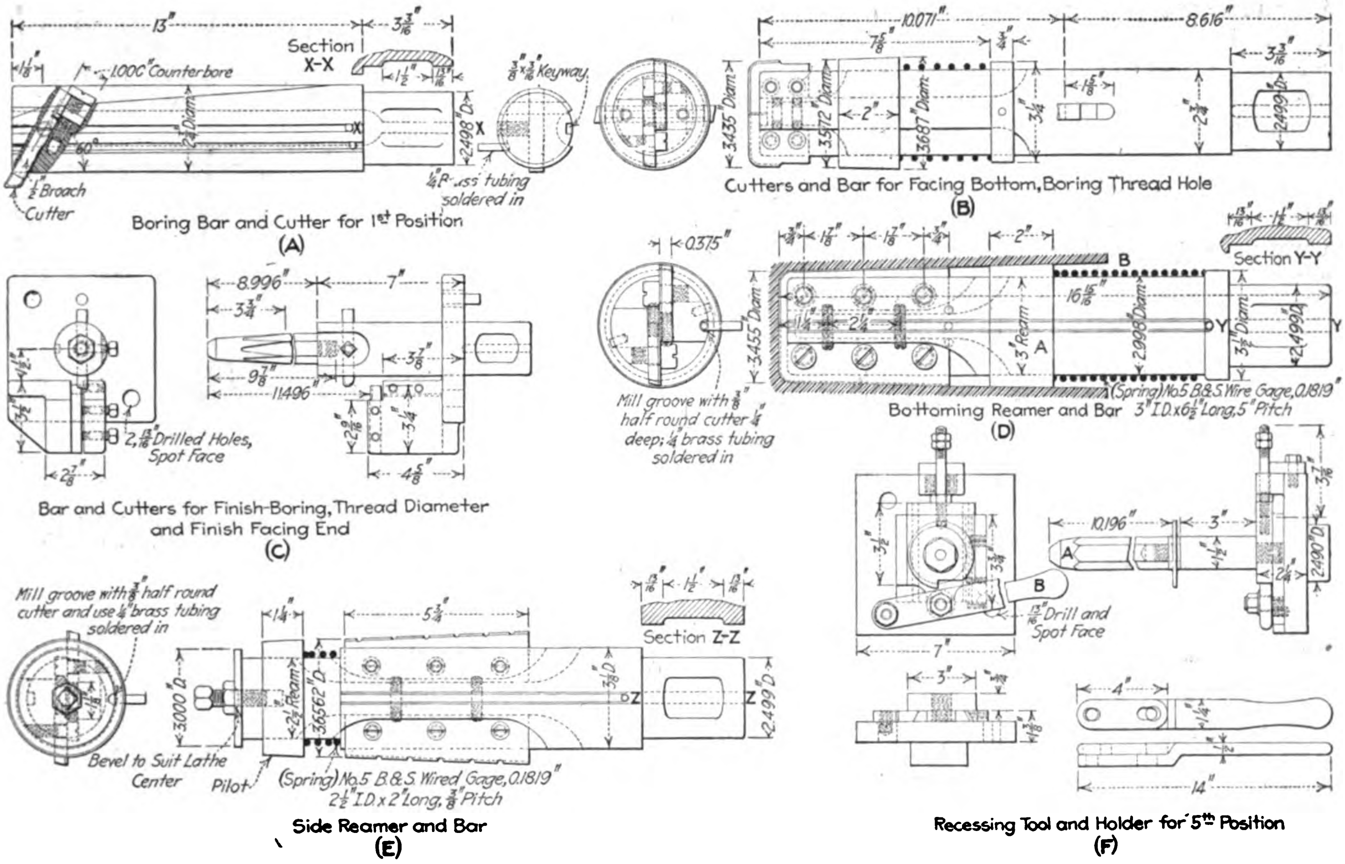


FIG. 11. DETAILS OF BORING TOOLS SHOWN IN FIG. 9

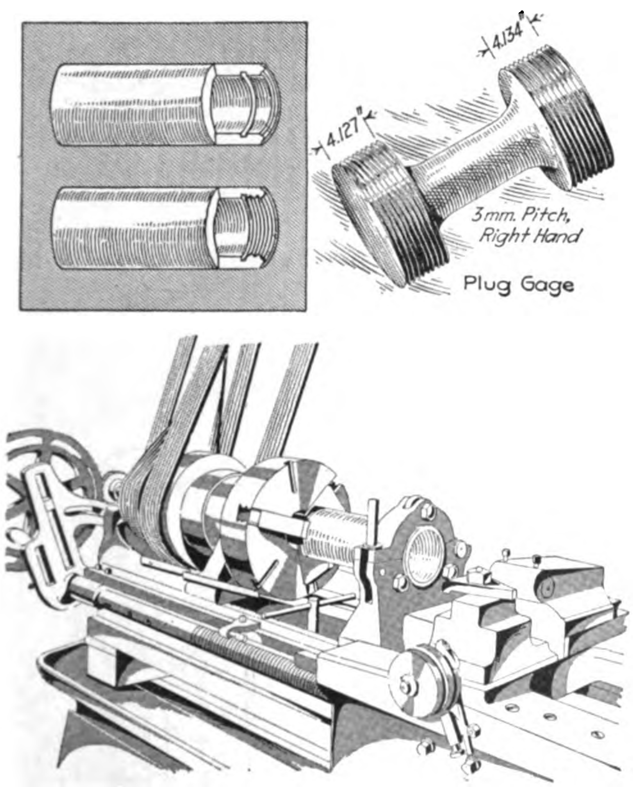


FIG. 13. OPERATION 6: THREADING NOSE OF SHELL

Machines Used—Automatic threading lathe and Lees-Bradner hobber.
Special Fixture—Roller rest; one tool only in lathe.
Gage—Threaded plug.
Production—8 per hr.

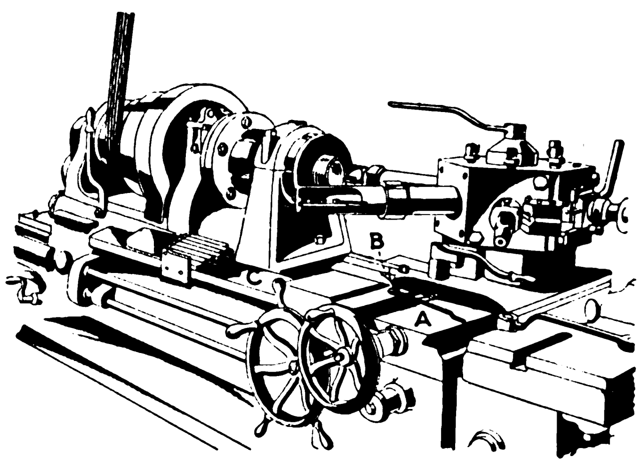


FIG. 12. THE LATHE WITH STOPS AND INDEX NEEDLE

diameter. Suboperation No. 5 takes care of the recess for the thread and chamfers the inside of the shell, while the sixth and last suboperation finishes the tongue at the outer end of the shell, completing the fifth operation in an average time of 40 min., although the operation has been done in 24 min.

After this comes a bench inspection, from which the shells go to a Lees-Bradner thread miller, to have the threads cut in the nose. Three threading lathes of the Automatic Machine Tool Co. are also used for this work, a roller rest being provided, as shown in Fig. 13. Only one threading tool is used on the work in the automatic threading lathe. The production averages 8 shells per hr.

The seventh operation is grooving and knurling, Fig. 14. The driving plug is screwed into the nose of the shell, as shown, the work being done in a 21-in. LeBlond lathe with a turret tool post. The groove is roughed out with a square-nosed tool in an Armstrong holder. The second suboperation cuts the eight small grooves, leaving seven ridges.

The third suboperation is undercutting the back side of the groove, this being done by a tool fixed at the

proper angle and fed into the bottom of the groove before cutting. By moving the carriage the desired distance to the right the undercut is easily made. This is controlled by two stops on the lathe bed, as shown, the depth of all the tools being determined by a single stop at the back of the cross-slide.

The fourth and last suboperation is the knurling, with a knurl about 2 in. in diameter and having plain, straight grooves properly spaced so that the resulting effect at the bottom of the band groove is a series of square raised points all around the groove. The use of the large knurl, mounted on a substantial ½-in. pin, makes this a comparatively easy operation.

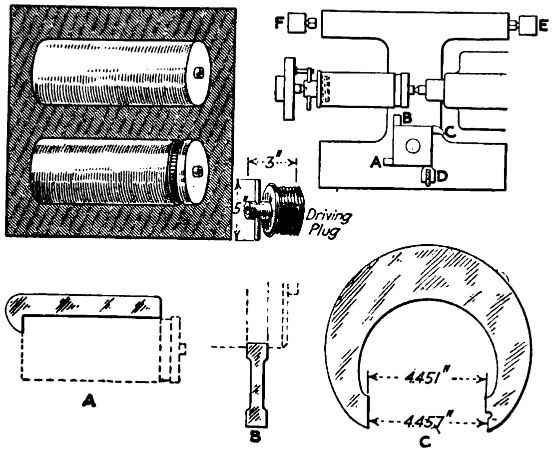


FIG. 14. OPERATION 7: GROOVING AND KNURLING

Machine Used—LeBlond 21-in. lathe.
Special Fixtures—Stops for carriage in undercutting driving plug.
Gages—A, location of groove; B, width of groove; C, diameter of groove.
Production—5 to 6 per hr.

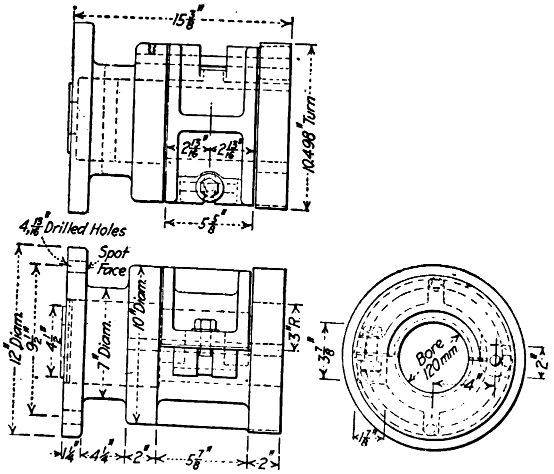


FIG. 17. DETAILS OF FLAP CHUCK

With the driving plug still in the end of the shell, it goes to the eighth operation—finish-turning in a Prentice geared head lathe. Three tools are used in a special tool post, as shown in Fig. 15. One tool turns the relief ahead of the groove, the second roughs the back end for the cartridge case, and the third finishes. This operation averages 14 min. each.

Then follows a bench inspection, after which the driving plug is unscrewed and the shells go to a lathe equipped with a flap chuck, as shown in Fig. 16, to have the back end faced off and the finish bevel put on the corner. This requires 11 min. Details of the chuck are given in Fig. 17.

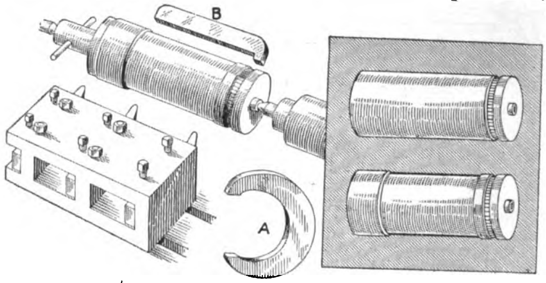


FIG. 15. OPERATION 8: FINISH TURNING

Machine Used—Prentice geared head lathe.
Special Fixtures—Driving plug and multiple tool block.
Gages—A, diameter, one for size, one for relief; B, length of relief from groove.
Production—14 min. each.

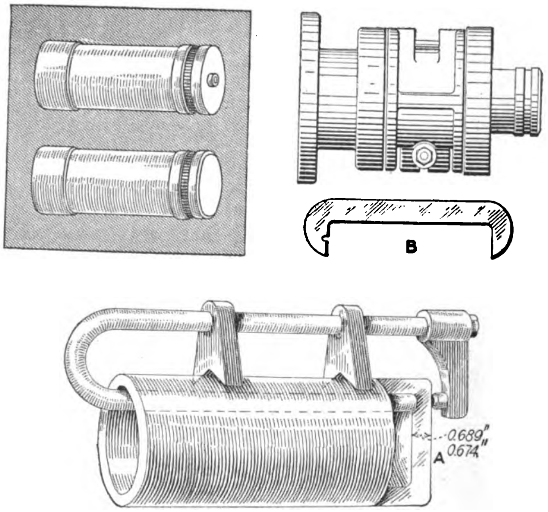


FIG. 16. OPERATION 9: FINISH BACK END

Machine Used—Le Blond 21-in. lathe.
Special Fixture—Flap jaw chuck.
Gages—A, thickness of bottom; B, length.
Production—11 min. each.

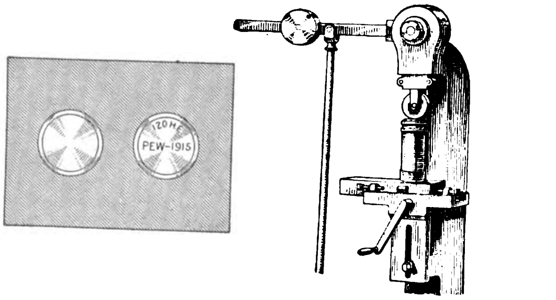


FIG. 18. OPERATION 10: MARKING BACK END

Machine Used—Noble & Westbrook.
Special Fixture—Roll stamp.
Gage—None.
Production—50 per hr.

The back end is then marked on a machine of the Dwight-Slate pattern, Fig. 18, at the rate of about 50

per hr. Then comes the Government inspection. After the stamping, the shells are cleaned in a soda tank to cut out all the grease and oil, after which they go to the inspection bench to be looked over by the Serbian

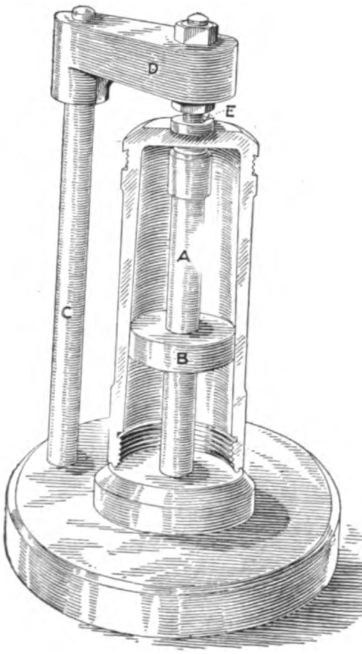


FIG. 19. BENCH INSPECTION GAGE FOR THICKNESS OF BOTTOM

Government inspectors. If satisfactory, the shells are stamped and passed for further operations.

They are now ready to have the ogives screwed in, so that these can be finished in place on the shell body. Before carrying this work through, it will probably be best to take up the manufacture of the ogives themselves.

The inspection benches are well equipped with gages and are built of the most convenient height for the

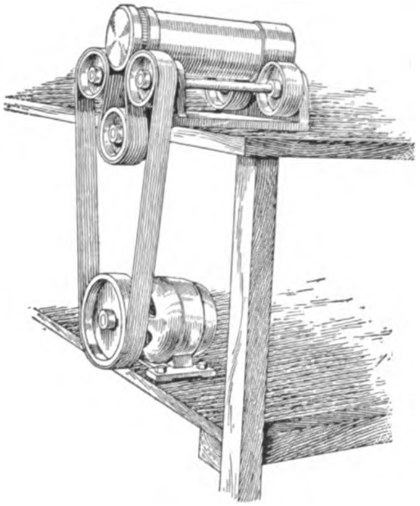


FIG. 20. RUNNING BELT FOR THREAD INSPECTION

work to be done. A gage used for testing the thickness of the back end is shown in Fig. 19. The shell is placed over the center spindle *A*, being guided by the enlarged portion *B*. The measuring upright *C* carries the head *D*, which is located by a shoulder on *C* and carries the adjustable measuring point *E*. This can be handled very rapidly and gives good results.

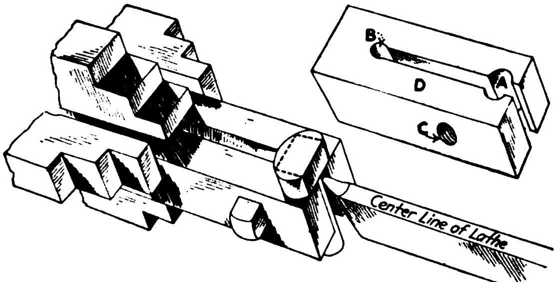
For testing the threads in the ends of shells a belt arrangement is used, as shown in Fig. 20, which saves both time and fatigue on the part of the inspector. This belt runs continuously. By laying a shell on the belt-covered pulleys it is revolved so that the plug gage need only be held still in the hand. For running the gage out, the inspector uses the gage as a handle and turns the shell end for end on the belt. In this way the rotation is reversed and the plug gage is unscrewed.

How To Square the Heads of Bolts in a Lathe

By John Hayes

A large number of extra-long $\frac{7}{16}$-in. square-head screws were to be made, and neither miller nor shaper was included in the equipment. The heads of the screws were squared in the lathe, using the little kink shown, which may of use to others up against the same proposition.

A 6-in. piece of $\frac{3}{4}$x$\frac{7}{8}$-in. cold-rolled steel was drilled $\frac{7}{16}$ in at *A* and $\frac{3}{16}$ in. at *B*. It was then slotted with the



SHOWING POSITION OF CHUCK JAWS AND POSITION OF TOOL

hacksaw, as shown; drilled for a $\frac{3}{8}$-in. screw at *C*; relieved on one side of the slot and threaded on the other, making a clamp, as shown.

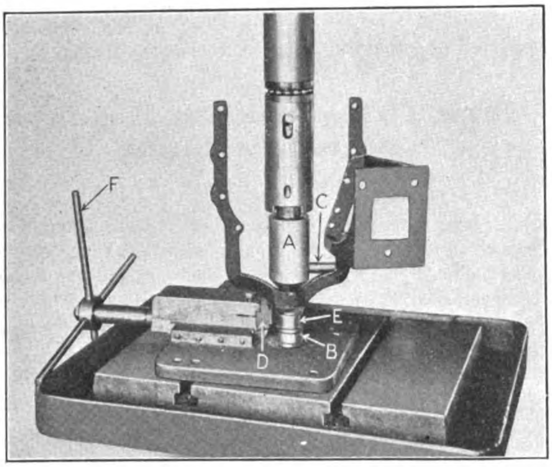
The piece was held in a four-jawed chuck, with the face *D* set at about the center. A piece of flat steel and a C-clamp on the bed of the lathe acted as a stop for the carriage. After one side was faced, the screw was turned one-quarter way around and the operation repeated. The job was done much quicker and better than it could have been done by filing or grinding.

Iron-Ore Production—In 1880 the production of iron ore was 7,000,000 long tons, as compared with 60,000,000 tons in 1913. The production of pig iron increased in the same period from less than 4,000,000 tons to more than 30,000,000 tons, the value of which in 1913 exceeded $458,000,000. The United State produces annually about 40 per cent. of the world's supply of iron, and is abundantly supplied with iron ore, yet there are excellent arguments in favor of encouraging imports of ore from Cuba and South America. Iron ore forms the basis of the largest manufacturing industry in the United States. The profits to both labor and capital are made from the manufacture and sale of iron and steel products rather than from iron-ore mining. Therefore so long as the United States can utilize the cheap ores from Latin America and export to those countries as well as to Europe the fabricated iron and steel goods there is reason to favor the continuance of these conditions.

Turning an Awkward Piece in a Drilling Machine

By E. A. Thanton

A method of doing a very awkward job is here shown. To turn the end of the casting in a lathe would have meant the making of some sort of holding fixture, more or less complicated and difficult to handle. By using a drilling machine the difficulties were greatly lessened, and a good job was the result. The work is done in the shop of the Disco Electric Starter Co., Detroit, Mich., and may suggest similar applications to other classes of products.



TURNING AN AWKWARD JOB IN A DRILLING MACHINE INSTEAD OF THE LATHE

The casting is put into a drilling jig, the holes in the "arms" drilled and also a hole drilled lengthwise of the bearing to be turned. The driver *A* has on the end a pilot that goes down through the hole in the bearing and into a bushed hole in the center of the boss *B*. A pin *C* rests against one of the arms and serves to rotate the casting as the drill spindle revolves. The cutting tool *D* is fed to the bearing *E* by turning the capstan wheel *F*. It will be noticed that the cutting tool is a formed one and set into the end of the tool slide at an angle, so that, as it dulls, the end may be ground and the tool set up again without changing any adjustments and with little trouble.

A Rapid Method of Milling Flutes in a Reamer

By C. Smith

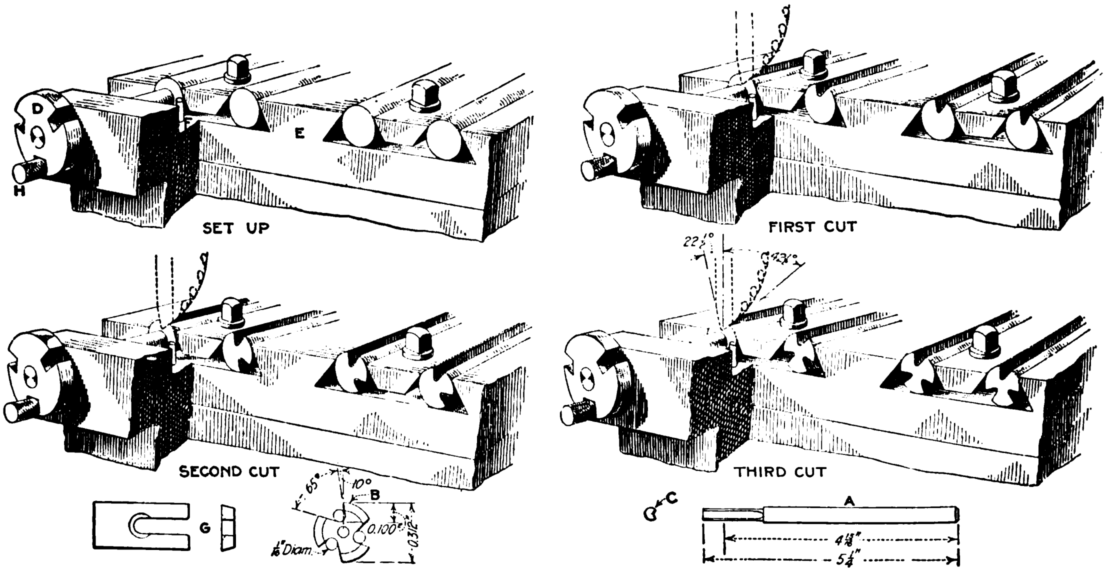
The illustration shows how flutes were milled in a barrel roughing reamer. The fixture is shown with *A* representing the reamer blank to be milled and *B* an enlarged view showing the style of flutes wanted.

The first milling operation is to take hold of the body of the reamer in a hand-miller chuck to mill the $\frac{3}{32}$-in. radius oil groove in the shank, as in the section shown at *C*. This groove acts as a locating point. The point of the screw in the index collar *D* lines up the oil groove with the first flute cut. The index collars were put on the shanks of four reamers and put into the fixture *E*, against stop pins *F*, with the index pins in the fixture, as indicated at *H*, clamped down with four screws and four straps *G* into 20-deg. angle jaws in the fixture.

The 20-deg. angles did not work well, so 5-deg. angle jaws and straps were put in and found to be a decided improvement.

Four reamers are milled at a time. After the first cut is taken, the four clamp screws are loosened and the four index pins, shown at *H*, pulled out. The index collars are rotated to the next slot in the collar, the pins put in and the second cut milled. The third cut is made in the same manner.

This method holds the reamers rigid, and they can be milled with a good stiff feed and a great deal faster than it would be possible to mill them on centers where there is very little support to avoid excessive vibration.



DETAILS OF A RAPID METHOD OF MILLING FLUTES IN REAMER

The Small-Shop Grinder

By John H. Van Deventer

SYNOPSIS—Machine grinding is not by any means restricted to large shops. It is true that the average small shop cannot afford to install a specialized machine with a small range of work for this purpose, but it should investigate the use of grinders of the universal type having a broad range. In this article the problem is attacked from the small-shop angle, and the causes and remedies of common grinding troubles are given.

The small-shop man does not ordinarily make his acquaintance with the art of grinding on what is called a "grinder." His introduction to this method of removing metal comes by way of a casting snagger, such as was described in "The Small-Shop Grinding Wheel," on page 11 of this volume. This acquaintanceship broadens out through experience with various improvised grinding devices, which are applied at various times to each machine in the shop, from the engine lathe to the planer, usually with more or less unsatisfactory results. Finally comes the ultimate achievement—the purchase of a "tool grinder"—which usually accompanies the advent of the first miller. In the majority of small shops the owner "guesses" that this is as far as it is safe to go in the installation of grinding equipment. Whether this is a good or a bad guess depends greatly on the kind of work that is being done, but I venture to say that it is a bad guess in a great many cases.

One of the wrong notions of grinding is that its object is only to obtain a fine, smooth, accurate job. In 75 per cent. of the large shops that finish work by this means the compelling object is not the fine finish so much as the reduction in cost that can be obtained over the old method of finishing by fussing with fine cuts and a file. Lathe hands will not start to file on a shaft that is left full of grooves from a roughing cut—it is too much like work. The grinder has no such notions about the matter, however, and will tackle the roughest job with the same degree of self-confidence that it displays on going over a glasslike surface. One good way to look at the grinder is as a filing and polishing machine, a device that will do the finishing much more quickly and with less need of skill than is required to manipulate the file and emery cloth.

"I don't need a grinder in my shop," says Bill Jones; "my lots are too small. I seldom have more than six like pieces going through the shop at the same time." By the same token, as the Irishman would say, Bill doesn't need a lathe or any other tool in his shop; for having such small lots, he should hog out the work with vise and cold chisel. You will find someone able to advance the most plausible objections against the use of any improvement that ever was invented, and the old

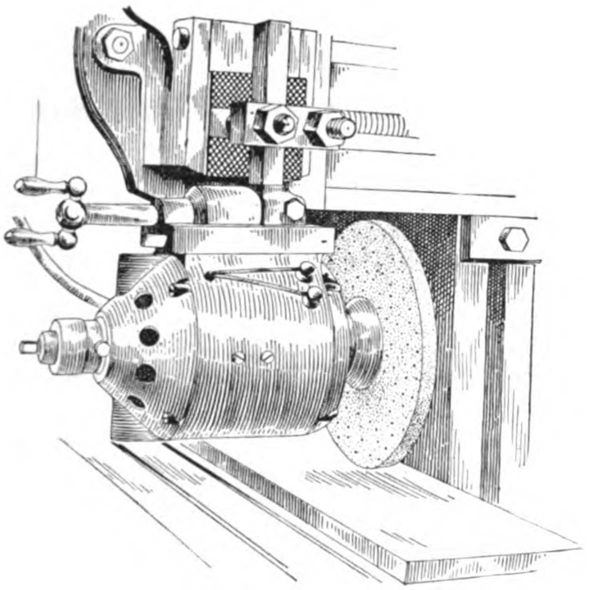


FIG. 1. SURFACE-GRINDING ATTACHMENT APPLIED TO THE PLANER

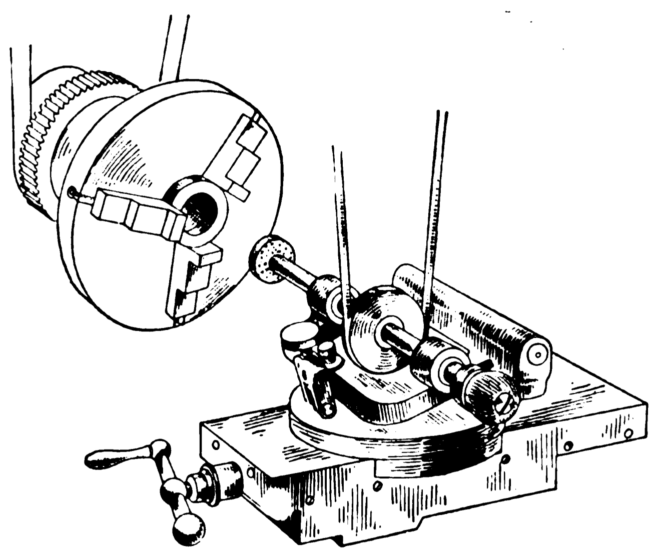


FIG. 2. TRAVERSE SPINDLE GRINDER ATTACHED TO THE ENGINE LATHE

excuse of "small lots" is a standby in the shop where progressiveness has taken a back seat in favor of precedence and habit.

It is easier to set up a grinder for an average job than to get a lathe ready for business, and the time saved even on one piece will often overbalance the setting-up time of the additional machine. Work that is similar, such as grinding shafts of various lengths, can be handled with the same set-up simply by moving the tailstock and obtaining a suitable work speed. Where there's a will there's a way; and where a way is found, nine times in ten there is profit also discovered.

The small shop that wishes to cut its eye teeth on the subject of grinding, at a minimum of expense, may do so by means of a tool-post grinder similar to that shown in Fig. 1. The advent of a small and durable electric motor makes this arrangement practical, as it dispenses with long overhead pulleys and traveling belts. An outfit of this kind will convert almost any machine tool into a grinder of sorts. In the illustration, Fig. 1, it is shown applied to a job of surface grinding, in

which a planer table is used to traverse the work and the planer head to crossfeed the wheel. Such a device cannot be expected to do the work of a machine especially designed for grinding. For one reason, the bearings are less rigid and will in time get loose; but if they are kept in first-class condition and too heavy cutting is not attempted, this tool-post grinder will answer the double purpose of grinding the lathe tools and cutting down the time otherwise wasted in walking to and from the regular tool-grinding wheel.

For a more accurate class of work the traverse-spindle grinder, shown in Fig. 2, is applied to lathes or millers with satisfactory results. The accuracy of the grinding, assuming that the fixture is in good condition, depends

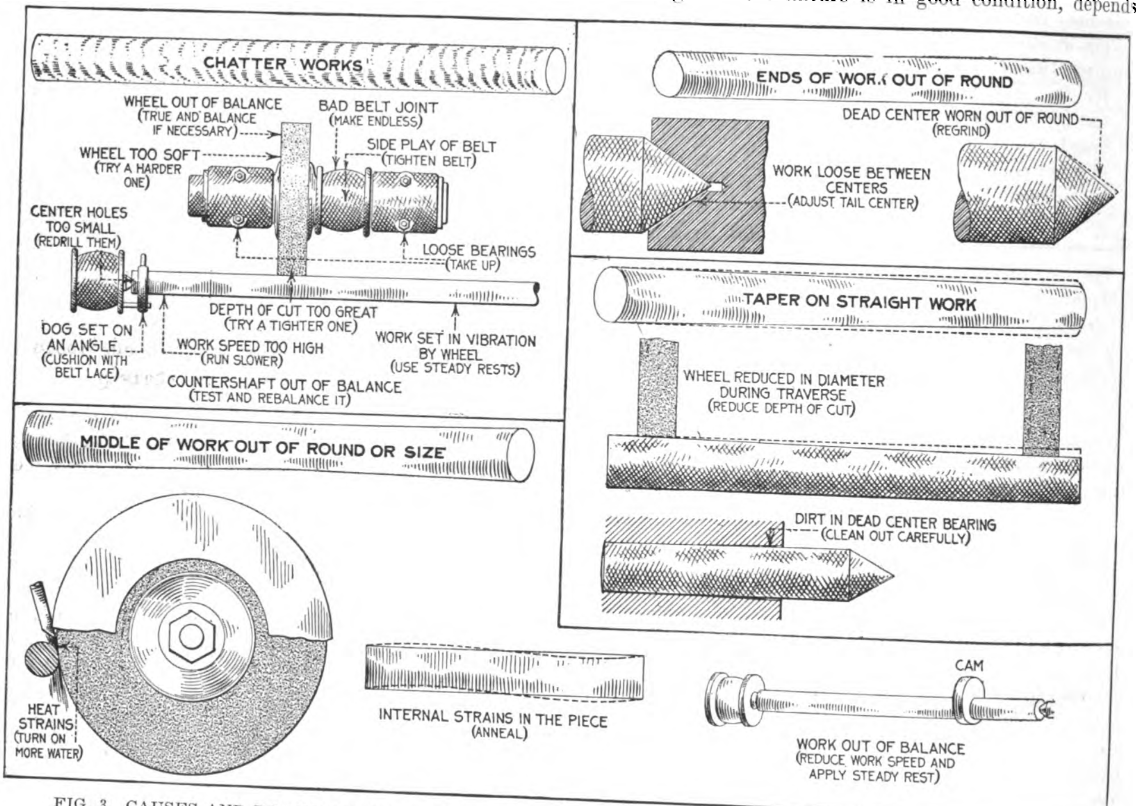


FIG. 3. CAUSES AND REMEDIES FOR MANY OF THE COMMON GRINDING TROUBLES MET IN BOTH SMALL AND LARGE SHOPS

purpose on the occasional job that cannot be handled by any other means. A grinder of this same type does excellent work in the lathe, if the precautions necessary to be followed in doing the same kind of work on a regular grinder are observed.

In many shops it is considered sufficient to stick the motor-driven grinding wheel in the tool post, put long slender work between centers and start to cut. In such cases it is usual to run the work speed well beyond the limit required for turning the same diameter, and also to use a hard close-grained wheel. When the job is finished, the boss wants to know who has been hammering at the shaft and has put in all the flat spots that are plentifully distributed over the surface of the work. A much softer wheel, a work speed one-third that required for a high-speed tool cutting on similar material and the use of back rests supporting the work from the back and from beneath on shock-absorbing wooden blocks will give quite different results.

A portable grinder of this kind can be used all around the shop. On the miller it will grind a fresh edge on cutters without removing them from the spindle; and when no other pressing use can be found, it can be bolted to the vacant end of the lathe bed and made available for solely on the truth of the headstock or miller spindle by which the piece to be ground is rotated. An outfit of the kind shown is inexpensive and will handle the most accurate work. It is driven from overhead, usually by means of a round or twisted belt, and necessitates the use of a drum pulley for this purpose, unless a small motor equipped with a driving pulley is mounted on the same slide.

One of the peculiar things about a traverse-spindle grinder that its operator must learn by experience is that the bearings are not in proper condition unless they run hot. If they do not, it is a sign that they are too loose for an accurate grinding job to be obtained. When you can rest your finger with comfort on the bearings of a contrivance of this kind, there is something the matter with it!

A grinding device of this simple and inexpensive type is suitable, not only for internal work, but also for angular and external work, since it can be swiveled about to any angle. In spite of its apparent lightness and the small dimensions of its spindle and bearings it will handle a very respectable cut in hardened steel.

The universal grinder presents itself as the next step in advance for the small-shop man who has outgrown

the use of the foregoing expedients. It is true that a machine of this kind costs considerably more than a simple tool grinder that may fill the bill for some time after its purchase. On the other hand, the range of work of a universal machine is so great that this must be taken into consideration and weighed as a part of the value received per dollar expended. A machine that costs $800 and that is capable of earning $8,000 during its life of usefulness is a much better investment than one that costs but $200 and can earn $1,000. In the case of the universal grinder you have as an asset its capability of handling commercial grinding, not as rapidly, of course, as it could be done on a plain machine of the same capacity, but fast enough to bring in a good profit. Such a machine should always be equipped for wet grinding.

This type of tool will handle not only all the grinding requirements of the small-shop tools and cutters, but also its commercial precision grinding—internal, external and angular—and a good range of commercial cylindrical and taper grinding in addition. In the average small shop it will be a long while before the demands for commercial work on a machine of this sort exceed its capacity in spare time. When such a time does arrive, it will be sufficiently soon to investigate the plain grinder as a means of handling this work.

Wet or Dry Grinding

The question of "wet or dry" is an absorbing one to the citizens of many of our states, where the matter is eventually settled by ballot. When it comes to grinding, opinion is more unanimous and is quite in favor of "wet." The use of a lubricant, or rather "coolant," on the grinder helps to make quick time and to give a smooth job, but its main purpose is to prevent the distortion that would otherwise occur, due to heating. When you consider that the chips torn from the work in grinding are raised to a temperature corresponding to the welding point of steel, the subject of temperature and the need of a cooling fluid take on a new importance. Oftentimes the water attachment is dispensed with as being a mussy contraption, a green hand finding that he needs a bathing suit more than a micrometer to help him navigate a grinder. This is all wrong and unnecessary; for if the stream is properly directed against the work, there will be absolutely no splash.

Among the things to keep in mind in operating a grinder are to use work surface speeds ranging from 25 to 35 ft. per min. whne roughing, and 25 per cent. faster for finishing. As soft a wheel as possible should be used for the job, and the traverse per revolution should be between five-eighths and seven-eighths of the wheel face, in order to prevent wearing away its edges.

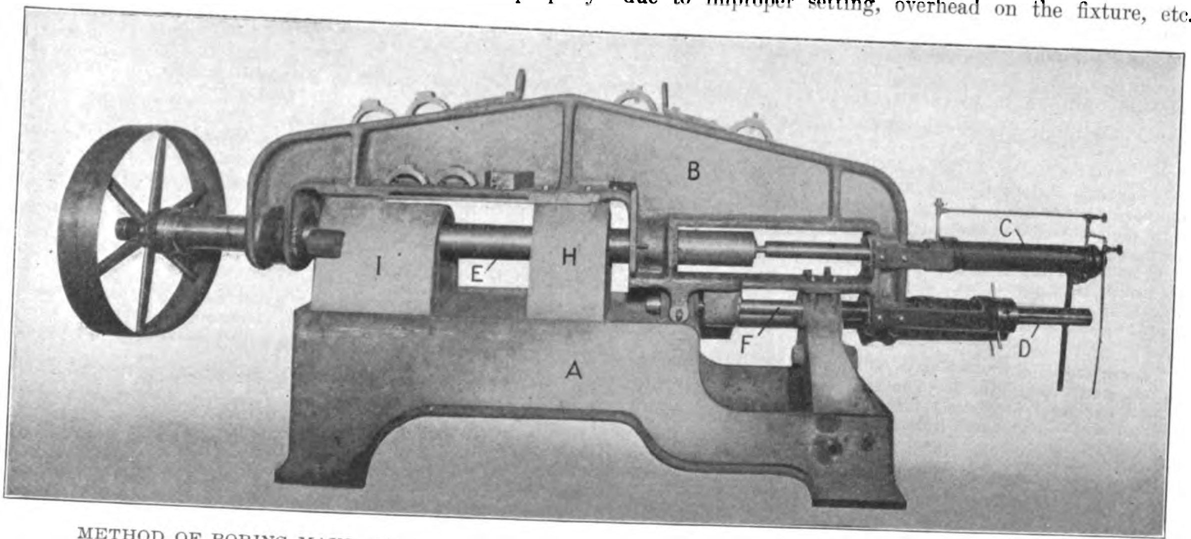
Some of the most common grinder troubles are represented in Fig. 3, which gives their causes and also the remedies to be applied in getting rid of them. They are included in this article, not to dishearten one who is contemplating the use of the grinder, but as a help for those who already have such machines. The former must remember that even in a foundry there are forty-seven ways of making a bad casting and that the comparatively few causes of trouble on grinders are really a recommendation for this type of machine.

Boring Lathe-Frame Bearings with Portable Fixture

The illustration shows a portable fixture designed and used by the Lombard Governor Co., of Ashland, Mass., for boring the spindle and turret bearings in the frame of the Warren automatic hydraulic lathe.

The frame *B* of this fixture is arranged to bolt to the frame of the lathe *A*, becoming practically a part of it. The boring bars are driven by pulleys and are fed longitudinally, as shown at *C* and *D*. The upper bar, which bores out the bearings *I* and *H*, is fed by hydraulic pressure; and the lower bar is fed by hand by means of a capstan screw. In this way the spindle and turret bearings are brought into close alignment more easily than could be accomplished on a horizontal boring machine.

This is an excellent example of the use of a large fixture, the body of the fixture being fully as long as the lathe bed. The utilization of fixtures of this size is not common, but there can be no question as to the economy of the method when the product is of sufficient volume to warrant the outlay. This is one of the problems that must be figured from many points—labor, spoiled work due to improper setting, overhead on the fixture, etc.



METHOD OF BORING MAIN AND TURRET BEARINGS OF WARREN AUTOMATIC HYDRAULIC LATHES

Machining Bearings and Bracket for a Printing Press

By Robert Mawson

SYNOPSIS—The drill jigs used in machining some of the bearings and brackets used on a printing press are here described. Owing to the fact that these elements are of a simple character, the tools designed and used are also simple. The parts produced, however, are as desired and are interchangeable and produced at a low cost in time, both as regards machining and assembling in the jig.

The two-sheet rotary printing press manufactured by the United Printing Machinery Co., Woonsocket, R. I., was described on page 58. Some of the tools, jigs and fixtures used in machining various elements used on the press were shown on pages 138, 232 and 318. Other well-designed jigs used in machining three bearings and two brackets on the press are described in this article.

When drilling the transfer and delivery cylinder the casting is placed on a turned plug, which fits into a reamed hole and is locatel by a key which sets into a cored notch of the part.

The jig used in drilling the driving shaft bearing has a novel method of locating. The bored casting is placed on the jig base fitting over a turned plug and is located by a swinging strap. Not only does this method hold the work to close limits, but it is unusually rapid.

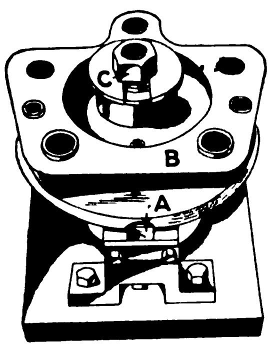


FIG 2

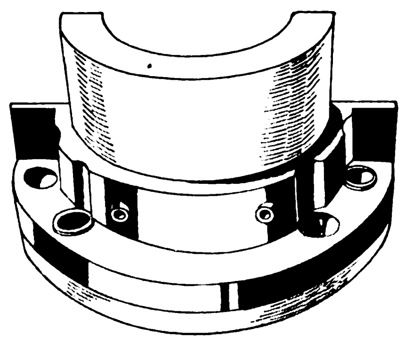


FIG 4

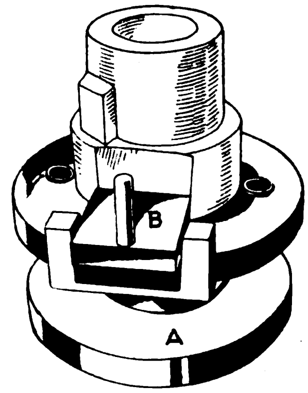


FIG 6

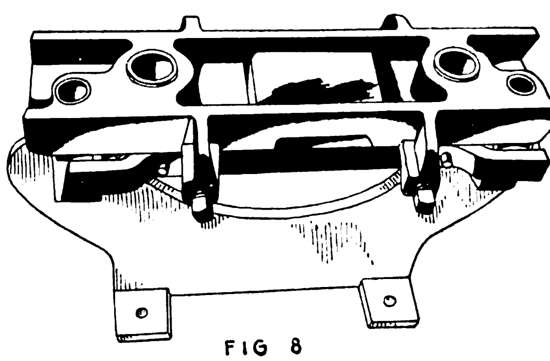


FIG 8

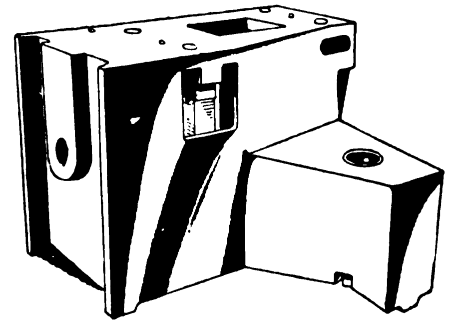


FIG 10

JIGS USED IN MACHINING PRACTICE ON TWO-SHEET ROTARY PRINTING-PRESS BEARINGS AND BRACKETS, WITH WORK SHOWN IN POSITION

FIGS. 2 AND 2-A

Operations—Drilling and reaming holes in transfer and delivery cylinder bearing, Fig. 1. The casting is placed on a 3-in. plug fitting into the machined hole and is located by the spring-operated key A. The cover B is then placed over the part and held down with the open washer and nut C.

Holes Machined—Two $\frac{3}{32}$-in. drilled, two $\frac{31}{64}$-in. drilled, two $\frac{5}{8}$-in. spot drilled and reamed, and one $\frac{1}{4}$-in. drilled.

FIGS. 4 AND 4-A

Operation—Drilling holes in upper and lower plate cylinder boxes, gear side, Fig. 3. The jig is slid over the casting, which has been previously bored, faced and turned. A pin-headed screw draws and holds the jig in position. The jig is designed so that both the upper and the lower parts may be drilled.

Holes Machined—Two $\frac{3}{32}$-in. drilled and one $\frac{1}{4}$-in. drilled.

FIGS. 6 AND 6-A

Operation—Drilling holes in driving-shaft bearing, Fig. 5. The casting, which has been previo[illegible]ored, turned and faced, is slid over the base A, made with a machined spindle to fit the bored hole in the piece. The jig is then dropped over the machined outside diameter of the piece and located with the swinging plate B.

Holes Machined—Three $\frac{13}{16}$-in. drilled. These holes are afterward tapped with $\frac{7}{8}$-in. U.S.S. threads.

FIGS. 8 AND 8-A

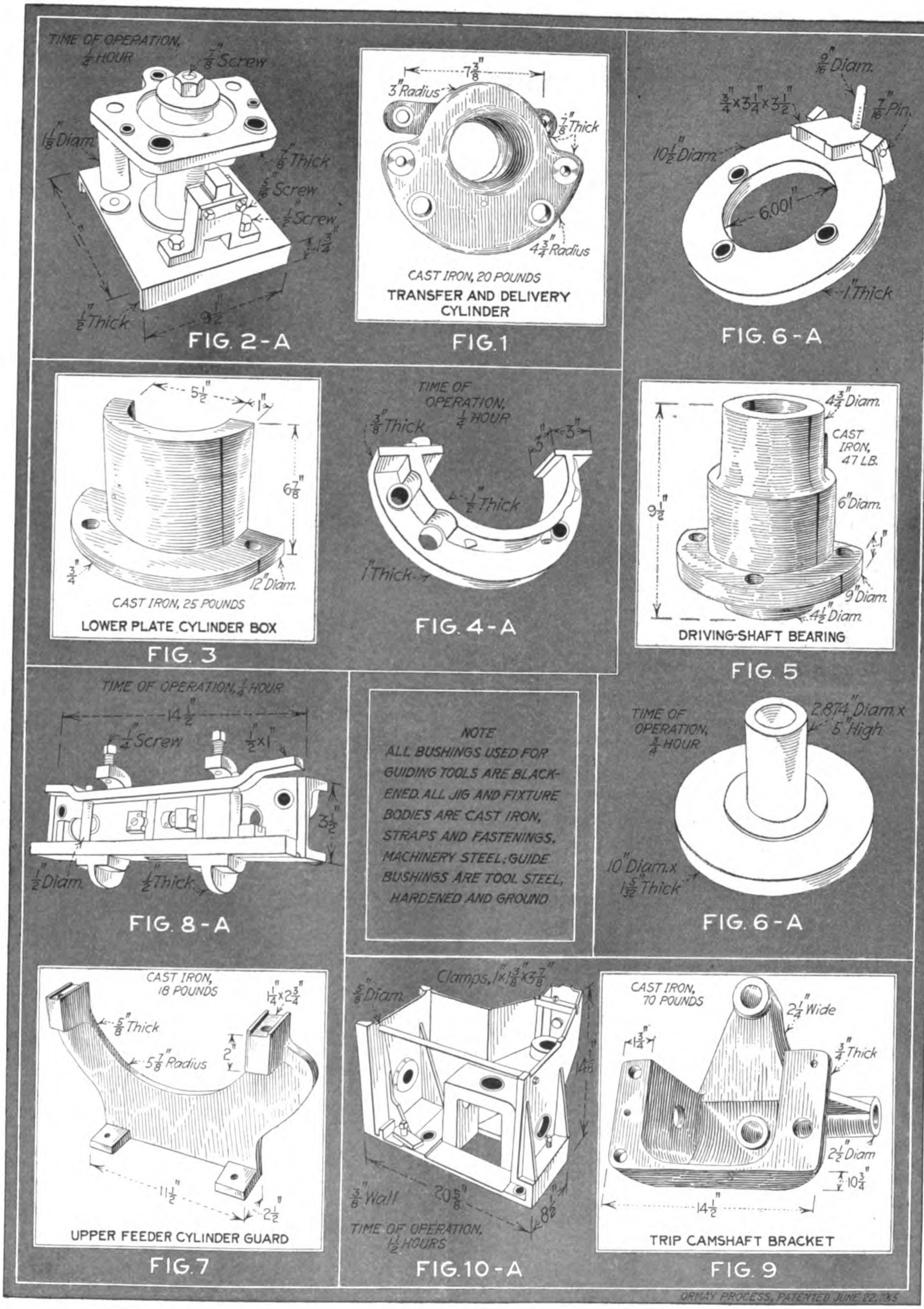
Operation—Drilling holes in upper surface of upper feeder cylinder guard, Fig. 7. The jig is dropped over the rough casting and forced against a stop with a pair of square-headed setscrews.

Holes Machined—Two $\frac{41}{64}$-in. drilled.

FIGS. 10 AND 10-A

Operation—Drilling and reaming trip camshaft bracket, Fig. 9. The milled casting is located against adjustable screws and held down with setscrews and straps.

Holes Machined—Two $1\frac{7}{8}$-in. spot drilled and reamed, one $1\frac{1}{2}$-in. spot drilled and reamed, one $1\frac{5}{32}$-in. drilled, two $\frac{5}{32}$-in. drilled, two $\frac{31}{64}$-in. drilled and one $\frac{1}{4}$-in. drilled.



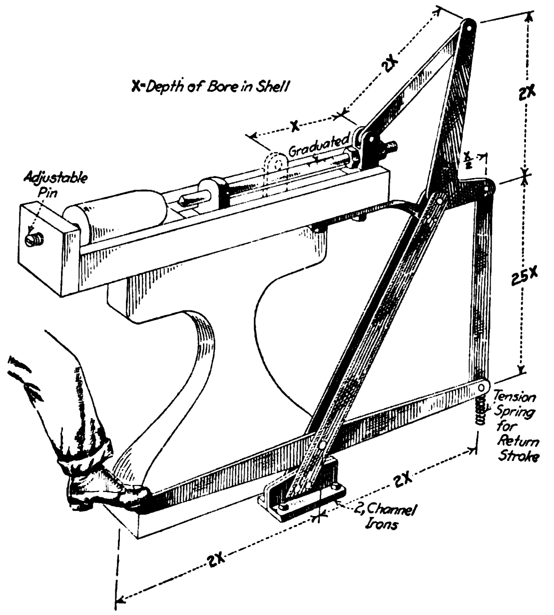
DETAILS OF JIGS USED IN MACHINING PRINTING-PRESS BEARINGS AND BRACKETS

Gage for Measuring Shrapnel

By L. E. Olsen

The gage shown in the illustration has many advantages over the common saw-frame style or the vertical standard with pin-dropping device.

It leaves both hands of the operator free and consequently increases his capacity for work. It does away



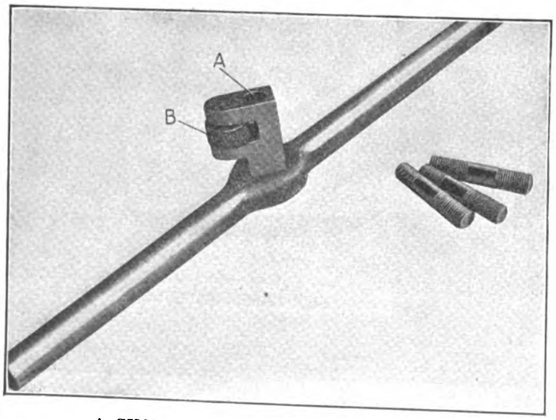
GAGE FOR MEASURING SHRAPNEL

with lifting the shells, as they can be rolled along the table into a V-groove for measurement. This gage is cheap to make, and it can be used for various sizes by making a new gage pin.

A Stud Driver

By E. V. Allen

I saw a fine stud driver in use in the Henderson Motorcycle Co. shop in Detroit not long ago. It is shown in the accompanying illustration. Various sizes were in use, the one shown for driving studs into crank cases.



A SIMPLE AND RAPID STUD DRIVER

The wrench was placed over the stud, which went into the hole A. The knurled piece B, which is eccentric, was turned so as to lock the stud, which was then easily run down as far as the threads would allow. A stud can be removed just as easily with the same tool, by simply turning the eccentric knurled driver around in the opposite direction.

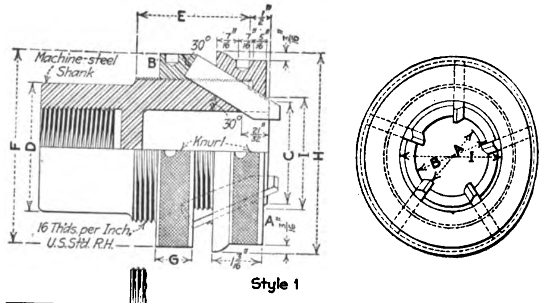
The name stamped on the tool was Edmund Sprung, Detroit.

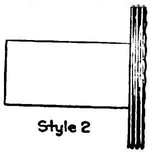
Adjustable Hollow Mill

By Edward L. Robenolt

The illustration shows an adjustable hollow mill that has proved useful in service. It is made in a manner similar to an adjustable milling cutter.

In changing from one size to another, slacken the cap A slightly and press the blades back against the





A	B	C	D	E	F	G	H	I
5/8 to 1	1 1/16	1 7/16	2 17/32	2 3/16	3 1/2	3/4	3 7/16	1 29/32
1 to 1 3/8	1 1/2	1 15/16	2 15/16	2 7/16	4 3/16	13/16	4 1/16	2 5/16
1 3/8 to 1 3/4	1 7/8	2 3/8	3 5/8	2 11/16	4 1/2	7/8	4 11/16	2 23/32

All Dimensions in Inches

DESIGN DATA FOR ADJUSTABLE HOLLOW MILL

adjusting nut B; screw up the nut until the tools cut the proper size, and then tighten the cap.

When this mill is used on a drilling machine, the shank should be made like style 1; and when used in a lathe, like style 2.

The accompanying table contains data that will aid in designing mills for the various sizes shown.

Attractive Calendars

Among the numerous 1916 calendars received those distributed by the following machinery-building firms are especially attractive: The National-Acme Manufacturing Co., Cleveland, Ohio; The Cleveland Twist Drill Co., Cleveland, Ohio; The American Tool Works Co., Cincinnati, Ohio; Pacific Tool and Supply Co., San Francisco, Calif.; Diamond Saw and Stamping Works, Buffalo, N. Y.; J. N. Lapointe Co., New London, Conn.; White & Bagley Co., Worcester, Mass.; Portage Lake Foundry and Machinery Co., Hancock, Mich.; Noble & Westbrook Manufacturing Co., Hartford, Conn.; The Ashton Valve Co., Boston, Mass.; De La Vergne Machine Co., New York City; Goldschmidt-Thermit Co., New York City; The Standard Tool Co., Cleveland, Ohio.

It is assumed that any available supply of these calendars can be drawn upon by our readers.

Manufacturing Adapters for 18-Lb. High-Explosive Shells

By J. H. Moore

SYNOPSIS—In this article are shown the methods, tools and gages used in manufacturing No. 4 adapters for 18-lb. high-explosive shells. The adapter is made from bar stock and the turning, threading, recessing and final cutting off are performed on turret lathes. Two jigs are then used for the subsequent drilling and tapping operations, and after a thread-sizing operation the adapters are nickel plated on two faces as the final operation.

It is now no matter of surprise in the munition-manufacturing line of business to hear of sudden changes from regular lines of work to that of war material. This article describes the methods employed in a factory whose regular product is cream separators. Although still manufacturing these machines, with extra equipment the factory turns out some of the required munitions. The part handled is the No. 4 adapter, and it might be profitable to describe this part of a high-explosive shell, so that

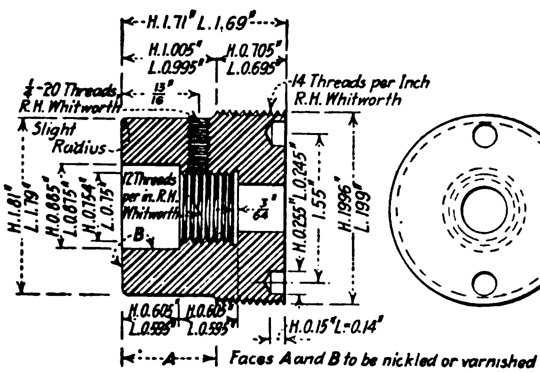


FIG. 1. DETAILS OF NO. 4 ADAPTER

readers will be well acquainted with the piece and its position in the shell.

In Fig. 1 is shown a detail of the adapter. The high-explosive shell is of the same shape at the nose as the English shrapnel, but differs in that in place of the brass socket of the shrapnel there is a steel socket. It is into this socket that the adapter screws. The material used is mild steel, with a minimum breaking test of 25 tons and an elongation of at least 12 per cent. in a 2-in. test piece. The internal thread takes what is known as the gaine, which is an altogether separate piece. The stock for this work is rolled specially, being rolled to the nearest diameter to the required size, so that the least amount of stock is left to turn off.

The lathe work is completed in one operation or setting, the stock being cut off in bars of suitable length to accommodate the machines. As can be readily understood, it is not necessary in this case to have any special chucks, the collets being satisfactory for this work. In Fig. 2 is shown the plan layout of turret positions.

In the first turret position a three-step drill is used, which has a 1¼-in. straight shank, this being a very convenient size to grasp in the holder. The drill has ample allowance for grinding and is made of high-speed steel. Allowance of $^1/_{64}$ in. per diameter is made for reaming.

On the second position this reaming is done with a three-step reamer, a detail of which is shown in Fig. 3.

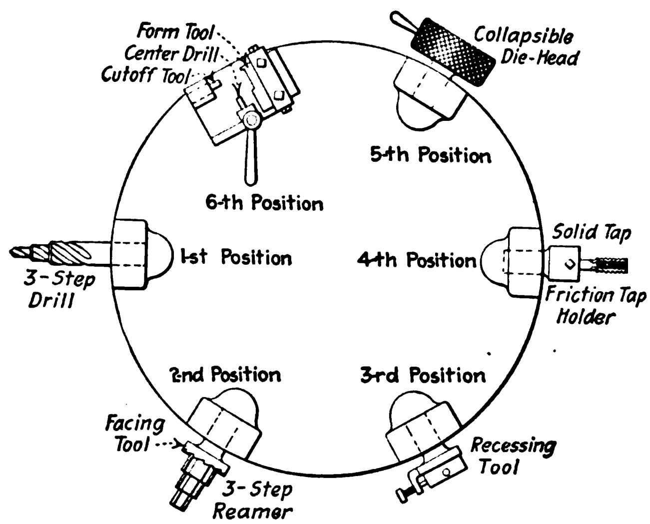


FIG. 2. LAYOUT OF TURRET POSITIONS ON J. & L. LATHES FOR NO. 4 ADAPTERS

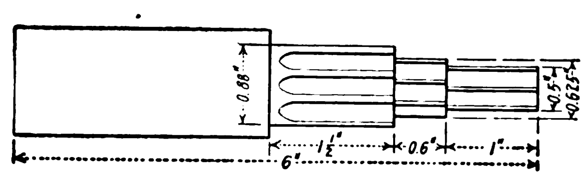


FIG. 3. DRILL AND REAMER FOR NO. 4 ADAPTERS

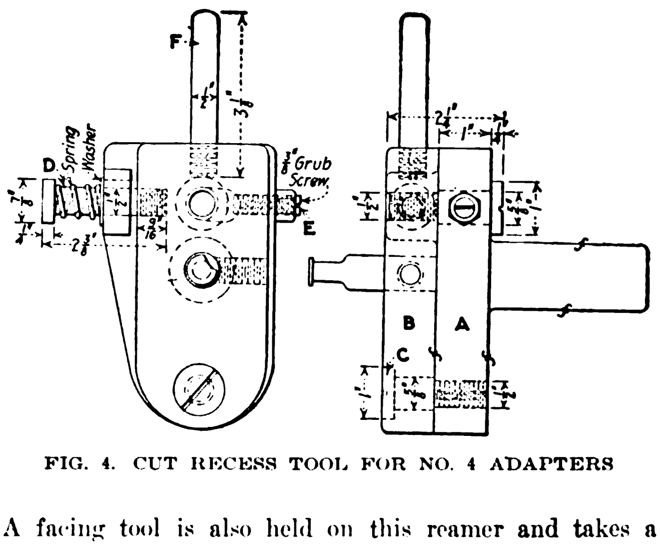


FIG. 4. CUT RECESS TOOL FOR NO. 4 ADAPTERS

A facing tool is also held on this reamer and takes a slight skim off the adapter.

The third position is a rather difficult and awkward one. First, the recess tool must be of such size as to enter a ⅝-in. diameter hole. Another trouble is the width of the recess, $^3/_{64}$ in. To overcome these two features, the tool, Fig. 4, was made.

Referring to the illustration, *A* is the part held in the turret. *B* is the swivel or moving part. A radial slot to accommodate the slide bolt is made in part *A*, the radius being of course the distance from the swivel bolt *C* to the center of the slot. The spring *D* is placed to pull the tool always back to the dead center, as this point is most important; otherwise the tool would get jammed and broken. The recessing tool is plainly seen and needs no description. Briefly the action of the tool is as follows: Adjust the stop screw *B* to the required recess, pull the handle *F* over toward the operator until the stop is reached. When the operator releases the handle, the tool goes to the head center and the carriage can be pulled back immediately. This spring feature makes the tool foolproof.

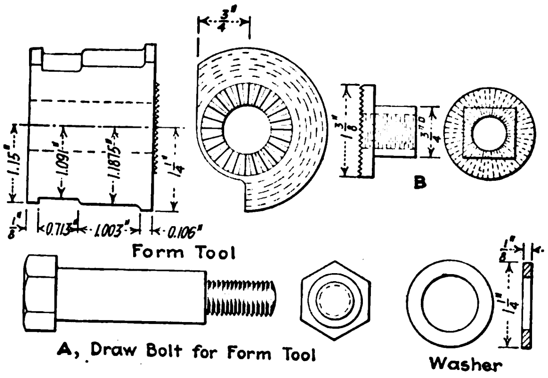


FIG. 5. DETAILS OF FORM TOOL FOR NO. 4 ADAPTERS

The fourth turret position is that of a collapsible die head for external threading. As this work is of common occurrence, no further mention is made.

The fifth turret position is the internal tapping, and here is used a friction tap holder with a solid tap.

The sixth and last position holds three tools—a center drill, which is used first to center the work, the form tool and the cutoff tool. The cutoff tool and the center drill need no comment, but the method of fastening the circular forming tool is rather out of the ordinary. In order to utilize the usual type of stand or holders for the cutoff tool as supplied by the turret-lathe manufacturers, the forming tool was made as shown in Fig. 5. The form tool proper was placed in the regular stand, a hole being drilled in the stand to allow the draw bolt *A* to pass through. A square hole was filed in the opposite side of the stand to accommodate the piece *B*. The draw bolt, pulling on the part *B*, draws it tight against the forming tool, holding it quite securely.

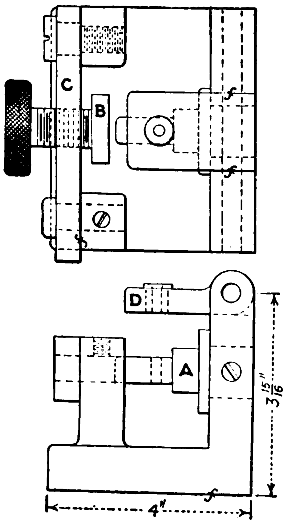


FIG. 6. FIRST DRILL JIG

After leaving the lathe the adapters are taken to a two-spindle drill press and drilled and tapped for the fixing screw in the side. A jig, as shown in Fig. 6, is used. The piece is placed on the pin *A*. The screw *B* in the swing clamp *C* is screwed up against the work. After drilling, the bushing plate *D* is swung out of the way, and the work is tapped on the second spindle.

The second drilling and facing operation is completed on similar drill presses, the work being that of drilling the two holes for the spanner. In the lathe operation, 0.015 in. more than the required length was left on, and in this operation the surplus is taken off by the facing tool shown. The pilot is made concave at the point. The reason for this is to allow no chips to gather between the stop rod of the drill and the face of the jig. The jig used for this operation is shown in Fig. 8. A rather easy and novel method of keeping the jigs in line with the centers of the spindles is used on these presses and is shown in Fig. 9. The jigs slide in the groove *A*, are always on the center and cannot turn around. Therefore they help the operator considerably.

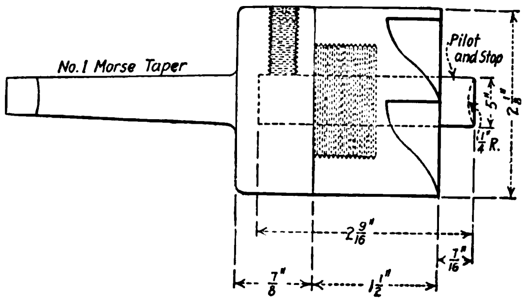


FIG. 7. FACING TOOL USED ON SECOND DRILL AND FACE OPERATIONS FOR ADAPTERS

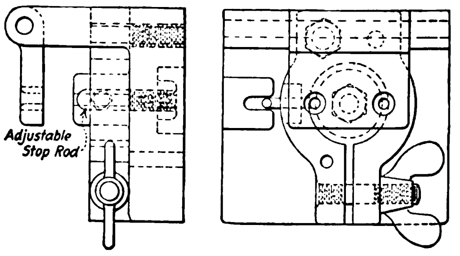


FIG. 8. DRILL JIG FOR TWO HOLES IN TOP OF ADAPTER. THIS JIG IS ALSO USED ON FACING TOP

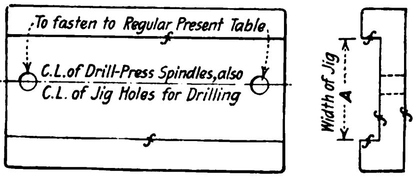


FIG. 9. GUIDE FIXTURE FOR DRILL ADAPTER WORK

The final shop operation is that of sizing the threads with an adjustable solid type of die to assure accuracy, as inspectors are most insistent on this point. A little 14-in. lathe is used for this purpose, and as the work is simple, no comment is necessary.

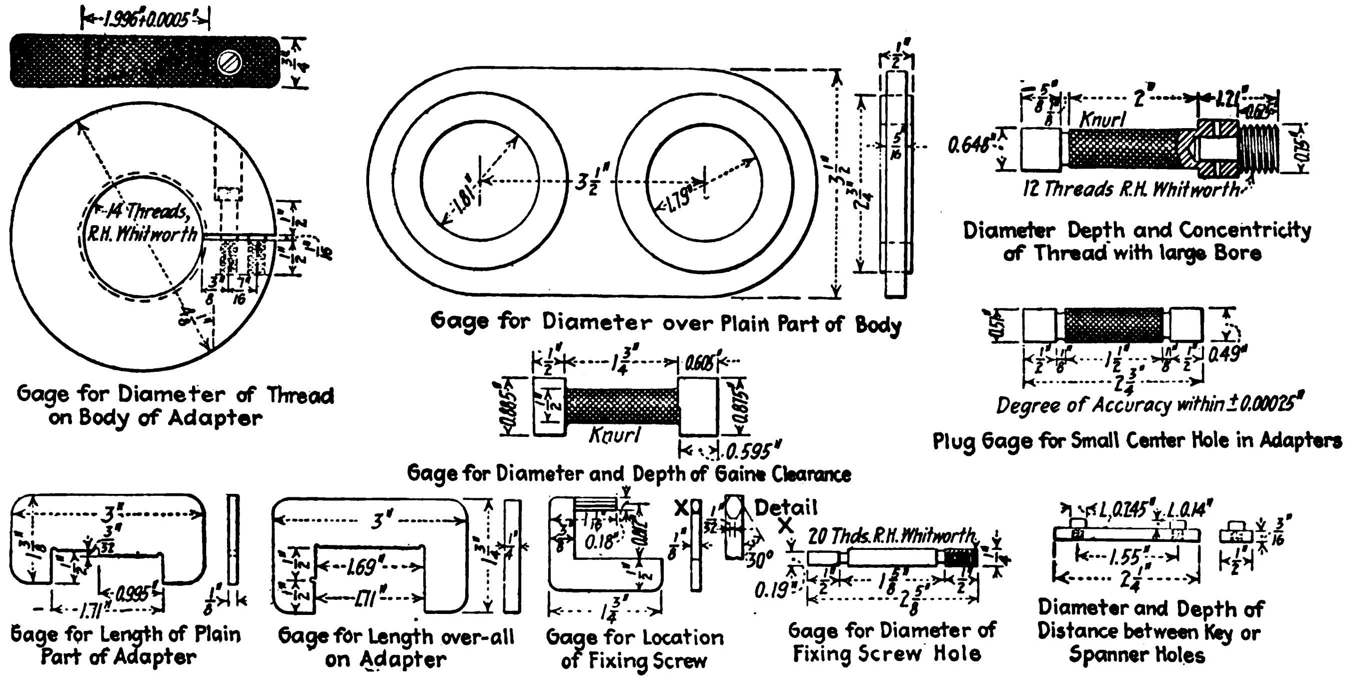


FIG. 10. GAGES USED IN MANUFACTURING HIGH-EXPLOSIVE SHELL ADAPTERS

This completes the adapter with the exception of nickel plating on the faces *A* and *B*. After being plated, the adapters are inspected by the Government inspector and must conform to the various gages shown in Fig. 10.

Souvenirs from the Trenches

By Hi Sibley*

When the irrepressible French soldier is not actually fighting for his country, he is busy making souvenirs—allowing some time for sleep and eating. He utilizes everything available that is significant of the war and turns out some remarkably ingenious specimens.

Probably the most popular bit of his handicraft is the *bague des tranchées,* or trench ring, which he fashions from the aluminum of a certain type of German shell nose picked up in the vicinity. So great is the demand for aluminum for this purpose that one of these fuse tips is rated worth a dozen of the solid brass ones, from a souvenir standpoint. The rings are made up in numberless designs, and some of the workmanship is decidedly artistic, particularly those in which a figure made from the copper compression band of a shell is inlaid in the face of the ring. Some are embellished with the lion cut from a Belgian copper two-centime piece; others have a miniature shell in relief, or a human figure or a coat of arms, and nearly all are engraved with the name and date of some battle, as the Marne or Ypres.

In making these rings the aluminum is fused in a ladle and then poured into a rough mold hewn in a brick. At Nieuport one of the soldiers was using a piece of a plaster statue from a shattered church for this purpose. The ring in the rough is then carved and scraped into shape with the crudest of tools, usually a worn-out file and a pocket knife. During my service with the American ambulance squad in Flanders last summer, I had opportunity to collect a great many of these rings. My stock was as high as twenty at one time; but the French *marins* were so liberal in giving us any ring we admired that I became prodigal with mine, too, with the result that when our squad was unexpectedly removed to a ringless district, I had only five left. They are shown at *A, B, C, D* and *E*.

The one I prize most highly was made to my measure by a soldier-jeweler at Crombeke, Belgium, and bears the symbol of ambulance service, the red cross, in copper, as shown at *A*. The workmanship is exceptionally fine. The others were made near Nieuport, which is right on the firing line. One of our men was fortunate enough to secure a bronze ring made from a Nieuport church bell, but these rings were very rare on account of the difficulty of working the tough metal with hand tools.

Combination pen-and-pencil holders made by soldering the ends of cartridges together were very common at the front. The Frenchman is a true utilitarian, for to get the solder for these souvenirs he melted up meat tins. One in my collection, *F*, was given me by an unfortunate culprit on the eve of his court-martial. I was passing his prison yard when he begged for a cigarette; and as I thrust a handful through the fence bars, he gave me this holder. Another one, *G*, is made up of British and German cartridge shells and a German and a Belgian ball. I got it from artillery Captain Bartholet, formerly wireless operator on *La Savoie,* who was convalescing in a hospital at Zuydcoote, Belgium, with shattered ear drums. Captain Bartholet was exceedingly reticent on the subject of how he became injured, but I learned from other sources that he lost his hearing when his battery had been struck by a German shell. Several of his comrades were killed. The ammunition had not been destroyed, however, and Bartholet returned and made several trips under fire to carry the ammunition to a place of safety. Naturally, I think a great deal of this particular souvenir.

Nearly every soldier we encountered carried a handmade *briquet,* or cigarette lighter, and we were constantly besieged by them for a little *essence,* or gasoline, with which to fill these *briquets.* There was no standard design or pattern, but the majority of them were very neat and

*Chauffeur in American ambulance squad in Flanders, June to September, 1915.

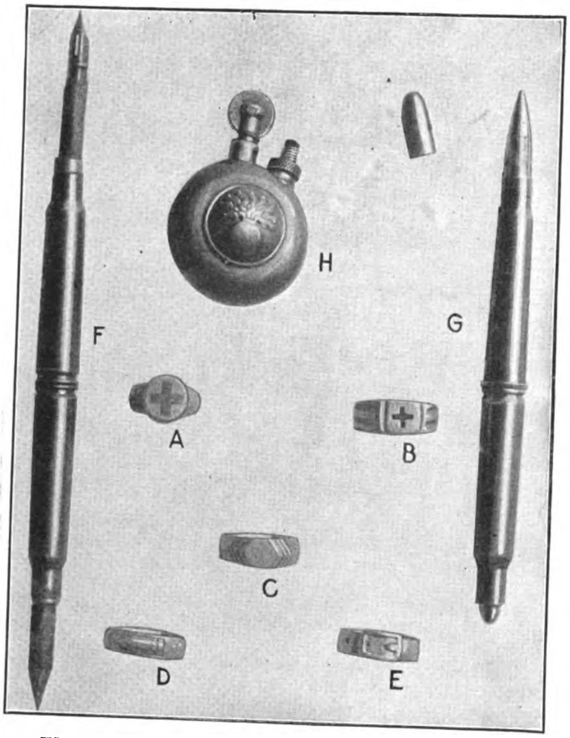
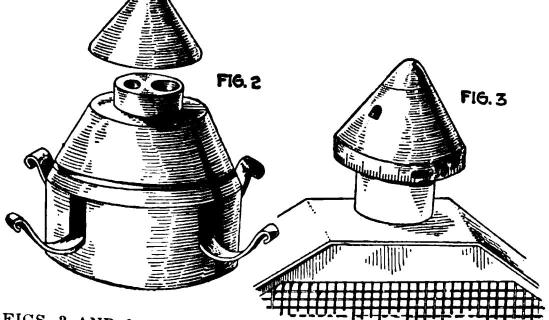


FIG. 1. SOUVENIRS MADE IN TRENCHES NEAR NIEUPORT BY FRENCH SOLDIERS

attractive; a few were really handsome. This particular specimen, *H*, has a body of brass from a shell nose, decorated with French infantry buttons on each side. The flint wheel is procured at any of the numerous tobacco shops that have sprung up all along the front. Kept properly filled with gasoline, they are very reliable. One appreciates them at the front, too, where matches are none too plentiful.

Other forms of trench-made souvenirs were legion—cigarette cases, cocktail shakers, paper weights and some very handsome paper cutters made from the brass *soixante-quinze* shells. I have a unique inkstand and pen-rack made from parts of a shell, as in Fig. 2; and several of the men on our squad used graduated time noses from German shells for radiator caps, Fig. 3.

One asks when the soldier finds time for all these things; but bear in mind that he is not fighting every minute, and besides you can leave it to a Frenchman to find time to exercise his ingenuity. Furthermore, men must have something to take their minds off the horrors which surround them. When nerves are shaken by hours of crashing shell fire and the sight of wounded comrades, work of this kind takes them into new fields of thought and is more of a relief than might be imagined.

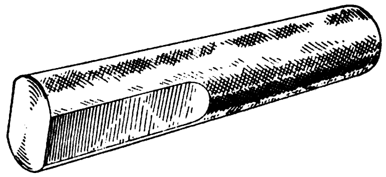


FIGS. 2 AND 3. INKSTAND WITH COVER AND PEN RACK MADE FROM NOSE OF SHELL AND BRASS CHAMBER

A Flat-Sided Brass Lap

By James McIntyre

The illustration shows a makeshift that I ran across recently. Having to lap a 0.750-in. ring gage 3 in. long, I made a brass lap as shown, milling a flat on two sides.



A FLAT-SIDED BRASS LAP

When the lap becomes small, a little peening on the flats with a hammer will make it cut again.

The tendency to bell mouth the hole is not nearly so great with this type of lap.

Alignment Charts for Design of Flat Plates--II*

By Axel K. Pedersen

The first two charts in this section finish the general cases commonly met with in the design of flat plates. The last two charts deal with stayed surfaces. Of these, Chart 8 covers the ideal case and Chart 9 applies to boiler plates and is worked out from the standards laid down in the Boiler Code of the American Society of Mechanical Engineers.

The following conditions must be considered in selecting points on the M_2 scale, Chart 9:

1. When doubling plates are fitted of the same thickness of the plates they cover, and not less in width than two-thirds the pitch of the stays.
2. If the diameter of riveted washers be at least two-thirds the pitch of the stays, and the thickness not less than the plates they cover.
3. When the plates are not exposed to the impact of heat or flame, and the stays are fitted with nuts and washers, the latter being at least three times the diameter of the stay and two-thirds the thickness of the plate they cover.
4. When the plates are not exposed to the impact of heat or flame, and the stays are fitted with nuts only.
5. When the plates are not exposed to the impact of heat or flame, and the stays are screwed into the plates, having the ends riveted over to form substantial heads.
6. When the plates are exposed to the impact of heat or flame, the steam is in contact with the plates, and the stays are fitted with nuts and washers, the latter being at least three times the diameter of the stay and two-thirds the thickness of the plates they cover.
7. When the plates are exposed to the impact of heat or flame, steam is in contact with the plates, and the stays are fitted with nuts only.

*The previous installment of this series appeared on page 373.

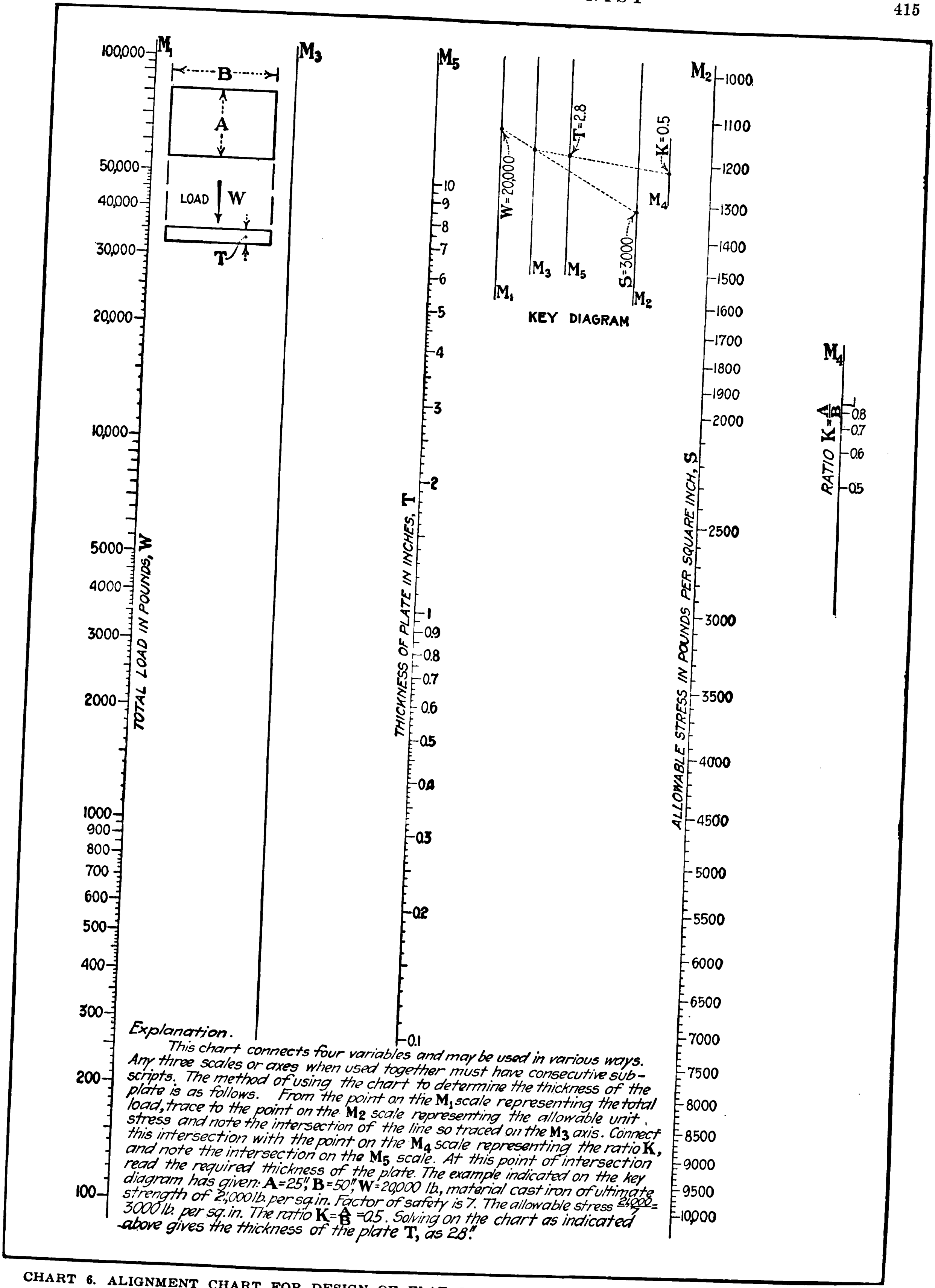
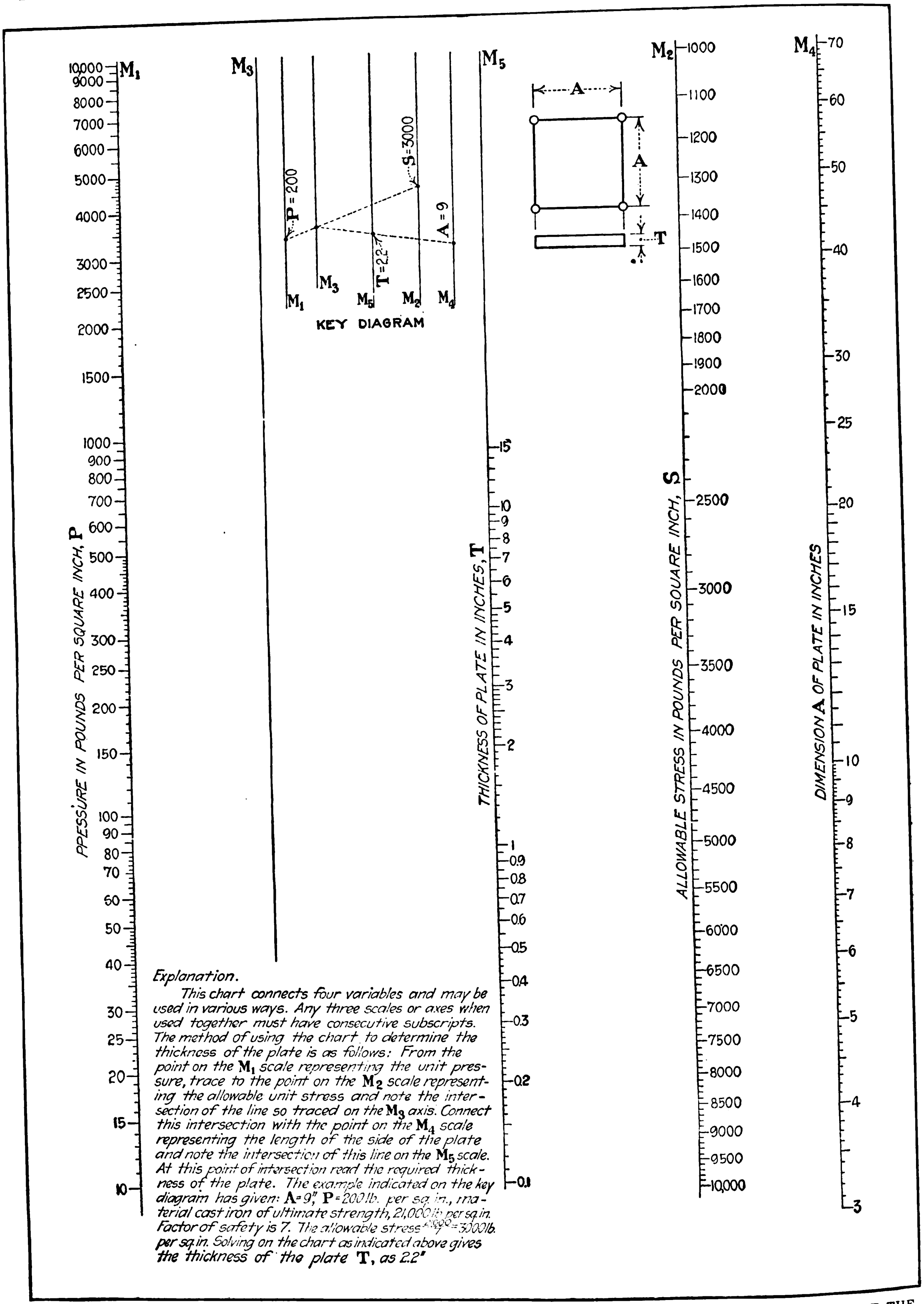


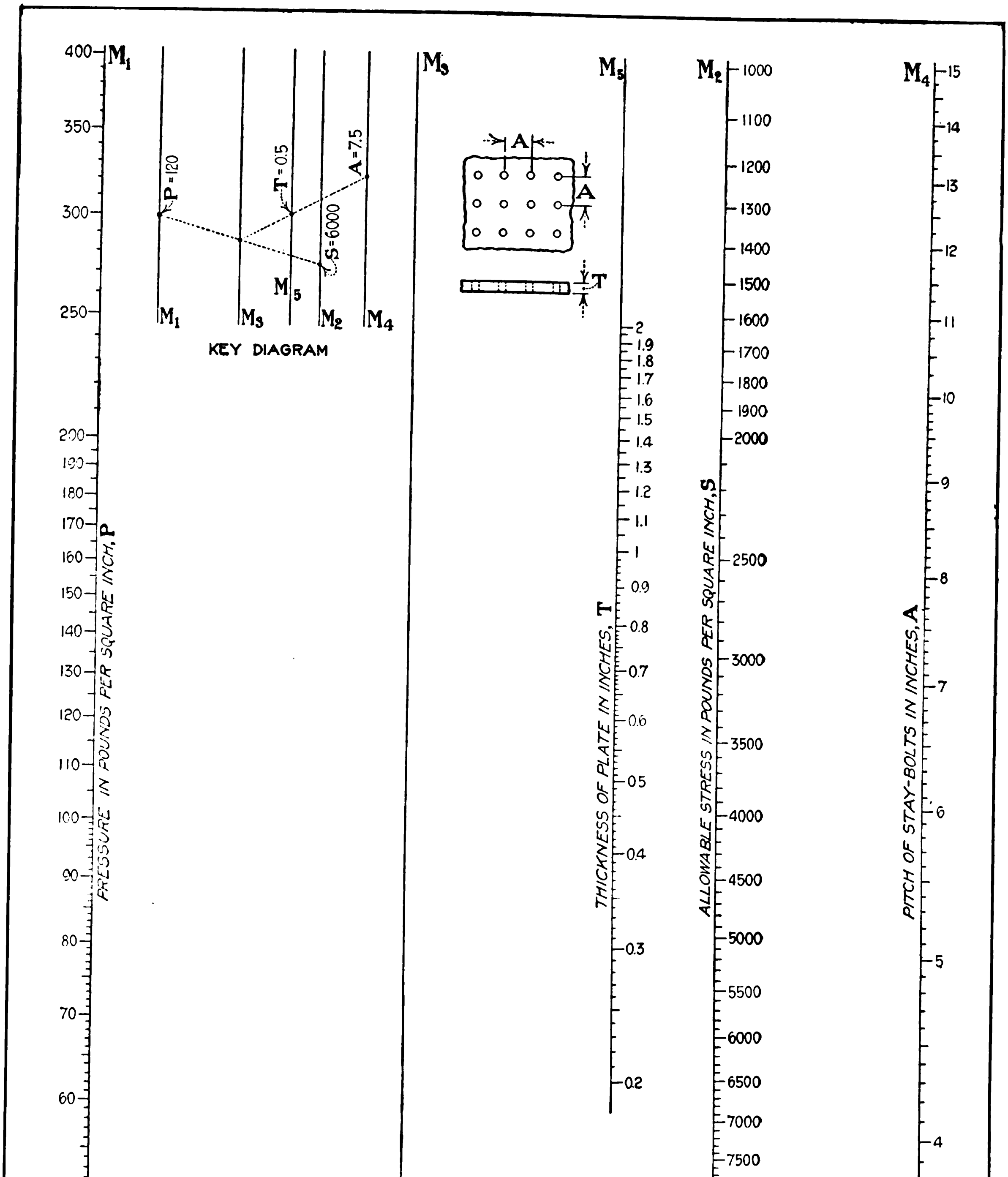
CHART 6. ALIGNMENT CHART FOR DESIGN OF FLAT, RECTANGULAR PLATES SUPPORTED AT EDGES WITH CONCENTRATED LOAD AT CENTER—BY AXEL K. PEDERSEN



Explanation.

This chart connects four variables and may be used in various ways. Any three scales or axes when used together must have consecutive subscripts. The method of using the chart to determine the thickness of the plate is as follows: From the point on the M_1 *scale representing the unit pressure, trace to the point on the* M_2 *scale representing the allowable unit stress and note the intersection of the line so traced on the* M_3 *axis. Connect this intersection with the point on the* M_4 *scale representing the length of the side of the plate and note the intersection of this line on the* M_5 *scale. At this point of intersection read the required thickness of the plate. The example indicated on the key diagram has given:* **A** *= 9",* **P** *= 200 lb. per sq. in., material cast iron of ultimate strength, 21,000 lb. per sq. in. Factor of safety is 7. The allowable stress* $\frac{21000}{7}$ *= 3000 lb. per sq. in. Solving on the chart as indicated above gives the thickness of the plate* **T***, as 2.2"*

CHART 7. ALIGNMENT CHART FOR DESIGN OF SQUARE PLATES UNIFORMLY LOADED AND SUPPORTED AT THE FOUR CORNERS—BY AXEL K. PEDERSEN



This chart connects four variables and may be used in various ways Any three scales used together must have consecutive subscripts The method of using the chart to determine the thickness of the plate is as follows:

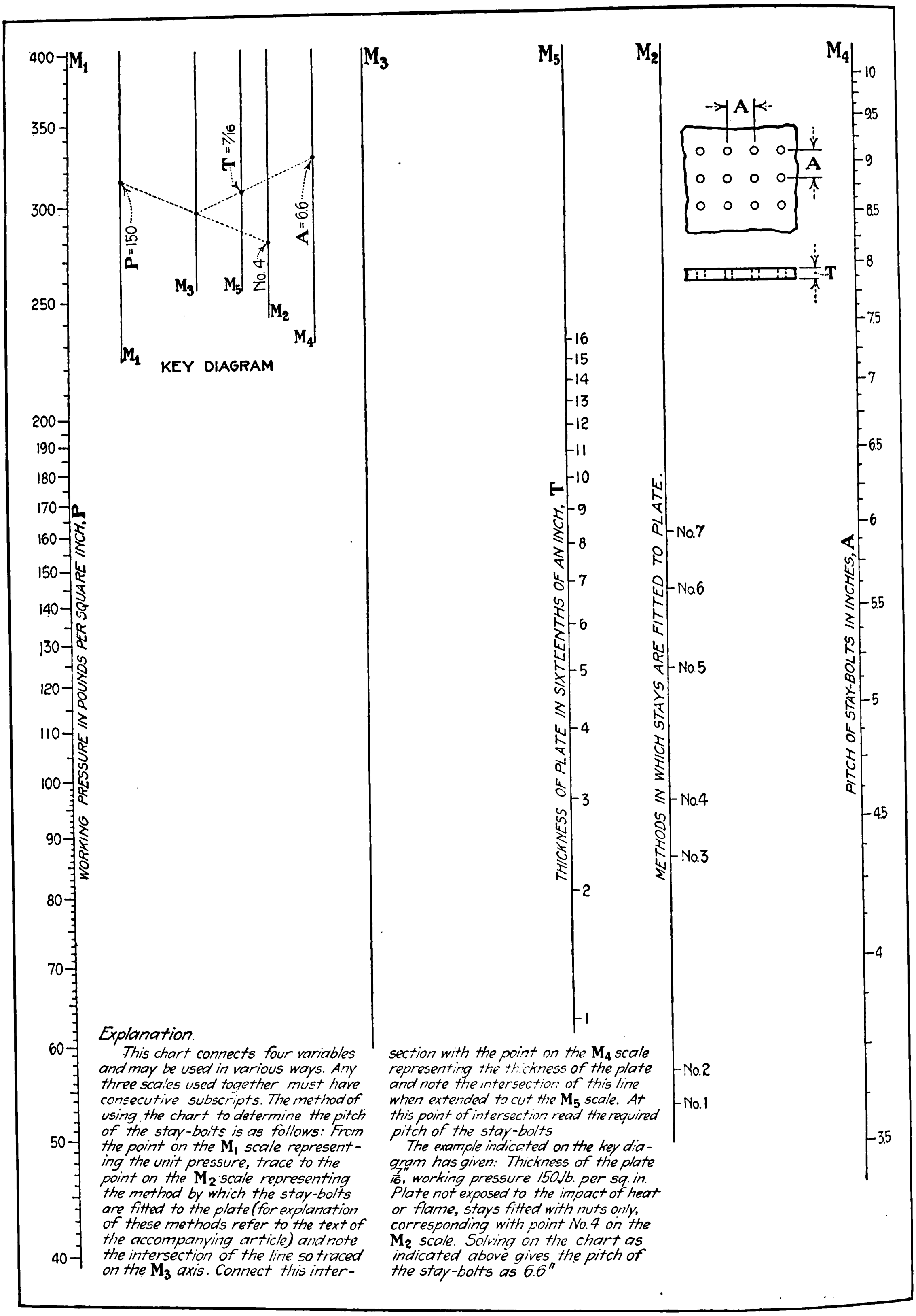
From the point on the M_1 scale representing the unit pressure, trace to the point on the M_2 scale representing the allowable unit stress and note the intersection of the line so traced on the M_3 axis. Connect this intersection with the point on the M_4 scale representing the pitch of the stay-bolts and note the intersection of this line with the M_5 scale At this point of intersection read the required thickness of the plate

The example indicated on the key diagram has given:

Working pressure, 120 lb per sq. in.
Allowable stress, 6000 lb per sq. in.
Pitch of stay-bolts, 7.5"

Solving on the chart as previously indicated gives the thickness of the plate **T** as 0.5"

CHART 8. ALIGNMENT CHART FOR IDEAL CASE IN DESIGN OF UNIFORMLY LOADED FLAT STAYED PLATES—BY AXEL K. PEDERSEN



Explanation.

This chart connects four variables and may be used in various ways. Any three scales used together must have consecutive subscripts. The method of using the chart to determine the pitch of the stay-bolts is as follows: From the point on the M_1 scale representing the unit pressure, trace to the point on the M_2 scale representing the method by which the stay-bolts are fitted to the plate (for explanation of these methods refer to the text of the accompanying article) and note the intersection of the line so traced on the M_3 axis. Connect this intersection with the point on the M_4 scale representing the thickness of the plate and note the intersection of this line when extended to cut the M_5 scale. At this point of intersection read the required pitch of the stay-bolts

The example indicated on the key diagram has given: Thickness of the plate $\frac{7}{16}$", working pressure 150 lb. per sq. in. Plate not exposed to the impact of heat or flame, stays fitted with nuts only, corresponding with point No. 4 on the M_2 scale. Solving on the chart as indicated above gives the pitch of the stay-bolts as 6.6"

CHART 9. ALIGNMENT CHART FOR FLAT STAYED PLATES UNIFORMLY LOADED, PLOTTED ACCORDING TO RECOMMENDATION OF A. S. M. E. BOILER CODE—BY AXEL K. PEDERSEN

Some Recent Developments in Tool-Steel Testing--I

By Edward G. Herbert*

SYNOPSIS—An important series of original tests and the deductions from the results of other experiments on the durability of high-speed steels are given in these articles. They are of particular interest in view of the comparative lack of data on finishing cuts, to which they chiefly appertain.

Since the tool-steel testing machine was first described in the *American Machinist* in Vol. 32, Part I, page 822, it has been the means of carrying out many investigations into the qualities of tool steel. Through the experience thus gained some modifications have been introduced in the design of the machine and the method of testing, though the principle remains unaltered.

A brief description of the machine as now made is essential for a clear understanding of the improved method of testing. The machine, Fig. 1, is essentially a vertical drilling machine, driven through variable-speed friction gearing. The spindle is weighted and carries in place of a drill a standard steel test tube *B* of ¾-in. diameter and ⅝-in. bore, guided at its lower end by a hardened-steel bushing. The sample of steel to be tested

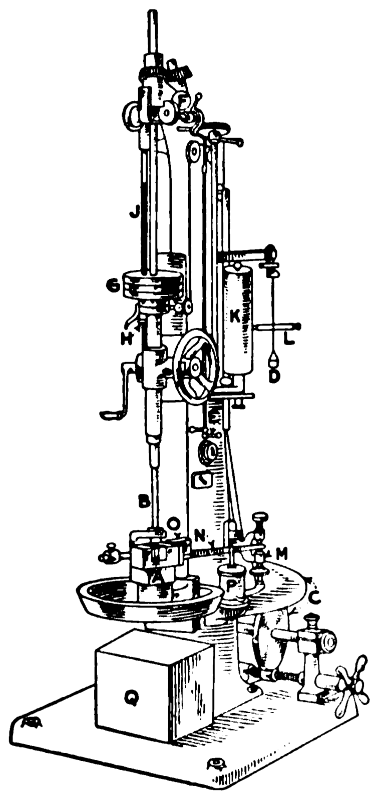


FIG. 1. THE TESTING MACHINE USED

is made into a tool, ground to standard shape and so fixed as to act on the end of the tube and turn it away. The durability of the tool is measured by the length of tube it will turn away before becoming blunted a standard amount. The feed is constant and in all standard tests is 0.0012 in. per revolution.

*Director, Edward G. Herbert, Ltd., Manchester, England.

In the original machine the feed was regulated and kept constant by adjusting the pressure of the tool against the test tube. For this purpose the tool holder or vise was mounted on knife-edges and provided with a steel guard and sliding poise. As the tool became blunt, more pressure was required to keep the feed constant, and it was applied by shifting the poise.

This adjustable feed arrangement has now been replaced by a feed screw *J* carrying a nut *H*, on which the

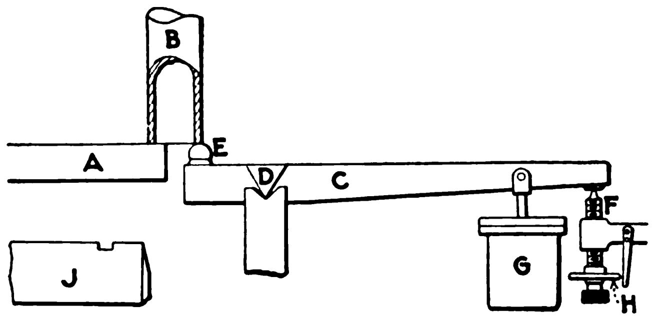


FIG. 2. EFFECT OF TEST ON TOOL

weighted spindle sleeve rests. The spindle and tube therefore receive a constant "permissive" feed. The tool *A* is fixed in a vise, which is no longer mounted on knife-edges, but rigidly attached to the machine.

The increased rigidity of the vise has a considerable effect on the test results. The tools stand up longer at all speeds and stand up at much higher speeds. There was, in fact, with the original machine an artificial limit to the speed at which any tool would keep its edge, this limit being imposed by the vibration that took place at high speeds, say above 120 ft. per min. With the tool rigidly held in a heavy vise this limit no longer exists. Consequently, the tests now show a greater contrast between carbon and high-speed steel, with respect to the maximum speeds at which they can be worked.

With the rigid vise and screw feed the former method of measuring the wear of the tool during the test is no longer applicable. The mechanism now employed for this purpose will be understood from Fig. 2, in which *A* is the tool and *B* the test tube. The beam *C* is mounted on knife-edges *D* and carries at one end a hardened-steel ball *E*, loosely resting in a conical socket so that it is free to revolve about its own center. A micrometer screw *F* is mounted in a bracket on the machine column and bears on the end of the beam opposite the ball; an oil dashpot *G* serves to hold the beam steady. The micrometer is insulated and forms part of an electric-bell circuit, so that the bell rings when the micrometer touches the beam. In making a test the procedure is as follows:

The cut is started, and the beam is allowed to take up its position with the ball pressing lightly upward against the end of the tube, its own weight and that of the dashpot plunger holding the beam in this position. The micrometer is then screwed upward until it just makes contact with the under side of the beam, this adjustment being made very accurately with the aid of the electric bell.

The dial *H* of the micrometer is set to zero and locked in that position. The micrometer screw is now turned so as to lift the end of the beam 0.005 in., which causes the beam to tilt on the knife-edges and lowers the ball from the tube end. The actual movement of the ball is one-fifth that of the micrometer, since the distance from the knife-edge to the ball is one-fifth the distance from the knife-edge to the micrometer. There is therefore a space of 0.001 in. between the tube end and the ball. At the instant when this adjustment is made, the recording mechanism is put into action and the pencil begins to register the length of the tube turned away.

As the test proceeds, the tool gradually becomes blunted. This effect, of course, takes place at the part of the edge that is actually cutting the tube, and the effect is that illustrated at *J*, Fig. 2, a slight notch being worn in the edge. The actual cutting edge is now the bottom of this notch; and the end of the tube, which is necessarily on a level with the cutting edge, is now lower than at the commencement of the test by the depth of the notch. As soon as the notch is 0.001 in. deep, the tube will come in contact with the ball and by pressing on it will tilt the beam slightly, so as to break the electric contact between the beam and the micrometer. When this occurs, the bell ceases ringing and the test is immediately stopped.

The autographic record shows the length of tube which the tool has turned away before being blunted 0.001 in., which is a measure of the durability of the tool at the particular speed under investigation. Tests are made at cutting speeds of 20, 30 and 40 ft. per min. and so on up to the highest speed the tool will stand, and the durabilities are plotted to form the "speed curve" of the steel.

Advantages of Tests Made Without Lubrication

In all the former tests the tool and tube were kept flooded with water; but this practice has been abandoned, and all standard tests are now made dry. Several advantages are gained by this alteration.

The average length of test is less than it would be with water, and this fact counteracts the lengthening of the tests that would otherwise result from the increased rigidity of the tool. The temperature of the cutting edge is of course much higher without water, and the tests can therefore be completed at lower speeds.

The coloration of the chips that takes place when cutting dry is an indication of the cutting temperature and serves to connect particular points on the speed curve with corresponding conditions of workshop practice. For instance, at a speed of 60 ft. per min. the chips produced by the testing machine are blue; at lower speeds they are yellow or white. It may be inferred that the cutting temperature at 60 ft. is similar to that of a lathe tool when cutting under conditions (speed, depth of cut and traverse) just sufficiently severe to produce blue chips. A tool steel that gives a good test result at 60 ft. on the testing machine is one that will stand up well under blue-chip conditions on the lathe. Another steel may not do well under test at 60 ft., but may prove durable at 40 ft.—the highest testing-machine speed that produces no coloration in the chips—or at 130 ft., which gives red-hot chips. In either case the steel may be expected to do well in the workshop under corresponding conditions—that is to say, under conditions which heat the cutting edge to the same temperature. These corresponding conditions include not only the speed but the shape of the tool, the hardness of the work, the dimensions of the work, the depth of cut and the traverse. The cutting speed may be either higher or lower than the corresponding testing-machine speed.

Curves Showing Chip Conditions at Various Speeds

Fig. 3 is a typical speed curve from high-speed steel, showing the condition of the chips produced at various speeds. It will be seen to include the whole range of the cutting temperatures that are found in ordinary workshop practice; indeed, the testing-machine conditions go beyond the conditions of the workshop in both directions. At 150 ft. the tool, the chip and the work are all red hot. Such a state of things is not found in normal workshop practice, though speeds much higher than 150 ft. per min. are commonly used, with much heavier cuts.

There are several reasons for the generation of such a high cutting temperature with a small cut at a moderate speed. The test tube is light in section and cannot conduct away the heat rapidly like a solid bar or heavy mass of metal; the tube is made of very tough steel

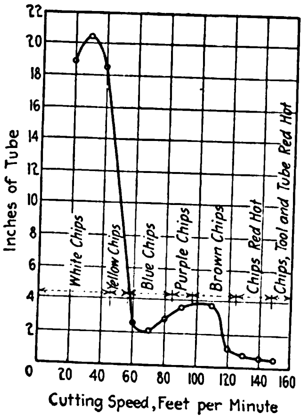


FIG. 3. CHIP COLORS ON THE TESTING MACHINE

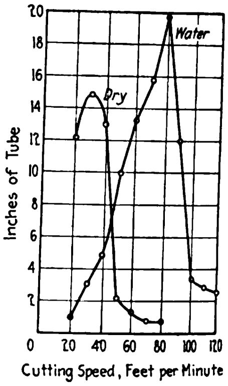


FIG. 4. CUTTING DRY AND WITH WATER

in a semihard condition, and the tool is ground to an angle that is inefficient for cutting, being equivalent to a lathe tool set opposite the work center, with no top or side rake. Such a tool necessarily generates a large amount of heat. This inefficient form of tool was adopted partly because of the ease with which it can be reproduced and partly because its inefficiency is an advantage for the purpose of the test. With a keen cutting tool a much longer range of observation extending to high cutting speed would be required to exhaust the cutting possibilities of the steel. The tests would be longer and more expensive, but would give no more information. The function of the testing machine is to measure durability through the widest possible range of cutting temperatures with a minimum expenditure of time and material, and this end is attained by using a tool shape that generates a high temperature without using excessive speeds.

At the other end of the scale—the low temperature—we have a tool taking a chip 0.0012 in. deep and $\frac{1}{16}$ in. wide at 20 ft. per min. The temperature under such conditions is lower than would be found in ordinary workshop operations, and it can of course be brought still

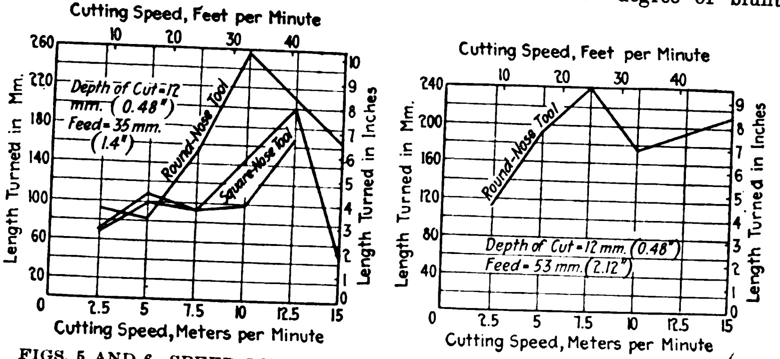
lower by turning on the water. The effect of water cooling at such a low speed as 20 ft. is always to lower the durability of the tool. Thus a comparison of the curves in Fig. 4, made from the same steel cutting with and without water respectively, shows that at speeds from 20 to 45 ft. the dry cutting tool was the more durable.

Another notable fact is that in each case the durability is less at 20 ft. than at somewhat higher speeds. These two effects, which are contrary to the general experience of the workshop, are not exceptional, but are characteristics invariably found in the speed curves produced by the testing machine. They have been shown in a previous article to be manifestations of some physical fact; namely, that a rise in temperature (between certain limits) increases the hardness and toughness of tool steel and therefore increases its durability.

The manner in which the rise in temperature is brought about is immaterial. Whether by application of artificial heat, by increasing the cutting speed or by turning off the water and cutting dry, the result is the same—the tool lasts longer.

A Peculiar Phenomenon and Occurrence

This peculiar phenomenon, first established by the tool-steel testing machine, takes place only between certain temperatures, which are not the same for all steels, but generally lie between atmospheric temperature and 200 deg. C. In the majority of workshop operations the temperature of the cutting edge is considerably higher than 200 deg. C., even when a coolant is used, and the phenomenon does not occur.



FIGS. 5 AND 6. SPEED-DURABILITY CURVES DEVELOPED FROM LATHE TESTS MADE BY PROFESSOR POLIAKOFF

Such a low cutting temperature can only occur when a very light cut is taken at a low speed. Many isolated cases have been noticed, when this somewhat unusual combination of conditions was present and the phenomenon duly made its appearance; but its occurrence has not apparently attracted much attention, and it has entirely escaped the notice of the best-known investigators of cutting phenomena, who have somewhat unaccountably confined their attention to what may be classed as roughing cuts.

The durability of tools in finishing cuts is in some respects more important, because such cuts are usually made with a fine feed and therefore take a long time and because it is essential in finishing work that the tool should retain its sharp edge, so as to leave a smooth surface. One can only surmise that experimenters have been deterred from entering this field of investigation by certain difficulties connected with the carrying out of the tests. Finishing tools are not generally run to the breakdown point, but only to the point at which they become too blunt to leave a fine finish. Therefore, it is only possible to obtain a measure of their durability by adopting some means for estimating their bluntness, and this must be done without stopping the cut.

The Experiments of Professor Poliakoff

Finishing-operation cuts have been made the subject of recent experiments by two skilled investigators. Professor Poliakoff, of the University of Moscow, whose work in connection with the testing of twist drills is well known, has carried out an important series of lathe tests with finishing cuts. His purpose was to find how the durability of the finishing tool and the character of the finished surface are affected by variations in the depth of cut and in the cutting speed. His work has been published in the Russian language only. Perhaps he may be persuaded to make it available to readers of English, but in the meantime he has kindly placed at my disposal a number of highly interesting microphotographs of turned surfaces and some speed-durability curves made with lathe finishing tools.

The tests were made by turning a steel bar in the lathe and measuring the area of turned surface that could be produced before the tool arrived at a standard degree of bluntness. In measuring the bluntness of the tool advantage was taken of the well-known fact that a tool "loses its cut" as it becomes blunt. If a tool is set to turn parallel when sharp, the effect of blunting is to make the work taper, the increase in diameter of the bar at any point being double the amount that has been worn off the tool nose. An indicator was fixed to the slide rest immediately behind the tool and was caused to bear on the turned surface. So long as the tool remained sharp, the indicator needle was stationary; but any blunting of the tool was shown by a movement of the needle. In this way the bluntness of the tool could be measured continuously, and the test was stopped as soon as the standard bluntness had been produced.

Figs. 5 and 6 are speed-durability curves produced by this method. It will be noticed that in every case the durability of the tool increased as the speed was increased, and after having attained a maximum at a certain speed, the durability declined. The curves are in conformity with those produced on the testing machine, and they establish the fact that the curious phenomenon referred to is not in any way peculiar to the testing machine, but must be taken into account in all machining operations that involve the one essential condition—a very low cutting temperature.

(To be continued)

Great Economic Waste resulting more or less directly from unscientific employment methods was made the subject of an address presented by Dr. Ernest F. Nichols, president of Dartmouth College, before the fourth annual meeting of the Chamber of Commerce of the United States. Dr. Nichols suggested the appointment of a committee by the national chamber to deal with the subject of employment managers.

The Only Shop in Argentina Making Its Own Steel

SPECIAL CORRESPONDENCE

The illustrations are from the works of La Cantabrica, Buenos Aires, Argentina, which has the distinction of being the only plant in South America that produces its own steel for making nuts, bolts and other similar products. Reverberatory furnaces are used, and Fig. 1 shows a section of the rolling mill, with some of the heated rods passing through the rolls.

Fig. 2 gives a general idea of the shop construction, showing the monitor roof with ample skylights, the steel-channel construction of the columns, crossbeams and braces and the way in which countershafts are supported. The long braces of channel section add materially to the strength of the structure and the stiffness of the roof. The monitors give an even distribution of light and assist ventilation.

A section of the bolt department is shown in Fig. 3, some of the vertical headers being shown in the background at the right. The lathe at the left, with its gap bed, proclaims its English origin, and the two columns show very clearly how the roof is supported.

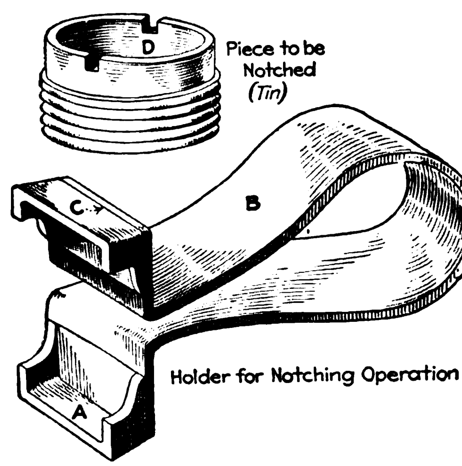
Fig. 4 shows the part of the shop where general work is performed, the usual arrangement of lathes, benches and vises being followed here. These views were taken by the *American Machinist* representative, Duncan N. Hood, through the courtesy of the manager, José De Soto.

Safety Holder for Press Work

BY J. H. MOORE

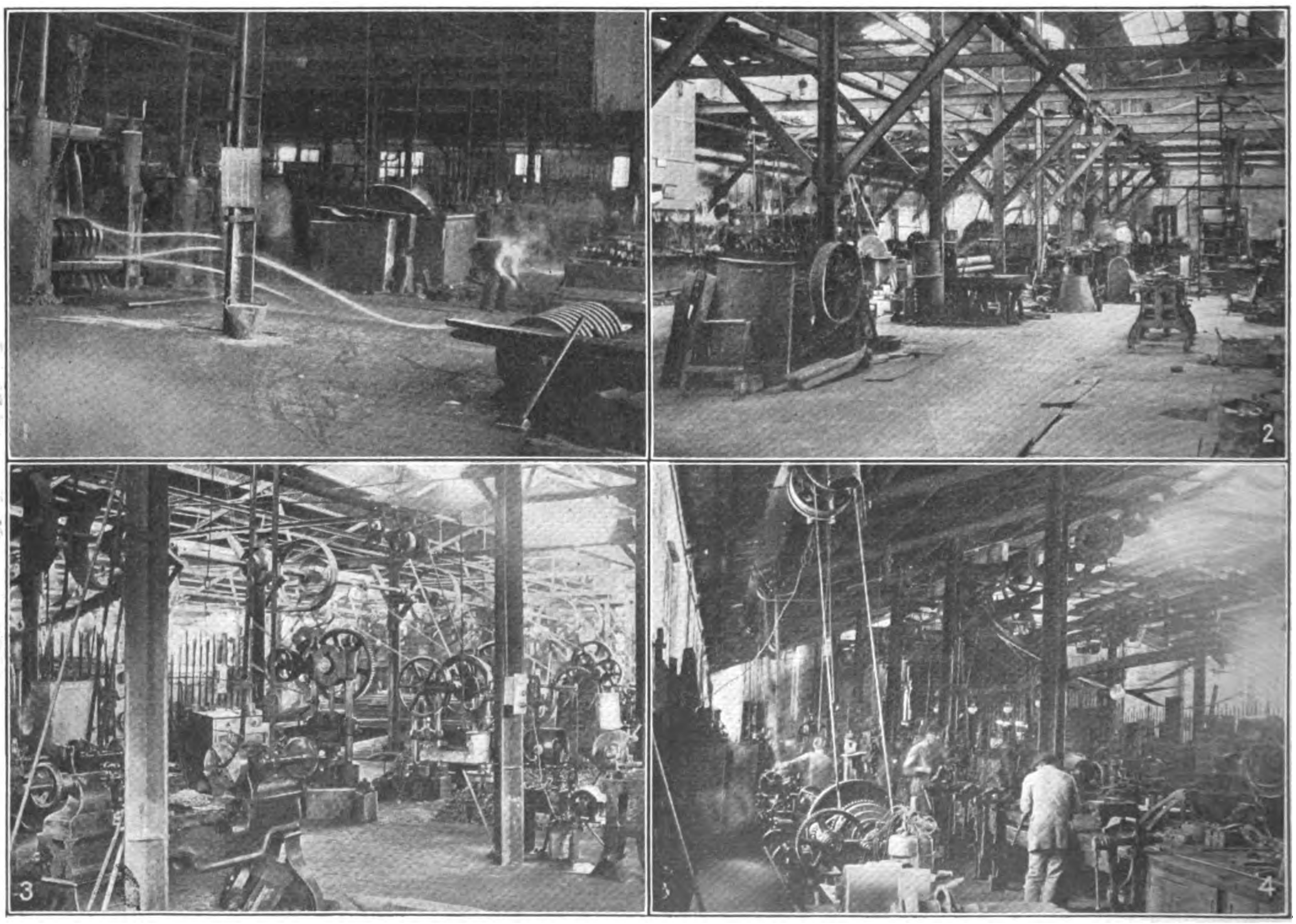
The spring safety holder shown has saved not only time, but doubtless numerous fingers, which are much more valuable. Its simplicity is apparent.

The space *A* is made of a size to suit the work, the particular piece in this case being shown at *D*. The



SAFETY HOLDER FOR PRESS WORK

spring *B* shows all the action that is required to hold the piece in position to be notched. The pieces *A* are soldered at the joint *C*. As these notching punches come in from the side, it was an extremely dangerous operation before this holder was designed and put in general use.



FIGS. 1 TO 4. AN UNUSUAL SOUTH AMERICAN SHOP

Fig. 1—In the rolling mills. Fig. 2—To show shop construction. Fig. 3—The bolt-heading department. Fig. 4—The general machine shop

Standardizing Shop Drawings of Machine Details

By A. C. Spencer*

SYNOPSIS—This plan is intended to relieve the drafting room of the large amount of duplication which is often considered necessary in the details of manufactured articles. It substitutes a form, printed on bond paper for easy blueprinting, and enables stock orders and instruction cards to be made by filling in a few blanks or crossing out unnecessary directions. A careful study of some of these forms should be helpful to many drafting-room heads.

The illustrations present a number of interesting examples of a plan for reducing labor in the drawing room by making it unnecessary to draw many of the details used in standard machines, and for making possible the issuing of blueprint instruction sheets at a very low cost. A little study of these sheets will show their almost universal application, as well as the surprising amount of detailed instructions which can be given with all the necessary variations for different pieces. These variations are easily secured by crossing out unnecessary operations and putting in special figures wherever necessary, such as the length of time to be kept hot and the drawing temperature for pack hardening.

The actual size of the sheets shown is 6x8 in., although a larger size, 8x12 in., has also been used for some purposes. The sheets are printed on a bond paper in a printing press, and blueprints are easily made.

It will be noticed that the necessary stock is shown at the top of each sheet, as well as the list number of the sheet in the upper right-hand corner. An outline of the piece, not drawn to scale, gives all necessary dimensions, and below this are instructions covering the type of machines on which the work is to be done, all necessary directions as to spindle speeds and the necessary gearing, as well as the standard time per piece.

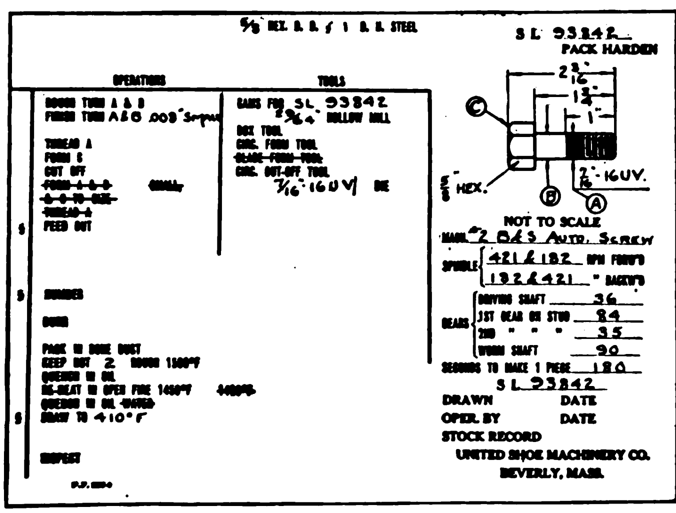


FIG. 1. SHEET FOR ⅝-IN. CAPSCREW

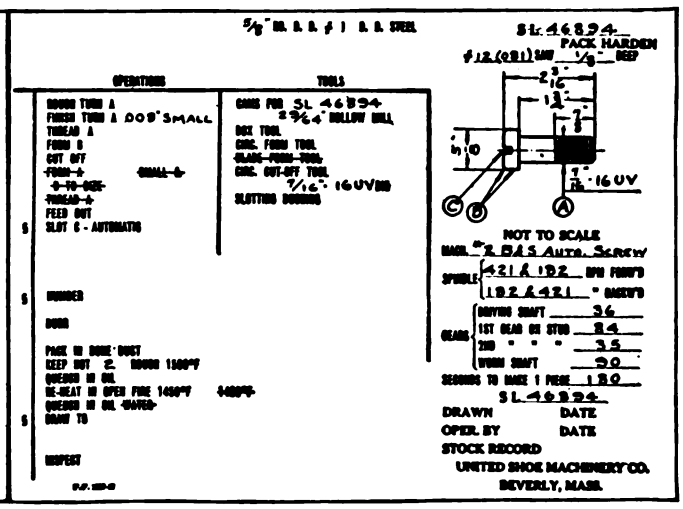


FIG. 2. SHEET FOR ⅝-IN. SCREW

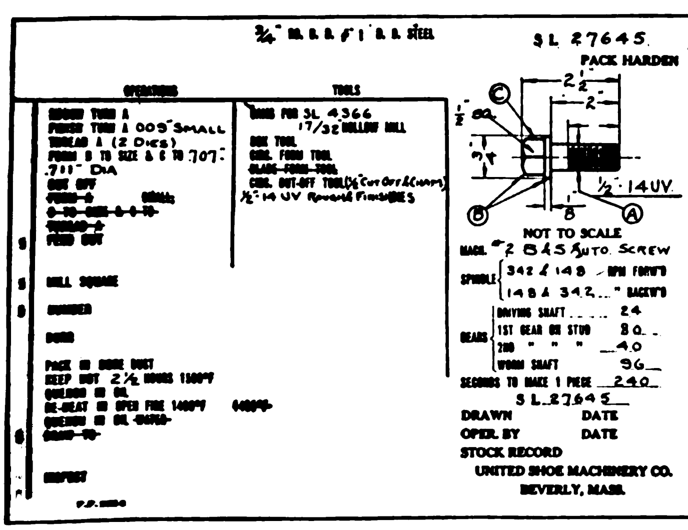


FIG. 3. SHEET FOR COLLARED CAPSCREW

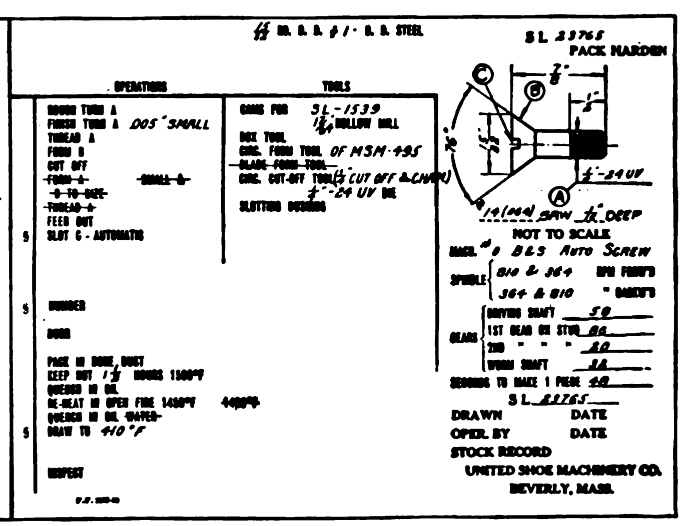


FIG. 4. SHEET FOR CONE-HEAD SCREW

*Chief draftsman, United Shoe Machinery Co.

The left-hand column contains all the necessary operations and any special directions. Unnecessary operations are crossed out, and below this there are directions for the proper pack hardening in each case. The central column shows the necessary tools to be used.

Although only 16 examples are shown these printed sheets now cover about 30 subjects and will be added to from time to time. They include, in addition to the parts shown, cam rolls, shouldered cap screws, special screws and work of this nature. It can easily be varied or enlarged to suit the individual of different shops.

This method, as will be seen, gives a very uniform set of drawings. As the draftsman is only required to add a few dimensions and perhaps cross out a few unnecessary

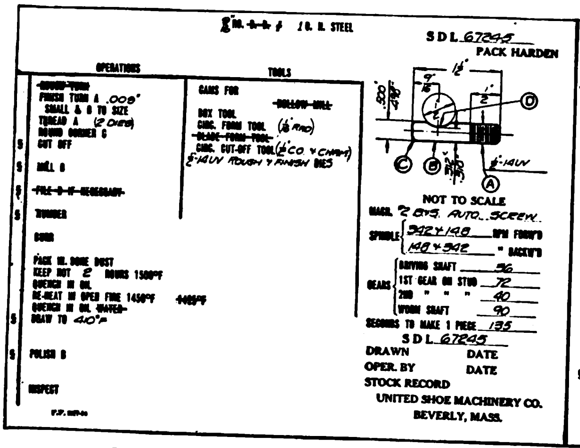


FIG. 5. SHEET FOR SPECIAL STUD

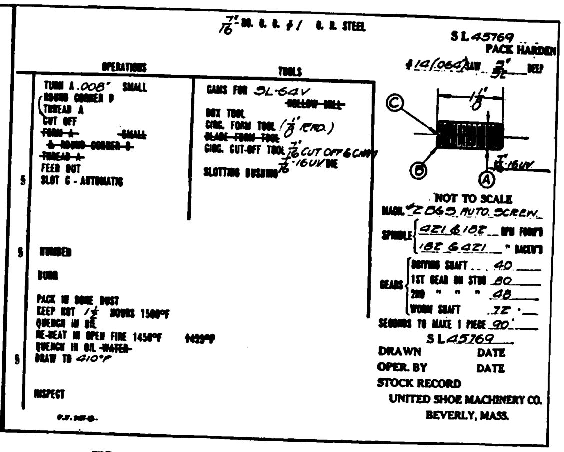


FIG. 6. SHEET FOR HEADLESS SCREW

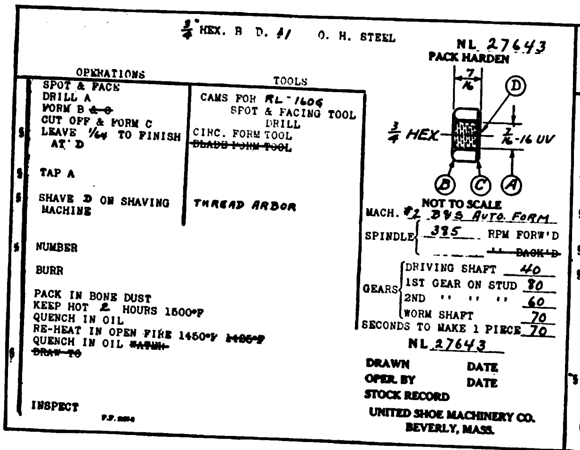


FIG. 7. SHEET FOR ¾-IN. HEX NUT

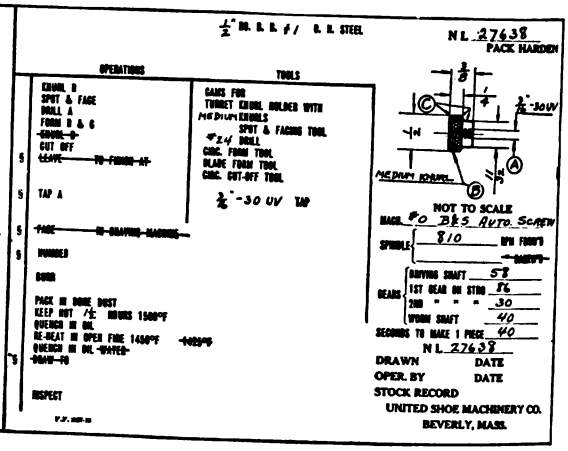


FIG. 8. SHEET FOR ½-IN. KNURLED NUT

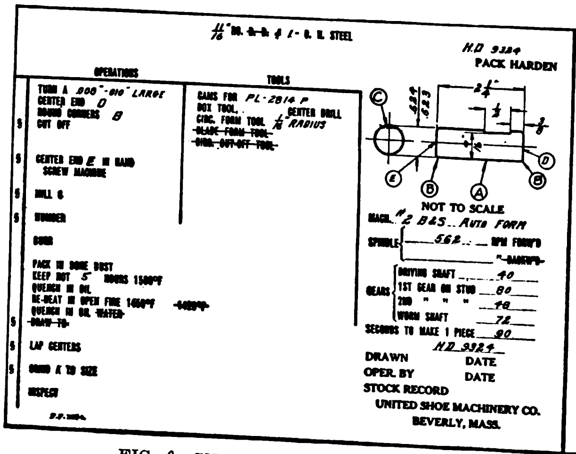


FIG. 9. SHEET FOR SPECIAL PIN

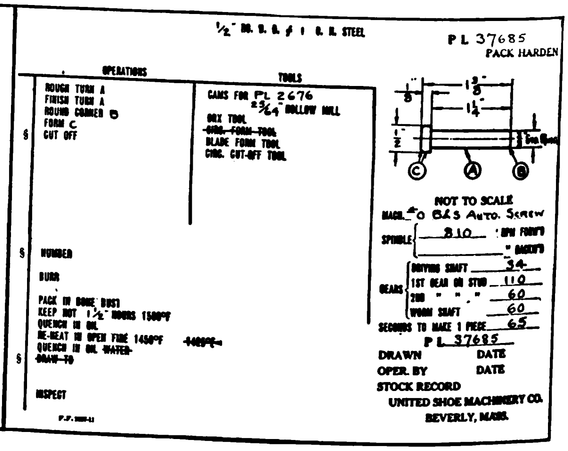


FIG. 10. SHEET FOR HEADED PIN

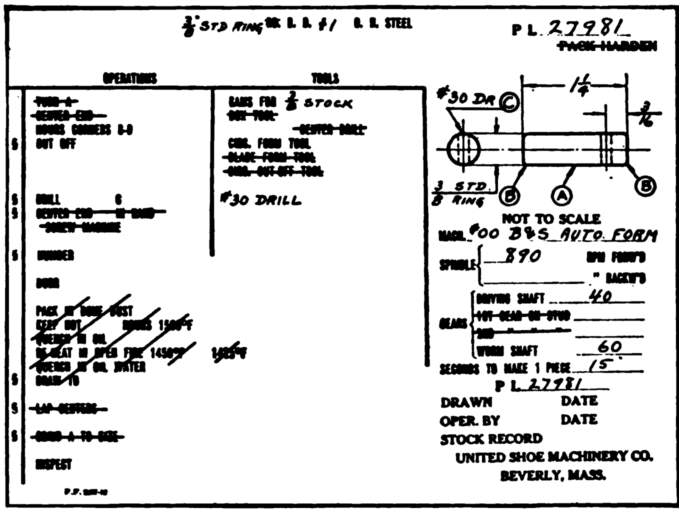


FIG. 11. SHEET FOR ⅜-IN. PIN

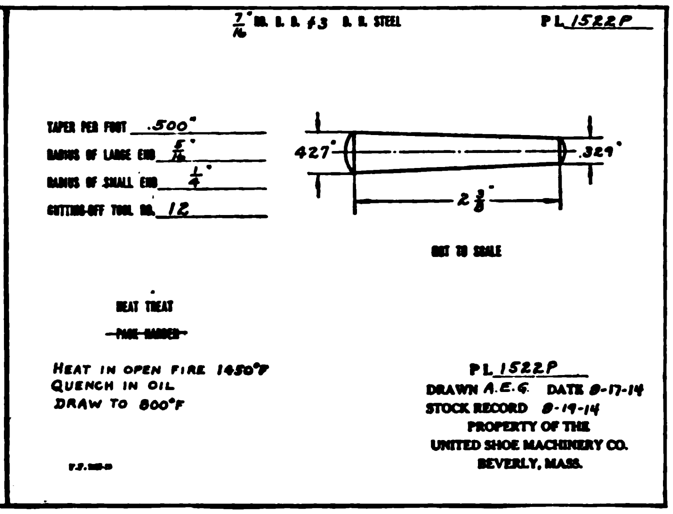


FIG. 12. SHEET FOR TAPER PIN

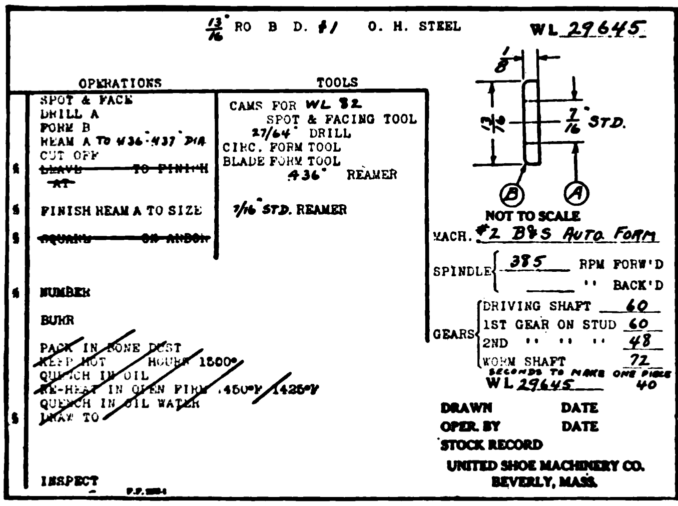


FIG. 13. SHEET FOR THIN COLLAR

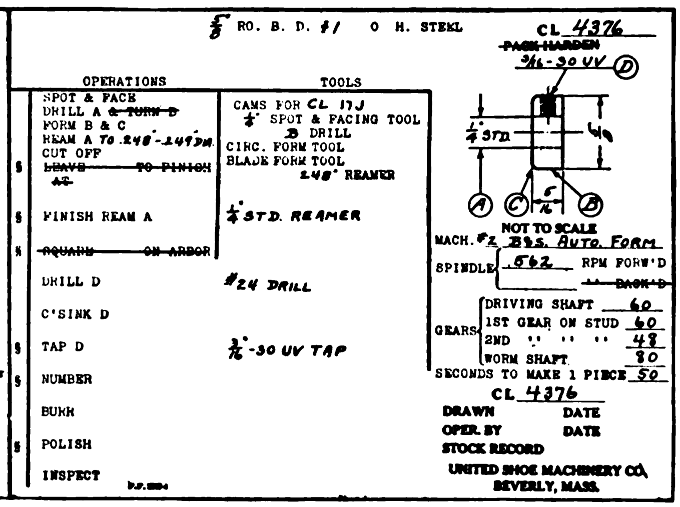


FIG. 14. SHEET FOR COLLAR WITH SETSCREW

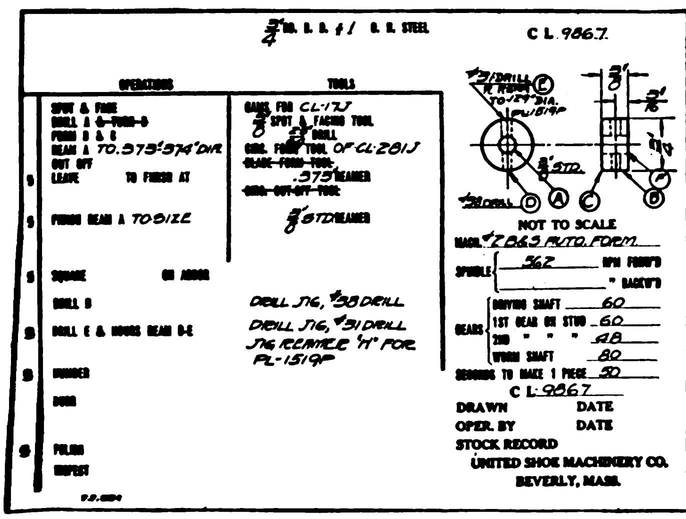


FIG. 15. SHEET FOR ¾-IN. COLLAR

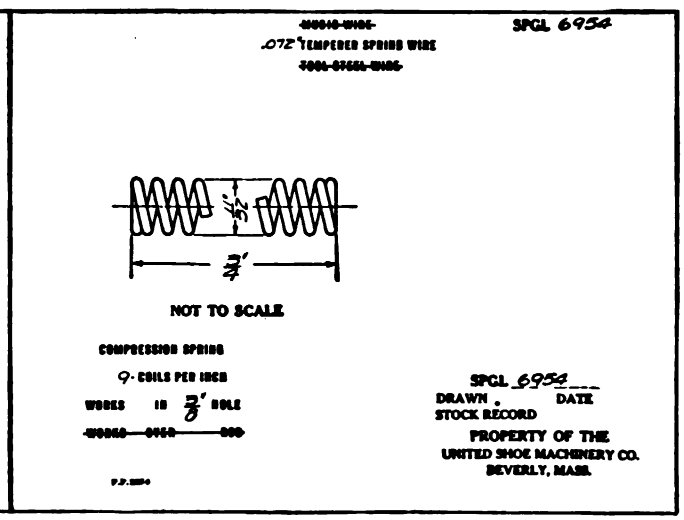


FIG. 16. SHEET FOR HELICAL SPRING

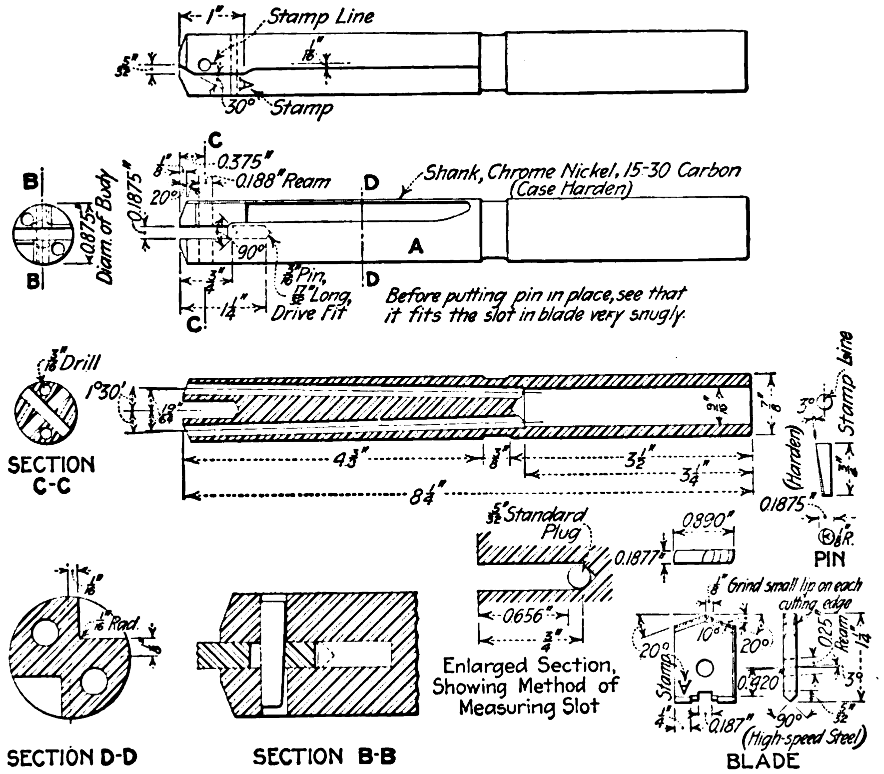
instructions, it effects a large saving of time. It also gives uniform printed lettering in each case, which avoids all difficulty as to instructions not always being perfectly legible. The instructions which are added can be done on the typewriter if preferred, as the sheets are small enough to be handled easily in that way.

This system was designed by the writer some time ago and has been put into practice in the drafting rooms of the United Shoe Machinery Co., Beverly, Mass., where it is proving highly successful in every way. This system can be modified to suit almost any shop conditions where the work is of sufficient volume to warrant printing the blanks.

An Inexpensive Inserted-Blade Oil-Feed Drill

By B. W. Raymond

With the price of high-speed steel soaring to nearly $3 per lb., it becomes necessary to take special precautions to save the high-speed steel one has on hand. The drill shown herewith was designed with this purpose in view. The body *A* is of cheap chrome-nickel 15-30 carbon steel; the blade is of high-speed steel. As it is very small, it is not expensive. The rest is self-explanatory.

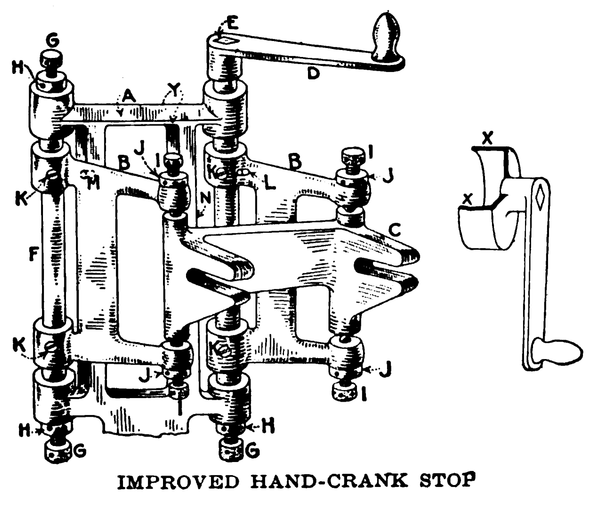


AN INEXPENSIVE INSERTED-BLADE OIL-FEED DRILL

Improved Hand-Crank Stop for a Small Machine

By George G. Little

The illustration shows the upper half of a small machine used for cutting very thin sections of specimens for microscopic work. Rigidity and free action are essential.



IMPROVED HAND-CRANK STOP

A knife, not shown, is held in the jaws of the casting *C* by two screws, also not shown. The casting *C* is moved from right to left by the swing arms *B* and works on the pivot screws *I*, which are locked by the collars *J*. The arms *B* are controlled by the shaft *E*, the upper end of which is squared to receive a hand crank *D*. By pulling the hand crank from right to left the arms *B* will be swung around until the stop pin *L* comes in contact with the corner of the frame *A* at *N*. The left-to-right movement brings the pin *M* in contact with the other side of the frame *A*, thus making two limit stops.

The headless screws *K* secure the arms *B* to their shafts *E* and *F*. These screws are large enough to stand all the strain of the work of moving the knife back and forth, but the mechanical principle of applying the limit stops is all wrong. The pull on the hand crank causes the shaft *E* to move a part of one revolution, causing the arm *B* to swing around until stopped by the pin *L* striking against the frame *A*, thus throwing all the strain on the points of the screws *K* and working them loose.

The limit stop should be applied in such a manner that any other pressure on the hand crank will not cause any part of the machine to become distorted or loosened. The small detail showing the hand crank remodeled gives a better method of stopping the arms—by the edges *X* coming in contact with the frame at *Y*. This principle is one that is easily applied, as well as one that is frequently overlooked in designing machines.

Spontaneous Explosions

Every little while an explosion occurs in a subway, sewer or trench or in an electric-wire tunnel or some other subterranean conduit or passageway under circumstances such that it is exceedingly difficult to determine the cause of the accident satisfactorily. Such explosions have often been attributed to sewer gas, which contains a considerable proportion of methane and hydrogen. These gases are exceedingly combustible and quite capable of exploding with extreme violence when mixed with air in the right proportion and fired with a spark or a flame. This much is quite generally admitted; but in many cases the difficulty is to account for the ignition of the mixture, when it appears to be impossible to ascribe it to the action of any recognizable external agent, such as electricity or flame.

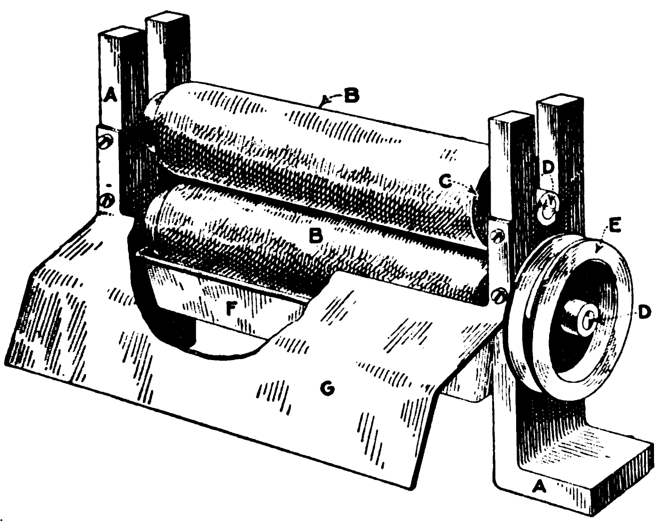
It is well known that, during the decomposition of the organic matter in sewage, microscopic plants of a certain kind grow in the mass and act upon it in such a way as to cause about two-thirds of it to liquefy, while the remaining third remains in the solid state. When the conditions are favorable, phosphine gas is occasionally generated in the course of the bacterial action; and this gas, when impure, has the peculiar and unusual property of taking fire spontaneously upon coming in contact with the air.—"The Travelers Standard."

Letters from Practical Men

Device for Oiling Stock in a Punch-Press Room

This device can be made to requirements. For oiling stock, it is both quicker and cleaner than a brush.

Two pieces of flat cold-rolled steel *A* are bent to the desired height. The rollers *B* are made of wood and covered with felt *C*. The shafts *D* are of iron pipe, one being longer than the other so as to carry the driving



DEVICE FOR OILING STOCK IN A PUNCH PRESS

pulley *E*. The oil pan *F* is carried on two side supports and two adjusting screws, at a height so that the bottom roller is in oil for about one-fourth of its diameter. The sheet-iron support *G* is to take the strain off the rollers and allow the stock to be fed in and carried off on the other side by the friction of the two rollers.

The device is driven by a belt off the main or countershafting, and when not in use can be thrown off.

New York, N. Y. A. Elting.

Chuck for Packing Rings

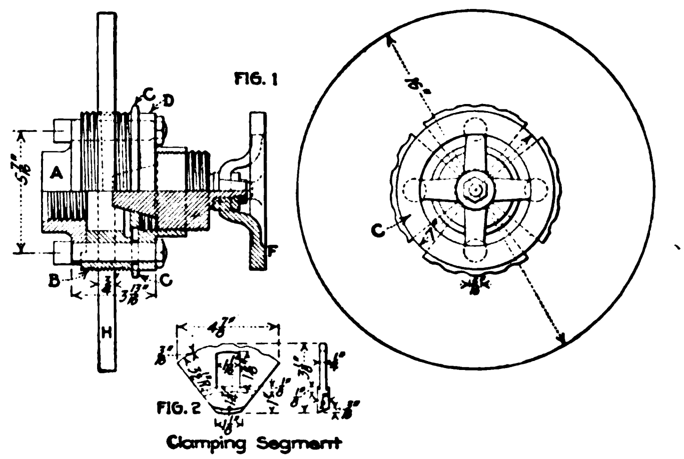
There is a variety of opinions as to how cylinder packing rings should be finished for various kinds of duty. Some men hold that grinding on a magnetic chuck is the only proper way to insure a true face; others say that facing one side at a time in a split bushing gives the best results. From close observation of both methods I have found that the chucking of the casting from which the rings are cut necessarily distorts it. After the rings are cut off with a fraction of an inch of stock for finishing, the chucking strain is relieved; and the result is a warped ring. Now if this warped ring is drawn down on a magnetic chuck and faced, the same warp will appear when the magnetic influence is withdrawn.

The principle is exactly the same when the ring is crowded into a split bushing and faced. When the holding force of the bushing is relieved, the ring will be more or less warped and will rock on a surface plate.

The illustrations show a device that overcomes these obstacles by facing both sides of the ring at the same time, and any irregularities in the ring are faced off without chucking strains. Fig. 1 shows a sectional view of the assembled chuck. The plate *A* fits the spindle of the lathe, and to it are bolted by means of the fitted bolts the parts *B*, *C* and *D*. The segments *C* are free to move on steel ferrules.

The operations necessary to chuck a ring are as follows: Revolve the faceplate *H* on the disk *B* so as to square up a packing ring that is placed over the four segments *C*. Tighten the ring by turning the wheel *F* clockwise. When the ring is sufficiently tight, start the lathe and back the faceplate *H* toward the headstock. This action will allow both the inside and the outside faces of the ring to be cut at the same time by means of a forked tool.

The segments *C* are constructed as seen in Fig. 2, with the width $\frac{1}{16}$ in. less than the finished width of the ring. The faceplate *H* can be made large enough to



CHUCK FOR PACKING RINGS

include the largest size of ring, so that it is only necessary to have one set of segments for each inch of increase in the diameters of the packing rings.

On this chuck from 200 to 250 rings can be faced in 10 hr., and every one will gage properly in any position.

Meadville, Penn. Floyd R. Stewart.

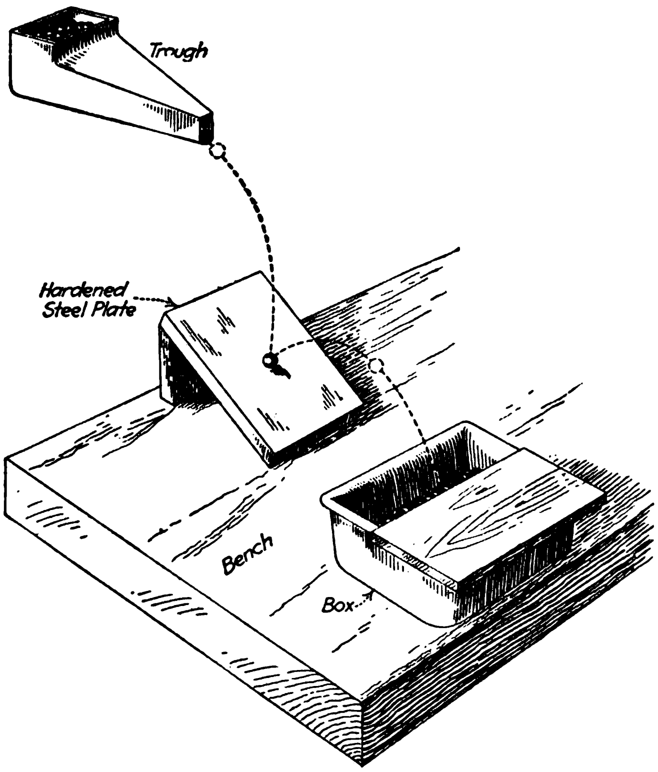
Balls for Ball Bearings

The diameters of balls that can be commercially obtained are marvelously accurate when the very low price is considered. Of equal importance is a uniform hardness in each ball, especially when the load is near the maximum. To measure the diameter of the ball is not difficult, and the spherical form seems to be generally perfect. A very clever way to select the balls so that their hardness will be practically the same is as follows:

A hardened steel plate, either firmly fastened to a bench or of sufficient weight in itself not to be easily moved, is set at an angle. The steel balls are put in a trough so made as to allow one ball at a time to roll out and drop, say a foot, onto the steel plate, from which the ball will bound and fly off at an angle. A selected ball is dropped onto the plate, and a steel box is moved

along the bench until the sample ball in bounding will just get over the edge and fall into the box.

A second steel plate is laid on the top of the box just far enough from its edge to allow the steel ball to enter it. If now a second ball is dropped from the trough onto the plate and it is of the same hardness as the first, or sample, ball, it will also bound and pass through the



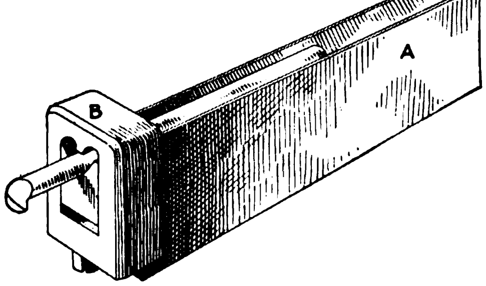
TESTING HARDNESS OF BALLS

opening into the box. It is evident that, if the balls are equally hardened, this system will separate them accordingly. Of course if the balls vary considerably in weight, this method would not work out very well; but in practice it will be found to be quite serviceable under average conditions. A. R. NEMOUR.

New London, Conn.

Holder for Small Boring Tools

The illustration shows a holder for small boring tools. I made it some time ago for sinking small circular forms in cold striking dies. It answers the purpose much better than any holder I have used of the ordinary type, as it



HOLDER FOR SMALL BORING TOOLS

projects only a short distance above the V-block of the holder and the cutting edge of the tool.

The tool is held by the screw beneath drawing the clamp down on the tool and holding it firmly in the groove. The screw does not project below the bottom and so does not interfere with the free movement of the tool holder on the shoe of the tool post.

The holder *A* is of machine steel, carbonized, hardened and ground on the bottom. The clamp *B* is of tool steel, spring tempered. This has made a very convenient tool on small boring work of various kinds.

Bridgeport, Conn. C. W. OVIATT.

Drill Jig for Pins

In the illustration Fig. 1 is shown a simple drill jig for the pin shown in Fig. 2. The clamping member consists of a wedge *A* actuated by an eccentric cam *B*.

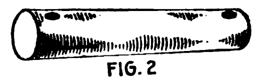


FIG. 2

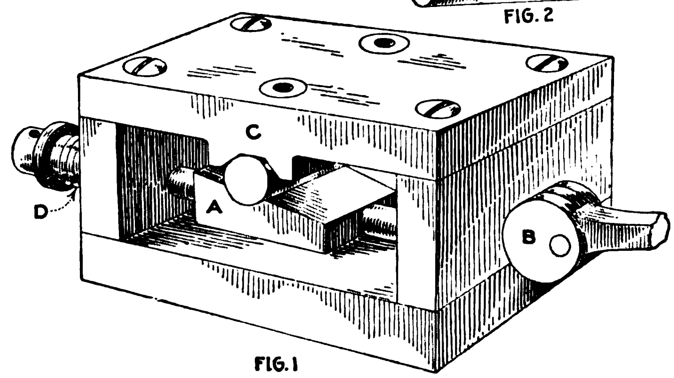


FIG. 1

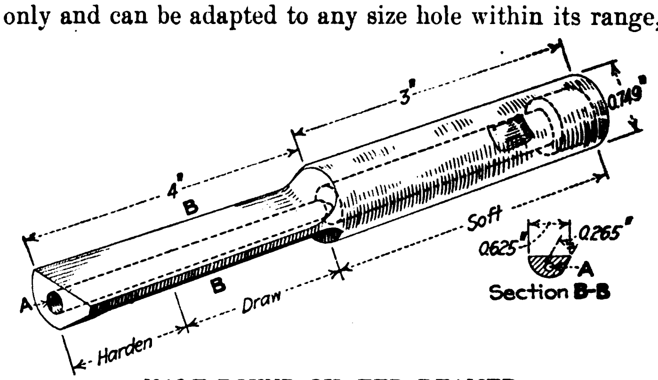
DRILL JIG FOR PINS

As the cam is rotated, the wedge bar is drawn endwise, thus clamping the pin in the V-block *C*. The function of the spring *D* is to return the wedge bar when the cam is released. The work is located by a stop pin *E* at one end of the V-block. The angle of the wedge-bar is made with the angle at least 5 deg. less than the angle of the V-block. Also, the rise of the cam should be about 10 deg., so that it will not slip. W. BURR BENNETT.

Bridgeport, Conn.

Half-Round Oil-Fed Reamer

A good design of half-round oil-fed reamer is shown in the illustration. The tool cuts on one side of the hole only and can be adapted to any size hole within its range,



HALF-ROUND OIL-FED REAMER

which in this case is 0.687 to 1½ in. The reamers were designed for extremely long holes, where other reamers got filled with chips and would not ream the hole to size.

An oil hole *A* runs through to the large hole in the shank, and the oil is pumped into the large hole at a pressure of about 10 lb. RAYMOND W. BECKMAN.

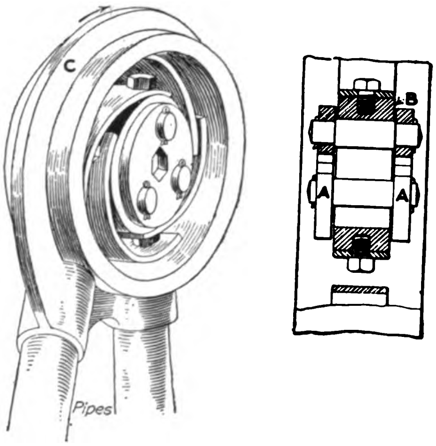
Dayton, Ohio.

Discussion of Previous Question

Preventing Rod Vibration on Automatic Screw Machines

On page 74, Raymond Grant complains about the difficulty of preventing severe vibration of the bar stock on automatic screw machines. This seems to be a common fault with screw machines and a detail to which little attention is given by designers. Of course, care should be taken to straighten the rods carefully, but even then the usual stock holder seems to be not efficient.

The accompanying illustrations show one way of helping the matter. In this device the bar stock is supported and guided by two plates *A*, which are broached to the proper section of the bar, leaving the correct clearance.



DEVICE FOR PREVENTING ROD VIBRATION ON AUTOMATIC SCREW MACHINES

These plates act as a carrier for hardened-steel rollers that track on the hardened-steel ring *B*. Thus as the bar revolves, it carries the plates and rollers with it and at the same time is free to feed endwise. Fastened to the outside of the steel ring *B* are four steel springs, shaped as shown and properly secured to the cast-iron frame *C*. In this way the center element of the device is flexibly supported and free to move in any direction, adapting itself to the "threading" of the bar stock. The frame should be rigidly supported from the floor by two pipes arranged as shown. W. Burr Bennett.

Bridgeport, Conn.

Over-Safetyized Machines

I can appreciate the feelings of H. B. McDermid, as expressed on page 371, and yet there is another side to the question. To my mind a pipe railing is a menace unless the space between is filled with netting in some such way as he mentions and to which he seriously objects. Such open rails are dangerous, as affording only false security instead of the real thing.

Floors often become slippery from oil, and many a man who was neither drunk nor careless has slipped when near a rail of this kind. And if he missed the rail itself, his arm or leg has gone between the rails and been injured by the machine inside.

The drilling machine was a horrible example, but largely because the guard was fixed instead of having a side open to shift the belt. Or better yet, a good belt shifter would have made this unnecessary and have been safer into the bargain.

I do not believe there is a tenth as many intentional injuries as many seem to think. And while many inspectors are doubtless deficient in mechanical judgment, they unfortunately have no monopoly on that—many shop men can give them a good run for their money.

What I object to most is the indiscriminate use of "Safety First" signs, carelessly put up and tending to make the term meaningless. Frank C. Hudson.

New York, N. Y.

Machinist Instruction in the Public-School System

It did my heart good to read the common-sense article by Mr. Prince on page 211. Much is expected of this vocational-school movement (I should have said trade-school movement, as the word trade pins us down to an objective, while the word vocational is a trifle evasive and elastic), and I had begun to fear that the trade school had already started to deteriorate into a manual-training proposition of ultra-shiny work and blue ribbons.

Trade schools are intended to teach trades, and the nearer you make the school shop like the commercial shop the better and quicker will the boy amalgamate with the commercial shop when he leaves the shelter of the school. No boy really knows a trade today unless he has speed as well as accuracy. As his day-rating is fixed according to the amount of work he turns out accurately during his first week in the shop, it is worth 25c. or 50c. a day for him to have speed the minute he enters the factory. Most of us know from experience that once the day-rating is set, it requires months of the hardest kind of plugging to have it raised. Besides, if a boy is slow when he starts on his new job and later acquires the necessary speed, the foreman takes upon himself the entire credit for the boy's whole training and overlooks everything else that he may have known when he entered the factory. It is a big asset for a school to nourish every little bit of school credit that it can.

Trades cannot be taught by educators. Trades can be taught only by men who know their trades thoroughly and in whom the boys have confidence. When I see the number of educators with their raffia-work sort of trade instruction, who have crept into our trade schools, I become alarmed for the future. They seem to fail to grasp the fundamental fact that trade schools were designed to make the boy self-supporting and family supporting. Many trade schools, even as early in the history of trade-school education as this, have declined to the same impractical level, as far as bread and butter is con-

cerned, as the general-course high school, and we all know what the educators have done to our high schools.

There have been so many repeated disappointments in the ability of our high-school graduates to hold down even elementary jobs that the public has come to expect very little from them. In trade-school work each instructor must hold himself, and must be held, responsible for each boy's instruction in his department. When the responsibility is spread out too thinly over an entire system, as in high-school work, then the school deliberately fails in its purpose. The instructor in planing, for instance, should be held directly responsible for the boys that make a specialty of planing, provided of course that he does not have such a large number of boys that he cannot make the instruction individual.

In going through one of our large factories one day a short time ago on a follow-up trip to see how our boys were doing on the job, a foreman pointed out to me a little fellow who was working away like a beaver. "Mr. Spence," he said, "young Nichols, there, took hold of that Norton grinding machine like a veteran from the beginning. You certainly gave him a flying start at the trade school." Immodest, perhaps, but if Nichols had proved to be a dismal failure, what alibi should I have had, as instructor in grinding, to hide behind?

If only responsible instructors are hired—men who have bucked up against shop conditions, who take pains to conscientiously prepare the boys to meet these conditions man fashion, and who instill into the boys the proper spirit toward their work—then the trade school can fulfill its mission.

In certain towns where manual-training work is being given under the guise of trade training, factory managers have no further use for the graduates of the school as a whole. The result is that the boys are forced to leave town to work where they and the school are not known. It is poor economics that permits this condition, for not only does the town lose the money already invested in the boy's whole public-school education, but it loses a future valuable citizen. It might be well for these schools to hire a few instructors whose hands are ingrained with cast-iron dust and drop overboard those whose knowledge extends only to the making of a parlor center-punch, a music rack or a tabouret. In our Worcester school the local demand for graduates has always exceeded the supply, and we always intend to live up to our standard of thorough trade training without any frills.

Worcester, Mass. ROBERT J. SPENCE.

Empirical Design of Piston Pins for Gas Engines

On page 111 Messrs. Lewis and Kessler show different details of piston-pin design, also formulas. On page 254 Mr. Sweet suggests cast-iron pins instead of steel. Gray-iron pins are satisfactory in steam engines, but not, in my experience, in gas engines.

Twelve years ago a plant in the western part of Pennsylvania changed the motive power for driving its hydraulic machinery from steam to gas, and gas engines of the crosshead type were installed. One of the superintendent's hobbies was gray-iron crossheads, and these of ample proportion were fitted to each gas engine. Special care was taken that they were sound, made of charcoal iron and carefully molded. They proved a failure, as they would last only from two to three months and then break. The only remedy was to make new ones, cast of steel instead of gray iron.

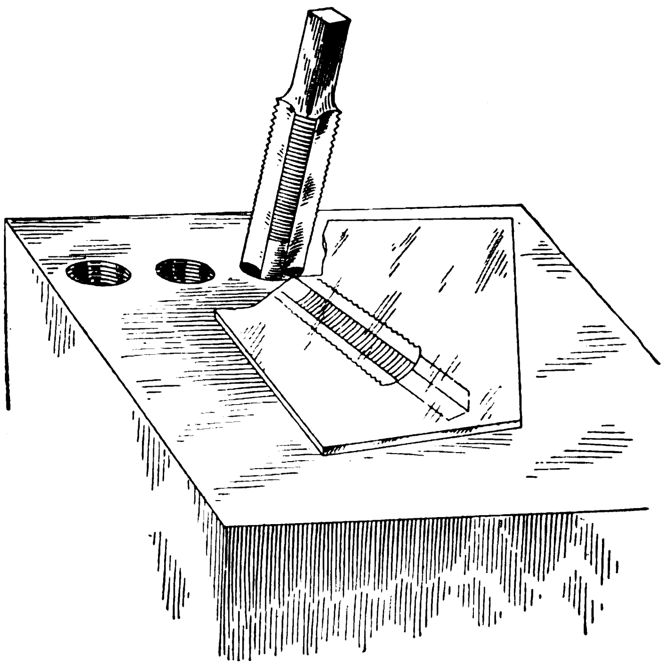
Another gas-engine builder using gray-iron crosshead pins had a similar experience, although he spared neither money nor brains trying to make a go of it. Therefore experience dictates that where hard or continuous operation is required, a high-carbon steel pin tempered and ground as stated in paragraph 3, page 111, should be used. Gray-iron piston pins in open-type pistons would mean a wrecked engine if they should break.

One point should be observed in regard to the taper of piston pins. A taper of 5/8, 1/2 or 1/4 in. per foot is better than 1 in., as given. A smaller taper gives a better grip in the piston bosses and is less likely to jar loose if crosshead brasses or bearing gets loose or pounds. owing to improper taking up for wear. G. STROM.

Titusville, Penn.

From a Small-Shop Notebook

Mr. Van Deventer's interesting pages from a small-shop notebook remind me of a much simpler method of starting a tap straight than any shown there. I occasionally use an old piece of a broken mirror, laid by the



SIMPLE METHOD OF STARTING A TAP STRAIGHT

hole to be tapped. The angle by which the tap deviates from the normal is doubled by the mirror, and the discrepancy is easily noted. When the tap and its reflection are in one straight line, the tap is normal to the work. This may be an old scheme, but I have never seen it described. K. PECK.

Ashtabula. Ohio.

A Beneficial Effect of High-Speed Steel Scarcity

The editorial on page 213, which discusses high-speed steel and the effects resulting from its scarcity, brings to mind a condition that existed in some shops prior to the advent of high-speed steel and furnishes another point to consider when the question of returning to

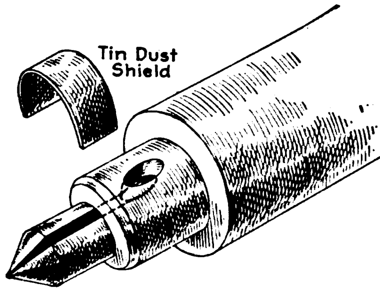
carbon steel presents itself. Many concerns were using cheap grades of steel for tools, and any attempt by foreman or machine hands to get a better grade was futile, because of a difference of perhaps 5 or 10c. per pound in cost.

When high-speed steel came into use, people changed from 10c. carbon steel to 80c. high-speed with scarcely a murmur, when they could not be induced to buy a 20c. carbon steel. It is one thing to strive for improvement in the output of carbon steel and another to strive for a good grade of carbon steel to increase the output.

Cleveland, Ohio. G. W. RICHARDS.

Oiling Dead Centers

Herewith is a sketch of my scheme for oiling centers. A hole in the tail spindle allows oil to flow in a groove on the dead center. Common machine oil ought to work



OILING DEAD CENTERS

all right for high speeds and light cuts on small work; but for large and heavy duty, something with more body to it, like a mixture of white lead, graphite and oil, should be used.

Stockton, Calif. M. JACKER.

Bending Small Tubes Without Rosin Filling

Referring to the article on bending small tubes, on page 118, we do a great deal of this sort of work using the spiral spring method. Instead of removing the spring by the means described, however, we have a cross-handle attached to the wire coil. A twist or two with the hand winds up the spring sufficiently to make it easily removable. This seems to us to be quicker than using the lathe.

At first, various grades of brass wire were tried, but the result was unsatisfactory. Steel wire has been substituted, and no trouble is now experienced, except that it is a little harder to withdraw the spring from a bronze tube than from a brass one. Thanks to Mr. Nemour, we are going to try a different lubricant, having so far used soap.

Jersey City, N. J. H. D. MURPHY.

Power-Press Accidents

On page 231 C. B. Hayward refers to power-press accidents. The operator will most naturally say that the guard failed to work properly and the ram descended the second time. To allow sufficient time between each operation is somewhat difficult, but it is my opinion that the majority of power-press accidents are due to haste and to disobedience to instructions. In the reduction of shells the operator, instead of keeping his fingers on the outside of the work, will invariably, after a time, place one or more fingers in the interior of the shells, as it is quicker to handle them in this way. This action places him in danger, should something go wrong with the mechanism of the press or guard, as the case may be.

With safety devices that compel the operator to use both hands in order to operate the press I have seen men attempt to manipulate the machines with one hand, using a wedge for tripping the other handle.

Some power-press operators do not appreciate the efforts to safeguard them, wilfully disobey instructions and improperly use the devices placed on the machines for their benefit. Regardless of the particular device used, the operator must at all times be alert and ask himself if it is worth while to take any chances.

East Rutherford, N. J. GEORGE F. KUHNE.

C. B. Hayward, in his article about accidents on power presses, page 231, ends by saying "Therefore, as there seems to be no feasible and practical way of preventing the 'falling gate,' it is up to the man running the press to keep his hands out from under the punch as much of the time as possible." In 16 years of experience having to do with a number of power-operated and also a great number of foot-operated presses I have never had a power press in our works repeat, or known of one's doing so.

We had one operator cut off part of a finger under a power press, and this man claimed that the press repeated; but the foreman questioned his statement, as he himself had worked on the same press for several years. Where work had to be put on the dies, we devised fingers, or pick-ups, so that there was no occasion for the operators to run needless risks either in placing or removing the work. It was quite a different story with our foot-press operators. It was a daily occurrence to have them slip their fingers, which would lead us to believe that most press accidents are due to inattention on the part of the operators. I do not mean to say that power presses do not and cannot repeat, but I believe that in many cases when accidents happen this explanation is a press-room fixture.

I have several sizes of presses fitted so that speeds can be varied, and I always start in new help by running the press at a very slow speed, then increasing it from time to time until the operators are capable of feeding at almost any speed.

Waterbury, Conn. THOMAS MCCABE.

Job-Hunting Technical Unions

Your editorial on page 300 points out that all the older national engineering societies are wrestling with the problem of the engineer and public esteem, from which it may be concluded that something is wrong.

In many respects the American engineer is admirable and is even superior to the foreigner; but he stands undeservedly low in the estimation of his fellow-citizens, which fact is known all over the world. Even a German "Herr Doktor" Engineer (I quote from memory) some years ago, after a flying trip through the United States, ventured a long-winded article in the *Zeitschrift des Vereines Deutscher Ingenieure* on the situation of the

American engineer. His parting shot was, "One day America will regret having mistreated its 'draftsmen' so badly." The word "draftsmen" was not translated. It indicated the educated engineer, and then and there is expressed fully and cleverly how lowly the American rates his technical men.

The doctor, however, drew his conclusions from conversations with American engineers. The ungratefulness of the public was pointed out as the cause of the engineers' troubles, but here I am forced to disagree with the doctor and his informers.

Having had the privilege of working ten years in Europe, Asia, Australia and America, I have had opportunity of judging by honest comparison, and I maintain that the public—the employer—is innocent. The guilty man is the American engineer himself. His social standing in his community is lower than that of his brother engineer in any other country, and he alone is to blame.

The American engineer lacks a becoming amount of professional self-respect, or respect for his profession. His recognition of the "just as good as you" principle, however admirable in its proper place, often prevents his "better" knowledge from taking a decided stand against opinions of those who lack proper training.

The American engineer "sees more" in salesmanship than in design or management. How can he expect recognition from laymen where he himself falls short? His desire for direct material gain at the cost of love for his profession has been fatal. Notwithstanding the American engineer's better salary, his foreign brother is better situated. Shorter hours, recognition, a fair salary and no lay-offs form the basis of a comfortable life.

The American engineer, especially the younger one, is less stable and more wasteful than the engineers of other countries, with the result that he usually is poor in pocket and has to accept what comes along.

The national societies alone cannot materially alter the public esteem; but each individual engineer, by word and action, has to prove that, besides the material end, there is something greater and more beautiful in engineering. The layman soon will recognize the "distinctive technical qualities" and his appreciation will be expressed in hard cash, that being the American way.

The small percentage of American engineers who have not jumped around and whose salaries are low on account of a (usually) imagined lack of experience might well study such books as Van Deventer's "Machine-Shop Management." Some of them will discover that they have grown unperceived into full-fledged superintendents or chief engineers. The consequent enthusiasm will have a marked effect on their pay envelopes.

Brooklyn, N. Y. JAN SPAANDER.

A Beneficial Effect of High-Speed Steel Scarcity

I read with interest the editorial on page 213, relative to the present scarcity and high cost of high-speed steel and the economies that are being practiced. This article recalls my own experience when confronted with a similar problem.

About 30 years ago I was employed as master mechanic and general mechanical factotum in a car-manufacturing plant, where the company was in the last stages of financial decomposition. As we could obtain no credit, we could not secure any tool steel.

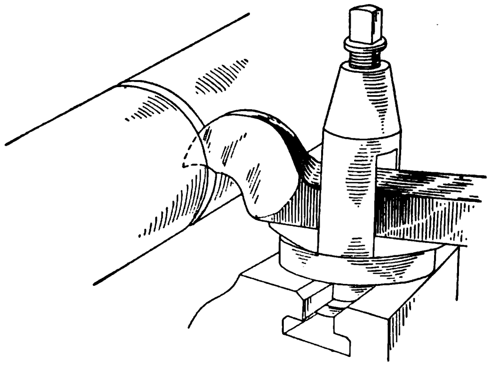
We made our own car wheels, so it occurred to me to experiment with chilled cast iron for tools. I was agreeably surprised at the excellent results obtained from the chilled cast-iron tools we came to use on all our lathes and planers. The greatest difficulty I encountered at first was that the tools would snap off where they were secured in the tool post. I overcame that by making the body of the tool heavier and also by making larger tool posts. During the time I remained with that company no other material than chilled cast iron was used for tools, and this practice was continued in that plant for over 10 years.

I also used chilled cast-iron tools successfully about 15 years ago. We had four locomotives, and all of them had badly worn tires. It was necessary to turn the tires, in order to keep the engines on the rails. I had the misfortune to be detailed for this work. Owing to their hardness, I was unable to find any brand of steel that would cut them. I suggested chilled cast iron and was directed to try it. While I had some doubt, on account of the hardness of the tires, the chilled tool cut everything it came in contact with; and it would stand a heavier cut than any high-speed steel I had previously used on similar work. The chilled-iron tool has the merit of being very cheap as compared to the high price demanded for tool steel, and I am surprised that more manufacturing plants have not used such tools, especially on roughing out work.

Mount Carmel, Ill. G. H. GREGORY.

Cutting Downward in the Lathe

Reading about backward cuts with a lathe, in your editorial on page 255, has led me to describe an interesting method of dividing, or cutting off, shafts. The illustration shows a dividing tool that never fails on any diameter, but the machine must be running backward.



GOOSENECK LATHE TOOL

As an example, I will state that I have parted 6-in. shafts between centers and outside the steadyrest with this design of tool, by throwing in the finest crossfeed and feeding to the center of the piece. The gooseneck is not for spring, but to get the cutting edge elevated to the center of the machine. A. G. BILLINGSLEY.

Sharon, Penn.

Editorials

Copying Machine Tools

The tremendous demand for American machine tools, the entrance of many new firms into this manufacturing field and the insistent pressure for early and still earlier deliveries have brought about a situation that might easily have been predicted. American machine tools are being copied by American designers. This is no new situation, but one that is more noticeable than usual because of its extent. Some comments have reached the *American Machinist* recently to the effect that this practice should receive wholesale condemnation—root, trunk and branch. We have been urged many times in the years gone by to take this same position with regard to German manufacturers who, it has been alleged, have resorted to wholesale copying of American machines. The *American Machinist* has persistently refused to take any such dogmatic position.

There are so many interests and principles involved in any discussion of machine-tool copying that clear thinking, and not opinion or emotion, must determine what is said and done.

The rights and interest of the public in such matters are clearly defined. Under our patent laws an inventor or owner of a patent has the exclusive right to his invention for a period of 17 years. At the end of that time his device becomes public property and can be copied, made, sold and used by anyone. At the end of the monopoly period his invention becomes a part of the great storehouse of mechanical knowledge, from which everyone is entitled to draw and does draw when he seeks to develop a new machine. This expression of a "common storehouse" is peculiarly applicable in the machine-tool field, for there are few machine-tool patents. The art is wide open.

Thus the designer who takes devices and mechanisms from machine tools not protected by patents is clearly within every legal right. Most of the "copying" has been of this nature. There are used on machine tools many constructions and devices that could very properly be considered as standard. In fact, the *American Machinist* has often pointed out that the standardization of machine-tool details promises decided benefits to users and builders alike and that this uniformity could be obtained with ease.

But there is another kind of copying that has been resorted to by a few firms and designers in the United States. There are cases where an attempt has been made to reproduce not only the mechanism, but the outward semblance of a well-established machine, extending in the most aggravated cases to exact copying of catalog illustrations and text. The motive behind this kind of copying is far different from that which governs the one first mentioned. And here, as in most things in life, the final result and effect must be judged by the motive behind them.

The designer or manufacturer who simply takes well-known, tried and tested devices and mechanisms from the common storehouse of mechanical knowledge and fits them together into a machine of his own, behind which he purposes to put his own reputation, is copying, to be sure, but he is acting from a straightforward motive. On the other hand, the manufacturer who not only takes tried and tested mechanisms from others, but designs a machine that has the exact outward appearance of the well-established product of a competitor may be working from a dishonest motive—trying to sell machines on the reputation of another. The most charitable view of such a course is that lack of time or designing ability has prompted a questionable act.

To show that in some cases descriptive circulars have been taken, word for word, the following parallel columns are offered. The items at the left are from a circular of a well-known firm that has been building the machine described for a number of years. The right-hand column consists of quotations from a machine-tool description published in one of our recent issues. This supposedly new matter was offered to the *American Machinist* as the description of a new machine tool. A comparison of the two columns will show any fair-minded man that the language of the second firm came from the circular of the first. The *American Machinist* regrets that it published this material in this form.

Automatic Chuck and Bar Feed are operated by the long lever in front of the head which gives increased leverage for closing the collet. A stepped wedge automatically adjusts the collet for slightly varying diameters. Extra capacity collets can be furnished for holding short-length work larger in diameter than the capacity through the spindle.	The automatic chuck and bar feed are operated by a long lever in front of the head, giving increased leverage for closing the collet. A stepped thimble automatically adjusts the collet for slightly varying diameters.
Independent Adjustable Stops operate automatically for each position of the turret. They are readily adjustable for the length of each cut.	Independent adjustable stops operate automatically for each position of the turret. They are readily adjustable for the length of each cut.
Turret Saddle has a supplementary taper base, by means of which the tool holes in the turret can be adjusted to the exact height of the center of the spindle. Taper gibs fitted the whole length of the saddle on each side, provide means of adjusting the slide sideways.	The turret saddle has a supplementary taper base, by means of which the tool holes in the turret can be adjusted to the exact height of the center of the spindle. Taper gibs, fitted the whole length of the saddle on each side, provide means of adjusting the slide sideways.
The hand longitudinal feed, regularly furnished with the cut-off for movement along the bed of facing, necking, etc., is operated by means of a hand-wheel in connection with spiral gears and an accurately milled screw, and is fitted with a graduated dial reading to 0.001 of an inch. Dial indicators are provided to obviate the necessity of making measurements of the longitudinal cuts.	The hand longitudinal feed is operated by means of a hand-wheel in connection with miter gears and a milled screw and is fitted with a graduated dial reading to 0.001 in. Dial indicators are provided to obviate the necessity of making measurements of the longitudinal cuts.
Geared Oil Pump delivers lubricant through an adjustable piping system to the proper place. It operates automatically when the machine is run in either direction. The steel oil pan is large and deep, giving ample space for chips.	A geared oil pump delivers lubricant through an adjustable piping system. It operates automatically.

Of course, the reputation of a machine is not made on its appearance. Beauty is only skin deep. Good material, accurate workmanship and durability have far more to do with the success of a machine than its looks or the words by which it is described. Any manufacturer who has tried to have his product duplicated abroad knows the truth of this statement. The reputable manufacturer has little to fear from his copying competitors, for in Kipling's convincing language:

They copied all they could follow, but they couldn't copy my mind.
And I left 'em sweating and stealing a year and a half behind.

The Business Languages of South America

An instructive incident grew out of the chance throwing-together of a small, energetic North American boy and three or four Spanish-speaking South American children of about his own age. After only a few days of romping and playing, the children's elders noticed that English was being used almost exclusively in the games. The North American lad was interviewed, and with rather an imperious toss of his head, he said: "Course, they use my names for things. I call things by their right names. If they didn't do the the same, we couldn't play."

The unwillingness of one who speaks English by right of birth to give up his mother tongue and the courtesy of the South American in adapting himself in gracious fashion to the wishes of another—these two traits are illustrated by this little happening. Because such a thing could happen, it is necessary to point out the languages of South America to North American business men and the attendant conditions which they must meet if they would do business on that great continent.

There are two business languages used in South America, and neither is English. The language of Brazil, with about 20,000,000 people, is Portuguese. The language of the rest of South America, comprehending an equal number of people, is Spanish. Portuguese and Spanish—these are the business languages of South America. The North American business man must not play the part of the imperious small boy, but must use in his correspondence and through those who represent him the language of the people he wishes to reach.

Under no conditions should a letter addressed to South America be written in English, unless the writer is positive that the person to whom it is addressed reads and speaks English fluently. If the writer does not know that the person he is addressing possesses this qualification, the letter must be in Portuguese if sent to Brazil and in Spanish if sent to any other South American country. On the other hand, it is always safe to answer a letter from South America in the language in which it is written.

The *American Machinist* has previously pointed out the racial traits of courtesy possessed by all South Americans, which tend at once to make them lenient of errors in language, provided the attempt to make oneself understood is genuine. Thus, a letter written in poor Portuguese or poor Spanish is far better than one written in good English. The English letter would probably reach the waste basket without an attempt being made to read it. On the other hand, the letter in understandable, though inelegant, Portuguese or Spanish would be read and its contents grasped.

All business letters written by South Americans are most courteous—in fact, to a North American, overcourteous—in style. They are cordial and even gracious. To us, both the salutation and the closing greetings are effusive. Scattered through the body of the letter are frequent phrases of direct address to the one who is to receive the letter, worded in the most polite terms. When reading such expressions, one can almost imagine the courtly lifting of the hat that accompanies the meeting and parting of business men in South America.

Three examples of common salutations in Spanish business letters are herewith given, each being followed by a rather literal translation into English: *Muy Señor mió*—My dear Sir; *Distinguido Señor*—Distinguished Sir; *Illustrissimo Señor*—Most Illustrious Sir. Three endings for letters, similarly translated, are also given: *Quedo de Vd. atto. y S. S.*—I remain to your Grace your attentive and obedient servant; *Me repito de Vd. atto. y S. S.*—I repeat to your Grace that I am your attentive and obedient servant; *Esperando sus ordenes S. S.*—Awaiting your orders, I am your obedient servant.

It is unnecessary to multiply these illustrations, for any good textbook of the language used will give numerous other examples, with comments as to how they should be employed. From these few phrases it is easily imagined how offensive our brusque North American style of letter writing must be to anyone who naturally, and by association and training, uses most courteous forms in addressing others. Fortunately, it would be impossible to translate into Spanish or Portuguese our slangy, punching, North American business-letter style.

The importance of using the language of the country in dealing with South America has been realized and acted upon by both the British and the Germans. The German has acted from his usual disposition to take advantage of everything that might count; the Englishman has accommodated himself to necessity. The final result is that the salesmen representing German and British houses are well equipped with a knowledge of the language of the countries with which they are doing business, the customs of the people and the niceties and refinements of business intercourse. These qualifications give them a decided advantage over North Americans who have failed to appreciate and learn these important things. In the case of the British, however, it must be confessed that this acquirement is a veneer, for when Englishman meets Englishman, or Englishman meets American, the brusque Anglo-Saxon ways again come to the surface.

This subject of business languages in South America is so important that everyone who is exporting to that continent should see to it that only Portuguese and Spanish are used and that the courteous forms of expression which enter into the daily business intercourse of the peoples of those countries are scrupulously observed.

Munition Manufacture Causes Many Shop Changes

One of the many effects of the making of munitions by the various shops of this country will be the emphasis laid on the advantage of subdivision of labor. Shops that have always done practically a jobbing business have been forced to subdivide the machining of shells, both in order to secure rapid production and to reduce costs.

How far the experience gained in this way will influence their work in the future, it is difficult to determine. But it is hardly conceivable that it will not affect the methods used on much of their work.

Cutting speeds will also probably be increased in many cases. Then too, more knowledge will be available as to what taps and dies can and cannot do. This of itself may have a wider influence on future machine work than we are apt to think of during the rush of the work itself. If different shops will keep notes as to the changes in methods it will make interesting and instructive reading.

Shop Equipment News

Heavy Manufacturing Lathe with Geared Head

The chief consideration in the design of the lathe shown was the manufacturing conditions for which it was intended, with the result that the spindle speeds have been limited to eight changes and the general features developed along what have come to be considered single-purpose lines.

Aside from the headstock the machine requires little description. All the parts are heavily proportioned, and the materials used follow the best accepted practice.

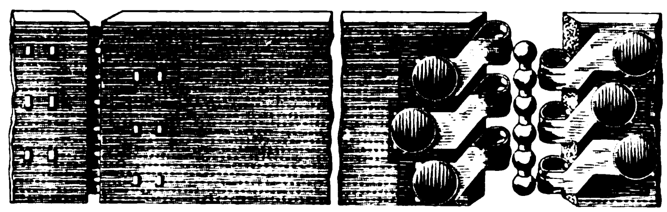
The headstock is of the selective sliding-gear type. It permits four spindle speeds from a single pulley drive, and a two-speed countershaft provides an additional four speeds. The sliding gears are mounted on the initial drive shaft directly above the lower shaft, carrying the gears keyed fast to it. The lower shaft carries a pinion that meshes with the large gear on the lathe spindle. As the sliding gears are operated by a single lever, it is impossible to engage opposite gears. Only the gears at work are in mesh. The lever operating the friction clutch in the drive pulley is interlocking with the gear-shift lever, making it necessary to release the clutch before the gears can be shifted and also to have the change gears properly meshed before the clutch can be engaged. Lubrication of change gears is taken care of by a reservoir in the headstock, permitting the gears to revolve in a bath of oil.

The machine is a recent product of Robert H. Snider & Co., Philadelphia, Penn., and is made in the one size.

Flexible Steel Belt Lacing with Ball-Bearing Joint

In addition to the noiseless and easily attachable features of the form of metal belt lacing shown, the main claim is the strength of the joint gained by the use of bifurcated rivets that clinch below the surface of the belt.

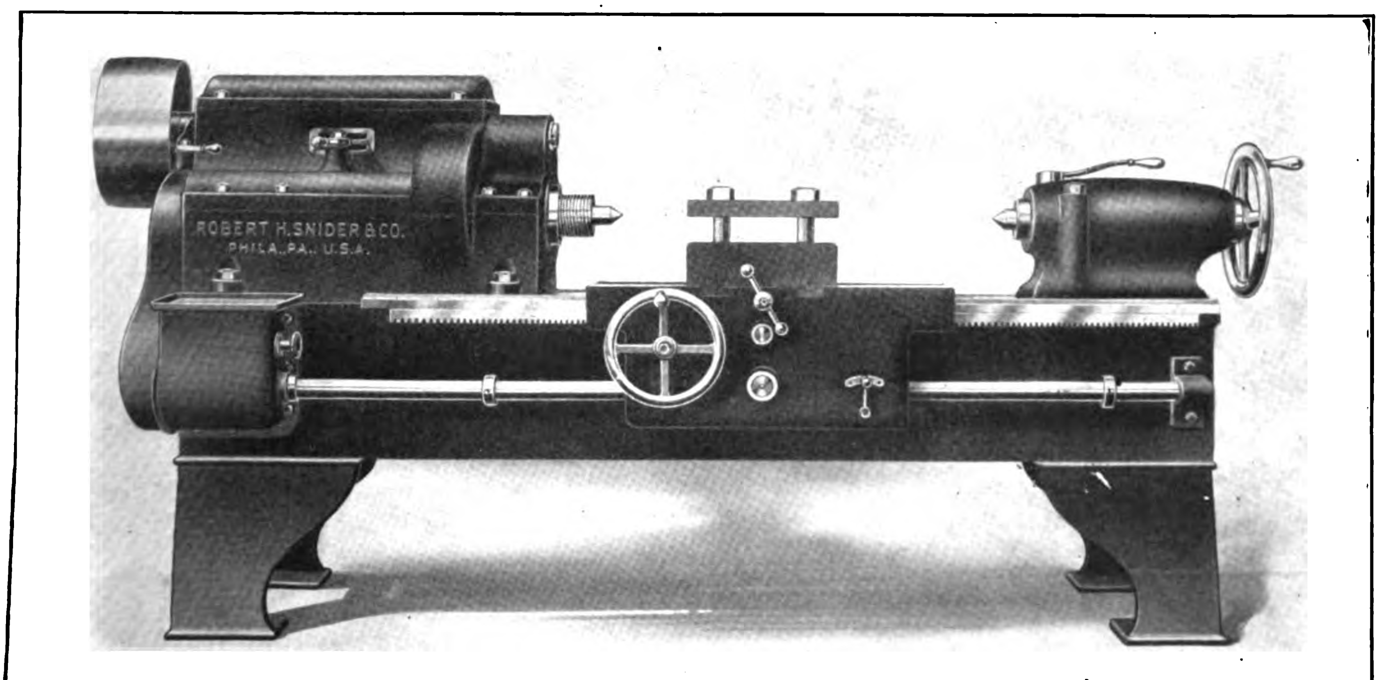
The pulley side of the joint made by this form of lacing is shown at the left, from which it will be observed that the teeth are slightly shorter than the thickness of the belt, thereby preventing any metal coming in contact



FLEXIBLE STEEL BELT LACING WITH BALL-BEARING JOINT THAT REDUCES FRICTION

with the pulleys. The right side of the illustration shows the construction of the fastener, in which the ball-bearing form is designed to reduce the joint friction to a minimum.

The lacing is made in a number of sizes to properly fit standard thicknesses of belt and is a recent product of the Manufacturers' Belt Hook Co., Chicago, Ill.

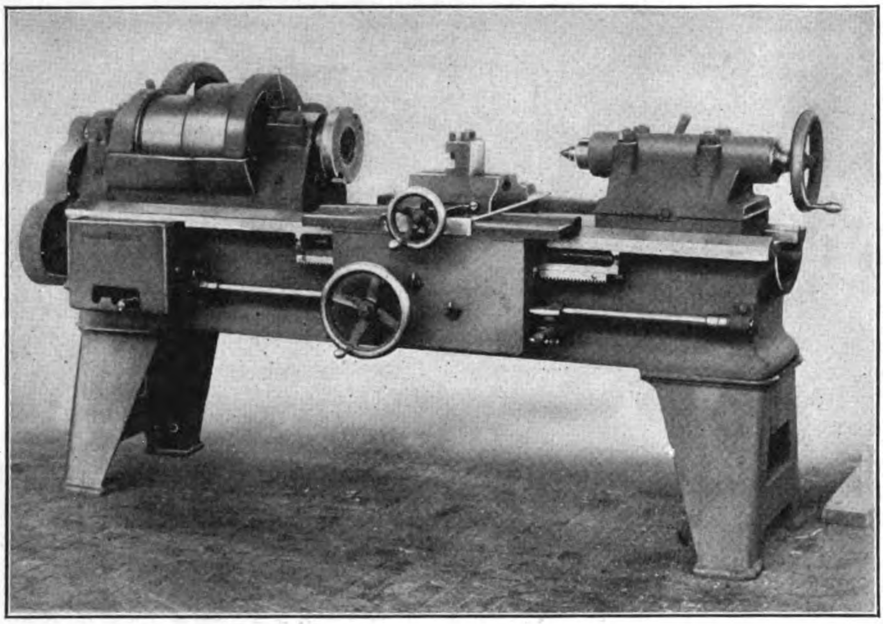


HEAVY MANUFACTURING LATHE DESIGNED ALONG SINGLE-PURPOSE LINES

Swing over bed, 18 in.; swing over carriage, 11¼ in.; distance between centers, 8-ft. bed, 38 in.; tailstock-spindle diameter, 4 in.; travel of spindle, 9 in.; minimum gear reduction, 3 to 1; maximum gear reduction, 15 to 1; driving-pulley face, 8 in.; speed of driving pulley, 250 r.p.m.; feed changes, ⅛ in., $\frac{1}{16}$ in., $\frac{1}{32}$ in.; net weight in 8-ft. bed, 4,100 lb.

Single Back-Geared Lathe

The latest addition to the ever growing list of heavy-duty manufacturing lathes is shown in the illustration. This machine is the product of the Davenport Locomotive Co., Davenport, Iowa, and in general follows the conventional lines in design and construction.



SINGLE BACK-GEARED MANUFACTURING LATHE

Swing over bed, 17¼ in.; swing over carriage, 9 in.; length of carriage, 30 in.; depth of bed, 15 in.; width of bed, 18 in.; distance between centers (7-ft. bed), 31 in.; weight, 3,500 lb.

From the illustration it will be observed that the design has been planned along what have come to be considered single-purpose lines. The main idea has been heavy-duty turning, for which driving cones of 11 and 14 in. in diameter, accommodating 6-in. belt width, are provided. The ratio of the back gearing is 6.25 to 1; the feeds, ⅛, $\frac{1}{16}$ and $\frac{1}{32}$ in., and the countershaft speed, 135 r.p.m.

Friction Surface Facing

As the result of successful application in the automobile field the Royal Equipment Co., Bridgeport, Conn., is offering its friction facing material, known as "Raybestos," for general machinery service. Various applications, such as friction clutches, hoisting drums and brake rings, will suggest themselves. The base of the material is long-fiber asbestos, so woven, rolled and treated as to possess maximum wearing qualities. The long-fiber base presents fraying, when drilled or otherwise cut.

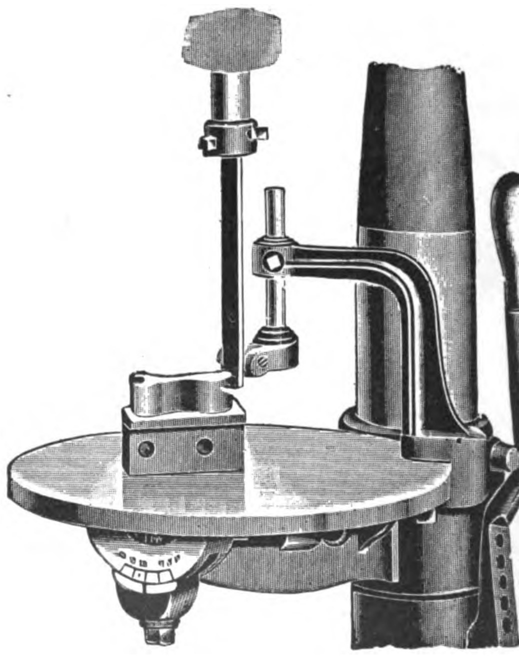
The material is claimed to be heatproof, oilproof and waterproof and can be obtained in various forms and sizes for special applications.

Combination Bench Filer and Hacksaw Machine

While the machine shown was designed primarily for die work, it is adapted for a wide variety of other applications where hand filing and preliminary drilling are usually performed.

Adjustment of the table to the right or left and forward or backward, to provide for practically any angle, is controlled by a single nut, with graduated plates on the table supports showing the angle to which the table is adjusted. It is also possible to adjust the elevation of the table for different lengths of files or changes in the stroke. A handle bolted to the base of the machine and attached to the work-table support enables the operator, by pushing the handle backward, to lower the table and remove the work from the machine without changing the position of the file or the roller guiding it.

The driving shaft at the top of the machine drives either the file or the saw in a vertical position, the cutting being accomplished on the down stroke; a quick return is provided. The range of stroke can be varied from 0 to 6 in. by loosening the nut on the crankpin and moving the latter toward or away from the center of the disk on the end of the driving shaft. The connecting-rod is pivoted on the frame of the machine and also has a pivot connection with the top of the saw frame. The file guide roller is made of soft steel and has a right and left screw to provide an adjustment for accommodating different thicknesses and shapes of files. When a saw is employed, a guide roller of hardened steel is substituted. For use when small circles are being filed or sawed or when the saw has a tendency to lift the work on the return stroke, a hold-down, consisting of a steel finger projecting in front of the file, is employed. This can be attached to any part of the work-table edge and is adjustable for any thickness of work up to 3 in.



COMBINATION BENCH FILER AND HACKSAW MACHINE

A punch-filing attachment is also provided. It is shown in the illustration and is designed for fitting work on blanking punches when they are being filed to fit a die.

It consists of an auxiliary guide roller supported by an adjustable bracket clamped to the edge of the table, as shown.

The main support for the file is provided by a roll under the table, which keeps the file in rigid contact with the work at all times.

The machine shown is the latest addition to the line made by the Extensive Manufacturing Co., 90 West St., New York City.

Shop Eye Guards

From a material known as "micalite," which possesses all of the qualities of celluloid and in addition is fireproof, Strauss & Buegeleisen, 489 Fifth Ave., New York, N. Y., are manufacturing shop eye protectors.

The material is made up in the form of eye-shields for shop workers and two colors are available in one piece without seam or pasted joint so that the line of vision is not impaired.

Spur-Gear Selection Chart

By E. E. Landahl*

The accompanying logarithmic chart is for readily determining the size of a gear when the horsepower to be transmitted and the shaft speed are given or, conversely, the horsepower that can be transmitted by a given gear running at a known speed. The table is based on the Lewis formula as given in Kent's "Handbook," using stresses for S as there tabulated for cut cast-iron teeth, one-half of these values for plain cast-iron teeth, one and one-fourth times these values for plain cast-steel teeth and two and one-half times for cut cast-steel gears. The table is based on a gear face three times the circular pitch. For other faces divide the determined horsepower by the face on which the table is based and multiply by the one to be used.

In using the table there are certain further factors of vital importance that must be carefully considered. One of these is the peripheral speed. Authorities differ as to the limiting speeds for safe usage, but good practice has determined 700 ft. per min. for rough teeth and 1,500 ft. per min. for cut teeth as the limits to be used. Another point that should be borne in mind is that the horsepower of the pinion should be traced out when the same material is used in both of the mating wheels.

As an example of the use of the chart, let us trace out a problem. Assume that we desire to determine the proper size for a gear to transmit 25 hp., the shaft speed being 45 r.p.m. This problem is traced out with a heavy line on the chart. The procedure is as follows:

Find the horizontal line corresponding to 45 r.p.m. and trace to the right until this line intersects an imaginary diagonal corresponding to 25 hp. between the lines given for 20 and 30 hp. From this point go directly up or down the table, depending on the kind of gear tooth desired. Assuming a plain cast-iron tooth, the downward direction is taken. It will be noticed that the vertical path intersects the horizontal line representing 15 teeth midway between the curved diagonals for 2½ in. and 2¾ in. This means that 2¾-in. circular pitch should be used for a 15-tooth pinion. For a 17-tooth pinion a 2½-in. pitch is satisfactory. Gears of other types can be similarly determined from the tables above the r.p.m. section, notice being made that circular pitch is plotted for cast teeth and diametral pitch for cut teeth. For example:

1. If we wish to use cast-steel cast-tooth pinion, 17*T* should be 1¾-in. pitch; 16*T* and below should be 2-in. pitch.
2. In the cast-steel cut-tooth table we could use 19*T*—2½ diametral pitch; or 15*T* to 18*T* inclusive, 2¼ pitch.
3. Passing on up to the cast-iron cut-tooth gears, we could use 20*T*—1¾ diametral pitch or 1½ pitch with any less number of teeth.

For finding the horsepower for a certain gear at a given speed simply reverse this operation.

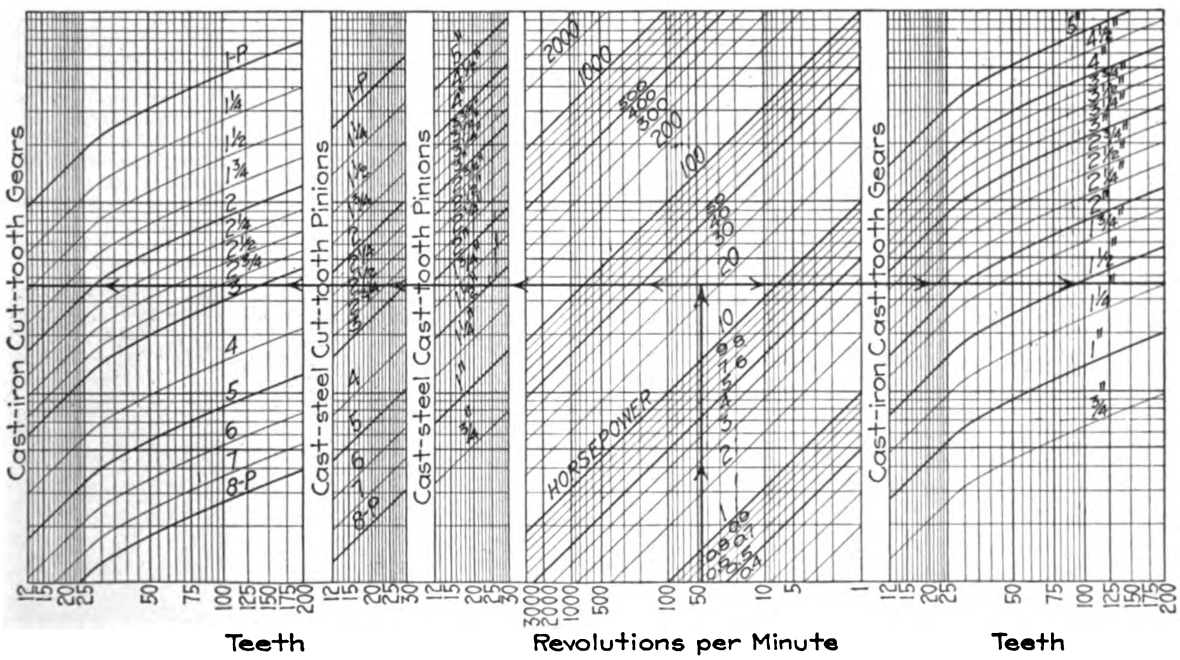


CHART FOR DETERMINING THE SIZE OF GEAR OR HORSEPOWER

*Assistant chief engineer, Webster Manufacturing Co., Tiffin, Ohio.

NEW PUBLICATIONS

THE METALLOGRAPHY AND HEAT-TREATMENT OF IRON AND STEEL—By Albert Sauveur. Second edition. Four hundred and seventy-one 7x10½-in. pages; 438 illustrations; indexed; cloth bound. Sauveur & Boylston, Cambridge, Mass. Price, $6.

Professor Sauveur's "Metallography of Iron and Steel," published in 1912, now appears in a revised and enlarged edition. In its rewriting a large part of the book has been devoted to the study of heat-treatment. Thus the new title is more accurately descriptive of its contents. Fifty pages of new matter and nearly 100 new illustrations have been added. Recent developments in the metallography of iron and steel have been included, as well as the applications of theoretical knowledge to industrial practice in the art of heat-treating.

MACHINE DESIGN—By Albert W. Smith and Guido H. Marx. Four hundred and eighty-three 6x9-in. pages; 277 illustrations; indexed; cloth bound. John Wiley & Sons, Inc., New York City. Price, $3.

In the preparation of this, the fourth, edition of a well-known college textbook on machine design, the former material has been revised and enlarged, as is plainly shown by the references to engineering information as recent as 1913 and 1914.

The original plan of emphasizing fundamental principles and methods of reasoning has been retained, and there has been no effort to make the volume cyclopedic in scope. The task of revision was undertaken and executed solely by the junior author.

INVENTIONS AND PATENTS—By Philip E. Edelman. Two hundred and seventy-eight 5x8-in. pages; indexed; cloth bound. D. Van Nostrand Co., New York City. Price, $1.50.

The author's preface states, "This volume is intended particularly for all persons interested in patents, either as inventors, investors or manufacturers. It is intended that the layman also will find considerable matter of interest."

It is difficult for the reviewer to believe that all the space occupied has been used to advantage in carrying out this purpose. The two opening chapters are historical in character, dealing with the development of the patent system and the United States Patent Office. Then follow 12 short chapters, which outline patent procedure and contain much information and good advice. The two final chapters, a number of blank pages for memoranda and an appendix, occupying in all 85 pages, do not seem pertinent or in keeping with the purpose of the volume. The lack of an interesting literary style also tends to make the reading of the book drag.

Numerous volumes have been brought out, dealing with various phases of our patent system, patent procedure, inventors and inventions. Thus a new book, to attract attention and make a place for itself, must either approach the subject from a new angle with an abundance of fresh material or develop a style of its own that will make old matter fresh and readable. In neither respect does this volume seem adequate.

MECHANICAL DRAFTING—By Charles B. Howe. One hundred and forty-seven 8¼x11-in. pages; 166 illustrations; indexed; cloth bound. John Wiley & Sons, New York City. Price, $1.75.

Reviewed by A. L. Ormay*

Although the subject is undoubtedly overwritten, the book under review immediately justifies itself in a manner with which, unfortunately, only a few of its predecessors can be accredited.

The noteworthy features are, first, thoroughness, and, secondly, the practical exclusion of all nonessentials to the subject of mechanical drawing. The book forms an excellent manual for teachers, in that it supplies all the conventions and problem sheets likely to be found necessary in any course. The treatment of orthographic projection is splendidly conceived and thoroughly worked out.

The book is divided into ten chapters under the following headings: Materials and Instruments, Principles of Drafting, Geometry of Drawing (two chapters), Working Drawings, Machine Drawing, Plan Drawing, Plot and Map Drawing, Pictorial Representation and Sketching, Blueprinting.

The treatment is well proportioned to the importance of each subject, and it is a relief to find that less than ten pages are devoted to materials and instruments, which is in marked contrast to most of the works on the subject of drafting.

In the chapter on the principles of drafting, all the operations necessary in the execution of any drawing are clearly set forth and explained. The two chapters on geometry of drawing, primarily devoted to orthographic projection, the intersection of surfaces and the development of surfaces, are simply and comprehensively worked up. A marring feature here, as well as throughout the volume, is that the wax illustrations not only present a somewhat stiff appearance, but in some instances account for misplaced shade lines and still further produce a rather amateurish effect in the surface shading.

The chapter on working drawings is essentially complete, from the manual point of view, while the chapter on machine drawing contains all the conventional screw threads, bolts and stock parts, with a number of excellent examples showing the method of dimensioning the layout of holes, ordinary and standard tapers, shafts, long screws, etc.

Individually, the chapters on plan drawing and plot and map drawing are calculated to be of value, although the elaborate treatment of architectural drafting is slightly afield in a manual on mechanical drawing. Likewise, the chapter on plot and map drawing—well written but poorly illustrated—is scarcely well classified.

In the chapter on pictorial representation and sketching the construction of isometric, perspective and cabinet drawings is taken up and the rules formulated for making working sketches.

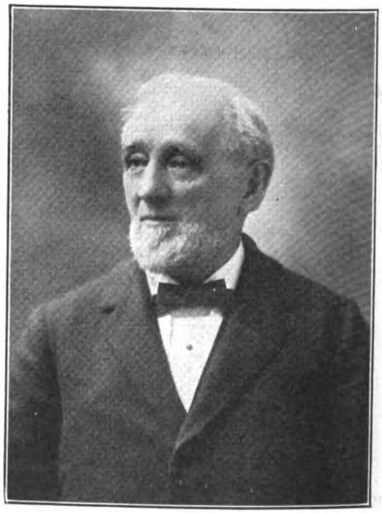
The book as a whole reflects a conscientious effort to make the treatment comprehensive, lucid and simple and conspicuously avoids the crowding in of minor details. Especially commendable features are the elegance of the typography, the arrangement of the cuts and the pleasing effect obtained by the use of an unusually good quality of paper.

*Chief Draftsman, Hill Publishing Co.

Franklin Alter

Franklin Alter, founder and president of the American Tool Works Co. and for many years a conspicuous figure in the machine-tool building industry, died at his home in Cincinnati on Feb. 23, after a long illness. Throughout a business career of more than 60 years Mr. Alter had exhibited an exceptional capacity for organization and administration. Although he had passed his eighty-fifth year, the fact that he did not live to see the completion of the new American Tool Works building now in the course of erection caused additional regret to his closest former associates.

Franklin Alter was born in Carlisle, Penn., October 28, 1831. His boyhood was spent at Hagerstown, Md., where his father was proprietor of a large farm and flour mill. When 19 years old he journeyed to Pittsburgh where he boarded a steamer for the lower Ohio and Mississippi Rivers, with the intention of going to New Orleans. The boat arrived at Cincinnati and remained several days to complete its cargo for Southern points. Mr. Alter took a look at the Queen City, was impressed with its natural advantages and decided to establish himself there.



FRANKLIN ALTER

He obtained a position as clerk with the L. Booth Co., wholesale hardware dealer. His business ability won repeated

promotions for him until he became vice-president and finally sole owner of the concern. There then followed a period of several years in which Mr. Alter devoted his energies to the establishment of several shoe-manufacturing plants. Then came his contact with the machine-tool industry, the first conspicuous step being the purchase of the Davis-Egan Co. in 1900, which was soon organized into the American Tool Works of which he remained the head until the time of his death.

During the past 15 years Mr. Alter took an active part in many of Cincinnati's civic organizations and movements and was an influential figure in the financial circles of that city. He gave unsparingly of his time to local government welfare work, and through his zealous and discriminating inspection of civic appropriations he earned the characterization of "watchdog of the treasury."

Mr. Alter is survived by his wife, three daughters and two sons. The latter, Robert and L. W. Scott, are respectively secretary and foreign trade manager, and production engineer of the American Tool Works Co.

PERSONALS

W. S. Chase, for thirteen years at the head of the sales department of the National-Acme Mfg. Co., Cleveland, Ohio, has retired from active business and for the present will devote himself to personal affairs. Mr. Chase expects to spend much of his future time on his ranch at Meridian, Idaho.

F. C. Mason, a frequent contributor to the columns of the "American Machinist" for many years back, and for the past 15 years superintendent of the metal departments and master mechanic of the Bissell Carpet Sweeper So., Grand Rapids, Mich., has accepted the position of works manager of the Houk Mfg. Co., Buffalo, N. Y.

Benton Hopkins, representing the Samuel Austin & Son Co., Cleveland, Ohio, and the Morgan Engineering Co., Alliance, Ohio, sailed for Russia on Feb. 22 for the purpose of formulating plans and supervising the initial construction of a string of automobile plants in Russia. A group of influential Russians are behind the project.

H. L. Wadsworth, inventor and designer of the sand-blast apparatus bearing his name, has become factory manager of the new plant in Cleveland of the combined American Foundry Equipment Co. and the Sand Mixing Machine Co. Charles L. Benham, an old employee of the Sand Mixing Co. has been appointed factory superintendent.

OBITUARY

Frank Thompson, until recently assistant general manager of the American Car & Foundry Co., Chicago, Ill., died in Miami, Florida, Feb. 27. Mr. Thompson joined the American Car and Foundry Co. when the Wells & French plant was absorbed.

Edward I. Leighton, who at one time or another was identified with a number of Cleveland machinery-building firms, died in St. Augustine, Florida, Feb. 26, aged 66 years. Mr. Leighton was one of the founders of the Van Dorn & Dutton Co., and up to the time of his death retained a financial interest in it and several other Cleveland firms, including the Acme Machinery Co., the Van Dorn Electric Tool Co. and the Reliance Machine Co. Besides his widow, Mr. Leighton is survived by one son, Thomas E. Leighton who is purchasing agent of the Van Dorn & Dutton Co. and the Van Dorn Electric Tool Co.

TRADE CATALOGS

Schum Bros., Metropolitan Tower, New York. Folder. Improved automatic nut lock. Illustrated.

Simonds Mfg. Co., Fitchburg, Mass. Catalog. Saws, files, knives, steel. Illustrated, 180 pp., 6½x9 in.

Marvin & Casler Co., Canastota, N. Y. Catalog E. Casler offset boring head. Illustrated, 14 pp., 6x9 in.

The New Departure Mfg. Co., Bristol, Conn. Treatise. "Ball Bearings in Commercial Applications." Illustrated, 48 pp., 9x12 in.

The Blanchard Machine Co., Cambridge, Mass. Catalog. High power vertical surface grinders. Illustrated, 34 pp., 8½x11 in.

Whiting Foundry Equipment Co., Harvey, Ill. Catalog No. 118. Whiting cupola. Illustrated, 32 pp., 6x9 in. Catalog No. 119. Air hoists. Illustrated, 20 pp., 6x9 in.

Reliance Electric and Engineering Co., Cleveland, Ohio. Bulletin No. 1013. All-gear motor drive for application to cone-pulley lathes. Illustrated, 4 pp., 8x10½ in.

Louis Hanssen's Sons, 213-215 W. 2nd St., Davenport, Iowa. Catalog No. 64, entitled "Hanssen's Unusual Book of Hardware, Factory, Mill and Contractors' Supplies and Tools." Illustrated, 1138 pp., 6x9 in.

D. J. Kelsey, 51 Elm St., New Haven, Conn. Circular. Tilting drafting table with lifting swing blade attachment. Illustrated. Circular. Draftsman's universal square and protractor, combination angle and scale. Illustrated.

BUSINESS ITEMS

The report of a recent fire at the plant of the Cleveland Twist Drill Co. was much exaggerated. The plant was not destroyed—only a small unused building was slightly burned.

The Eagle Stamping Co., Buffalo, N. Y., has opened a New York office at 114 Liberty St., which will be in charge of J Prescott Gage.

The American Foundry Equipment Co., Cleveland, Ohio, and the Sand Mixing Machine Co., New York City, have combined interests and moved into a new plant, located at No. 1111 Power Ave., Cleveland, Ohio. The executive offices will be maintained at 52 Vanderbilt Ave., New York, N. Y., and will be in charge of V. E. Minich, vice-president and general manager.

FORTHCOMING MEETINGS

A course of free lectures on military engineering will be given under the auspices of a committee representative of the four national engineering societies, by Captains Robins, Coiner and Ardery, Corps of Engineers, U. S. A. This course will be under the direction of Major-Gen. Leonard Wood and is designed to assist those who desire to enter the engineering battalion which will be formed at Plattsburg next summer. All engineers interested in preparedness will be welcome, but attendance at these lectures does not imply obligation to subsequent camp duty. Through the cordial attitude and coöperation of the United Engineering Society, the auditorium of the Engineering Societies Building has been placed at the disposal of the army officers. These lectures will be given weekly, having begun on Feb. 14, under the following divisions:

March 13, 1916—The construction, maintenance and repair of roads, bridges and ferries; the selection and preparation of fords.

March 20, 1916—The selection, laying out and preparation of camps and cantonments; the service of general construction; and the special services, including all public work of an engineering nature which may be required in a territory under military control.

March 27, 1916—The construction, operation and maintenance of railways under military control and the construction and operation of armored trains.

American Society of Mechanical Engineers. Spring meeting, April 11-14, New Orleans, La., Calvin W. Rice, secretary, 29 West 39th St., New York, N. Y.

American Society for Testing Materials. Annual meeting June 27 to July 1, 1916, Hotel Traymore, Atlantic City, N. J. Edgar Warburg, secretary, University of Pennsylvania, Philadelphia, Penn.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Wednesday each month. J. A. Brooks, secretary, Brown University, Providence, R. I.

New England Foundrymen's Association. Regular meeting second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. Secretary, R. H. Barnes, Taylor Instrument Companies, Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. J. H. Warder, secretary, 1735 Monadnock Block, Chicago, Ill.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Technical League of America. Regular meeting second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York, N. Y.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	Mar. 3, 1916	Feb. 4, 1916	Mar. 5, 1915
No. 2 Southern foundry, Birmingham	$15.00	$15.00	$9.50
No. 2 X Northern foundry, New York	19.75	19.75	14.25
No. 2 Northern foundry, Chicago	18.50	18.50	13.00
Bessemer, Pittsburgh	21.45	21.45	14.55
Basic, Pittsburgh	18.95	18.70	13.45
No. 2 X, Philadelphia	20.00	20.00	14.25
No. 2, Valley	18.25	18.50	13.00
No. 2 Southern, Cincinnati	17.90	17.90	12.40
Basic, Eastern Pennsylvania	19.50	19.50	13.50
Gray forge, Pittsburgh	18.45	18.45	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger from jobbers' warehouse:

	New York			Cleve-	Chi-
	Mar. 3, 1916	Feb. 4, 1916	Mar. 5, 1915	land	cago
Steel angles, base	2.95	2.60	1.85	3.00	2.90
Steel T's, base	3.00	2.65	1.90	3.00	2.90
Machinery steel (bessemer)	2.95	2.60	1.80	3.00	2.90

Steel Sheets—The following are the prices in cents per pound from jobber's warehouse:

	New York			Cleve-	Chi-
	Mar. 3, 1916	Feb. 4, 1916	Mar. 5, 1915	land	cago
No. 28 black	3.50	3.50	2.60	2.95	3.10
No. 26 black	3.40	3.40	2.50	2.85	3.00
Nos. 22 and 24 black	3.35	3.35	2.45	2.80	2.95
Nos. 18 and 20 black	3.30	3.30	2.40	2.75	2.90
No. 16 black	3.75	3.45	2.35	2.70	3.30
No. 14 blue annealed	3.70	3.35	2.25	3.35	3.20
No. 12 blue annealed	3.65	3.30	2.20	3.30	3.15
No. 28 galvanized	5.65	5.50	3.75	5.25	5.25
No. 26 galvanized	5.35	5.20	3.45	4.95	4.95
No. 24 galvanized	5.20	5.05	3.30	4.80	4.80

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot:

	Black		Galvanized	
	Mar. 3, 1916	Mar. 3, 1915	Mar. 3, 1916	Mar. 3, 1915
¾- to 2½-in. steel butt welded	74%	80%	57½%	69½%
3- to 6-in. steel lap welded	73%	79%	56½%	68½%
Diameter, In.				
¾	2.99	2.20	5.35	3.60
1	4.42	3.40	7.91	5.20
1¼	5.98	4.60	10.70	7.00
1½	7.15	5.50	12.79	8.40
2	9.62	7.40	17.21	11.15
2½	15.21	12.20	27.20	18.60
3	20.65	16.10	35.57	24.20
4	29.43	22.90	50.87	34.50
5	39.96	31.00	68.82	47.00
6	52.84	40.40	91.08	61.00

Bar Iron—Prices are as follows in cents per pound at the places named:

	Mar. 3, 1916	Feb. 4, 1916
Pittsburgh, mill	2.40@2.50	3.10
New York	2.60	2.20
Warehouse, New York	2.90	2.50
Warehouse, Chicago	2.90	...

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-sized lots the following discounts hold:

New York	List price
Cleveland	List price
Chicago	15%

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York	$4.50
Cleveland	4.80
Chicago	3.60

In coils an advance of 50c. is usually charged.

Antimony—Chinese and Japanese brands are quoted as follows in cents per pound for spot delivery, duty paid:

New York.... 43½c. Cleveland.... 50c. Chicago.... 44½c.

Copper Bars from warehouse sell as follows per pound:

New York.... 39.5c. Cleveland... [illegible]c. Chicago.... 30c.

Miscellaneous Metals—The present New York quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	Mar. 3, 1916	Feb. 4, 1916	Mar. 5, 1915
Copper, electrolytic (carload lots)	27.25*	26.00	14.75
Tin	47.00	41.75	....
Lead	6.50@6.75	6.10	4.10
Spelter	20.15	19.50	11.00

ST. LOUIS

Lead	6.50@6.75	5.95	....
Spelter	20.00	19.50	....

*This quotation is for May delivery. For March 28½c. is asked, and for April, 28c.

	New York			Cleve-	Chi-
	Mar. 3, 1916	Feb. 4, 1916	Mar. 5, 1915	land	cago
Copper sheets, base	35.00	32.00	19.75	35.00	35.00
Copper wire (carload lots)	35.00	32.00	16.50	36.00	36.00
Brass rods, base	37.00	38.00	16.00	35.00	35.00
Brass pipe, base	41.00	43.00	18.00	38.00	39.00
Brass sheets	37.00	38.00	18.00	35.00	35.00
Solder ½ and ½ (case lots)	29.37½	26.00	....	30.00	29.70

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York	
	Mar. 3, 1916	Feb. 4, 1916
Copper, heavy and crucible	23.00	21.00
Copper, heavy and wire	22.00	20.50
Copper, light and bottoms	19.00	17.50
Lead, heavy	5.25	5.00
Lead, tea	4.75	4.50
Brass, heavy	14.00	13.25
Brass, light	12.00	10.50
No. 1 yellow rod brass turnings	17.00	12.50
Zinc	14.00	12.00

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	31.50	32.00	32.50	33.00	36.00
¼ to 5/16	31.25	31.75	32.25	32.75	35.75
⅜ to 1⅞	31.00	31.50	32.00	32.50	35.50
1 15/16 to 2⅞	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3 7/16	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3½ to 3 15/16	32.25	32.75	33.25	35.75	36.75
Squares					
3 1/16 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4 15/16	33.00	33.50	36.00	36.50	37.50
5 to 6 15/16	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places indicated:

	New York	Cleveland	Chicago
Best grade	55@60	60@65	55@60
Commercial	25@30	25@30	25@30

SHOP ACCESSORIES

Nuts—From warehouses at the places named, the following amount is deducted from list:

	New York	Cleveland	Chicago
Hot pressed square	$3.00	$3.70	$4.00
Hot pressed hexagon	3.20	3.80	4.20

Tap Bolts—The discount from list at warehouses is as follows:

New York	20%
Cleveland	30%

Wrought Washers—From warehouses at the places named the following amount is discounted on fair-sized orders:

New York....$4.50 Cleveland....$6.60 Chicago......$6.50

At this rate the net prices follow:

Diameter, In.	New York	Cleveland	Chicago
9/16	$9.50	$7.40	$7.50
¾	7.70	5.60	5.70
⅞	6.90	4.80	4.90
1	6.00	3.90	4.00
1¼	5.20	3.10	3.20
1⅜	4.70	2.60	2.70
1½	4.60	2.50	2.60
1¾	4.50	2.40	2.50
2, 2¼, 2½, 2¾	4.30	2.20	2.30
3, 3¼	4.50	2.40	2.50
3½, 3¾	4.70	2.60	2.70
4, 4¼, 4½	5.00	2.90	3.00

For cast-iron washers the base price per 100 lb. is as follows:

New York .... $2.50 Cleveland $4.00

Carriage Bolts—From warehouses at the places named the following discounts from list hold:

	New York	Cleveland
⅜ by 6 in.	60%	65 and 5%
Larger and longer	50%	50 and 15%

Length, In.	New York ¼	New York ½	New York ¾	Cleveland ¼	Cleveland ½	Cleveland ¾	Chicago ¼	Chicago ½	Chicago ¾
1½	$0.40	...	...	$0.33	...	...	$0.32	...	...
2	.44	...	...	.36	...	...	.35	...	...
2½	.48	$1.63	$4.25	.40	$1.38	$3.61	.38	$1.26	$3.23
3	.52	1.77	4.50	.43	1.50	3.82	.41	1.34	3.42
3½	.56	1.91	4.75	.46	1.62	4.04	.44	1.45	3.61

Bolt Ends—Fair-sized orders of bolt ends with hot-pressed nuts from warehouses at the points named sell at the following discounts from list:

New York		50%
Cleveland	small sizes	65 and 10%
	large sizes	50 and 20%
Chicago		60 and 10%

Turnbuckles—From warehouses at the places named the following prices prevail:

Size	New York	Cleveland	Chicago
½	$0.27	$0.18	$0.18
¾	.38	.25	.25
1	.53	.35	.35
1½	1.05	.75	.60
2	1.86	1.59	1.06

These prices are for buckles having right and left stub ends with turnings between the heads measuring 5½ in.

Rivets—The following are the base quotations from warehouse for fair quantities:

	New York	Cleveland	Chicago
Steel 7/16 and smaller	65%	70%	60—10%
Tinned	65%	70%	60—10%*

*An addition of 3.5c. per lb. is usually charged.

For button heads ¾, ⅞, 1 in. diam. by 2 in. to 5 in. sell as follows per 100 lb.:

New York.... $4.50 Cleveland.... $4.00 Chicago.... $3.25

Cone heads, same sizes:

New York.... $4.60 Cleveland.... $4.00 Chicago.... $3.35

	Extra per 100 Lb.
1¼ to 1¾ in. long, all diameters	$0.25
⅝ in. diameter	0.15
½ in. diameter	0.50
1 in. long and shorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

Coach or Lag Screws—For fair-sized orders, the discount from list at warehouse is as follows:

New York	65%
Cleveland	65, 10 and 5%

Machine Bolts—From warehouses at the places named the following discounts hold for fair-sized orders:

	New York	Cleveland
⅜ by 6 in. and smaller	60%	65 and 10%
Larger and longer	50%	50 and 20%

Length, In.	New York ¼	New York ½	New York 1	Cleveland ¼	Cleveland ½	Cleveland 1	Chicago ¼	Chicago ⅝	Chicago 1
2	$0.71	$1.93	$8.00	$0.56	$1.54	$6.40	$0.54	$2.01	$5.76
2½	.74	2.06	8.45	.58	1.65	6.76	.56	2.15	6.08
3	.78	2.19	8.90	.61	1.75	7.12	.58	2.29	6.40
3½	.81	2.32	9.35	.64	1.86	7.48	.60	2.43	6.73

MISCELLANEOUS

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Feb 12	Feb. 19	Feb. 26	Mar.4
Prompt furnace	$3.00@3.25	$3.25@3.75	$3.00@3.50	$3.50@3.75
Prompt foundry	3.75@4.25	3.75@4.25	3.75@4.25	3.75@4.25

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire

⅜, 11/32, 5/16, ¼, 7/32, 3/16	8.50
No. 8, 5/32 and No. 10	9.25
⅛	10.00
No. 12	11.00
3/32, No. 14 and 1/16	12.00
No. 18	14.00
No. 20	16.00

Special Welding Steel

⅛	33.00
5/32	30.00
3/16	28.00

Cast-Iron Welding Rods

¼ by 19 in. long	22.00
3/16 by 12 in. long	26.00
⅜ by 19 in. long	20.00
½ by 21 in. long	20.00

Vanadium Wire in Coils or Sticks

1/16	15.50
3/32	15.00
⅛	14.00
5/32	12.00
3/16 and larger	11.00

These prices are subject to change according to quantity and shipment desired.

Seamless Drawn Tubing—The base price per pound from warehouse is as follows:

	New York	Chicago
Brass	41c.	38c.
Copper	42c.	39c.

For immediate stock shipment 3c. is usually added, which offers the following quotations:

Diameter, In	Copper New York Mar. 3, 1916	Copper New York Mar. 5, 1915	Copper Chicago	Brass New York Mar. 3, 1916	Brass New York Mar. 5, 1915	Brass Chicago
⅜ to 2½	45.00	22.00	41.00	43.00	19.00	41.00
3	45.00	22.00	41.00	43.00	19.00	41.00
3½	46.00	22.00	42.00	44.50	19.50	42.50
4	47.00	23.50	43.00	45.50	20.00	43.50
4½	49.00	24.50	45.00	47.50	21.00	45.50
5	51.00	25.50	47.00	49.50	22.00	47.50
6	52.00	28.50	48.00	50.50	25.00	48.50
7	54.00	30.50	50.00	52.50	27.00	50.50
8	56.00	32.50	52.10	54.60	29.00	52.60

Tin Plates—The following prices in cents per pound are in effect from warehouse:

Coke tin plate, 14x20:

	New York	Cleveland
100-lb.	$5.00	$4.75
I. C. 107-lb.	5.15	4.90

Base Weight	Net Weight	Coating	New York	Cleveland
100-lb.	200	8	$9.00	$8.60
I. C.	214	8	9.30	8.90
I. X.	270	8	11.30	11.10
I. C.	218	12	12.00	10.10
I. C.	221	15	13.00	10.90
I. C.	226	20	13.50	12.20
I. C.	231	25	14.25	13.40
I. C.	236	30	15.50	12.40
I. C.	241	35	17.00	15.60
I. C.	246	40	19.00	16.60

Zinc Sheets—The following prices per pound prevail:

Carload lots, f.o.b. mill 25.00

	New York	Cleveland	Chicago
In casks	26.00	25.50	28.00
Broken lots	26.50	26.00	30.00

Cotton Waste—The prices in cents per pound are as follows:

	New York	Cleveland	Chicago
White	10.00@12.00	11.00@15.00	11.00
Colored mixed	7.00@ 9.00	7.00@10.00	10.50

Sal Soda—These quotations are per 100 lb. at the places named:

New York	$1.35	Philadelphia	$1.10
Cleveland	2.00	Chicago	1.85

Roll Sulphur in 360-lb. bbl. sells as follows:

New York.... $2.25 Cleveland.... $2.60 Chicago.... $2.85

Linseed Oil—These prices are per gallon:

	New York	Cleveland
Raw in barrels	$0.79	$0.84
5-gal. cans	.89	.94

Boiled, it is 1c. per gal. higher.

White Lead, dry and in oil, in cents per pound sells as follows:

100-lb. keg	9.00
25- and 50-lb. kegs	9.25
12½-lb. keg	9.50
1- to 5-lb. cans	11.00

Red Lead, dry, in cents per pound sells as follows:

100-lb. keg	9.00
25- and 50-lb. kegs	9.25
12½-lb. keg	9.50

In oil, the price in cents per pound is as follows:

100-lb. keg	9.50
25- and 50-lb. kegs	9.75
12½-lb. keg	10.00

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

Bell Bros., manufacturer of shoes, Salem, Mass., plans to construct a factory at Showhegan, Maine.

Plans are being prepared for a 1-story garage for Bennett Rockman, 127 Humbolt Ave., Roxbury, Boston, Mass. Estimated cost, $10,000.

The Colonial Realty Trust Co., 30 State St., Boston, Mass., awarded the contract for the construction of a 2-story, 110x240-ft. garage at Boston. Estimated cost, $100,000.

The Harrison Avenue Garage Trust will build a garage at 485 Harrison Ave., Boston, Mass.

The contract has been awarded for the construction of a 55x140-ft. addition to the Three Field Garage, Commonwealth Ave., Allston, Boston, Mass.

The Gunning Boiler & Machine Co., New Bedford, Mass., will build an addition to its plant on South Water St., New Bedford.

Plans are being prepared for the construction of an addition to the plant of the Hampden Toy Co., Westfield, Mass.

Bids will soon be received for the construction of a factory at Bristol, Conn., for C. G. Garrigus Machine Co. Noted Feb. 24.

The Colt's Patent Fire Arms Manufacturing Co. awarded the contract for the construction of a 4-story, 60x175-ft. addition to its plant at Hartford, Conn. Noted Feb. 10.

F. H. and A. H. Chappel Co., Bank St., New London, Conn., will build a 1-story, 57x110-ft. garage at New London.

The Eastern Brass and Ingot Co. plans to construct a 58x200-ft. factory at Waterbury, Conn.

MIDDLE ATLANTIC STATES

The John E. Smith's & Sons Co., Buffalo, N. Y., manufacturer of butchers' and packers' machinery has awarded the contract for a 2-story reinforced concrete building. Estimated cost, $35,000.

Plans are being prepared for a commercial garage for William H. Bissell, Buffalo, N. Y.

Fire, Feb. 14, destroyed the munitions plant of the General Electric Co., Schenectady, N. Y.

The Traymore Co., Atlantic City, N. J., is having plans prepared for a garage.

Plans are being prepared for a 4-story garage for the Hezamer Auto Co., 219 Hudson St., Hoboken, N. J.

Contract awarded for 2-story garage for the Allentown Auto Works, 1411 Chew St., Allentown, Penn. Estimated cost, $12,000.

E. F. Stichter, Macungie, Penn., will build a general machine shop.

Directors of the Carnegie Steel Co., contemplates extensions to its plant at New Castle, Penn. Estimated cost, $4,000,000.

P. G. Glynn will construct a garage at 32 West Highland Ave., Philadelphia, Penn.

The Harrison, Rea Co., 1027 Wood St., Philadelphia, Penn., will build a garage. Estimated cost, $10,500.

The Koelle-Speth & Co., Philadelphia, Penn., will build a 2-story machine shop.

Morgenthaler Bros., 2nd St. and Snyder Ave., Philadelphia, Penn., awarded contract for a 2-story machine shop addition.

The Pennsylvania Equipment Co., Coleman Bldg., Philadelphia, Penn., is in the market for 2 second-hand whirles.

The Stewart & Stevens' Iron Works, Philadelphia, Penn., purchased the building at 1718-1722 North 9th St., Philadelphia, and will build an addition for the structural iron and steel department.

Plans are being prepared by Watson & Huckel for a 1-story addition to the plant of the Hess Bright Manufacturing Co., Front St. and Erie Ave., Philadelphia, Penn., manufacturer of ball bearings.

Contract awarded for 1-story garage for Simon Weil, 2103 Germantown Ave., Philadelphia, Penn. Estimated cost, $12,000.

Plans are being prepared for a commercial garage and service station for McAllister Bros., Pittsburgh, Penn. Estimated cost, $60,000.

The Machinists Supply Co., Pittsburgh, Penn., is in the market for 61,000 taper pins as follows: 20,000 6-in., No. 7, 10,000 6-in., No. 8, 1,000 6-in., No. 9, 30,000 7-in., No. 9, with ¼-in. taper per ft.

The Packard Motor Car Co., Detroit, Mich., has awarded the contract for the construction of a 2-story, 100x223-ft. service building at Pittsburgh, Penn. Estimated cost, $200,000.

The Carpenter Steel Co., Reading, Penn., will build an addition to its plant.

The Sharon Foundry Co., Wheatland, Penn., has awarded the contract for an addition to its steel foundry.

Plans are being prepared by T. J. Litzelman, Arch., 149 West 4th St., Williamsport, Penn., for a 1-story foundry at Williamsport.

The Hess Steel Corporation, Witherspoon Bldg., Philadelphia, Penn., has awarded contract for a 1-story building at Baltimore, Md.

The contract has been awarded for the construction of a 2-story, 77x85-ft. garage at Maryland and Mt. Royal Ave., Baltimore, Md., for William H. Marcus, 525 Equitable Bldg. Noted Dec. 9.

The contract has been awarded for the construction of a reinforced-concrete garage and repair shop at 27 South Charles St., Baltimore, Md., for the Mid-City Garage and Motor Supply Co., Baltimore. Estimated cost, $75,000. Noted Dec. 9 and Feb. 24.

The Motorcar Co., Baltimore, Md., has leased site at 1021-25 Guilford Ave., Baltimore, Md., and will establish a garage and service station.

The Paye Bus Co., 1728 North Charles St., Baltimore, Md., has awarded the contract for the construction of a 2-story garage at 27 East North Ave., Baltimore.

SOUTHERN STATES

The contract has been awarded for the construction of a 3-story, 44x131-ft. garage on Broad St., Richmond, Va., for William M. and G. M. Schwratzschild. Estimated cost, $25,000.

The Seaboard Air Line Ry. has awarded the contract for repair shops at Hamlet, N. C. W. D. Faucette, Norfolk, Va., Ch. Engr. Estimated cost, $150,000.

Plans have been prepared for machine shops at Roysters, S. C. (Columbia post office), for the Southern Ry. B. Herman, 1300 Pennsylvania Ave., Washington, D. C., Ch. Engr.

Plans have been prepared for the construction of a 2-story, 75x100-ft. garage for the Georgia Automobile Exchange, Columbus, Ga. Estimated cost, $10,000.

Press reports state city of Macon, Ga., will construct garage. J. J. Gaillard is City Engr.

The contract has been awarded for the construction of a garage for the Citizens and Peoples Mortgage Co., Pensacola, Fla. Estimated cost, $10,000.

Press reports state that the Mobile & Ohio R.R. will take over, enlarge and operate the Armstrong Machine Shop in Meridian, Miss.

The Illinois Central Railroad Co. has awarded the contract for the construction of shops at Jackson, Tenn. A. S. Baldwin, 135 East 11th St., Chicago, Ill., Ch. Engr.

Plans have been prepared by W. H. Sears, Chattanooga, Tenn., for a 3-story garage at 613 Broad St. for the Southern Auto and Supply Co., Chattanooga, Tenn. Estimated cost, $16,000.

The Moran Flexible Steam Joint Co. will build a 4-story factory at Louisville, Ky. Estimated cost, $15,000.

The Recip-Roto Engine Co., Owensboro, Ky., incorporated with a capital stock of $400,000, contemplates building a plant for the manufacture of a patented rotary engine. C. F. Moors, Pres.

The Sturgis Auto Sales Co., Sturgis, Ky., will equip a garage. T. E. Jenkins is Pres.

MIDDLE WEST

The contract has been awarded for the construction of a 2-story, 31x32-ft. addition to the plant of M. L. Andrews & Co., manufacturer of wood working machinery, at Colerain and Alabama St., Cincinnati, Ohio. Noted Feb. 24.

The contract has been awarded for the construction of a 2-story, 65x112-ft. garage for the Belvins Auto Sales Co. at Cincinnati, Ohio. Estimated cost, $25,000. Noted Mar. 2.

The contract has been awarded for the construction of a 2-story, 65x85-ft. addition to the factory of John Steptoe Shaper Co. on Colerain Ave., Cincinnati, Ohio. Estimated cost, $20,000. Noted Mar. 2.

Bids will soon be received for the construction of a 1-story, 132x152-ft. garage at Cleveland, Ohio, for the Adams Express Co., 333 Superior Ave., N. W., Cleveland. Estimated cost, $50,000. Noted Mar. 2.

Bids have been received for the construction of an addition to the plant of the Ajax Manufacturing Co., Manufacturer of nut and bolt machinery, at Cleveland, Ohio. Noted Dec. 9.

We have been informed that the plant of the Cleveland Twist Drill Co., Hamilton Ave. and East 49th St., Cleveland, Ohio, was not destroyed by fire as stated in our issue of Mar. 2. The fire damaged only an unused shed.

The Kilby Manufacturing Co. has awarded the contract for the construction of a 1-story, 46x167-ft. addition to its foundry at Cleveland, Ohio. Estimated cost, $15,000.

The King Bronze and Aluminum Co., 1730 East 37th St., Cleveland, Ohio, will build an addition to its plant at Cleveland.

Preliminary plans are being prepared for the construction of a 1-story, 92x230-ft. garage at Cleveland, Ohio, for Henry P. Oster, 10550 Euclid Ave., Cleveland. Estimated cost, $30,000.

Plans are being prepared for the construction of a 1-story, 132x132-ft. garage for the Taber Ice Cream Co., Payne Ave. and East 35th St., Cleveland, Ohio. Estimated cost, $25,000.

The contract has been awarded for the construction of a 1-story, 60x165-ft. garage at Marion, Ohio, for A. A. Starner, 271 South Main St. Estimated cost, $10,000.

The C. C. Fouts Co. plans to enlarge its plant at Middletown, Ohio, for the manufacture of a metal flume.

The contract has been awarded for the construction of a 3-story, 50x50-ft. addition to the factory of the Acklin Stamping Co., manufacturer of sheet metal stamping, at Toledo, Ohio. Estimated cost, $6,200. Noted Dec. 2.

Preliminary plans are being prepared for the construction of a 1-story, 88x100-ft. garage on Van Buren St., Columbia City, Ind., for Johnson & Diffendarfer. Estimated cost, $10,000.

The contract has been awarded for the construction of a 1-story, 80x140-ft. machine shop at Kokomo, Ind., for the Superior Machine Tool Co. Estimated cost, $15,000. Noted Feb. 17.

The Grand Rapids Brass Co., Grand Rapids, Mich., is constructing a factory at Belding, Mich. Noted Feb. 10.

The Bour-Davis Motor Car Co. plans to construct a factory on Kercheval Ave., Detroit, Mich. C. J. Bour is Pres.

August C. Fruehauf, manufacturer of automobile bodies, has awarded the contract for the construction of a 2-story, 50x164-ft. factory at Detroit, Mich. Estimated cost, $5,000.

Plans are being prepared for the construction of a 1-story, 60x155-ft. brass foundry and machine shop at Detroit, Mich., for the Marx Brass Foundry.

The Michigan Stamping Co. plans to construct a factory at Detroit, Mich.

The contract has been awarded for the construction of a 3-story, 62x92-ft. factory at Detroit, Mich., for the National Can Co.

The contract has been awarded for the construction of a plant at Detroit, Mich., for the Timken-Detroit Axle Co. Noted Feb. 3.

The contract has been awarded for the construction of a 2-story factory at East Grand Blvd. and St. Aubin Ave., Detroit, Mich., for E. J. Woodison Co., manufacturer of fire brick foundry equipment and platers and polishers supplies.

The contract has been awarded for the construction of a 1-story, 78x132-ft. and 26x127-ft. factory at Flint, Mich., for the J. B. Armstrong Co., manufacturer of steel springs.

The Standard Building and Fuel Co. plans to construct a 40x40-ft. washing and screening plant at Grand Rapids, Mich. Estimated cost, $20,000.

The contract has been awarded for the construction of a 2-story, 80x150-ft. addition to the plant of the Steel Furniture Co. at Grand Rapids, Mich. Estimated cost, $15,000. Noted Mar. 2.

Work will soon be started on the construction of an addition to the plant of the Ford Motor Co., Highland Park, Mich. Estimated cost, $1,000,000. Frank L. Klingensmith, Detroit, is Vice-Pres. Noted Dec. 30.

The Brownwall Engineering and Pulley Co. contemplates constructing a 2-story, 50x100-ft. factory at Holland, Mich. Estimated cost, $25,000. F. A. Wall is Mgr.

The Michigan Foundry Co. will construct a 100x105-ft. factory at 8th and Fairbanks Ave., Holland, Mich. John Glupker is Mgr.

Bids will soon be received for the construction of a foundry for the Novo Engine Co. at Lansing, Mich. Noted Nov. 25.

W. K. Prudden & Co. has awarded the contract for the construction of a 2-story, 70x540-ft. addition to its plant at Lansing, Mich. Estimated cost, $120,000. Noted Feb. 24.

The Linderman Manufacturing Co., manufacturer of metal products, is constructing the 2nd addition to its plant at Muskegon, Mich.

Bids will soon be received for the construction of a 1- and 2-story, 68x100-ft. garage for R. H. Lewis at Alton, Ill. Estimated cost, $10,000.

The contract will soon be awarded for the construction of a 1-story, 168x272-ft. plant at Argo, Ill., for the Elgin Motor Car Corporation. Estimated cost, $50,000.

WEST OF THE MISSISSIPPI

The Chicago, St. Paul, Minneapolis & Omaha Ry. contemplates improving its shops at Howard and 22nd St., Sioux City, Iowa. Estimated cost, $60,000. H. Rettinghouse, St. Paul, Minn., Ch. Engr.

Plans have been prepared for 2-story garage for F. E. Prezzler, 2514 Pierce St., Sioux City, Iowa. Estimated cost, $20,000. F. E. Colby, 510 Davidson Bldg., Arch.

Bids will soon be received for a 2-story garage and machine shop for Mueller Bros., Gaylord, Minn. Estimated cost, $12,000. W. D. MacLeith, Fulton Bldg., St. Paul, Arch. Noted Feb. 24.

The Minnesota Furnace Supply Co., St. Paul, Minn., will build a factory at Rice and Pennsylvania Ave.

Bids will soon be received for a blacksmith shop for Atchison, Topeka & Santa Fé Ry., Topeka, Kan. Estimated cost, $70,000. C. F. W. Felt, Railway Exchange, Chicago, Ill., Ch. Engr.

Bids will soon be received for a 2-story garage at 9th St. and Broadway, Hannibal, Mo., for Thomas L. Anderson. Estimated cost, $15,000. M. S. Martin, Hannibal Trust Bldg., Arch.

Contract for a garage for Verne Norton, Joplin, Mo., has been awarded. Estimated cost, $15,000.

Contract for 6-story plant to be built at Kansas City, Mo., for the Willys-Overland Co., Toledo, Ohio, has been awarded. Estimated cost, $250,000.

Plans being prepared by William B. Ittner, Arch., 9th and Locust St., for a 2-story factory for Fred Medart Manufacturing Co., St. Louis, Mo., manufacturer of steel ladders. Estimated cost, $40,000. Noted Jan. 27.

Contract for rebuilding the shops of the Texas & Pacific Railway Co., Marshall, Tex., has been awarded. C. H. Chamberlin, Dallas, Engr. Noted Jan. 6.

Contract for roundhouse and shops for the International & Great Northern Railroad Co., San Antonio, Tex., has been awarded. Estimated cost between $300,000 and $400,000. O. H. Crittenden, 603 Mason Bldg., Houston, Ch. Engr. Noted Jan. 13.

The San Antonio Machine & Supply Co., San Antonio, Tex., has increased its capital stock from $300,000 to 450,000, and will enlarge and improve its machine works.

The Stanford Motor Co., Stanford, Tex., will construct an automobile repair shop at Stanford.

Contract for garage for Kezia Descombes Estate, Chickasha, Okla., has been awarded.

The Sharpe Motor Car and Body Co., Oklahoma, Okla., will build a factory for the manufacture of automobile bodies.

Bids will soon be received by William Cowe, Arch., 508 Mack Bldg., for a 3-story garage and sales building at Denver, Colo., for Vasso Chucovitch. Estimated cost, $40,000.

WESTERN STATES

Beem & Hammerquist will construct a commercial garage and machine shop at Filer, Idaho.

P. Gustavson and John McLarty, Chehalis, Wash., plan to construct a plant at Chehalis for the manufacture of motor trucks.

J. P. Hoerlock, Medford, Ore., plans to construct a commercial garage and machine shop at Wallowa, Ore.

Work has been started on the construction of a 6-story, 120x240-ft. auto depot and repair shop at Bush St. and Van Ness Ave., San Francisco, Calif., to be occupied by J. W. Leavitt & Co. Estimated cost, $400,000.

The Superintendent of Schools of Santa Barbara, Calif. is in the market for several lathes.

H. J. Watje, 400 West 60th St., Los Angeles, Calif., plans to construct a commercial garage and machine shop at Moneta and Slauson Ave., Los Angeles. F. A. Brown, Investment Bldg., Los Angeles, is Arch.

CANADA

The Louden Machine Co., Guelph, Ont., will build an addition to its plant. Estimated cost, $20,000.

The Automobile Owner's Association, 108 King St. W., Hamilton, Ont., will construct a garage at Hamilton.

The Hall Motor Co. will equip a plant at Markham, Ont., for the manufacture of motors, motor trucks, etc. E. A. Hall is Mgr.

William Kennedy & Sons, Ltd., Owen Sound, Ont., manufacturer of water power equipment, machinery, steel castings, etc., has taken over the plant of the old Cramp Steel Co., Owen Sound, and will remodel it for the production of steel for munition and other purposes.

The Sudbury Construction and Machinery Co., Sudbury, Ont., will build an addition to its plant. Estimated cost, $6,000.

The Brown Copper & Brass Rolling Mills Co., Toronto, Ont., will build an addition to its plant. Estimated cost, $25,000.

The Sheet Metal Products Co. of Canada plans to construct an addition to its plant at 199 River St., Toronto, Ont.

White & Thomas, 212 Simcoe St., Toronto, Ont., will build an addition to their plant for the manufacture of galvanized iron products.

The contract has been awarded for the construction of a 4-story, 125x130-ft. addition to the plant of the American Can Co. at Vancouver, B. C. Estimated cost, $70,000. Noted Feb. 10.

GENERAL MANUFACTURING

NEW ENGLAND STATES

Plans are being prepared by Densmore & Le Clear, Arch., 88 Broad St., Boston, Mass., for the construction of a factory at Portsmouth, N. H., for the Morley Button Manufacturing Co.

The contract will soon be awarded for the construction of a 1-story, 77x150-ft. addition to the cotton mill of the Davis Mills, Quequechan St., Fall River, Mass. Estimated cost, $12,000.

Fire, Feb. 27, damaged the factory of the Kushion Komfort Shoe Co., State St., Lynn, Mass. Loss, $4,000.

Plans are being prepared by the Pratt Engineering Co., Atlanta, Ga., for the construction of a chemical plant at Medford, Mass., for the Commonwealth Acid Phosphate Co., Dover, Del. Estimated cost, $250,000.

The Tait Bros. Paper Co. has awarded the contract for the construction of a 1-story, 50x100-ft. addition to its factory at Bridgeport, Conn.

The contract has been awarded for the construction of a 2-story, 50x90-ft. addition to the plant of the New Haven Carriage Co. on Water St., New Haven, Conn.

MIDDLE ATLANTIC STATES

The Utica Steam and Mohawk Valley Cotton Mills, Utica, N. Y., will build a 4-story addition to its factory.

Fire, Feb. 17 destroyed the plant of the Essex Specialty Co., New Providence, N. J., manufacturer of fire works.

The contract has been awarded for the construction of a 3-story mill at Riverside, N. J., for William F. Taubel, Inc., manufacturer of hosiery. Estimated cost, $25,000.

The Essex Specialty Co., Berkley Heights, N. J., manufacturer of fireworks, will establish a plant at Stirling, N. J.

The Bayard Chemical Co., Woodbridge, N. J., plans to establish a plant on Prospect Ave.

The contract has been awarded for the construction of a factory at 9th Ave. and Hallowell St., Conshohocken, Penn., for F. L. Freas, manufacturer of hydrometers and thermometers.

The Northampton Silk Co., Easton, Penn., plans to construct factory buildings at Ann and St. Joseph St. Estimated cost between $50,000 and $75,000.

The International Wood and Paper Products Corporation, 112 North Calverton Rd., Baltimore, Md., will build an addition to its plant.

SOUTHERN STATES

The Marion Extract Co., Marion, Va., has awarded the contract for a new factory.

Plans are being prepared by the Gwathney Engineering Co. for a plant at Money Point, Va. (Norfolk post office), for the Virginia Hide and Fur Co. Estimated cost, $500,000.

Swift & Co., Chicago, Ill., has awarded the contract for the construction of a cold-storage plant at Norfolk, Va. Estimated cost, $25,000.

According to press reports the E. I. Du Pont de Nemours & Co., Wilmington, Del., plans to construct a plant at Suffolk, Va.

Ray Barnett and Bob Sawyers will build a garage at Graham, W. Va.

The contract has been awarded for the construction of an addition to the plant of the Empire Furniture Co., Huntington, W. Va.

Bids will soon be received for a 60x140-ft. factory at Lumberport, W. Va., for the Mound City Cut Glass Co., Moundsville. Estimated cost, $15,000.

The contract for 2-story garage for the West Morgantown Improvement Co., Morgantown, W. Va., has been awarded. Estimated cost, $25,000. Noted Jan. 27.

The Mound City Cut Glass Co., Moundsville, W. Va., will build a corrugated iron and frame building. Estimated cost, $15,000.

A. C. Summerville plans to construct an 18,000 spindle cotton mill at Charlotte, N. C.

The White Manufacturing Co., Kimesville, N. C., recently incorporated, will establish a plant for the manufacture of yarn. G. A. Foster, is Pres.

J. D. Chason and associates are organizing a company with a capital of $200,000 to establish a packing plant at Bainbridge, Ga. Estimated cost, $150,000.

The contract has been awarded for the construction of a 2-story, 130x130-ft. syrup refinery for the Hardway Cargill Co., Columbus, Ga. Estimated cost, $32,796.

The Merck-Hetrick Manufacturing Co., Gainesville, Ga., will install new machinery for the manufacture of hosiery. Estimated cost, $17,000.

The Grantville Hosiery Mills, Grantville, Ga., will build additions to its plant. Park A. Dallis Co., Atlanta, Engr.

The Union Cotton Mills, Lafayette, Ga., plans to install one hundred 60-in. looms.

Brooks Simmons, Statesboro, Ga., is interested in establishing a packing plant.

The Richmond Hosiery Mills, Rossville, Ga., plans to construct a 1-story, 50x100-ft. mill at Soddy, Tenn.

Plans have been prepared for additions to the plant of the Davis Hosiery Mills, Chattanooga, Tenn. Estimated cost, $150,000.

The Ocoee Woolen Mills, Cleveland, Tenn., recently incorporated, plans to construct a 2-story, 60x100-ft. factory. W. H. Durkee, Mgr.

Nood & Co., Nashville, Tenn., will construct a 7-story, 80x80-ft. addition to its cold-storage plant.

The American Woolen Co., Louisville, Ky., will build additions to its plant.

MIDDLE WEST

Fire recently destroyed the packing plant of Zimmerly Bros. on Manchester Rd., Akron, Ohio. Loss, $35,000.

Plans are being prepared for the construction of additions to the plant of the Meade Pulp and Paper Co. at Chillicothe, Ohio. Estimated cost, $150,000. Noted Jan. 13.

We have been advised that the American Bromine Co. is constructing a plant at Midland, Mich. Walter N. White, Englewood, N. J., is Pres. Noted Feb. 17.

The contract has been awarded for the contraction of a 1-story, 150x200-ft. plant at Clearing, Ill., for the Smith Form-A-Truck Co. Noted Feb. 17.

Bids will soon be received for the construction of a 2-story, 90x236-ft. factory at Decatur, Ill., for the E. Z. Opener Bag Co. Estimated cost, $30,000. Noted Oct. 14.

Plans have been prepared for the construction of a 4-story, 60x200-ft. and 2-story, 40x120-ft. addition to the plant of the La Crosse Rubber Mills Co. at La Crosse, Wis. A. P. Funk is Gen. Mgr.

Bids are being received for the construction of a 5-story packing plant at New Richmond, Wis., for the Inter-County Coöperative Packing Co. Estimated cost, $175,000. Noted Dec. 23.

WEST OF THE MISSISSIPPI

The Nelson Dry Cleaning Co., Ft. Dodge, Iowa, contemplates building a 2-story factory. E. O. Damon, Mason Bldg., is Arch.

The Mason City Mill Work Co., Mason City, Iowa, plans to build a 2-story factory at 1st and Jackson St. for the manufacturer of sashes, doors, etc.

The Minnesota Brick Co., recently organized will construct a plant at Minneapolis, Minn. Estimated cost, $500,000. C. E. Luce, Chicago, Ill., is interested.

Contract will soon be awarded for a plant on Roberts St., St. Paul, Minn., for Foot, Schultze & Co., manufacturer of boots and shoes. Estimated cost, $500,000. Noted Jan. 20.

Bids will soon be received by Hartford & Hausler, Arch., 1611 Pioneer Bldg., St. Paul, Minn., for a 4-story factory on 9th St., for Maendler Bros., St. Paul, manufacturer of brushes. Estimated cost, $50,000. Noted Feb. 10.

The Northern Insulating Co., will build an addition to its plant at St. Paul, Minn., for the manufacture of insulating material, for refrigerators, linings for building walls, etc. Estimated cost, $50,000.

The J. C. Teitzel Boot Co., Junction City, Kan., will build a factory at Wichita, Kan.

The Gravel Crushing and Washing Co., Cape Girardeau, Mo., contemplates constructing a new plant.

The Kansas City Paper Co., Kansas City, Mo., will construct a 7-story plant at 7th and May St., Kansas City, Mo. Estimated cost, $120,000.

Plans are being prepared for a 3-story cold-storage plant for Marionville-Logan Cold Storage Association, Marionville, Mo. Estimated cost, $40,000. J. L. Heckenlively, Landers Bldg., Springfield, Arch. Noted Feb. 17.

The Carr-Twombley Manufacturing Co., St. Louis, Mo., has acquired a building which it will equip with wood-working machinery for the manufacture of sash, doors and blinds.

The Glueck Box Co., St. Louis, Mo., will construct a box factory at 20th and Washington Ave., St. Louis, Mo.

H. H. Baird, Mobile, Ala., and associates plan to construct a plant at Toyan, Tex., for the manufacture of sulphuric acid and to refine sulphur.

The Wetmore Ginning Co., will build a cotton gin at Wetmore, Tex. Henry Stahl is interested.

The Mid-Continent Chemical Co., Sand Springs, Okla., will build a 1-story factory at Sand Springs. Estimated cost, $70,000.

Plans being prepared for oil refinery for Curtis Oil Co. at Yale, Okla. Robert Drake, Engr.

The Great Western Sugar Co., Denver, Colo., contemplates constructing a plant at 21st and Blake St., Denver.

The Nuckolls Packing Co., Pueblo, Colo., has awarded the contract for a packing plant. Estimated cost, $150,000. Noted Oct. 21.

WESTERN STATES

R. Bugge, of the Scandinavian American Bank, Marshfield, Ore., and Claude Thompson, of the Coos Bay Produce Co., Marshfield, are back of project to construct canning plant at Marshfield.

F. F. Thompson, E. R. Feurborn and L. L. Andrews, Corona, Calif., are interested in project to construct a fruit canning plant at Corona.

CANADA

The St. Maurice Paper Co. plans to construct a factory in the spring at Cap Magdeline, Que.

The Belgo Canadian Pulp and Paper Co., Shawinigan Falls, Que., will build an addition to its plant.

The Imperial Co., Sarnia, Ont., will build a large addition to its machine shop.

The Avon Knitting Co., Erie St., Stratford, Ont., will construct a 3-story addition to its plant.

Classified Advertising

The Classified Advertising section appears on pages 148, 149, 150, *of this issue and will in future appear in the same relative position in the paper.*

American Machinist

MACHINE DESIGN AND CONSTRUCTION

Volume 44, No. 11
Issued Every Thursday
Hill Publishing Company

NEW YORK, MARCH 16, 1916

Price, 15 Cents

Contents, First Page
Advertising Index, Last Page

Immediate Shipment

The Following List of

High-Power Drills

Made of

High-Speed Steel

are in stock for immediate shipment

Diameters in Inches

They Stand Up Under Heavy-Duty Service

5/8	7/8	1 1/8	1 7/16
21/32	29/32	1 5/32	1 15/32
43/64	15/16	1 3/16	1 1/2
23/32	61/64	1 7/32	1 17/32
3/4	31/32	1 1/4	1 9/16
49/64	1 1/64	1 9/32	1 19/32
25/32	1 1/32	1 11/32	1 5/8
13/16	1 1/16	1 3/8	1 41/64
27/32	1 3/32	1 25/64	1 21/32
		1 13/32	

Other sizes not mentioned above also in stock.
This drill not made in sizes less than $\frac{5}{8}$".

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It will receive immediate attention.

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DENVER, COLO.........Hendrie & Bolthoff Mfg. & Supply Co.
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American Machinist

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VOLUME 44 — MARCH 16, 1916 — NUMBER 11

CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormay processes, protected by United States patent issued June 22, 1915, and another pending

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This includes the English Edition. None sent free regularly, no returns from news companies, no back numbers.

Talks With Our Readers

By the Publisher

DRY ROT is the deadliest of the species. It begins at the heart, and, unseen, saps the life blood.

The leaves remain green, and the trunk and boughs, to all intent and purposes, as strong as ever. But the strength is only apparent—the tree is just a shell —a victim of dry rot.

Dry rot is a very common disease in commercial and industrial life.

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If this superiority is false, he has to make it real before his advertising campaign will be successful.

The whole tendency of a vigorous, well-worked-out advertising campaign is invariably to make sound both the company advertising and the product advertised —to keep the dry rot out—to keep the old firm young.

BUY *advertised equipment and supplies, and make sure that you are getting the best that the best has to offer.*

Standardized Machine-Tool Drive

By W. L. Schellenbach

SYNOPSIS—The complete design of a machine-tool drive in the form of a lathe headstock, giving speeds in a geometric progression with the ratio 1.4142. Both cone and geared types are shown. The drive can be adapted to any machine tool in which speed variations are necessary.

The standardization of machine-tool drives is always an interesting subject for discussion, and it has been my experience that the more thought one puts into it the more advantages can be seen. For some time past I have had a thorough knowledge of Carl G. Barth's ideas of speed ranges for machine tools and am quite sure that many designers are not entirely familiar with what Mr. Barth is endeavoring to accomplish. One's first impression of Mr. Barth's ideal speed range does not have the force that comes from better acquaintance with him and his arguments in trying to bring order out of chaos.

A short time ago an engineer who had recently designed a machine-tool drive was quite confident that his speed range was in accordance with Mr. Barth's idea, simply because the range was in geometrical ratio. The *American Machinist* has presented Mr. Barth's method, and there should be no excuse for misunderstanding the chromatic speed range at this time. For those who have not followed the matter closely and may yet fail to understand it—and I am sure there are some—I will repeat it briefly.

The Barth chromatic speed range is based upon the square root of 2, which is 1.4142. This increment can also be reduced to the smaller increment of 1.189, which is $\sqrt[4]{2}$. The logarithmic scale gives a number of values, which Mr. Barth is endeavoring to have established as standard practice in designing speed ranges. They are approximately as follows: 4.75, 5.67, 6.75, 8, 9.5, 11.3, 13.5, 16, 19, 22.6, 26.9, 32, 38, 45.2, 53.8, 64, 76, 90, 108, 128, 152, 181, 215, 256, 304, 362, 430, 512. It is my understanding that all speeds must come somewhere within this list and correspond with the values given, although the increment of change may be any power of 1.189.

After becoming thoroughly familiar with this system, the designer will find it a simple and easy method of laying out his speed range. We may all just as well as not decide on some standard speed range and apply it generally. Mr. Barth does not take the arbitrary stand that his method is best, but that something should be adopted alike for all. This plan can in no way affect individuality or limit the designer in other directions. I am favorable to Mr. Barth's range and think it the best yet proposed. The principal reason is because the back-gear ratios are 2, 4, 8 and 16, according to the range used. This point looks good to me, because on some classes of machines—especially lathes—the back-gear ratio can be utilized for conveniently obtaining coarse leads, something which I believe has not before been claimed for it.

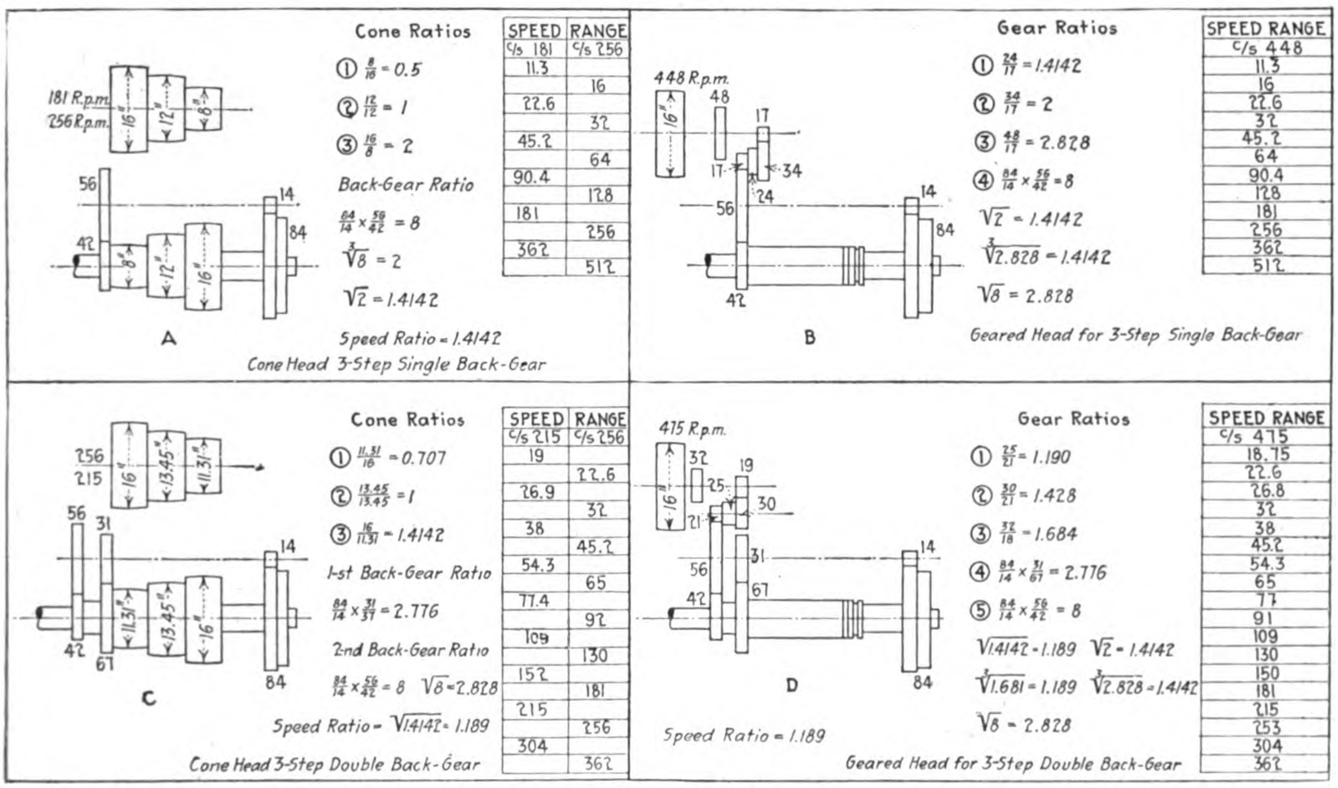


FIG. 1. CONE AND GEAR DIAGRAMS FOR THREE STEPS AND BOTH SINGLE AND DOUBLE BACK GEARS

I used the Barth chromatic speed range in designing a lathe headstock that forms the basis of this paper. I show the device as a headstock, although those familiar with machine-tool designs will readily see that this method slightly modified can be used on almost any machine tool requiring speed changes. The general method of obtaining

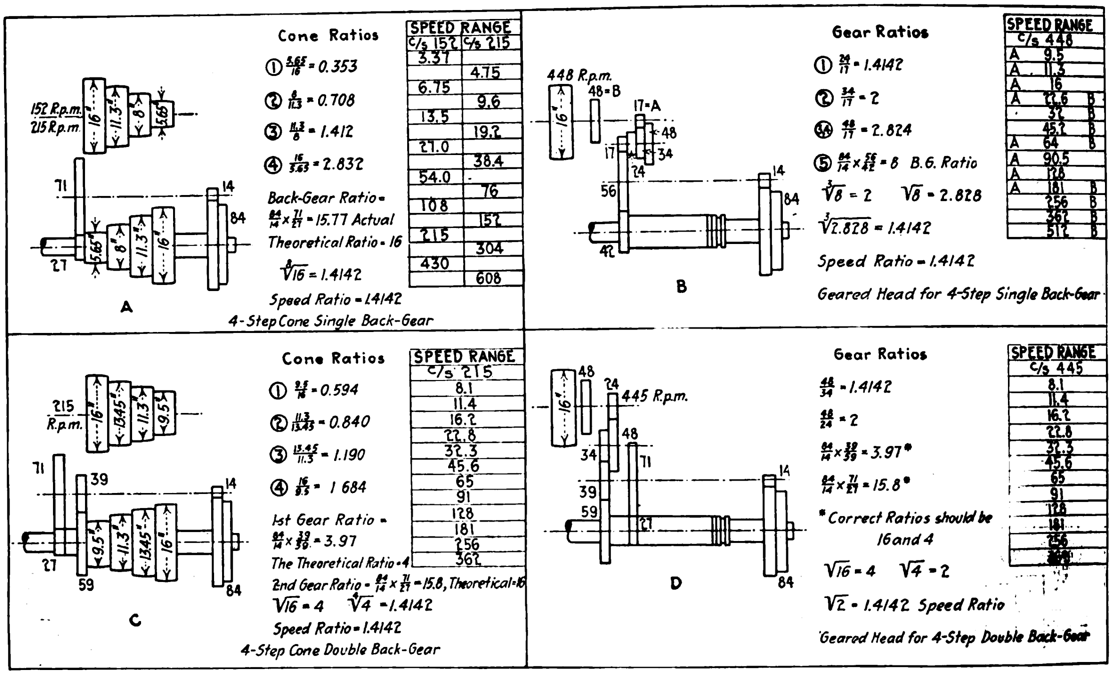


FIG. 2. CONE AND GEAR DIAGRAMS FOR FOUR STEPS AND BOTH SINGLE AND DOUBLE BACK GEARS

the speed ranges is the simplest I have ever seen. The geared and cone drives can be arranged so that the speeds are identical in either case. Very few gears are used in the transmission of the power, and it requires but few gears to do the actual speed changing. This fact obviates the necessity of using so many hardened gears.

I have adopted the chromatic speed range and submit a number of gear diagrams covering all existing types of headstocks of the cone and geared design. Referring to *A*, Fig. 1, it will be noticed that with a two-speed countershaft running 181 and 256 r.p.m. 12 speeds are obtained. This is a three-step cone single back-geared drive. The corresponding geared drive is shown at *B*, Fig. 1. It will be seen that the same speeds are obtained as with the cone drive, but with a single speed of 448 r.p.m. for the driving pulley. Referring to the diagram *C*, Fig. 1, the well-known type of three-step cone double back gear is shown. The countershaft in this case has speeds of 215 and 256 r.p.m., giving a speed range of from 19 to 362 r.p.m. with the increment of speed change at 1.189. Diagram *D*, Fig. 1, shows the same speed range obtained with the geared headstock. In this case it will be seen that 11 gears are used for obtaining 18 speeds, while in the single back gear 9 gears are used for obtaining 12 speeds.

The gear diagram of *A*, Fig. 2, shows a four-step single back gear, and diagram *B*, Fig. 2, shows the same headstock with gearing arranged for obtaining 13 spindle speeds with a single speed of driving pulley. It will be observed in referring to the table *B*, Fig. 2, that two combinations of gears are used for obtaining three of the speeds. This is done to keep the speed range from exceeding the necessary limits. It will be noticed that 10 gears are used for obtaining the 13 speeds, but it would be possible, if the speeds were needed, to obtain 16 speeds with this number of gears.

Diagram *C*, Fig. 2, shows a four-step double back-gear cone headstock giving a speed range of from 8.1 to 362 r.p.m. with a single speed of countershaft. Diagram *D*, Fig. 2, shows the necessary gearing for obtaining the same speeds in the geared head. Ten gears are used in this construction.

On diagram *A*, Fig. 3, a five-step single back gear is shown, giving 20 speeds with a two-speed countershaft. Diagram *B*, Fig. 3, shows the geared headstock to match

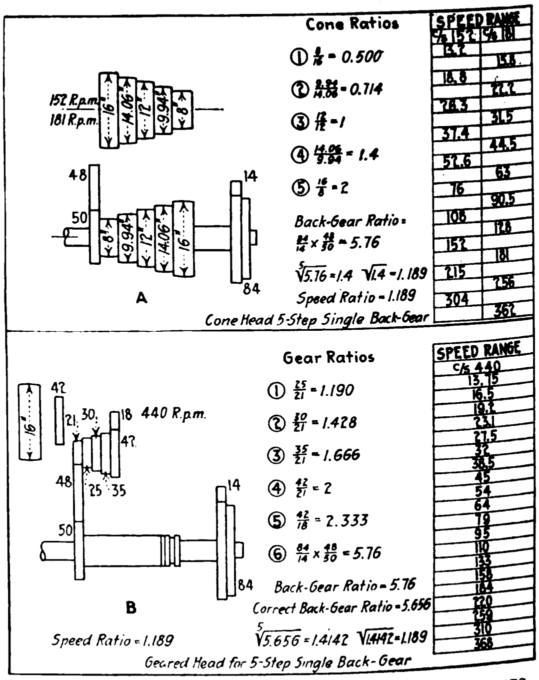
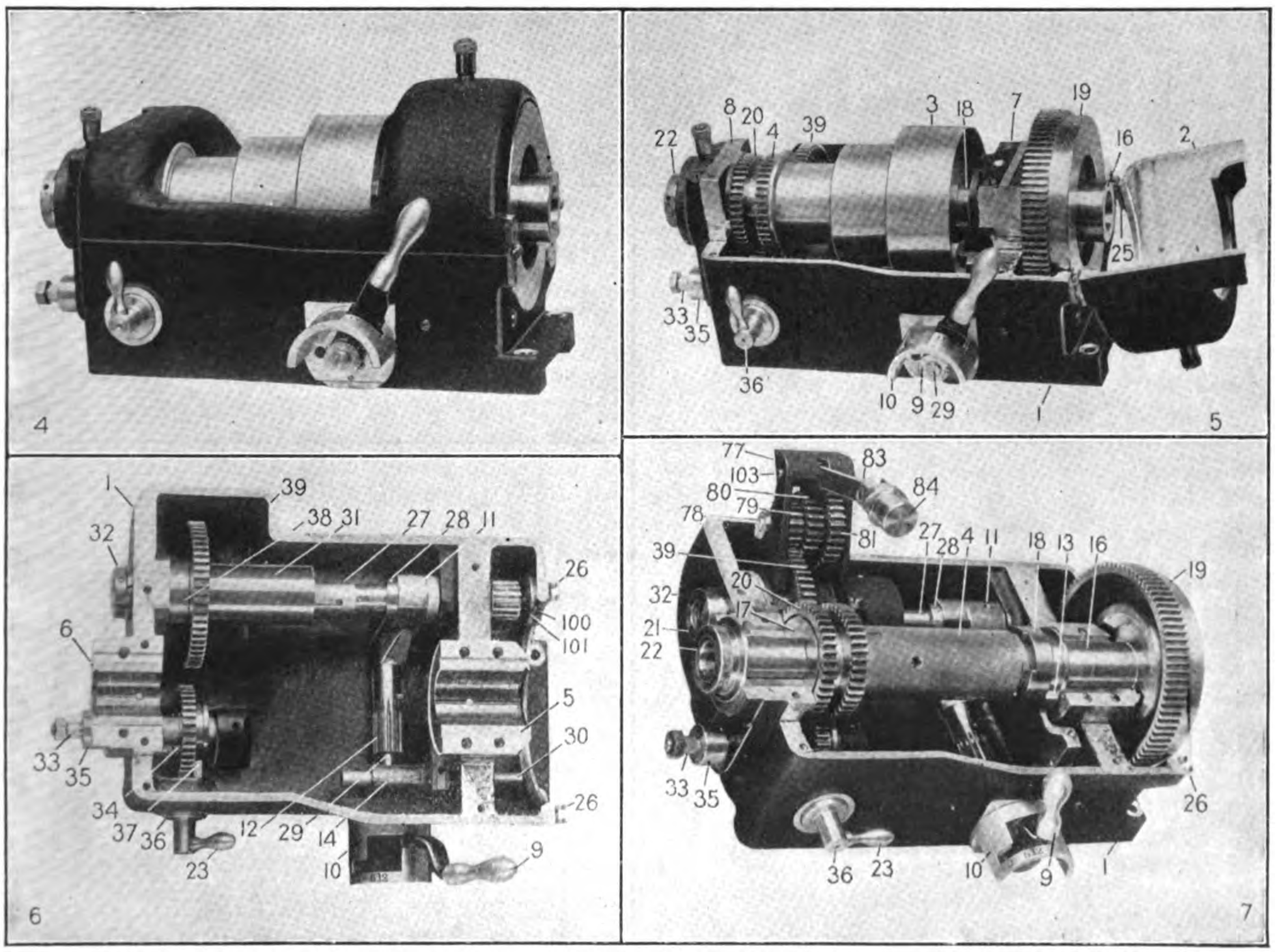


FIG. 3. CONE AND GEAR DIAGRAMS FOR FIVE STEPS AND SINGLE BACK GEARS

this, which gives approximately the same speeds. In the last-named diagram 20 spindle speeds are obtained **with but 11 gears and with but a single speed of the driving pulley.**

Other combinations of gearing may be used for obtaining similar results, but the simplicity of this drive and its flexibility in being adaptable for both the cone and geared heads make it the simplest I have seen. For the purpose of reducing this idea to practice a complete headstock was built and operated under power, and this fact should overcome the too frequent objection advanced when plans only are shown. In the design of this headstock the following points were considered as being vital: (1) Simplicity, or few and easily machined details; (2) standardization or interchangeability of cone and geared head parts; (3) anti-friction bearings; (4) hardened gears where clashed or meshed under power; (5) oil immersion for the geared drive; (6) few gears in mesh under pressure; (7) outside or direct drive to the faceplate or chuck; (8) accessibility of parts; (9) convenience of obtaining speed changes; (10) a fundamental headstock unit for both types; (11) optional reverse or brake.

A general view of the cone type of headstock with the cover in place is shown in Fig. 4. In Figs. 5, 6 and 7 the head casting 1 receives the hinged cover; the face gear 19 is mounted at the outside of the front spindle bearing, but still within the main headstock housing. The spindle 16 has a flange, the outside diameter of which receives the face gear 19, which is threaded to receive the faceplates or chuck. A pilot at the front end of the spindle is made to receive the bore in the faceplates or chuck, and the threaded part of the gear does the driving. This arrangement insures a solid drive direct at the dog or chuck and overcomes the tendency of the spindle to vibrate under heavy back-geared cuts. The cone-gear sleeve 4 is bronze bushed and runs loosely on the spindle, except when the splined clutch 18 engages it and locks it with the spindle. The cone gear 4 has a key near its gear, and the cone pulley is bored and keyseated to fit the outside diameter of 4. A feed gear 20 is keyed to the spindle and forms a bearing for the hardened thrust washer 17. The rear end of the spindle has a collar 21 splined to it and a nut 22 for taking up end thrust. Fig. 6 shows the spindle removed and exposes the back gear and the method for shifting.



FIGS. 4 TO 7. THREE-STEP CONE HEADSTOCK AND DETAILS OF SPINDLE AND GEARING

Fig. 4—Cone-type headstock with cover closed. Fig. 5—Cone-type headstock with cover open. Fig. 6—Headstock with spindle removed. Fig. 7—Headstock showing spindle and speed arm

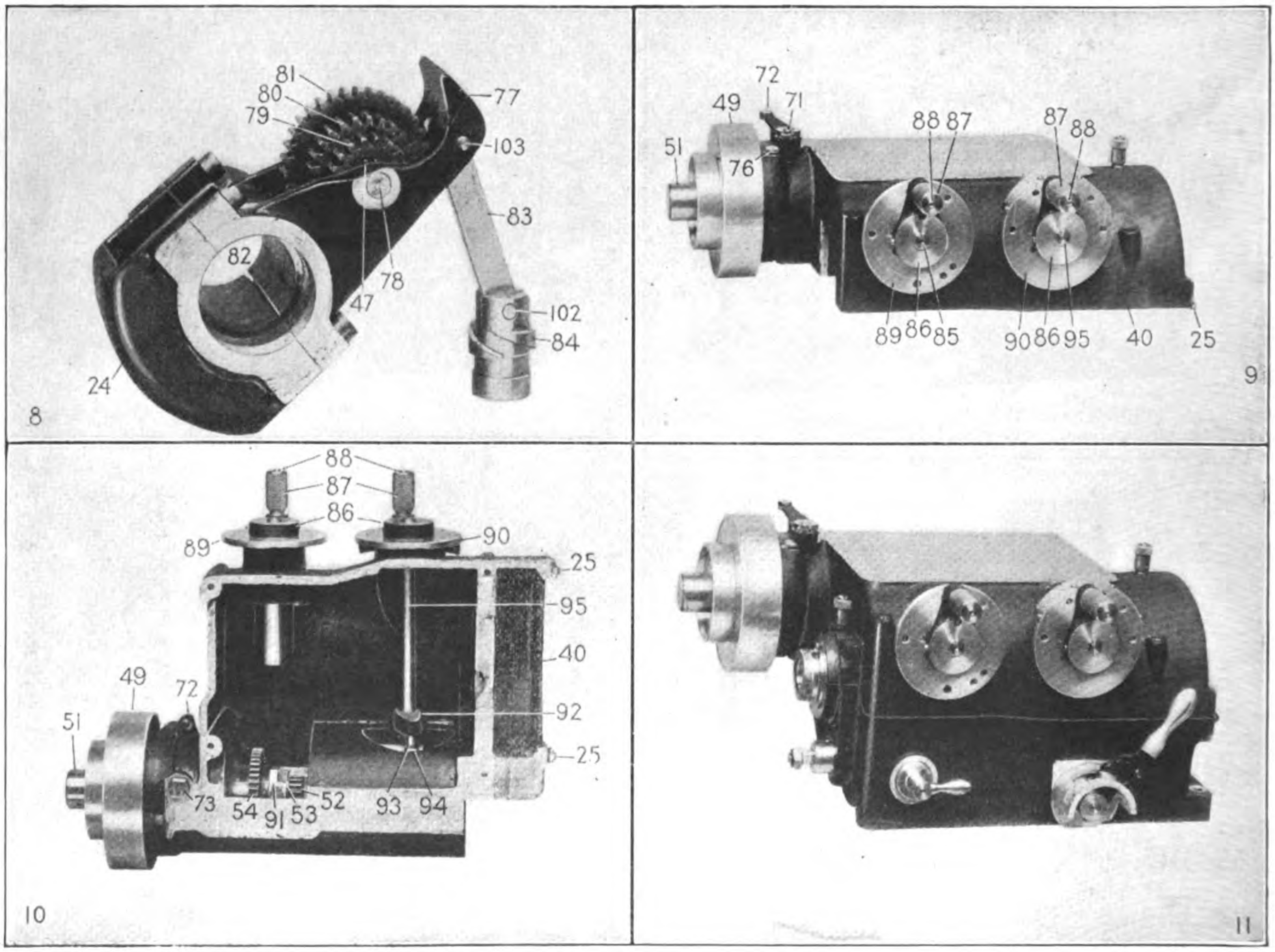
The back gear 27 revolves in the bearing 11 and is confined to it longitudinally by a collar 28. The back-gear pinion is splined to slide in the sleeve 31, to which is keyed the back gear 39. The sleeve 31 takes its bearing in a bronze bushing 38. The collar 32 confines the sleeve 31 against end movement. The cross-shaft 29, Figs. 5 and 6, has the arm 12 pinned to it, one end of which engages a

bushing 11, the other end having teeth cut upon it to engage the rack 14 sliding upon the rod 30. The rack 14 has a shoe, or fork, 13 fitted to it, to engage the spindle clutch. A guard 10 insures the proper engagement and disengagement of the direct and back-geared speeds. It will be noticed that these speeds are stamped upon the guard.

Fig. 7 shows the spindle again in place, with the cone pulley removed and the speed arm 77 taking its bearing on the bushing 38 and on the sleeve 31. The speed arm itself is more clearly shown in Fig. 8. This arm is provided with a cap 24 secured with screws and contains a cone of gears 79, 80 and 81. This cone of gears is hardened and runs on a roller bearing 47 and a pin 78. The headstock was built in accordance with the diagrams of A and B, Fig. 1, and is arranged to provide 12 speeds in the geared head lathe with but a single speed of driving pulley. The arm 77 spans the gear 39, Fig. 6, and this gear meshes with the pinion 79 of the arm. The pins 102, 103 and the link 83 form a connection between the threaded plunger 84 and the arm 77. This arm has only a swinging action around the back-gear shaft, for the purpose of meshing its cone of gears with either of the gears 52 or 54 on the top cover 40, as shown in Fig. 10.

Figs. 9 and 10 show clearly the cover used for the geared-head construction and the drawing, Fig. 12, shows a section through the bored portion of the cover. The outer end of this cover has a flange 42 secured to it by screws. This flange receives ball bearing 44, held by nut 43. The driving pulley 49 is keyed to the internal gear 50 and held in place by the nut 51. A support 74 provides a seat for the ball bearing 44′. This ball bearing supports the sleeve 56 at the inner end, and the sleeve at the outer end is supported by a ball-bearing 45 mounted on the stem 99, which is fitted into the sleeve. A ball bearing 46 supports the internal gear under the friction.

The tapered part of the internal gear fits into the tapered part of the sliding friction gear 66, which is keyed to the sleeve 56. The sliding of gear 66 is accomplished by the toggles 67 and 68. A loose ring 65 is fitted to the gear 66 and carries the pinions 61, which transmit motion from the internal gear 50 to the sliding friction gear 66 when the ring 65 is held stationary by the contracting band 75. The sleeve 56 has four keyways, which receive the sliding shaft of the pinion 52, mounted in a roller bearing 48 and also carrying the gear 54. Both gears 52 and 54 are arranged to mesh with any one of the three gears 79, 80 and 81 on the arm 77. The shaft 52 is arranged to slide longitudinally by means of the carrier 91, which has a groove turned in it to receive a block 94, mounted on the pin 93 of the crank 92, which is pinned to the shaft 95.



FIGS. 8 TO 11. THE SPEED ARM AND COVER CONSTRUCTION OF THE GEARED HEADSTOCK

Fig. 8—Headstock speed arm. Fig. 9—Cover for geared-head construction. Fig. 10—Inside of cover for geared-head construction. Fig. 11—Geared-head construction complete

Referring now to Fig. 10, it will be seen that the shaft 95 is revolved by the crank 86, which has a knob and pin to determine its proper angular position on the index plate 90. Secured to this index plate is a speed with an adjusting screw 71, which engages the plunger 76 bearing against the contracting ring 75.

Fig. 13 shows the device with the reverse omitted and a brake provided. The same method for operation is used

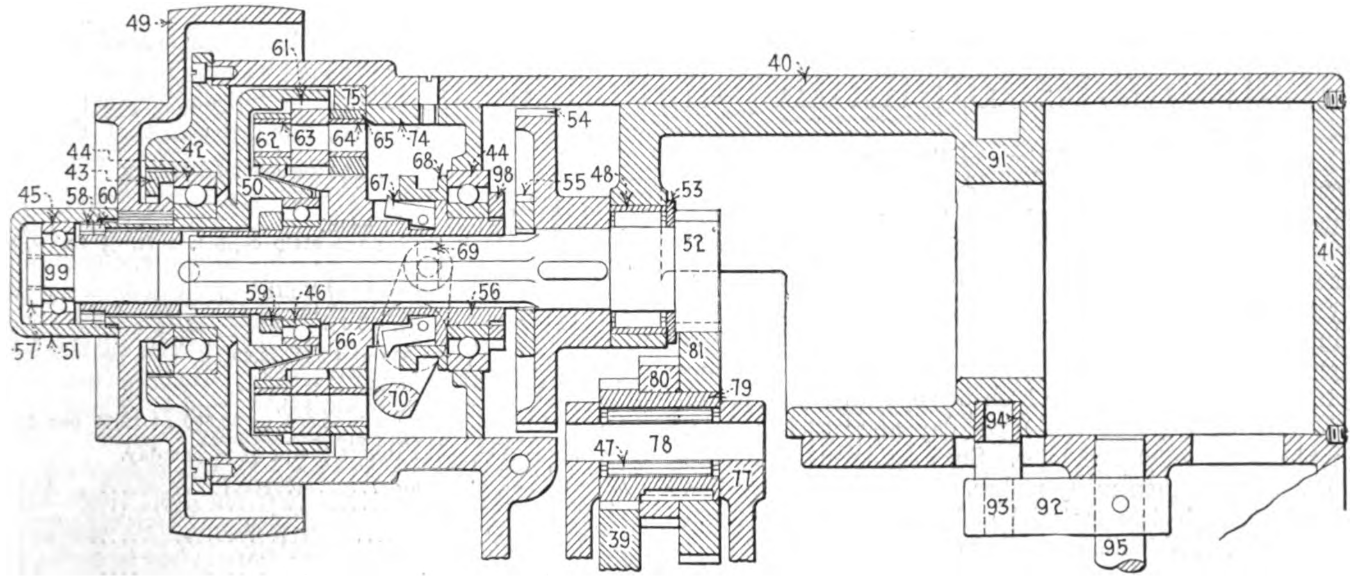


FIG. 12. SECTION THROUGH BORED PORTION OF THE GEARED-HEAD CONSTRUCTION COVER

plate giving a list of speeds. The swinging movement of the arm 77 (see Figs. 8 and 10) is obtained by the engagement of the threaded plunger 84 into the sleeve 85, which also carries a crank 86 engaging the index plate 89.

Fig. 9 shows a lever 72, which is keyed to the shaft 71 passing down into fork 70, the function of which is to slide the collar 68 and depress the toggles 67 (Fig. 12).

Referring now to Figs. 9 and 12, it will be seen that when the friction is engaged the drive will be direct with

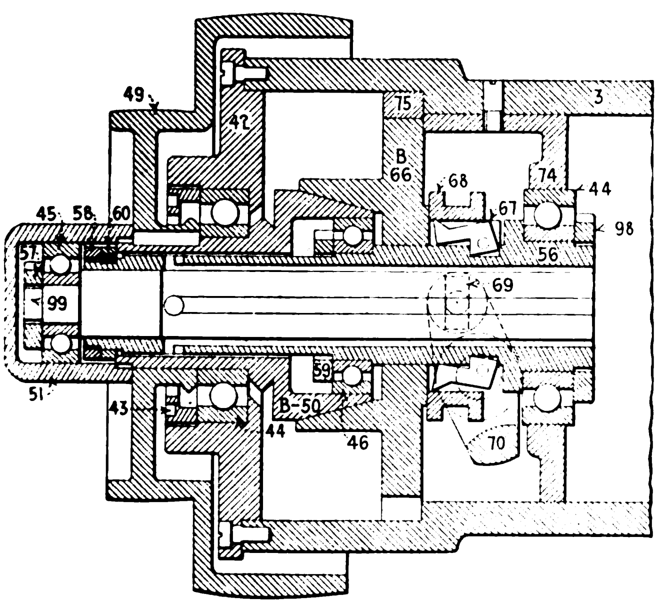


FIG. 13. SECTION OF FRICTION PULLEY AND BRAKE

the pulley, but that when this friction is released and when the contracting ring 75 holds the pinion carrier 65 against rotation the power is then transmitted from the internal gear to the gear 66 in the opposite direction and at an increased speed. This method is used for reversing. Fig. 9 shows the extended end of the lever 72 provided in both cases, *B* 66 having a disk integral with it for engaging the contracting band 75 in the regular way.

Fig. 11 shows the geared head complete, the top planed off to receive a motor. The center of the pulley shaft has been kept as nearly to the top of the headstock as is possible, in order to drive from the motor without more

TABLE OF PARTS IN SCHELLENBACH HEADSTOCKS

	Castings	Steel Cut Off from Bar	Anti-Friction Bearings	Screws	Pins	Nuts	Keys
Cone type	18	18	..	29	13	1	6
Geared type, total	41	56	6	49	22	2	12
Parts interchangeable with cone type	15	18	..	28	13	1	6
Additional for geared type	26	38	6	21	8	1	6

than one intermediate gear. An accompanying table lists the parts used on the cone type, the additional number of parts required for the geared type and the parts that are interchangeable on both types of head.

Why Munition Contracts Have Been Delayed

By A. B. Hazzard

There has been much speculation as to why some of the old-line concerns that have always been successful in former years have lost large sums of money by taking contracts for munitions. In the majority of instances it was a case of trying to do the impossible—trying to equip a plant with machinery, in 60 to 90 days, to manufacture a high-class product with a class of mechanics who had little or no experience in precision work. Some companies went so far even as to buy badly worn second-hand machine tools and lost time and money in overhauling them. In a number of cases the banks absorbed plants, took on war contracts, placed inexperienced men in the management and manipulated the stock to suit.

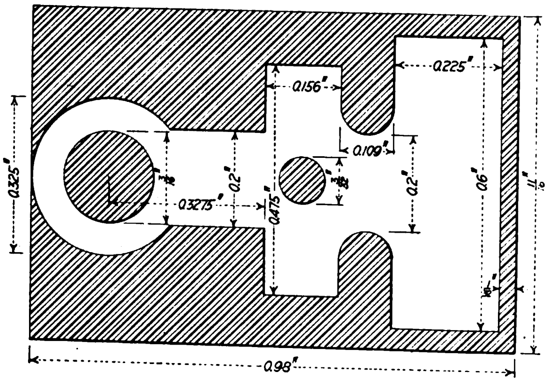
Estimating from a drawing, without giving the proper consideration to the material, has been a very serious drawback. The automatic-machine time on standard bar stock was found to be from 50 to 75 per cent. faster than was possible with the special stock necessary to make munitions. This is due to its being much harder, especially where bar brass is used. As a result, in many cases it was necessary to purchase more modern tools—a fact that was discovered only after serious loss of time, which proved very expensive.

Consider the true conditions of the plant before taking on the war contract; realize that every man was thoroughly familiar with the line-up of tools, knew where all fixtures were located and how to help himself with the usual accessories. It took a long time to get this organization—years, in some cases. Then imagine calling in the superintendent and foreman and telling them that they must prepare to make munitions; that orders for so many hundred thousand shells have been taken, with a guaranteed delivery of 4,000 or 5,000 per day after such a date, probably 60 to 90 days later. Such action presents more of a problem than many realize. It involves a new line of work, high-class material and a refined product—an impossible combination in many cases.

How to Estimate Die Work

By R. W. Johnson

In many factories handling punch and die work in more or less limited quantities the cost of the punch and die has to be written off on the first contract received for the parts for which these tools are made. Further, many times no systematic attempt is made with reference to the preparation of the estimate, with the result that some jobs are taken at an actual loss instead of at a profit, as



THE PART TO BE MADE

would be the case if the estimating had been done in such a manner as would place before the proper official all the information on the subject for which the estimate was prepared. This question is of particular importance when the metals worked are brass, copper or silver.

A concern handling a considerable quantity of miscellaneous work of the above character, generally in limited quantities, was having trouble with its estimating methods and decided to place all estimating in the hands of the engineering department, but arranged so that details of each estimate made would become a matter of record to which reference might be made, should future occasion require. With this end in view the purchasing department was instructed to prepare and send to the chief engineer on the first of each week a memorandum giving in detail the prices of all materials used in the production of the various articles, so that the matter of material costs would be on a safe and sure footing and no errors on this score would creep in.

The chief engineer then worked out a method of making and recording his estimates, such as is shown in the accompanying table. This gives full and explicit details of every step to be taken, from the cost of the raw

DATA AND ANALYSIS OF DIE WORK

Area of blank, 0.328 sq.in.
Area of waste, 0.366 sq.in.
Area of whole piece, 0.694 sq.in.
Material, No. 17 B. & S. gage strip copper, soft, 11/16 in. wide, to be bought in rolls.
Weight, 2.05 lb. per sq.ft.
Material per 1,000 blanks, 84.27 lin.ft.
Material per 1,000 blanks, 9.635 lb.
Weight per 1,000 blanks, 4.5 lb.
Weight of waste, 5.2 lb.
Cost of material per 1,000 at \$0.28, \$2.69.
Credit for 5.2 lb. scrap at \$0.19, \$0.99.
Material cost per 1,000 blanks, \$1.70.
Estimated cost of blanking die, \$65.
Daily production, estimated, 50,000 to 60,000 at \$2.50 per day.
Estimated cost of forming die, \$25.
Daily production, estimated, 6,000 at \$1.25 per day.
Cost per 1,000:

Actual labor, blanking	\$0.042
Actual labor, forming	.20
Total direct labor	\$0.242
Factory expense at 100 per cent.	.242
Material cost	1.70
Total	\$2.184

Percentage of labor to material, 15 per cent.
Remarks—From the above analysis it will pay to study the cutting weight of the blank in order to make any substantial cost reduction.

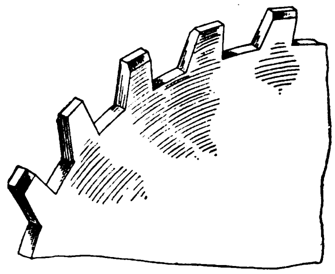
material, including the making of the tools, to the overhead to be charged on getting out the product. In the illustration is shown a detail of the part to be made.

The success that has resulted from the introduction of this improvement in the concern's estimating methods and the measure of satisfaction that has resulted from its use for some time past, not only on the part of the engineering staff, but on the part of the office as well, show that accurate, reliable and permanent records are well worth their preparation and careful filing, in the small factory as well as in the large plant.

Grinding Cold Cutting-Off Saw

W. J. Wells

When a saw jumps and kicks and refuses to cut as it should, it is not always dull, as might be suspected. We had a saw that did this when it was quite sharp. After



CORNERING COLD CUTTING-OFF SAW TEETH

trying several different ways of grinding, we tried cornering each alternate tooth, and the difficulty was ended. This was five years ago, and I have never seen saws ground like this give trouble.

Hardening and Softening Steels in the Small Shop

BY JOHN H. VAN DEVENTER

SYNOPSIS—This article throws light on some right and some wrong ways to harden and anneal carbon and high-speed steels. The use of lead baths, cyanide of potassium and various quenching compositions is treated in detail.

To take his diploma as an all-round small-shop machinist, a man must, in addition to many other requirements, be a fair blacksmith and a first-class tool hardener. The average small-shop owner cannot afford such a luxury as a tool specialist and may perhaps consider himself lucky that he cannot. The idea of specialization has been carried too far. If specialization were the real and ultimate object of man, we should be built differently. Some of us would have nothing but noses—we should do the smelling for the community; others would be exclusive specialists at seeing, and others at hearing. As it is, we are all constructed very much alike and evidently intended by nature to do many things well, although the teachings of the "superspecialists" would make us believe to the contrary.

Judging by the number of inquiries received by the *American Machinist* for information, the hardening and annealing of steels is a matter that is worth presenting to small-shop readers. Like a good many other subjects, different parts of it have been presented from time to time, dispersed over a number of volumes and a number of issues—each one bearing its share of information. In one or two articles on this subject I will try to gather together the most important things to be known and done in connection with hardening and annealing, especially from the viewpoint of practicability for use in the small shop.

METHODS OF HEATING FOR HARDENING AND TEMPERING

The various ways of heating steels group themselves into three distinct divisions: First, in the open fire, in which the piece to be heated is exposed directly to the fuel. This scheme, the oldest, the best known and the commonest, is the one followed in ninety-nine shops out of a hundred. The blacksmith forge as a hardening and tempering appliance is as well known in the large shop as in the small one, and provided care is taken to use fuel free from sulphur and phosphorus and to build the fire deep enough so that the heated metal is not exposed to the direct blast, good results can be obtained. In using the open fire the degree of heat must be gaged by color, which is a disadvantage of this method of heating. While it may give best results some of the time and good results most of the time, it will not give best results all of the time, such as are assured when the degree of heat can be accurately measured and controlled.

The second classification of heating devices may be described as closed retorts or furnaces, in which the piece is protected not only from drafts, but also from attacks by the gases and chemical elements in the fuel. The size of such an outfit may vary from a muffle capable of being juggled about in one hand to a gigantic furnace. When a furnace of this type is fired by oil or gas and is provided with a pyrometer, such as described on page 95, the heat may be closely regulated. I must not forget to mention in this class the electrically heated furnace, which is no doubt the most accurately controlled of any and which is largely used by makers of high-grade small tools as a means of heating their product.

HEATING THE WORK IN A HOT BATH

The third class of heating appliances may be indexed under the name "Bath," although quite different from the Saturday night bath of the small-shop man. It may consist of a pot of melted lead, of melted salt, of potassium cyanide, of sand or of heavy oil. These are of course hot baths, as distinguished from the quenching or cooling baths, which will be mentioned later. The advantages of a bath of this kind are easily obtained in the small shop by placing upon the forge a crucible or an iron kettle containing the bath material. A better way to heat it and one that allows for regulation is by means of a gas or crude-oil burner.

The reason for uniformity of temperature in hardening steels may not be fully understood; and when not, it is difficult for one to realize the importance of maintaining a uniform temperature. In its action, when heated, steel somewhat resembles water. Just as heated water reaches a point where it boils and changes into steam, steel heated sufficiently reaches a point where its particles are changed in their nature and relation. On being cooled to a temperature a little lower than the first the particles will change back again.

These temperatures are called the "critical points" of the steel and vary with different percentages of carbon. The proper hardening temperature is from 30 to 50 deg. above the first critical point. The ideal temperature would be exactly at this point, but allowance must be thus made for cooling in the interval of time before quenching. A table showing these temperatures is given for various percentages of carbon, and it will be noticed that the higher the carbon of the steel the lower this critical temperature becomes.

Steel has a peculiar property of losing its power of attracting a magnet when the critical point is reached, and this fact is taken advantage of by some small-shop owners who do not have pyrometers. A magnetic compass is applied to the piece of heated steel; and when the needle ceases to be attracted by it, the shop man knows that the critical point has been reached.

HARDENING AND ANNEALING TEMPERATURES FOR CARBON STEELS

Per Cent. Carbon	"Points"	Deg. F.
0.10	10	1,616
0.20	20	1,562
0.30	30	1,535
0.40	40	1,508
0.50	50	1,492
0.60	60	1,481
0.70	70	1,476
0.80 to 1.5	80 to 150	1,472

The nearer to the critical point that the small-shop man is able to quench a piece of steel, the finer will be its grain. Its hardness and toughness will also reach a

maximum under these conditions. Over and under this point the grains become gradually coarser, and the hardness decreases.

One thing to remember in heating steels for hardening is to keep the temperature "going up" until the critical point is reached. In other words, it will not do to go above this point and let the temperature drop before quenching. Apparently it is necessary to keep the temperature moving in one direction, in order not to impede traffic among the busy molecules of the heated bar. While this is true, it is equally true that fast heating must be avoided. A piece of steel is often heated so quickly that the outside only is in its proper critical condition.

Every mechanic who has had anything to do with the hardening of tools knows how necessary it is to take a cut from the surface of the bar that is to be hardened. The reason is that in the process of making the steel its outer surface has become decarbonized. This change makes it low-carbon steel, which will of course not harden. It is necessary to remove from $\frac{1}{16}$ to $\frac{1}{4}$ in. of diameter on bars ranging from $\frac{1}{2}$ to 4 in.

This same decarbonization occurs if the steel is placed in the forge in such a way that unburned oxygen from the blast can get at it. The carbon is oxidized, or burned out, converting the outside of the steel into low-carbon steel. The way to avoid this catastrophe is to use a deep fire. Lack of this precaution is the cause of much spoiled work, not only because of decarbonization of the outer surface of the metal, but because the cold blast striking the hot steel acts like boiling hot water poured into an ice-cold glass tumbler. The contraction sets up stresses that result in cracks when the piece is quenched. The next time you harden a milling cutter and have some of the teeth crack off, keep this suggestion in mind.

Preventing Decarbonization of Taps and Reamers

It is especially important to prevent decarbonization in such tools as taps and form cutters, which must keep their shape after hardening and which cannot be ground away on the profile. For this reason it is well to put taps, reamers and the like into pieces of pipe in heating them. The pipe need be closed on one end only, as the air will not circulate readily unless there is an opening at both ends for a "draft," so to speak.

Even if used in connection with a blacksmiths' forge the lead bath has an advantage for heating tools of complicated shapes, since it is easier to heat them uniformly and they are submerged and away from the air. You must remember, however, that unless the metal is stirred, the temperature of such a bath is not uniform. And always remember to use powdered charcoal as a covering for the top of the lead pot. Some may ask why it is necessary to repeat such a simple precaution, but a prominent firm making shrapnel incurred much expense for wasted lead until someone suggested the use of charcoal. A lead bath may be used at temperatures between 620 and 1,150 deg. F. Beyond this there will be much waste by evaporation.

To secure proper hardness, the cooling or quenching of steel is as important as its heating. Quenching baths vary in nature, there being a large number of ways to cool a piece of steel in contrast to the comparatively few ways of heating it.

Plain water, brine and oil are the three most common quenching materials. Of these three the brine will give the most hardness, and plain water and oil come next. The colder that any of these baths is when the piece is put into it the harder will be the steel; but this does not mean that it is a good plan to dip the heated steel into a tank of ice water, for the shock would be so great that the bar would probably fly to pieces. In fact, the quenching bath must be sometimes heated a bit to take off the edge of the shock.

Brine solutions will work uniformly, or give the same degree of hardness, until they reach a temperature of 150 deg. F., above which their grip relaxes and the metals quenched in them become softer. Plain water holds its grip up to a temperature of approximately 100 deg. F.; but oil baths, which are used to secure a slower rate of cooling, may be used up to 500 deg. or more. A compromise is sometimes effected by using a bath consisting of an inch or two of oil floating on the surface of water. As the hot steel passes through the oil, the shock is not as severe as if it were to be thrust directly into the water; and in addition, oil adheres to the tool and keeps the water from direct contact with the metal.

The old idea that mercury will harden steel more than any other quenching material has been exploded. A bath consisting of melted cyanide of potassium is useful for heating fine engraved dies and other articles that are required to come out free from scale. One must be careful to provide a hood or exhaust system to get rid of the deadly fumes coming from the cyanide pot.

Easing Off the Internal Stresses

Work quenched from a high temperature and not afterward tempered will, if complex in shape, contain many internal stresses, which may later cause it to break. They may be eased off by slight heating without materially lessening the hardness of the piece. One way to do this is to hold the piece over a fire and test it as Mrs. Small-Shop Man tests her hot flatiron—with a moistened finger. Another way is to dip the piece in boiling water after it has first been quenched in a cold bath. Such steps are not necessary with articles which are afterward tempered and in which the strains are thus reduced.

In annealing steels the operation is similar to hardening, as far as heating is concerned. The critical temperatures given in the table are the proper ones for annealing as well as hardening. From this point on there is a difference, for annealing consists in cooling as slowly as possible. The slower the cooling the softer will be the steel.

Annealing may be done in the open air, in furnaces, in hot ashes or lime, in powdered charcoal, in burnt bone, in charred leather and in water. There is surely some range of choice for the small-shop man when it comes to doing this work. Open-air annealing will do as a crude measure in cases where it is desired to take the internal stresses out of a piece. Care must be taken in using this method that the piece is not exposed to drafts or placed on some cold substance that will chill it. Furnace annealing is much better and consists in heating the piece in a furnace to the critical temperature and then allowing the work and the furnace to cool together.

When lime or ashes are used as materials to keep air away from the steel and retain the heat, they should be first heated to make sure that they are dry. Powdered charcoal is used for high-grade annealing, the piece being packed in this substance in an iron box and both the work and the box raised to the critical temperature and

then allowed to cool slowly. Machinery steel may be annealed in spent ground-bone that has been used in casehardening; but tool steel must never be annealed in this way, as it will be injured by the phosphorus contained in the bone. Charred leather is the best annealing material for high-carbon steel, because it prevents decarbonizing taking place.

Water annealing consists in heating the piece, allowing it to cool in air until it loses its red heat and becomes black and then immediately quenching it in water. This plan works well for very low-carbon steel; but for high-carbon steel what is known as the "double annealing treatment" must be given, provided results are wanted quickly, as is usually the case with water or oil-bath annealing. The process consists of quenching the steel in water or oil, as in hardening, and then reheating it to just below the critical point and again quenching it in oil. This process retains in the steel a fine-grain structure combined with softness. Large pieces of steel should be rough-turned before annealing. It will not be necessary to say anything about color tempering, this being a subject familiar to all. In drawing temper, however, the color is not the only gage that can be used. One of the best is a thermometer in a bath of heavy oil having a flash point between 500 and 600 deg., which will take care of all the tempers up to that corresponding to dark blue. The steel is first preheated slowly in a fire or furnace, as it might crack if plunged immediately into the hot oil.

In hardening high-speed steel the main requirement is to get the cutting edge hot enough. The air blast for cooling is going out of fashion and an oil bath is taking its place, which will be good news to the small shop that has no air compressor. Lathe and planer tools are usually left in their quenched condition for use, not being tempered or drawn. More complicated and expensive high-speed steel cutters are somewhat insured against breakage by drawing the temper slightly. Milling cutters are drawn to 400 deg. F., drills and reamers to 450 deg. and taps and dies are let down a little farther, not, however, reaching 500 deg.

Boring Pump Chambers in the Drilling Machine

By A. N. Patterson

In the illustration, Fig. 1, is shown a pump-chamber pocket that was bored in a drill press. The top flange was faced, drilled and tapped before the boring was done. This was permissible, as the pockets had no relation one to the other, and the distances between centers of the chambers did not have to be absolutely accurate.

In Fig. 2 is shown the arrangement of tools for all operations. *A* is a plate to hold the guide bushing *B*; this plate was secured to the top flange by capscrews in the tapped holes. The method of operation is as follows: The boring bar in the spindle of the drill press is raised clear of the work, the guide bushing *B* is slipped over the bar and the cutter inserted and secured. The bar is then lowered to the work, the bushing being pushed down in the plate, and the boring commenced.

A roughing and finishing cutter was used for each diameter to be bored. The dimensions of the bar and bushing were such that the bushing would enter the plate before the cutting commenced, so that the bar was always guided when boring.

The tool used for chamfering the bottom of the hole is

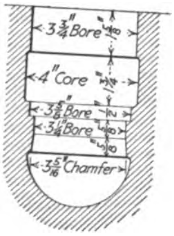


FIG. 1. THE HOLE TO BE MADE

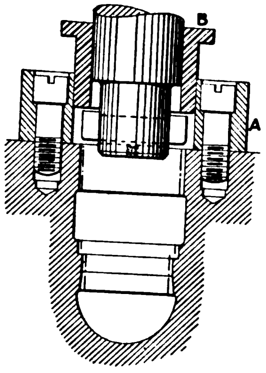


FIG. 2. ARRANGEMENT OF TOOLS

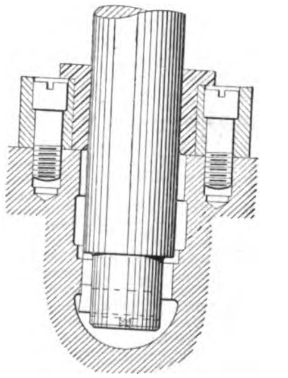


FIG. 3. THE CHAMFERING TOOL

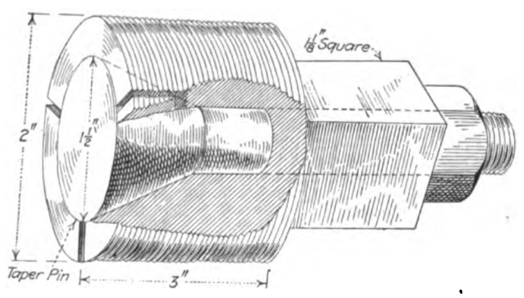
shown in Fig. 3. In doing this operation the bushing was raised clear of the plate and the boring bar and tool inserted eccentrically in the hole, to permit it to enter. The bushing was then forced into the plate, centering the bar, and by feeding upward the hole was chamfered.

A Handy Driver for Removing Shell Sockets

By John Dunn

The accompanying sketch shows a very handy driver for removing the brass socket from an 18-lb. shrapnel shell in order to correct the weight or put on a new socket.

The shell is first heated to break the solder joint between the brass socket and the tube. The plug is then screwed



SHELL-SOCKET REMOVER

in. Tightening the nut on top expands the plug; then by the use of a large wrench the socket may be backed out. This driver will not harm the socket, which may be put back in the ordinary way, and it makes an otherwise nasty job very easy.

Jigs for Machining Detail Parts of a Talking Machine

By Robert Mawson

SYNOPSIS—The jigs here shown and described are of a simple character, but are giving satisfaction. Those used in drilling the top and bottom plates are designed for a multiple drilling machine, thus enabling quick production of parts. In the jig used for the winding crank an adjustable stop plate makes possible any necessary adjustments.

In this article are shown some of the jigs used by the Rex Talking Machine Corporation, Wilmington, Del., in manufacturing its machines. It will be observed that the tools are of somewhat simple design, as the parts machined are not of a complicated nature. However, these tools have been found to give satisfaction both as regards the quality and quantity of work produced.

It will be observed that when machining the top and bottom frames, Figs. 1 and 6 respectively, the operation is performed in a multiple-spindle drilling machine. This enables the machining time to be cut to the lowest limit, and at the same time accurate results are obtained, as after the drill spindles have been once set correctly the drilling operation is of the simplest and requires a minimum of attention.

In drilling the holes in the edge of the top frame a simple yet effective jig is used. After the casting has been located in the jig by means of dowels fitting in previously machined holes a swinging strap and screw bearing on the piece holds it securely. The jig for the winding crank is provided with an adjustable stop, so that the hole may be kept in the correct position in the event of the length of the crank forging varying in any degree.

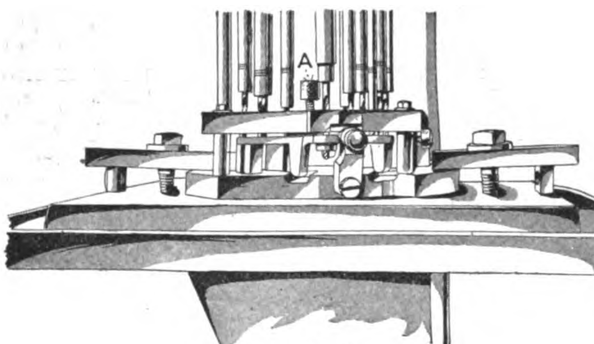


FIG. 2

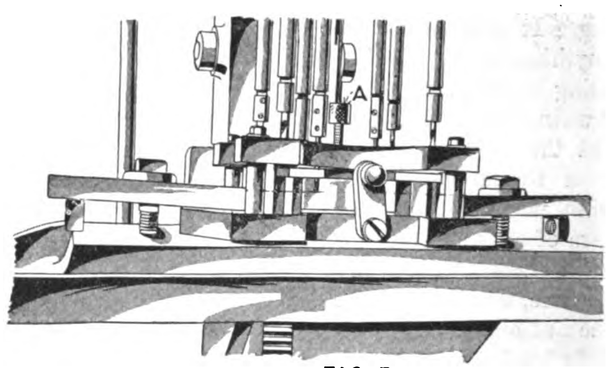


FIG. 7

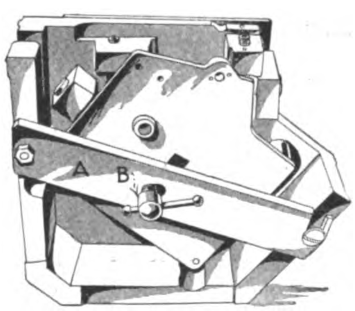


FIG. 3

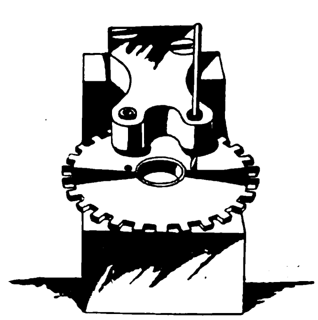


FIG. 5

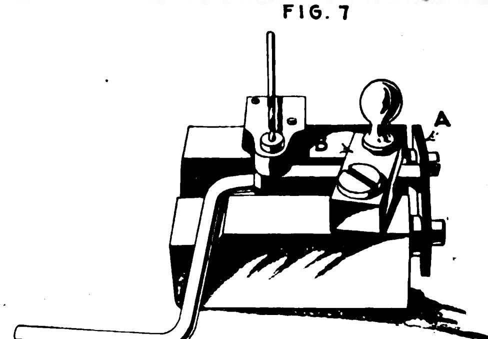


FIG. 9

JIGS USED IN MACHINING DETAIL PARTS OF A TALKING MACHINE, WITH WORK SHOWN IN POSITION

FIGS. 2 AND 2-A

Operation—Drilling holes in face of top frame, Fig. 1. The casting is located by stop pins, being forced against them by knurled-head screws on the opposite sides. The screw A holds the casting down securely. Two straps hold the jig rigidly on the drilling-machine table.

Holes Machined—Four No. 12 drilled, two No. 24 drilled, three No. 15 drilled, one No. 33 drilled, one 17/64-in. drilled and one 15/64-in. drilled.

FIGS. 3 AND 3-A

Operation—Drilling holes in edge of top frame, Fig. 1. The casting is located by dowels that fit into holes drilled in the previous operation. Cover A is then swung over and the screw B, being tightened, holds the casting securely in the jig.

Holes Machined—Two No. 33 drilled, one ¼-in. drilled, one No. 32 drilled, one 19/64-in. drilled and one 15/64-in. drilled.

FIGS. 5 AND 5-A

Operation—Drilling holes in winding gear, Fig. 4. The piece is located in the jig by fitting it into a machined hole. After one hole is machined, a drill is put through the bushing into the hole, as shown, to hold the part in alignment.

Holes Machined—Two No. 43 drilled.

FIGS. 7 AND 7-A

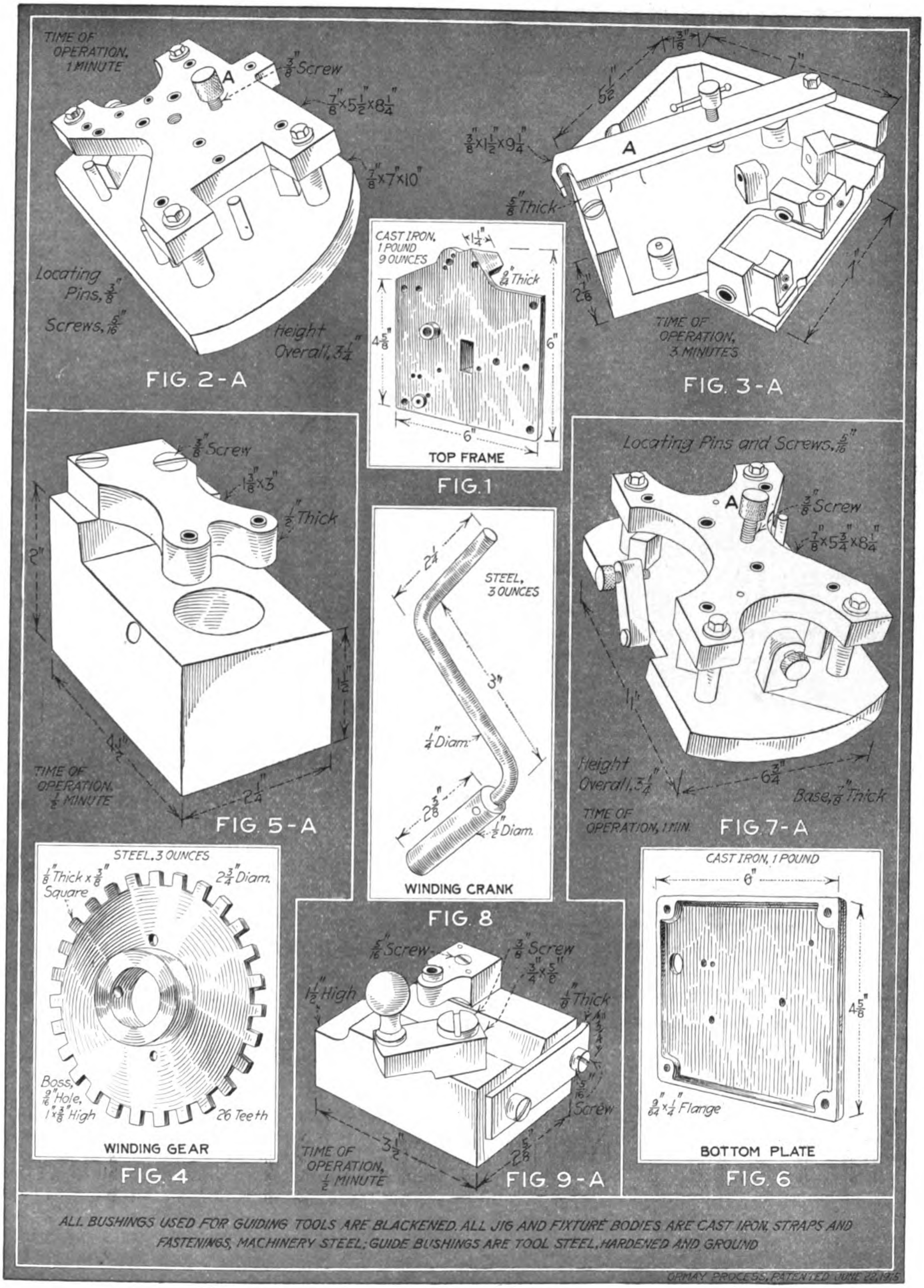
Operation—Drilling holes in bottom plate, Fig. 6. The rough casting is located against pins, being forced against them with knurled-head screws on the opposite side. The screw A is then tightened to hold the casting securely.

Holes Machined—Four No. 12 drilled and three No. 24 drilled.

FIGS. 9 AND 9-A

Operation—Drilling hole in winding crank, Fig. 8. The part is pushed back against the plate A and held in position by the plate B, which is swung over.

Holes Machined—One No. 43 drilled.



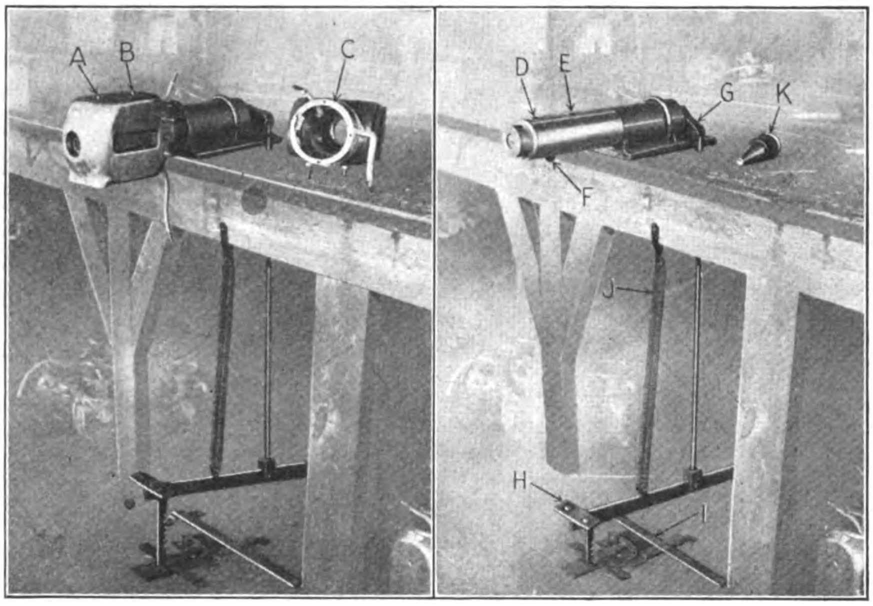
DETAILS OF JIGS USED FOR MACHINING PARTS OF A TALKING MACHINE

A Riveting Mandrel

By E. V. Allen

A special riveting mandrel, used to hold motor starting bodies while riveting in the field plates, is illustrated in Figs. 1 and 2. This device is used in the shop of the Disco Electric Starter Co., Detroit, Mich. Fig. 1 shows a body in place, with two of the rivets to be headed over at *A* and *B*. One of the bodies, turned to show the inside, may be seen at *C*.

Fig. 2 shows the mandrel with the work removed. Here two steel plugs are set in at *D* and *E* for the heads of the rivets to rest on. The body is slipped over the mandrel until the rivets rest on these plugs, then the plug *F* is forced downward by means of the short lever *G*, operated by the foot treadle *H*. As the foot treadle is forced down, it is held from flying up by a ratchet and dog on the floor. When it is desired to release the treadle, the lever *I* is kicked back, and the treadle is carried up by the springs *J*. The plug *F* is backed by an eccentric that forces it out as the lever *G* is moved downward. At *K* is shown a heavy rivet set for rounding over the ends of the rivets after they have been hammered down.



FIGS. 1 AND 2. RIVETING MANDREL WITH AND WITHOUT SPECIAL MOTOR WORK IN PLACE

Canada's Position with Regard to War Materials

With the exception of recruiting soldiers and financing the war there is nothing that has concerned the Canadians to a greater degree than the production of ammunition and the other necessities of war. In the actual manufacture of munitions Canada has done far more, and far better, than was expected. The manufacturers have accommodated themselves to entirely new conditions and lines of manufacture with a facility that is a surprise to mechanics who are familiar with labor conditions on both sides of the international border.

Great credit is also due to the financiers. There has been no difficulty in obtaining money from them in almost any amount for legitimate manufacturing enterprises. It is all very well to say that the financiers are looking to their own interests. Of course they are; but there are many cases where the backers of such concerns have, after writing off a moderate profit, voluntarily given the balance to the Government. There are so many such instances that this order of things can be considered the rule. The successes of these enterprises may have the salutory effect, after the war, of making the men with money less timid and much more willing "to take a chance" than they have been in the past.

The men who have done the actual work have benefited materially in more ways than one. They have earned good wages, for which they have turned in much and good work; but beyond this there are many so-called unskilled men who have learned at least some of the rudiments of trades that call for skill—and skill is an asset of value to any nation.

Just how much has been done by the Canadians in the way of munitions manufacture is not known to the general public, but a few of the facts will at least help to a better understanding of the matter.

The Imperial Munitions Board has issued orders in Canada for 22,800,000 shells of various sizes, chiefly from 3 in. to 6 in. in diameter. In the aggregate these shells have a value of $282,000,000. If the orders for cartridge cases, primers, forgings, frictions tubes, etc., be added, the total will reach $303,000,000. For this work, up to the end of 1915, $80,000,000 was paid out. The monthly output is now valued at more than $30,000,000. At this writing there are 422 plants working directly on war orders. How many more plants or how much employment is indirectly due to them is difficult to estimate. The War Purchasing Commission, which is separate from the Munitions Board, is the second largest buying agency in the western hemisphere, if not in the world, today. This body has nothing to do with the purchase of shells, but it does deal in every other requirement of the army. Its purchasing schedules cover over 5,000 different articles. The appropriation for the year just past amounted to $100,000,000.

It is safe to estimate that, if the war continues throughout 1916, there will have been spent on war supplies in Canada in 1915 and 1916 more than $500,000,000.

Makeshift Taper Gage

By A. N. King

In the course of job work we often have brought in broken axles on which there are taper fits. It is rather hard to get them accurate by ordinary measuring, and we seldom have the part with the taper hole in it, so that we can try the two together. The following method is used:

The taper part is laid against one jaw of a planer vise and the opposite jaw brought up against the taper and clamped. The new tapers are then turned until they fit into the opening between the jaws and enter to the proper depth.

Manufacturing 120-Millimeter Serbian Shells--II*

By Fred H. Colvin

SYNOPSIS—Making the ogives, or nose pieces, and the points, as well as the assembly, varnishing and painting, has many interesting features. Threading is done both in Jones & Lamson turret lathes and by hobbing, both methods proving satisfactory. Rethreading by power is also a feature on the points, which are largely the product of the automatic. Turning the shells by power to try the gages introduces a somewhat novel feature in gaging methods, while many of the gages themselves are interesting from their simplicity and effectiveness.

The ogive, which is the French term for the nose, or "pointed arch," comes in the shape of a forging weighing about 15 lb. The first operation is to drill a 1½-in. hole through the ends, a three-spindle Barnes gang drill being used for this purposes, as shown in Fig. 21. One man handles about 5 pieces per hour on this machine.

The second operation Fig. 22, forms the inside, turns the outside, and threads for screwing into the body of the shell. This operation is performed on a Jones & Lamson machine, its threading attachment proving very satisfactory for this work. The production is 20 for a 10-hr. day.

Two alternate methods of boring the ogives are shown in Fig 23. Both are on Bullard vertical lathes, the difference being in the method of using the forming cam. In the first, at the left, the boring was done by the side head, the cam being placed at *A*, as shown. This formed the inside of the ogive as the side head was fed down.

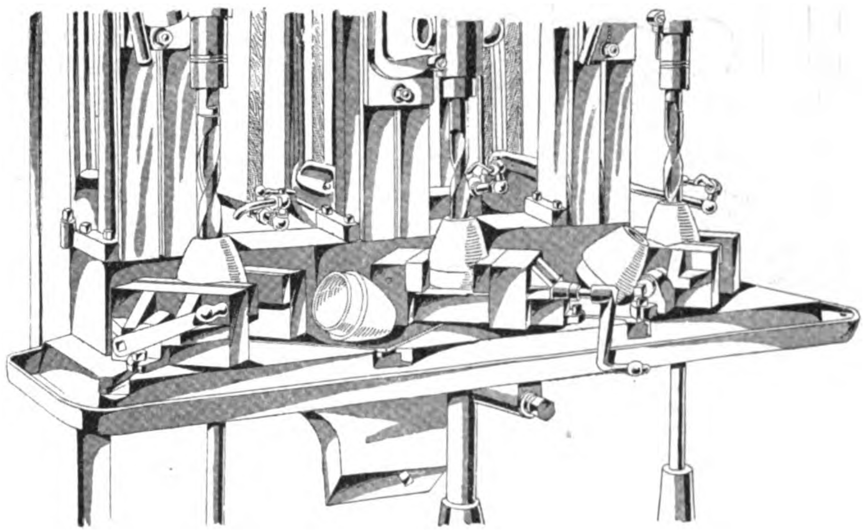


FIG. 21. OPERATION 1: OGIVE—DRILLING

Machine Used—Barnes gang drilling machine. Special Fixtures—Holding chucks. Gage—None. Production—5 per hr.

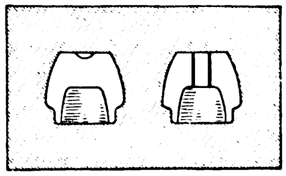
The second method is an improvement over this, as by placing the cam so as to utilize the boring tools in the turret it leaves the side head free to turn the outside for the thread at the same time. The difference in these methods is seen in the production times. For 150-mm. ogives the first way required about 2½ hr. each; and the second, 35 min.

For the third operation, Fig. 24, also performed in a Jones & Lamson machine, the ogive is held in a special chuck having a steel ring fastened to its face and threaded to receive the large end of the ogive. After it is screwed in place, the three inside jaws grip it firmly, while the outer ring not only centers it, but also prevents distortion. The small end is then bored out, enlarging the drilled hole to the proper size; a recess is cut for the end of the thread and the outer end faced to length.

The fourth operation threads the hole in the point, a special thread-hobbing fixture being used, as shown in Fig. 25. The hob runs 225 r.p.m., while the work turns 1 revolution in 2 min. This gives a production of 9 per hr.

The fifth and last operation, Fig. 26, rough-forms the ogive on a Prentice geared head lathe, using a form at the back of the carriage. The inspection is then made before the ogive goes to be assembled for final turning.

The point, or cap, that protects the thread in the ogives so that the fuse can be screwed in without difficulty is made from bar stock. This usage is an interesting variation from the brass, zinc and wooden caps that are now employed for this purpose. These points are turned from $2\frac{7}{16}$ bar steel on Gridley 4¼-in. automatics. The first operation is shown in Fig. 27, together with the tool layout, the production being 5 per hr. The side wrench slots are then milled,



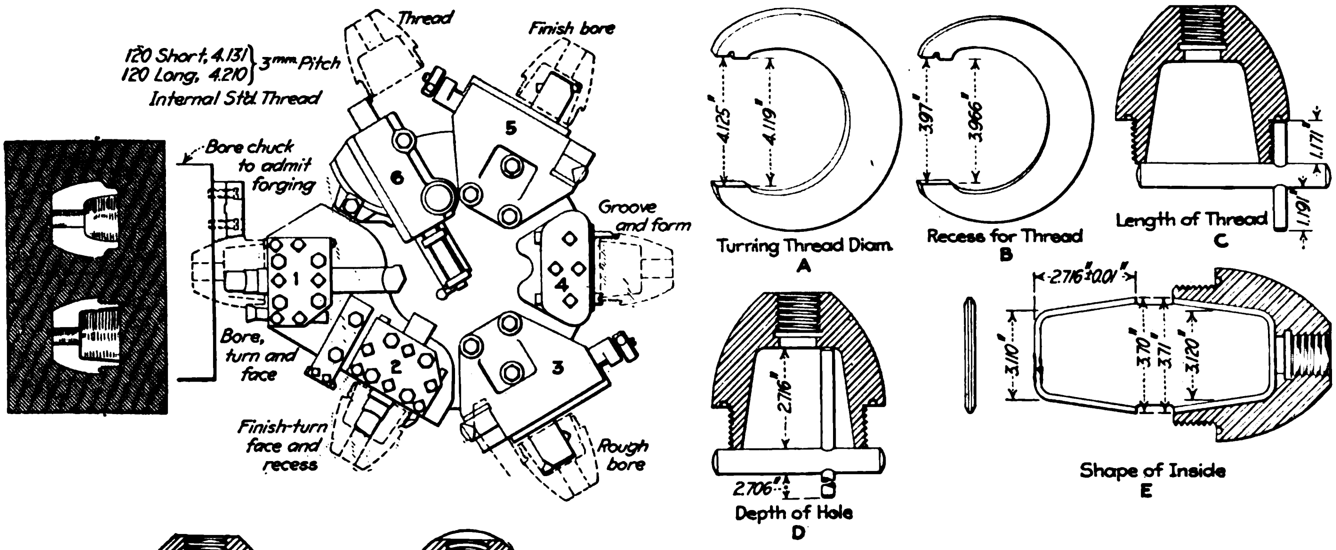
the point being held in a split chuck on a small hand miller, as in Fig. 28, and indexed in two positions, so that the end mill can cut the desired slot, the depth being determined by a suitable stop. The production here is 25 per hr.

The cone end of the point is shaved on a Bardons & Oliver hand turret at the rate of 20 per hr., the point being held in a screw chuck and a single tool used in the cross-slide for this purpose, as in Fig. 29.

Then comes the rethreading, which, instead of being done by hand, as in most cases, is handled on a vertical drill, as shown in Fig. 30 (spring prong) dies are used in the drilling-machine spindle, while the point to be rethreaded rests in a suitable pocket in a holding fixture on the table. The cap is prevented from turning by two studs that fit the wrench slots.

No difficulty seems to be experienced in catching the thread, a tapping head being used for reversal. It is also easy to prevent the die going on too far, by simply lifting

*Previous installment appeared on page 397.



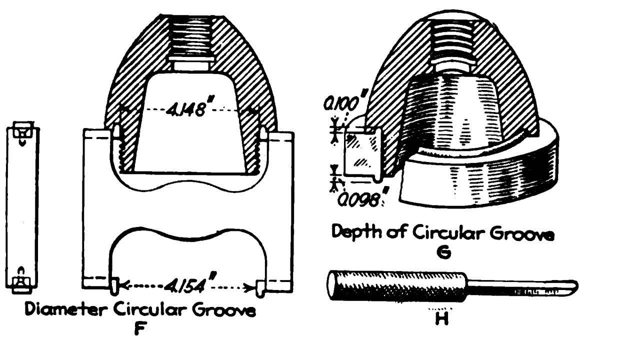


FIG. 22. OPERATION 2: OGIVE FORM INSIDE AND THREADS

Machine Used—Jones & Lamson.
Special Fixtures—Chuck jaws.
Gages—A, thread diameter; B, recess for thread; C, length of thread; D, depth of bore; E, form of bore; F, diameter of annular groove; G, depth of annular groove; H, operation gage for groove.
Production—1½ to 2 per hr.

the whole spindle so that the prongs do not engage, allowing the point to revolve with the die. This method is certainly easier than rethreading by hand, even though the production may not be as much higher as might be imagined. In this case it is 22 to 25 per hr., but it must be remembered that these points are of steel and that the thread is nearly 2 in. in outside diameter. The points are then inspected and go to the assembling department to be varnished inside preparatory to being screwed into place on the otherwise completely assembled shell.

Going back to the shells once more, we find them now ready to have the ogives screwed solidly into place. This work is done by hand while the shell itself is held in the vise of a clamp, shown in Fig. 31, which is mounted on a stand so as to be of convenient height. The shells are clamped in this vise by means of the cam shown, the ogives started in by hand and the assembling plug screwed into the nose of the ogive.

This plug consists of a central stud squared at one end, threaded at the other and having a thrust collar against which the ball thrust, shown, bears. The ball thrust is held in position by the three side fingers with hooked ends so that it is perfectly free to move. The stud is screwed into the nose of the ogive, and the ogive itself is forced into the shell by a large ratchet wrench fitting on the squared end of the plug.

These parts must be forced together very tightly, both on account of the necessity of their being virtually one piece of metal and on account of the difficulty of varnishing in case they are not. The latter difficulty comes from the fact that, if the stud and the ogive are not tight, oil is apt to be forced out when the shells are cleaned by air pressure on the inside, and this makes it difficult for either the varnish or the paint to dry satisfactorily. Two men working in conjunction obtain an average output on this operation of 30 pieces per hour.

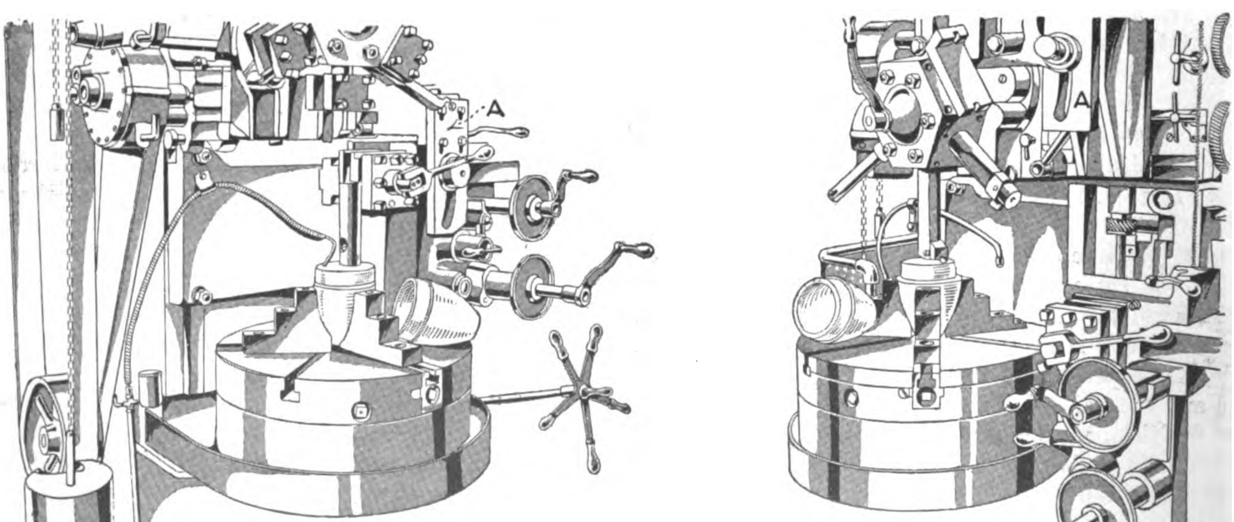


FIG. 23. ANOTHER METHOD OF BORING OGIVES ON BULLARD VERTICAL LATHES

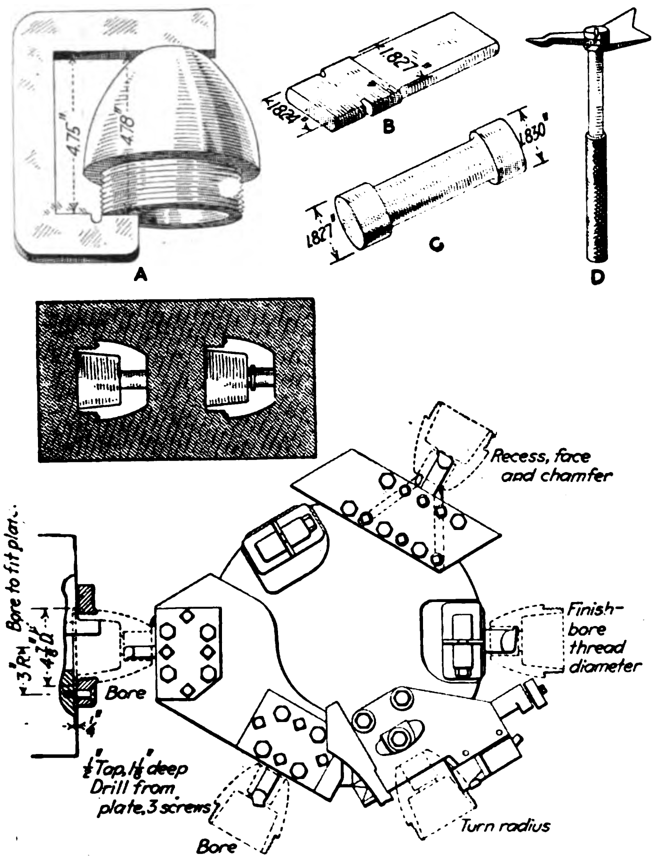


FIG. 24. OPERATION 3: OGIVE—BORE AND REAM NOSE
Machine Used—Jones & Lamson.
Special Fixture—Holding ring on chuck.
Gages—A, length; B, diameter of hole; C, hole for thread; D, diameter of recess below thread.
Production—8 to 10 per hr.

The fourteenth operation, Fig 32, uses the same style of chuck as that shown in operation No. 9 and finishes the curve on the ogive by a form on the back of the lathe-carriage turret. It also finishes the front end of the

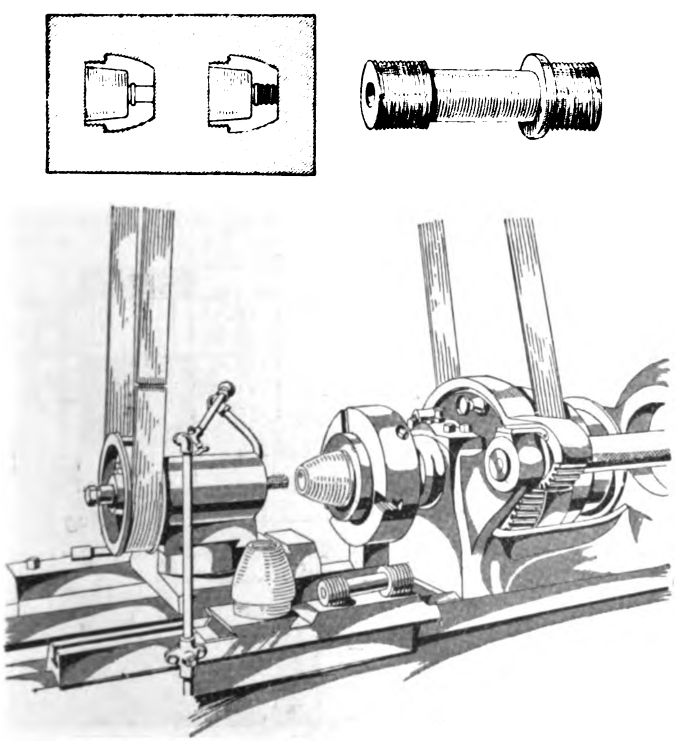


FIG. 25. OPERATION 4: OGIVE—THREADING NOSE
Machine Used—21-in. lathe.
Special Fixture—Hobbing head.
Gage—Plug thread gage.
Production—9 per hr.

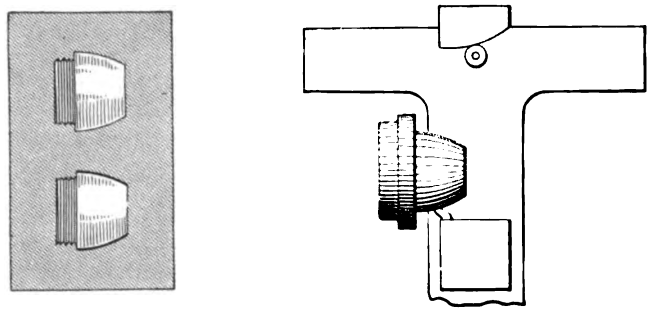


FIG. 26. OPERATION 5: OGIVE—ROUGH TURN OUTSIDE
Machine Used—LeBlond 21-in. lathe.
Special Fixtures—Form on taper slide, chuck.
Gage—None.
Production—15 per hr.

shell body itself, this curve continuing from the ogive back on to the body for about 1½ in. The finishing is done on 21-in. lathes of both Hendey and LeBlond makes, the production being from 2 to 2½ per hr. The gages are shown in Fig. 32.

The copper bands are next swaged on the shells, on a West tire-setting machine, each band being pressed in three positions at 1,500 lb. pressure. This work is handled at the rate of 30 per hr.

Then comes the turning of the band by the use of two tools in a tool post, Fig. 33. The first tool turns the band to the approximate outside diameter, while the second forms both sides and the outside diamter at the same time. The finished band is a trifle wider than the slot in which it is held. This operation uses the same style of chuck as that in operations 9 and 14, and production is 30 per hr. per machine. The whole shell is then cleaned in a tank of heated soda that is blown up into the inside by an air jet at the rate of 50 per hr. Then comes the final shop inspection and at the same time the inspection by the representatives of the Serbian government.

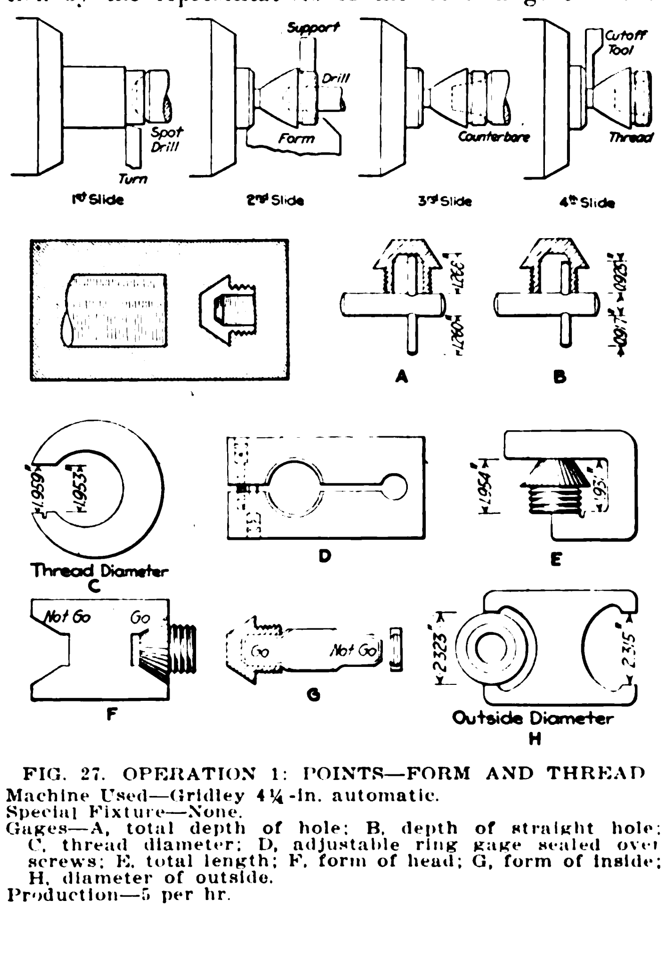


FIG. 27. OPERATION 1: POINTS—FORM AND THREAD
Machine Used—Gridley 4¼-in. automatic.
Special Fixture—None.
Gages—A, total depth of hole; B, depth of straight hole; C, thread diameter; D, adjustable ring gage sealed over screws; E, total length; F, form of head; G, form of inside; H, diameter of outside.
Production—5 per hr.

From here the shells go to the finishing department, where they are again washed in hot soda and also hot water. The tank used for this purpose is shown in Fig. 34, the compartment at the left being for soda water, while the other two compartments contain simply hot water as free from soda as can be maintained as the shells pass from one to the other.

Arrangements are made for a gang of six men, three on each side, each being provided with an upright washing pipe that has radial perforations at the upper end. The central stem controls an air valve, so that by dropping a shell over the upright pipe and pressing down, the air valve at the bottom is opened and a shower of hot water, either soda or plain, is forced all over the interior, cleaning it perfectly and allowing the shells to be handled very rapidly. The exact rate varies of course with the size and weight of the shells to be handled and the strength and agility of the men.

After cleaning, the shells are then ready for the inside varnishing, which forms the twentieth operation and is done on the machine shown in Fig. 35. This consists merely of two pairs of rollers, which are revolved by power and on which the shell to be varnished is laid as at *A*. The varnishing head is seen at *B,* carrying a nozzle that reaches to the bottom of the shell. This nozzle sprays the varnish on the inside, but does not become operative until the head has been pushed into the shell. Then an air valve is tripped, and the varnish is sprayed over the interior of the revolving shell as the varnishing head moves out by power. The spray is cut off at a predetermined point, as it is only necessary to varnish the lower part of the bore in most cases. This limit can, however, be easily varied for any length of shell and to varnish either a part or the whole interior, as may be desired. This inside varnishing can be done at the rate of 120 per hr.

The suboperation is the varnishing of the outside of the shell, which is done under a hood, shown at the right. A revolving spindle supports the nose of the shell and revolves it vertically, while the operator sprays on the varnish with the air-spraying arrangement shown at *C*. The protector *D* is swung in front of the shell to keep the varnish off the band. Inside the hood is a large exhaust fan to keep the atmosphere as clear of the varnish vapors as possible. The outside varnishing of the shells can also be handled at the rate of about 120

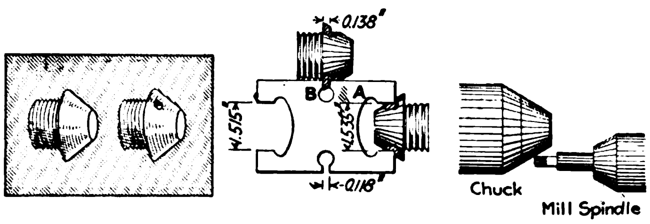


FIG. 28. OPERATION 2: POINTS—MILL KEY SLOT
Machine Used—Hand miller.
Special Fixture—Split chuck.
Gages—A, center distance of slots; B, thickness of metal below slot.
Production—25 per hr.

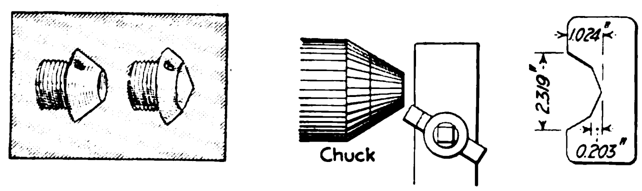


FIG. 29. OPERATION 3: POINT—SHAVE
Machine Used—Bardons & Olive hand screw machine.
Special Fixture—Split chuck.
Gage—Form of head.
Production—20 per hr.

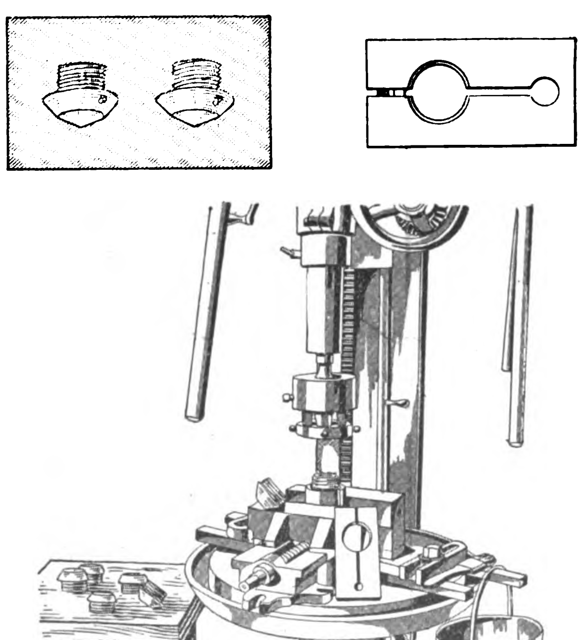


FIG. 30. OPERATION 4: POINT—RETHREAD
Machine Used—Vertical drilling machine.
Special Fixtures—Prong die and chuck.
Gage—Adjustable ring thread gage.
Production—22 per hr.

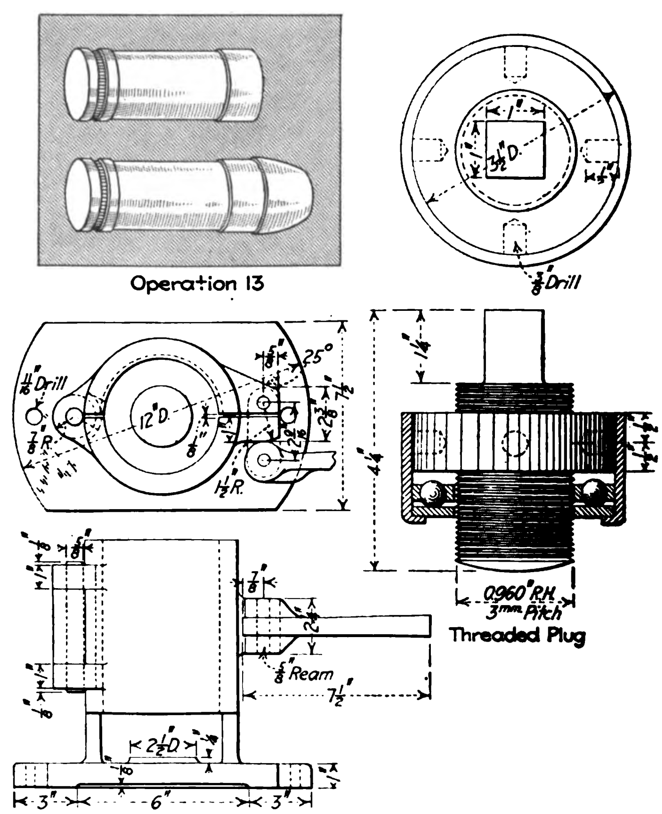
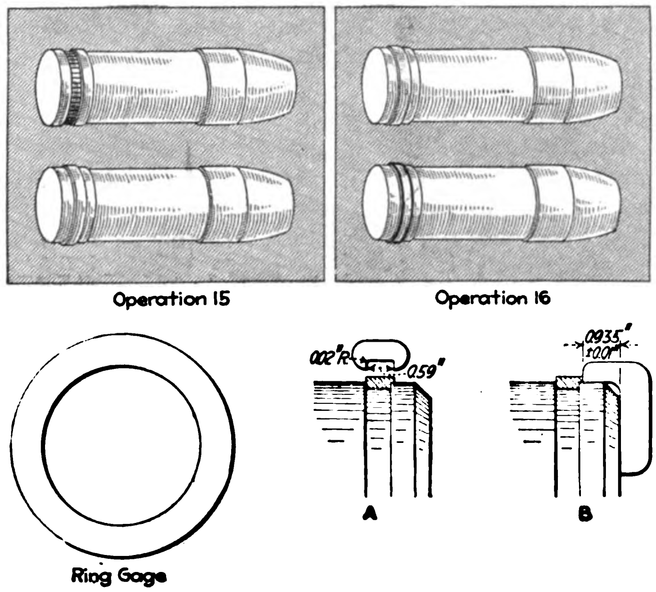


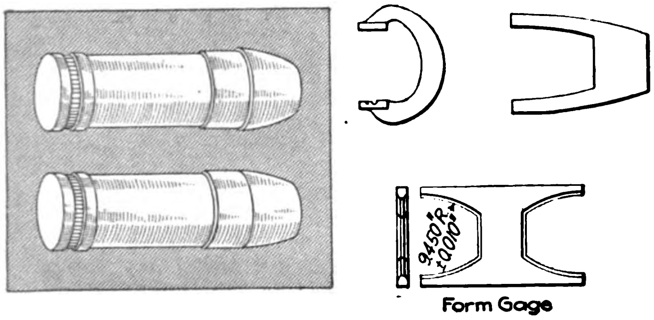
FIG. 31. OPERATION 13: SCREWING IN OGIVE
Machine Used—None.
Special Fixtures—Vise and screw plug.
Gage—None.
Production—30 per hr.

per hr. This is done in the De Vilbiss painting machine. The next, or twenty-first, operation is baking the varnish for 8 hr. at a temperature of about 300 deg. F. For this purpose the shells are placed in metal trucks, one of which is shown in Fig. 36. The trucks vary somewhat in construction, according to the size of the shell. The one shown is for the 70- and 75-mm. shells and contains movable separation strips, as shown. The trucks for the larger shells contain permanent divisions formed by crossbars of angle iron.

Operation 22—painting—is shown in Fig. 37. As can be seen, it is divided into stages, according to the number of operators. Four men are generally used, the first painting the end of the shell, the next a band the width of his brush, just below the bronze rifling ring, the third a band at the other end, and the fourth filling in the unpainted space. By working in this way 120 shells per hr. can be handled regularly.

High-explosive shells are painted a bright yellow, while shrapnel are painted a vivid red; but no paint must go on what might be called the bearing surface of the shell—both the copper band and the part just behind the ogive, which is an important diameter, as it fits the gun bore.





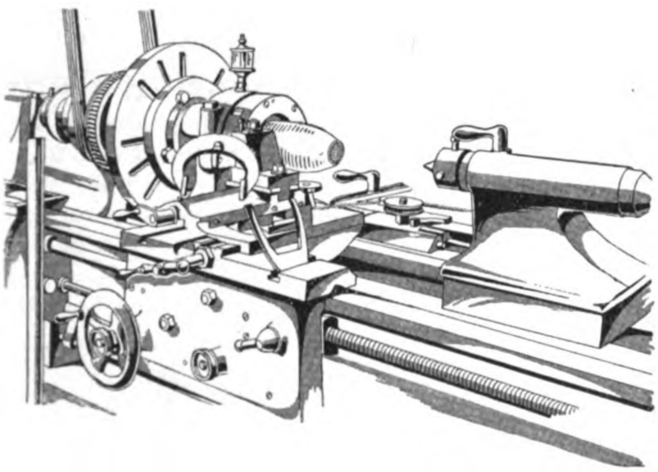


FIG. 32. OPERATION 14: FINISH-TURN OGIVE AND SHELL
Machines Used—Hendey and LeBlond 21-in. lathes.
Special Fixtures—Chuck and formers.
Gage—Form of nose.
Production—2 to 2½ per hr.

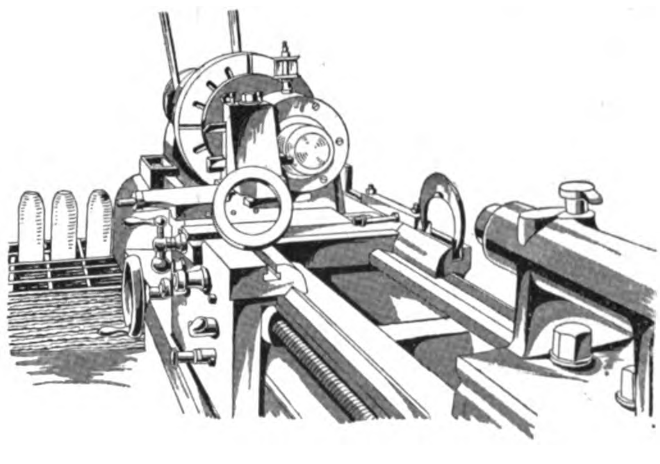


FIG. 33. OPERATION 16: TURN HAND
Machine Used—LeBlond 21-in. lathe.
Special Fixtures—Chuck; tool post.
Gages—A, width of band; B, distance from end of shell.
Production—20 per hr.

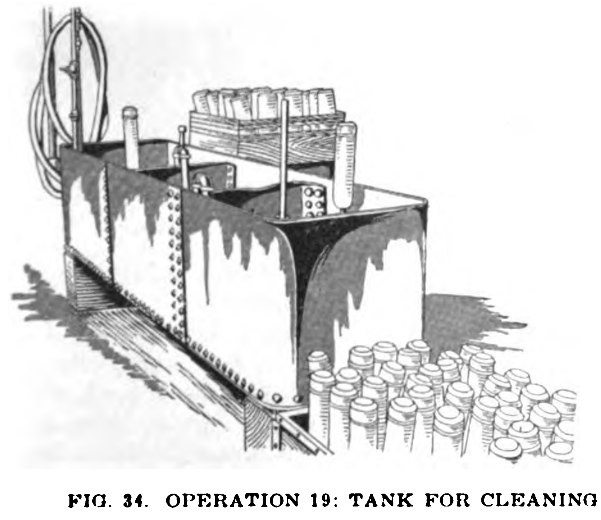


FIG. 34. OPERATION 19: TANK FOR CLEANING

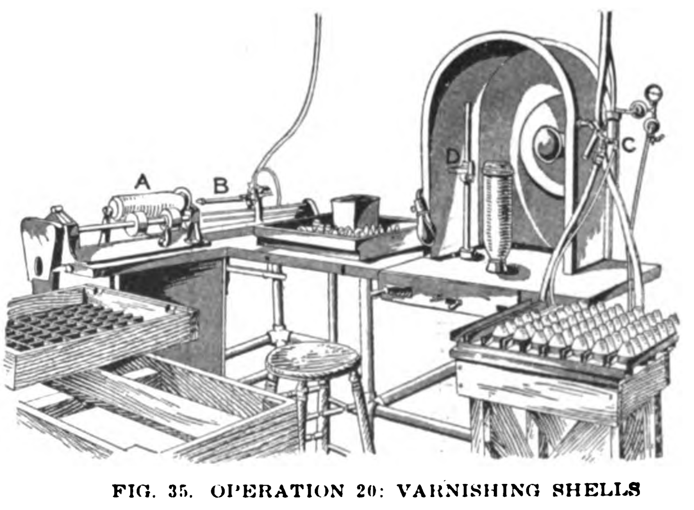


FIG. 35. OPERATION 20: VARNISHING SHELLS

After painting, the shells go to another drying oven at a temperature of 150 deg. F. for 12 hr. They are then ready to have the point screwed into place in the nose as a protector; this is done just before packing. These points have previously been varnished in the same place as the outside of the shell, some being shown in Fig. 35. Each shell is then wrapped in oiled paper and packed four in a box, as shown in Fig. 38. Separators are used to hold the shells firmly in position, and corresponding forms go on top of the shell, so that the cover holds them tightly in place. The construction of the box, the handles of light rope and the marking of the box are clearly shown.

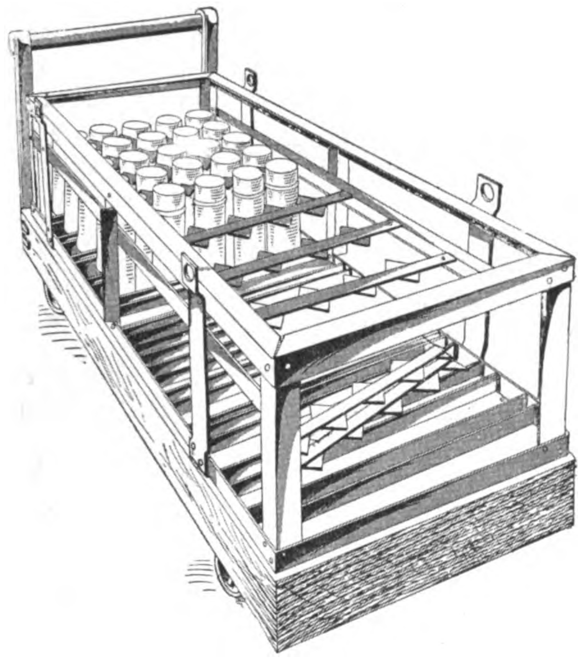


FIG. 36. TRUCK FOR BAKING SHELLS

The covers are screwed in place, and it will be noticed that some of the screw holes A are counterbored to nearly an inch in diameter—before the official sealing. After the screws have been put in place, sealing wax is poured into these holes, and the inspector presses into the wax a seal bearing the Government coat of arms. This is to insure against the shells being tampered with between the last Government inspection at the factory and their arrival at the various points where they are to be loaded.

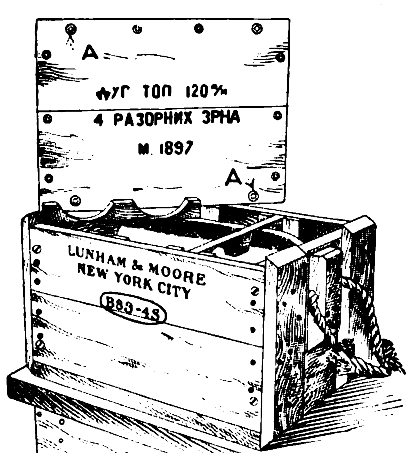


FIG. 38. BOXING BEFORE SHIPPING

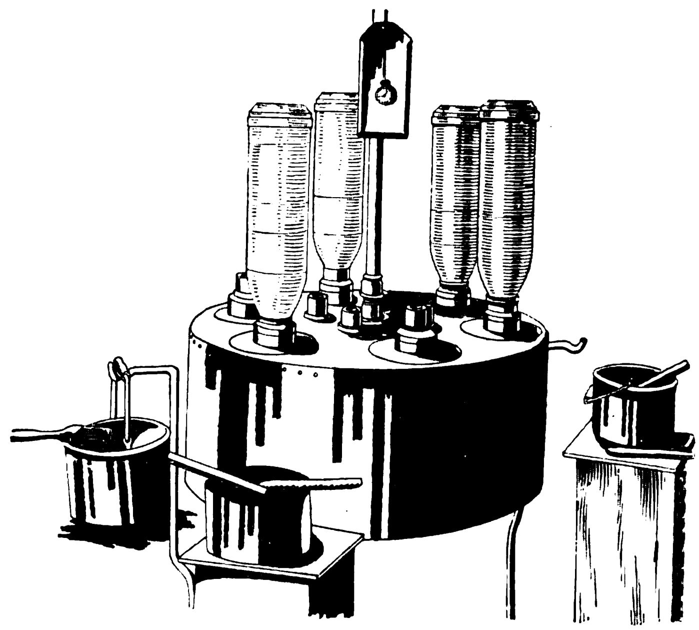


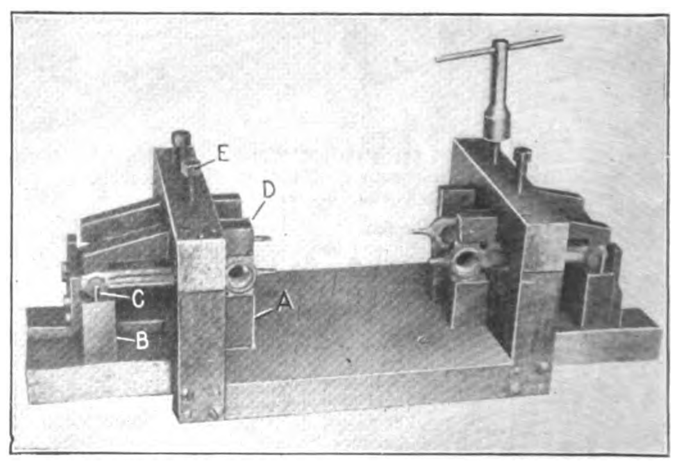
FIG. 37. PAINTING THE SHELLS

From these two articles it is hoped a good idea of Serbian shell requirements will be gained.

Milling Small Connecting-Rods

What is practically a continuous milling operation on a plain miller is taken care of by the fixture shown, found in use by the Henderson Motorcycle Co., Detroit, Mich.

The fixture holds four connecting-rods—two on each end. The gang of four milling cutters works in between the ends of the rods and machines both sides of two rods at a time. While the cutters are machining two of the rods, the operator removes the milled rods from the other end and replaces them with rough ones.



MILLING SMALL CONNECTING-RODS

The rods are located in the fixture on two blocks *A* and *B*. The front one *A* is a V-block, and the capscrew boss fits down into it. The rear block is flat-topped, with a pin *C* to butt the side of the rod against. The rod is held down by a floating clamp *D*, pressed down by means of a capscrew *E*.

Planning Delivery Dates in a Textile-Machine Plant

By Arthur O. Berry

SYNOPSIS—The method of planning the shop work for some time ahead is outlined in this article applicable to factories where orders for several similar machines are in hand at one time and where the machines are quickly built after being placed upon the erecting floor.

The work-planning sheet shown in Fig. 1 was devised to meet such conditions as those outlined above. The sheet itself is 16x20 in. and is divided into 14 spaces arranged in two columns. These are again divided into two parts, the right-hand column for recording the orders coming in from day to day are immediately cared for on the planning sheets, unless the dates for delivery are too far ahead.

The sheets themselves are made either of a black and white print or the ordinary blueprint paper, in either case produced from a positive made from the transparent paper original. Copies of the sheets are printed from the negatives as required. They are mounted on two light boards and held in position by thumb-tacks. Two sheets are placed one on top of the other on one board, the old sheets being removed when their use is no longer required. Spaces are provided at the top of the sheet for the names of the month and year.

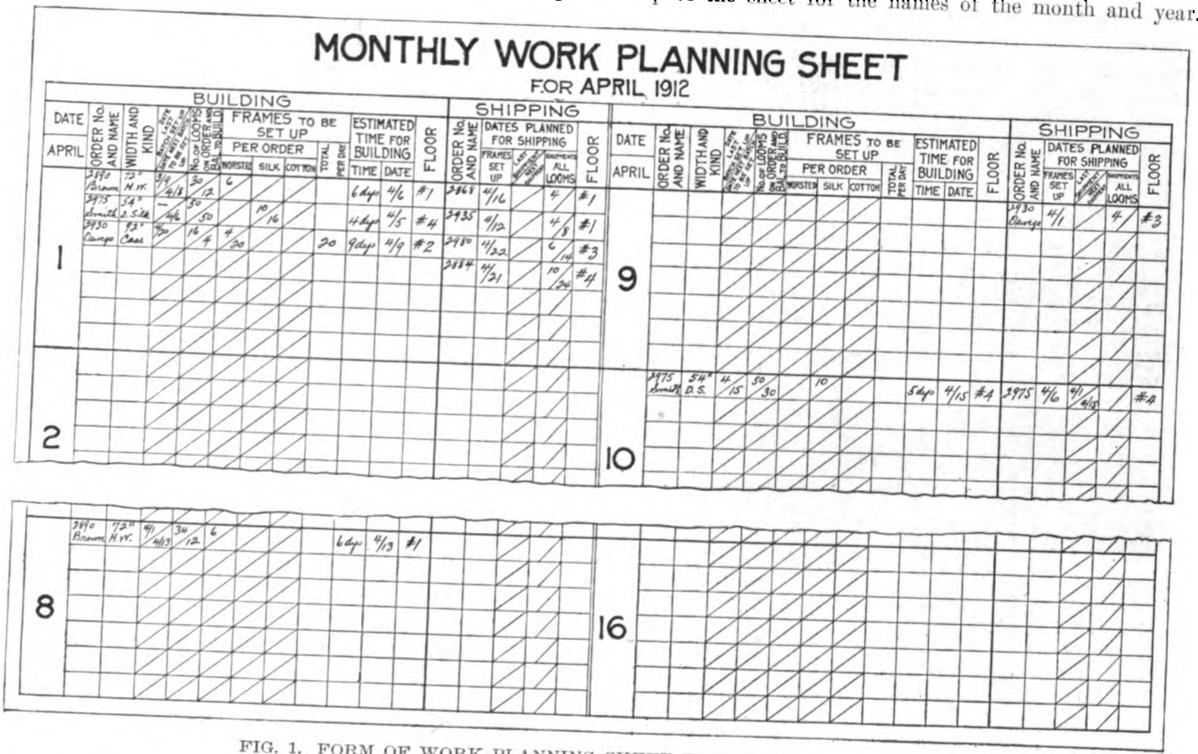


FIG. 1. FORM OF WORK-PLANNING SHEET FOR MACHINERY PLANT

setting up and building of the machine and the left-hand, the day's shipments. Both the setting up and the shipping columns are further subdivided for purposes indicated at the top of each column. Each of the 14 spaces also has seven subdivisions necessitated by the nature of the work and the number of orders running simultaneously. The purpose of the lines running diagonally across and dividing the squares formed by the crossing of the horizontal and vertical lines is indicated at the head of the respective column and will be more clearly explained later.

One of the 14 spaces with its seven subdivisions is allotted to each working day of the month. As only 14 days are provided for on each sheet, four or more sheets are required, running simultaneously. The new

In the first vertical space at the left of the columns the day of the month is placed in conspicuous figures.

A few words may be needed to make clear the use of one or two of the columns and the diagonal lines. It must be kept in mind that the sheet is devised for the planning of work on orders for quantities of machines varying in number from one to several hundred of a kind, and where the shipments are to be made at more or less regular intervals. Therefore, in planning for the building and shipping of an order by installments, it is desirable to be able to make easy reference to the dates previously, as well as subsequently, planned. The fourth column of the sheet is for this purpose, the top left-hand corner of the squares being used to indicate the earlier dates planned, while the

bottom right-hand corner indicates subsequent setting-up and shipping dates. These remarks apply also to the third column of the shipping section and the sheet headed "Last Shipment" and "Next Shipment."

To make the use of the sheet more clear, I will describe the planning of one or two orders. Starting, then, with Order 2890 for Brown, planned to be set up on the first day of April, you find this order to be for a number of 72 "H. W. looms." The fifth column tells you that there are 30 looms in the order and that 12 of these have already been set up, leaving a balance of 18 to come. By reference to shipping data you learn that six looms of this type will make a car load. It is desirable, therefore, to have them set up and built in batches or multiples of six.

From the fourth column of the planning sheet, you see that the last lot was set up on the ninth of the previous month. As the customer is now wanting a shipment every week, you plan to set up another lot of looms on the eighth of the month, and this is indicated in the fourth column. Again referring to the records you find that six days is sufficient to allow for building the looms. You therefore set down the shipping for the sixth of the month, noting this in the tenth and eleventh columns, while the twelfth column is reserved for indicating the floor upon which it is convenient to place the looms. By referring to the shipping section for Apr. 1, you see that there are four looms of Order 2868 and four of Order 2935 going off the floor, thus leaving floor space of sufficient area to accomodate the six looms you are now planning for.

Having decided the date for shipping, you transfer this information to the shipping section of the sheet

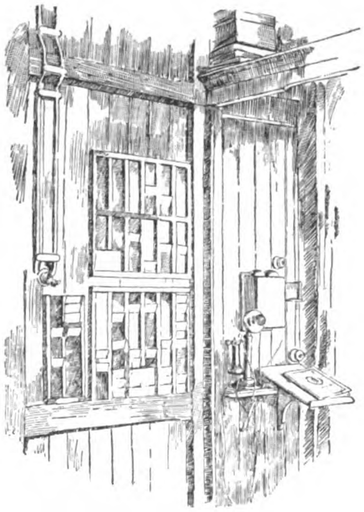


FIG. 2. CONVENIENT WALL BOARD

for the sixth day of the month, noting in the second column by cross-reference the day the looms were set up, also in the fifth column the number of the floor upon which they are placed. The fourth column of the shipping section indicates the number of looms to be shipped, while the third column refers to the dates of previous and subsequent shipments. The fourth column in the building section, headed "No. of Looms in Order and Balance to Build." provides a means for knowing at any stage the balance of looms that have still to be cared for in future planning.

Following the balance of Order 2890, since a lot of looms of the same order will go off the first floor on the sixth of the month, you decide to set up a batch of looms on the eighth of the month, and make the entry for that date, again noting in the fifth column that there are 30 looms in the order, but that a balance of only 12 remains. You plan to ship on the thirteenth

ORDER NO. 2890
NO. OF LOOMS 6
DATE SET UP 4/1/12
DATE TO BE SHIPPED 4/6/12
NAME Brown Co.

FIG. 3. FORM OF CARD FOR WALL BOARDS

of the month, and on this same date can also plan for the balance of the six looms of Order 2890, to go on the floor in the place of the six to be shipped. With the shipping date set down for the nineteenth of the month, this order will be done with, so far as the planning sheet is concerned.

Since it is certain that changes will occur and that rearrangements of the planning sheet have to be made from time to time, it will be wise to use a lead pencil in making all entries.

In addition to the planning sheets are a number of boards, each board representing one of the erecting floors. Fig. 2 shows one of these boards hung in a convenient position on the office wall. The boards themselves are made to any convenient size, but should bear some relationship to the size of the floors that they represent. A number of strips of wood arranged parallel with each other, are attached to the board, and slots are cut at an angle in the strips to allow the small cards, Fig. 3, to be slipped into any position on the board. A convenient size of card to use is 1x2 in. As the new orders are issued and planned, these cards should be placed on the board in the spaces machinery will occupy. The disposition of the machines on the erecting floor as indicated by the cards is checked each day from records supplied by the shop. Information regarding the machines that have been shipped and those that have been placed on the erecting floor is supplied by the departments concerned.

It must not be assumed that the order of work as set down on the planning sheet will be rigidly adhered to. Eventualities are sure to arise from time to time which will necessitate rearrangements of the planning sheet. A customer may "hold-up" an order for one reason or another—his mill may be new and in process of building, and not in a sufficiently advanced condition to allow him to receive the machines at the time he had originally expected to do; or he may call for changes in the construction necessitating the making of drawings and, possibly, new patterns. If the machines have already been placed on the erecting floor, serious inconvenience may be caused through the holding up of floor space planned to receive other machines. If the delay is likely to be protracted, it becomes necessary

to decide whether or not it will be wise to take down the machines and stand them at one side until the new material is ready, or in the case of machines held up on account of the customer not being ready to receive them, to decide whether or not they should be completed and stored away until such time as it is possible to ship them.

Machine Shops in Brazil

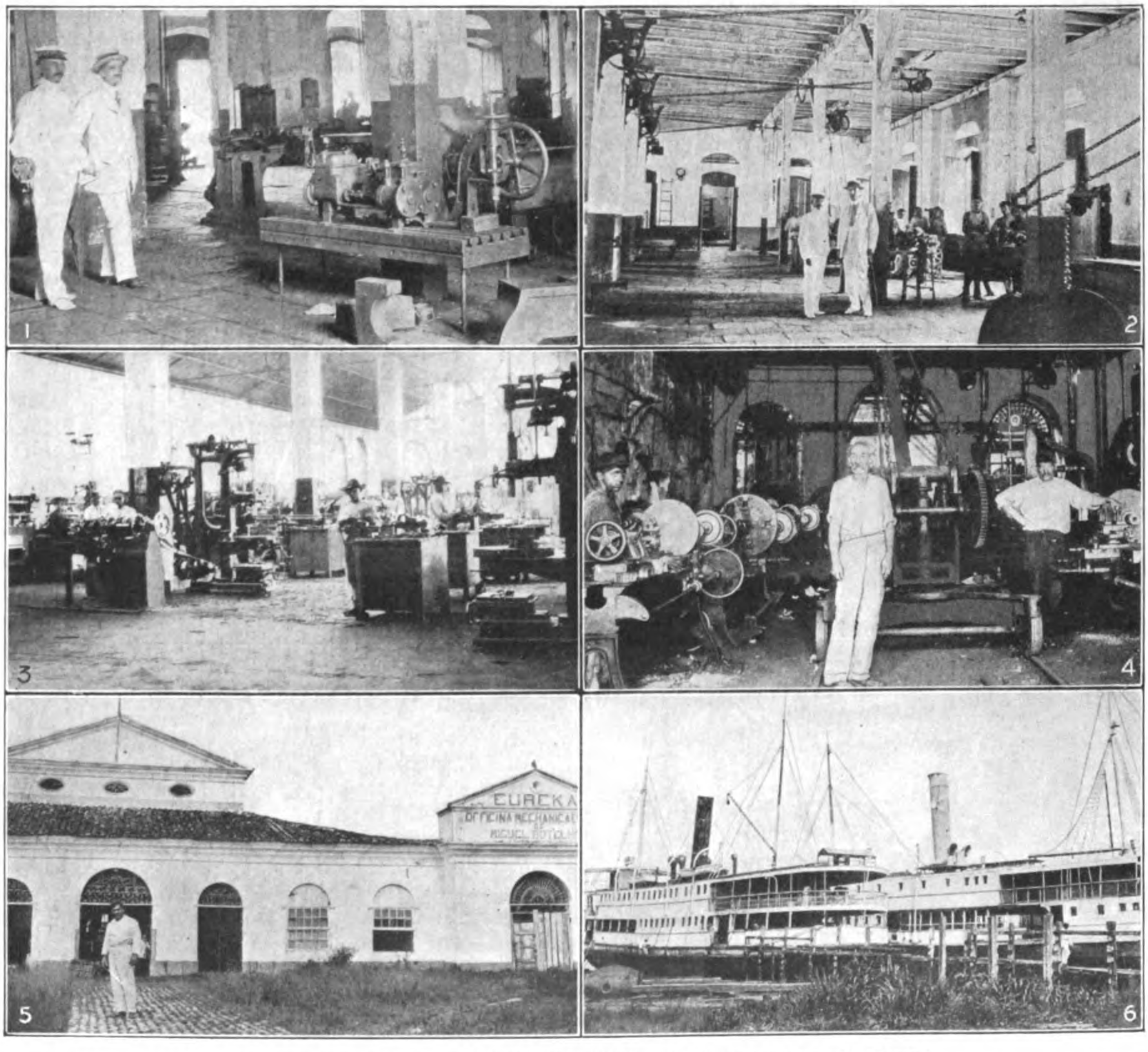
To show still further some of the interesting characteristics of South American machine shops, we illustrate herewith a number of shops in various parts of Brazil.

At Belem, in the State of Pará, is the Officina Arsenal Marinha, which is a small shop devoted to naval repairs. It is in charge of Capt. Tenente Aranha, the force consisting of 18 men in the machine shop and 12 in the foundry, with a total equipment of 13 machine tools, mostly of English make. The commandant is shown at the left in Figs. 1 and 2, the latter also showing the type of shop.

Fig. 3 shows the interior of the shop of the Compania Linha Circular, or Belt Line Railway, at Bahia, Brazil. It is devoted to street-railway repairs and employs about 170 men, of whom 28 are in the machine shop and 10 in the foundry. Nearly all its equipment is from the United States.

The view in the shop of Barão de Suassuna, at Pernambuco, Brazil, is shown in Fig. 4. This shop handles general repairs, employing about 45 men in the machine shop. The majority of the tools are from France.

Figs. 5 and 6 show the shop of Miguel Bothelho, this being known as Officina Mechanica e Naval Eureka. It is also in Belem, Pará, Brazil. The proprietor himself is standing on the main walk in Fig. 5, while Fig. 6 shows some of the repair work which he handles. The two vessels are in "dry dock," which in this locality means that they are run upon the bank of the Amazon at high tide, and work on the hull is done while the tide is out. They are mostly shallow-draft flat-bottom boats, which can be easily handled in this way by the 7-ft. tide.



FIGS. 1 TO 6. A BRAZILIAN NAVAL SHOP AND OTHER REPAIR SHOPS

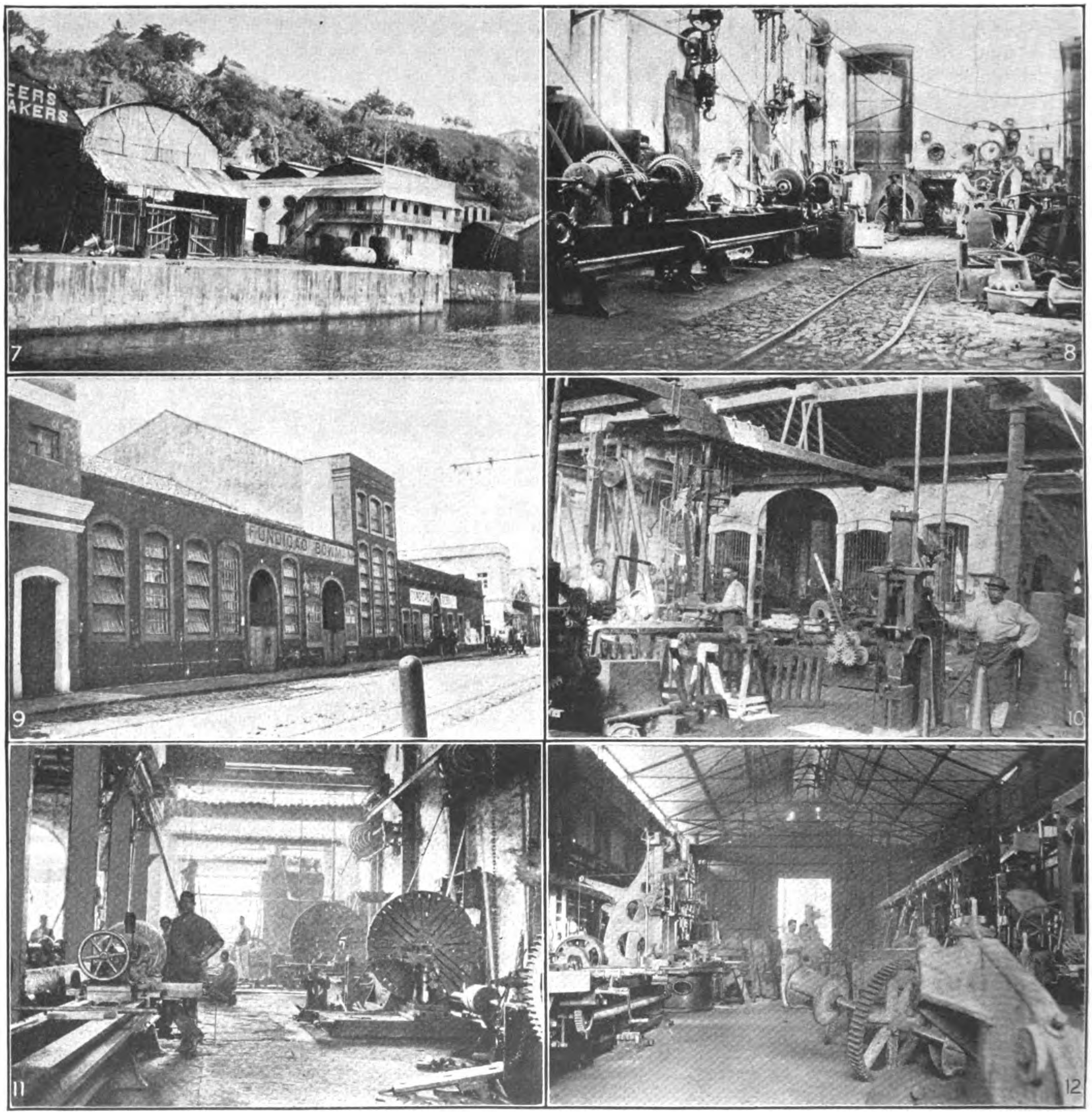
Fig. 1—Commandant Tenente Aranha. Fig. 2—In the Naval Arsenal at Belem, Pará, Brazil. Fig. 3—Belt Line Tramway Company, Bahia, Brazil. Fig. 4—Shop equipped with French machines. Fig. 5—Miguel Botelho and his shop. Fig. 6—Vessels in "dry dock" at low tide

Probably the largest jobbing shop in Bahia, Brazil, is that of Wilson & Sons, shown in Figs. 7 and 8. It is mostly devoted to ship repairs. The majority of the machine tools are English. Something of the picturesque location can be seen in the view showing the exterior, which also gives the dock and office buildings.

Figs. 9, 10 and 11 are from the Fundicion Geral, this being a combination of Allan Paterson & Bowmans. It is in Pernambuco, Brazil, and is a large shop devoted to general repairs. About 120 men are employed, 100 of them being in the machine shop. Nearly all the machinery is English.

Fig. 10 shows some interesting beam construction, and also the spiral stairs at the back. The grated windows appear very different from our own shop construction. Fig. 11 shows a large double-headed lathe and also the very peculiar partial saw-tooth roof effect down the shop bay. Four angular roofs form the sloping part of the saw tooth, the peculiarity being that there is no glass in the verticals, as with us, the opening between these slanting roofs being without covering of any kind. This construction makes for excellent ventilation, but it is also subject to rain and dust.

Fig. 12 shows the interior of another shop devoted to shop repairs—the Estelleros Port, of Pará. It is also located in Belem and is a good-sized plant, having a regularly equipped dry dock and employing 420 men. Only 42 of these, however, are in the machine shop. The majority of the machines came from England. The shop construction, it will be observed, is quite modern.



FIGS. 7 TO 12. VIEWS IN SOME OF THE LARGEST SHOPS IN BRAZIL

Fig. 7—Wilson & Sons, ship repairs; Bahia, Brazil. Fig. 8—A view in the machine shop. Fig. 9—Allan, Patterson & Bowman, Pernambuco, Brazil. Fig. 10—Interior of the forge shop. Fig. 11—The sawtooth roof without windows. Fig. 12—Interior of the Port of Pará Co., Pará, Brazil

Unusual Motorcycle-Muffler Work

By Ethan Viall

SYNOPSIS—The closing-in of the muffler tube in a punch press is of unusual interest and the result of considerable experimenting. Too rapid closing-in means buckling or other troubles. The piercing of the holes in the tubes also presented a number of difficulties, which were successfully solved.

It is a common saying that the man who says a thing cannot be done is constantly being interrupted by someone doing it. When it was first proposed to make muffler bodies from seamless tubing and to close in one end mechanically, the experts said it could not be done so as to be commercially successful. They advanced all sorts of reasons, but Superintendent Parker, of the Henderson Motorcycle Co., Detroit, Mich., believed otherwise. The mufflers in question are used on a four-cylinder, 12-hp. motor, and must not only successfully suppress the noise, but must be able to stand the vibration and hard service to which the average motorcycle is subjected.

It was decided to employ a punch press for the work of closing in one end of the muffler tubes. Considerable experimenting was needed to determine the exact amount that the tube could be closed in at each operation. Consequently the closing dies had to be changed a number of times to meet the conditions brought out by actual use. The final result was the making and using of four closing-in dies, as shown at *A, B, C* and *D*, Fig. 1. The short piece of seamless tubing from which the muffler is made is shown at *E*. The first and last closing-in operations are shown at *F* and *G*. The two intermediate closing-in operations will be readily understood from the description.

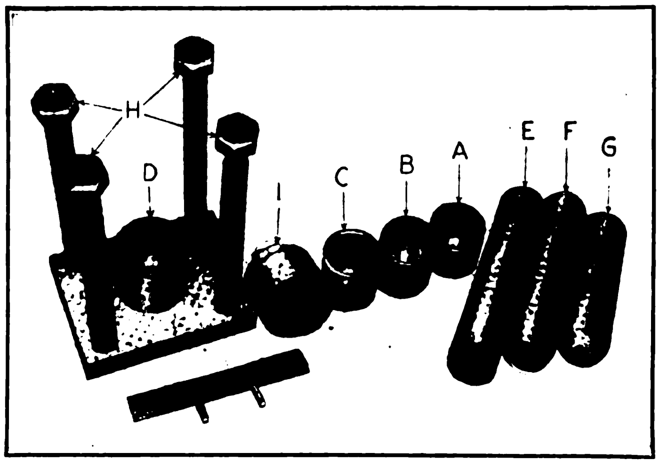


FIG. 1. THE CLOSING DIES AND EXAMPLES OF WORK

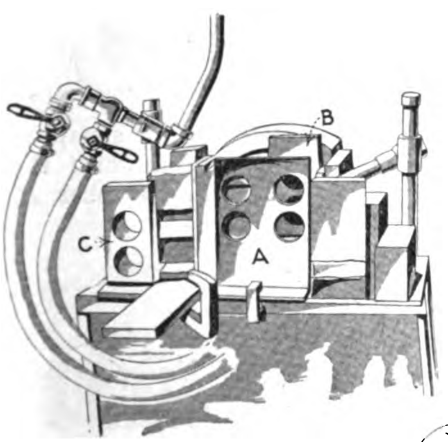


FIG. 2

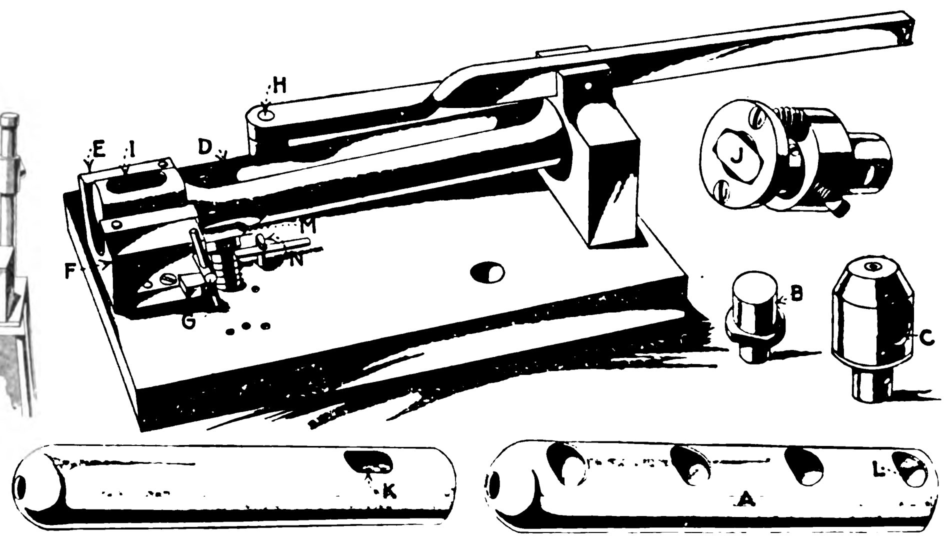


FIG. 3

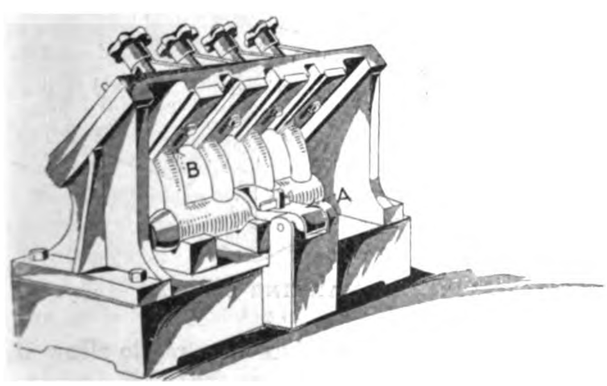


FIG. 4

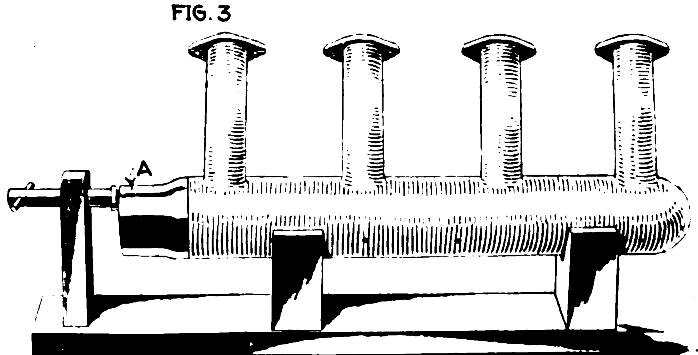


FIG. 5

FIGS. 2 TO 5—DETAILS OF MOTORCYCLE MUFFLER FIXTURES AND OPERATIONS

Fig. 2—Furnace for heating ends of tubes. Fig. 3—Piercing tools and examples of work. Fig. 4—Fixture to hold work for welding. Fig. 5—End-brazing fixture

The tubing used is 13 gage, $1\frac{7}{8}$ in. in diameter and is cut $13\frac{5}{8}$ in. long. To make room for working this length in the press, the dies are carried in a sling that is fastened underneath the press platen by means of four bolts *H*. The punch *I* is carried in the ram and is used to force the tube down into the die. The method of procedure is to set the punch and die for one operation, run through a given lot of tubes, then set up for the next operation, and so on. The first operation is done cold, using motor oil for a lubricant in the die.

The first reduction, or amount of closure, is from $1\frac{7}{8}$ to $1\frac{1}{8}$ in. The second operation closes the tube from $1\frac{1}{8}$ to $\frac{3}{4}$ in., the end of the tube first being heated to a cherry red. The third operation closes the end from $\frac{3}{4}$ to $\frac{9}{16}$ in., and the next and last from $\frac{9}{16}$ to $\frac{3}{8}$ in. Each operation after the first requires the heating of the end of the tube to a cherry red. Starting with a length of $13\frac{5}{8}$ in.,

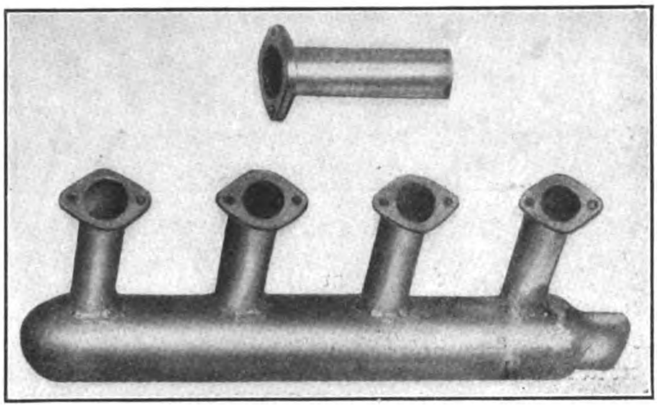


FIG. 6. FINISHED WELDED AND BRAZED MUFFLER

the final operation finds the tube reduced in length to $12\frac{7}{8}$ in., with a $\frac{3}{8}$-in. hole left in the beautifully rounded end.

The heating furnace used is shown in Fig. 2. It is a modified brazing furnace. The tubes to be heated are thrust through the holes in the piece of boiler plate *A* and through holes in the firebrick next to the flame. One of the firebrick referred to is shown in position at *B*, and the other is set on the front of the furnace at *C*. The object of using firebrick with holes in them is that the heat may be applied just where it is wanted. Only a small space is left between these special brick and the back of the furnace, so the flame plays upon only the ends of the tubes. Thus the ends that are to be closed are softened, but the rest of the tube is left hard, to resist the pressure.

Four large round holes and one oblong hole are pierced in the tube after the end is closed. This work is done with the tools shown in Fig. 3. A tube with the four $1\frac{1}{16}$-in. holes pierced in it is shown at *A* and the punch and die at *B* and *C*. The die is placed on the end of the mandrel *D* instead of the one shown. The tube is then thrust on the mandrel between the side guides *E* and *F*. The first hole is located by the stop pin *G*, which is pulled out after the hole has been pierced. The tube is then pushed on the mandrel until the stop *H* will enter the hole, thus locating the second hole. After this hole is pierced, it is used to locate for the next, and so on.

The oblong hole is $\frac{3}{4}$ in. wide and $1\frac{1}{2}$ in. long. The die used is shown in position at *I* and the punch at *J*. The tube is located for the hole *K* by thrusting it on the mandrel until the spring stop *M* will enter the hole *L*, next to the open end. When this stop is not in actual use, it may be locked away from the mandrel by turning the small handle until it catches under the hook *N*. In order to allow the tube to be slipped easily on the mandrel without binding between the end of it and the bed block under the end, about $\frac{1}{64}$-in. play is given. With a mandrel as long as this a spring downward of $\frac{1}{64}$ in. does not materially alter the alignment of the punch and die, yet gives ample clearance for the sliding in of the tube.

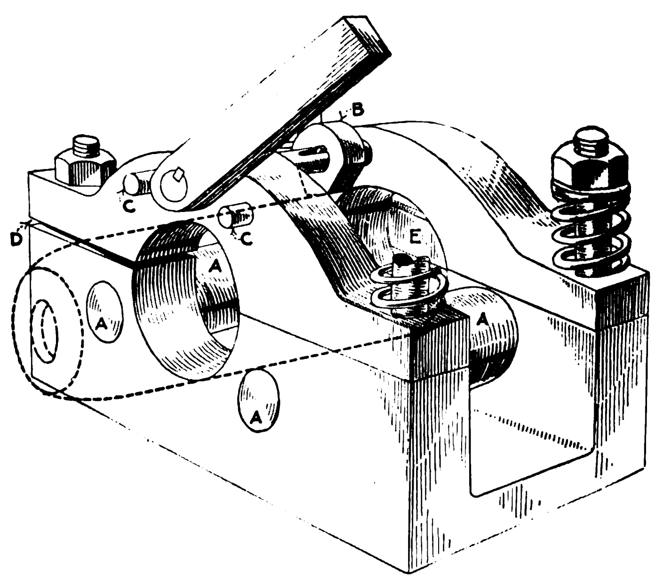
The four flanged tubes that lead from the exhaust valves to the muffler are welded on in the fixture shown in Fig. 4. The muffler tube is laid in V-blocks and is held in place by means of the hinged clamp *A*, which is locked by a taper pin. The four flanged tubes are held in place by means of forked clamps like *B*, the opposite ends simply being thrust through the round pierced holes in the muffler. The parts are then welded together with an acetylene torch and iron filler. A Prest-O-Lite outfit is used, and one man welds (on an average) 34 mufflers in an 8-hr. day, making four welds on each muffler. An 18-lb. tank of gas lasts about 6 days on this work.

An end is next brazed into the open end of the muffler, using the fixture shown in Fig. 5 to hold the parts in place. A regular gas blow-pipe is used to do the brazing, brass wire and a fluxing mixture of the usual kind being worked into the joint. A completely welded and brazed muffler, just as it comes from the fixtures described, is shown in Fig. 6. It gives a good idea of the way the welds around the small tubes look.

A Quick-Clamping Fixture for Marking Shells

By Fred Fruhner

The illustration shows a simple fixture for stamping shells. It consists of two rollers *A*, upon which the shell turns. The stamping is done with the roller *B*.



DEVICE FOR MARKING SHELLS

which is engraved and has the sides cut away to allow the shell to pass when the handle rests on the pin *C*.

The cutout at *D* allows for the difference in the shells, so as not to break the stamp. The springs act as a sort of gage of pressure. The strap *E* locates the shells.

Special Shell and Fuse Drilling and Tapping Machines--I

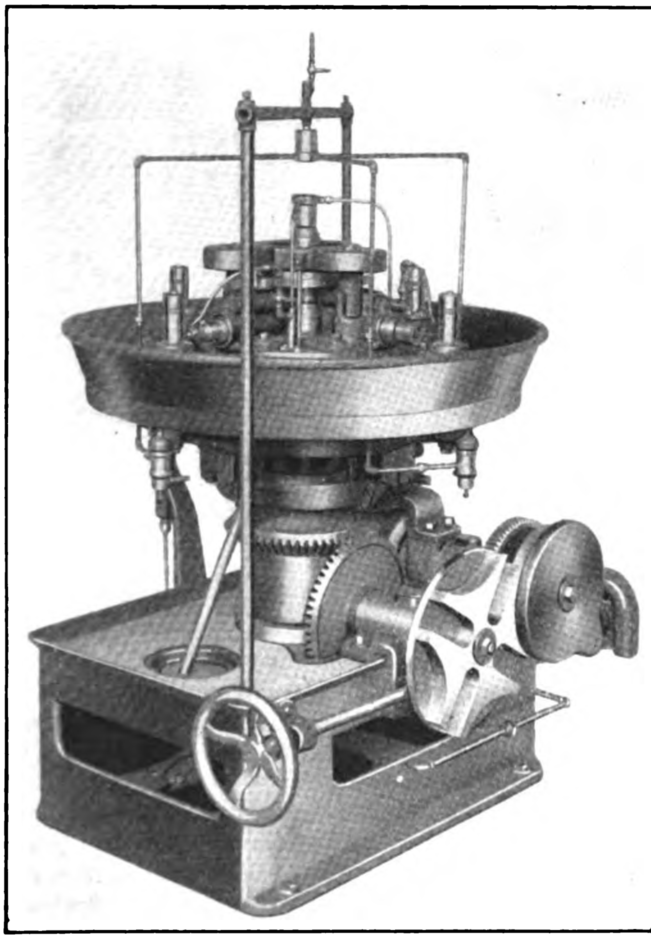
SYNOPSIS—Success in munition work seems to be obtained in two directions—with simple machines and special fixtures or with machines designed and built especially for the work in hand. The machines illustrated herewith are excellent examples of the latter class.

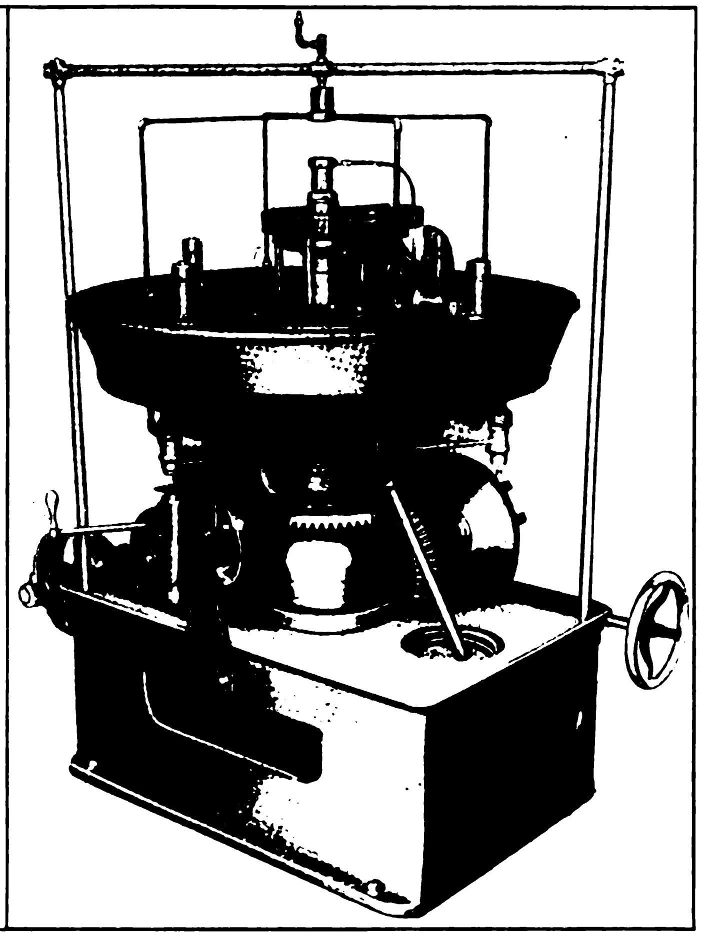
The demand for munitions of various kinds has given rise to many plans for special machines on which they can be manufactured. A number of such machines have been illustrated from time to time, but in no instance have we been able to show such a complete line of special machines for a variety of fuse or shell work as that of the Langelier Manufacturing Co., Providence, R. I. Some of these machines are illustrated herewith, together with the work they perform, the remainder being reserved for a later article.

The first machine is for drilling and tapping the grub-screw hole in the nose of the 18-lb. British high-explosive shell and is shown in Figs. 1 and 2. In Fig. 3 is shown the shell and Fig. 4 illustrates the details of the machine.

It has four work-holding stations, *A, B, C, D,* arranged equal distances apart upon a circular carrier *E,* which rotates around a central vertical post mounted upon a heavy cabinet base. Carrier *E* automatically brings each shell from the loading position *A* successively opposite a stationary drilling spindle *F,* a tapping spindle *G* and finally to the ejecting position *A,* pausing at each index just long enough to allow the drilling and tapping operations to take place. The work-holding stations *A, B, C, D* each have pneumatically operated expanding chucks *H,* in which the shells are inserted and which grip the shells very firmly by their bore the moment the index of the carrier begins.

The air-inlet valve then opens, an air pressure of 70 lb. per sq.in. drawing down the chuck center and forcing out the jaws tightly against the bore of the shell. The chuck is automatically contracted, and its grip on the finished shell is released for quick removal of the shell. At the completion of the cycle the downward projecting knob on the air valve rides up on the short curved rail opposite the ejecting and loading position, the operator depresses the foot treadle, shutting off the air pressure, which releases the grip of the chuck. By keeping the foot treadle depressed the action of the air valve may be rendered fully automatic. Three-point stops permit controlling the distance from the center hole to be drilled to the open end of the she





FIGS. 1 AND 2. TWO VIEWS OF THE CONTINUOUS DRILLING MACHINE FOR SHELL GRUB-SCREW HOLES

This cycle repeats for every shell. Consequently, there is a fully drilled and tapped shell removed at each index, one shell being drilled and another shell being tapped while unloading and loading are taking place.

The indexing of the carrier is accomplished through the intermittent action of the large Geneva motion shown, which is driven through the worm and bevel gearing from

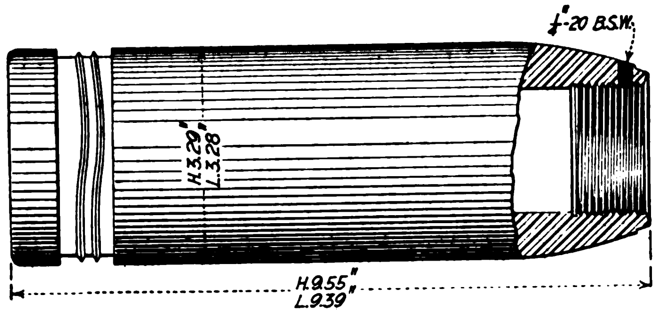


FIG. 3. BRITISH 18-LB. HIGH-EXPLOSIVE SHELL

the jackshaft, shown at the end of the machine and driven from the overhead countershaft. To bring the carrier more positively to stop at each index and lock it rigidly in position for the brief space of time required for the drilling and tapping operations, a locking toe, actuated by a rocker-arm in contact with the edge cam on the Geneva driver shaft, is moved into a slot on the under side of the carrier.

The vertical central post, around which the carrier rotates, houses a vertical sleeve that is intermittently operated by a large cylindrical cam on the Geneva driver shaft, accomplishing the feed and return of the drilling and tapping spindles. This sleeve, in turn, incloses a vertical shaft driven independently by a 12-in. pulley in

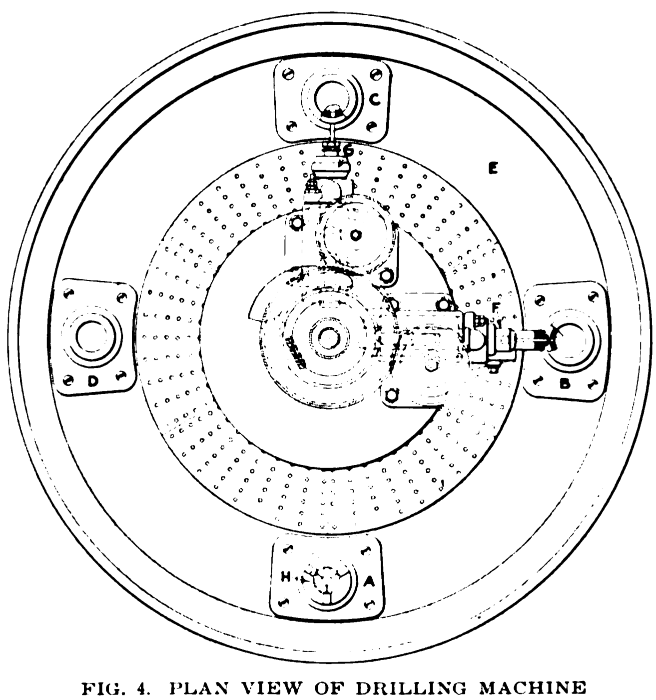


FIG. 4. PLAN VIEW OF DRILLING MACHINE

the base, carrying at its top a 72-tooth spur gear in mesh with two smaller spur gears or vertical shafts, on which are mounted spiral gears meshing at right angles with bronze spirals giving the drilling spindle 1,085 r.p.m. and the tapping spindle 366 r.p.m. The tapping spindle is equipped with a special Jarvis reversing tapping chuck that automatically reverses and withdraws.

The production actually secured with an unskilled operator from one machine averaged five steel shells drilled and tapped with one hole each per minute. This speed is easily maintained, because the machine drills and taps without stoppage for loading or unloading the shells or for securing the shells in working position.

Effective lubrication of the drill and tap is accomplished by an automatic oil feed. The circular pan surrounding the carrier affords ample capacity for catching chips and oil. The perforated false floor allows the oil to run into the base, whence it is pumped back to the work by a circular pump.

The drill is effectively supported and is prevented from glancing off the curved surface of the shell by a rigid steadyrest with long hardened-steel drill-guiding bushings. The feed of the drilling and tapping spindles is effected by a segment cam in contact with rollers mounted on studs and projecting from the sleeves of the drilling and tapping spindles and operating as already described. The floor space occupied by the machine is 44x56 in., and it is 66

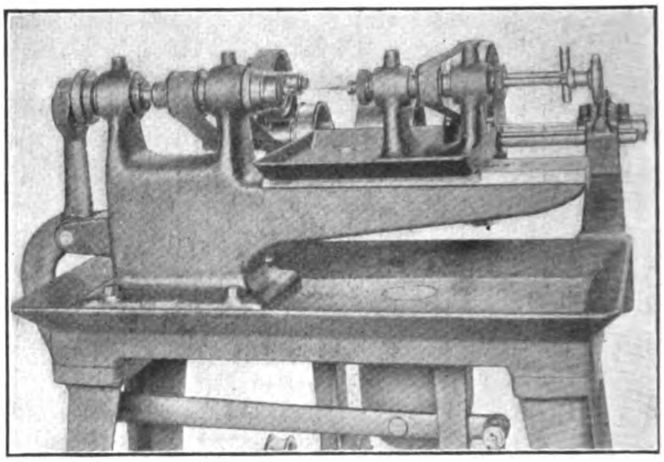


FIG. 5. DRILLING LATHE FOR GAINES AND PELLETS

in. high. It weighs approximately 4,550 lb. All gearing and exposed mechanism is carefully incased, to comply with safety regulations.

The machine shown in Figs. 5 and 6 was designed for drilling the small central hole in the gaine body, Fig. 7, and the graze pellet, Fig. 8. The output for the gaine body is 4 per min., or 240 per hr.; for the graze pellet, owing to the length of hole, 3 per min., or 180 per hr. The gaine body is made of steel and is drilled with a No. 68 0.031-in. drill. The graze pellet is of brass, the drill being a No. 56, of 0.0465 diameter. Both drills are stock sizes, but are specially tempered. The later specifications allow a much larger hole in the gaine and make the drilling correspondingly easier.

The drills being very small, the holes must be drilled at high speeds. To insure the holes being drilled straight and exactly in the center, both the drills and the parts are revolved. The proper speeds for both were determined after much experimenting and were found to be 4,500 r.p.m. for the drill used on the steel gaine body and 800 r.p.m. for the work; for the brass graze pellet, 6,000 r.p.m. for the drill and 1,200 r.p.m. for the work.

The drilling is done by means of a light sensitive floating spindle that is a sliding fit in the tailstock. A ball-bearing hand knob is mounted on the end for the operator, who feeds the drill by pushing. Thus it is easy to feel the cut of the drill and withdraw it when it fills or clogs

with chips. The holes are drilled accurately, and the liability of drill breakage is reduced to a minimum.

The machine consists of a headstock having an extended slide upon which the tailstock is mounted in any position, so that pieces up to 6 in. long can be drilled. For long pieces, such as the gaine body, a quick-operating steadyrest is used, which is adjustable to the diameter and the length of the piece to be drilled. For drilling the graze pellet no steadyrest was required. The headstock spindle is provided with a spring chuck for holding and driving the parts to be drilled. The chuck is opened by a foot pedal. A heavy compression spring inside of the spindle automatically closes the chuck when the operator removes his foot. Both spindles run in adjustable phosphor-bronze bearings, and both are driven from a self-contained

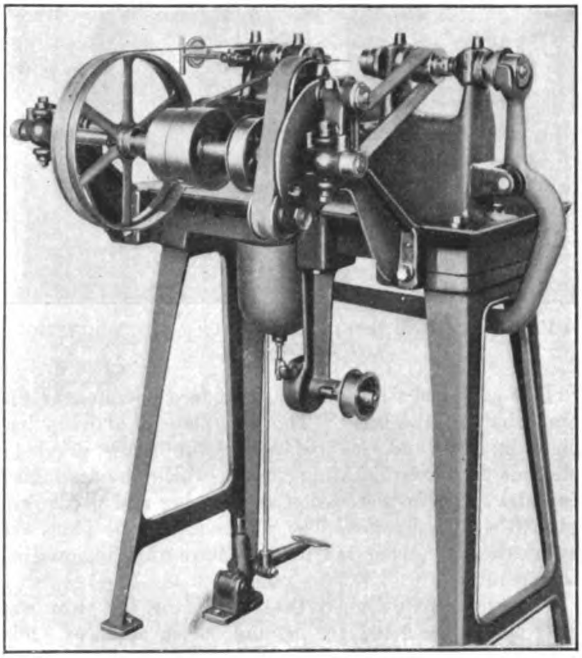


FIG. 6. REAR VIEW OF DRILLING LATHE

countershaft attached to the rear of the table upon which the headstock casting is mounted.

The tailstock-spindle pulley runs upon sleeves that are held stationary in the bearings and that drive the spindle by a double-keyed collar. This construction avoids the running pressure of the pulley upon the spindle, leaving it free so that the operator can sensitively feel the cut of the drill. The drilling spindle is driven by a 1-in. endless woven canvas belt and has a tightener. The headstock drive is unique in avoiding the use of a crossed belt, which would be necessary with a two-pulley drive, because the work must run against the cut of the drill. The open belt drive is obtained by means of a fulcrumed lever carrying two idle pulleys, the lever being mounted on the countershaft hanger at the rear of the headstock. The belt passes around these pulleys in such a manner that the driving pulley on the countershaft drives against the back of the belt. This arrangement secures the same result as with a crossed belt, but without its disadvantages. The headstock spindle is driven by a 1½-in. endless leather belt. The fulcrumed lever with the two idle pulleys also acts as a belt tightener.

An oil pump delivers oil to the drill, when drilling the gaine body. The oil is fed to the drill by a metallic flexible hose, the delivering end being clamped to the oil guard on the steadyrest. The pump is provided with an automatic shut-off valve that permits the flow of oil only during the drilling. It is operated by the foot lever and acts in unison with the opening and closing of the

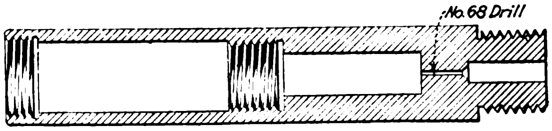
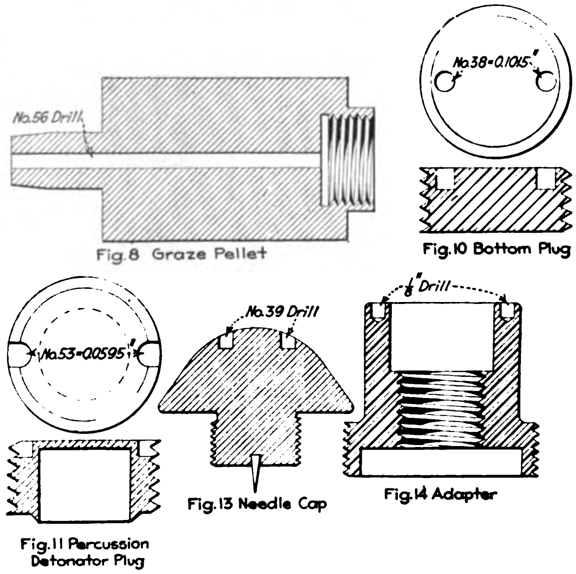


FIG. 7. DETAILS OF GAINE BODY

chuck. The pump is belted to the countershaft. The machine occupies a floor space of 3 ft. 1 in. by 2 ft. 7 in. and is 3 ft. 10 in. in height. Its net weight is 500 lb.

One of the standard Langelier drills is equipped with heads for drilling two No. 38 (0.1015 in.) holes 0.50 in. apart in the bottom plug, Fig. 10, and two No. 53 (0.0595 in.) holes 0.260 in. apart in the percussion detonator plug, Fig. 11. The output for the bottom plug, which is of steel, is 7 per min., or 420 per hr.; for the brass percussion detonator plug, 12 per min., or 720 per hr.

Both the plugs are centered with the drilling head by means of a spring steadyrest having a sliding fit on the cylindrical end of the drilling head. In the lower end of the steadyrest are a disk carrying the bushings for accurately starting the drills and also projecting prongs that exactly locate, by contact, the pieces to be drilled. The pieces are approximately located in their drilling



FIGS. 8, 10, 11, 13 AND 14. PARTS TO BE DRILLED

position on the table by means of a shouldered seat fastened to the table.

If the output for any one piece is sufficient to keep a machine continuously in operation, a machine and head are furnished as a unit; if not, one or more heads with different layout of spindles can be made to fit interchangeably in one machine. The drill heads with their steadyrests are self-contained and are easily interchanged.

The heads and drivers are of phosphor bronze and the drilling spindles of a special steel that permits a deep casehardening, so that they can be accurately ground to size, giving a hard surface with a soft center. The feed is actuated by a hand lever in conjunction with a rack and pinion.

The spindle pulley runs on sleeves anchored in the housing of the machine, thus avoiding the belt pull on the drilling spindle. Loose perforated bushings are used in all running bearings, increasing the wearing surface and insuring a free distribution of the oil.

The machine is arranged with a tight and loose pulley drive on the base and a foot belt shifter. The table has a working surface of 9x6½ in. and a vertical adjustment of 6 in. The machine occupies a floor space of 16x24 in. and is 5 ft. in height. Its net weight is 220 lb.

Drilling Caps and Adapters

Fig. 12 shows another standard drilling machine equipped and fitted with heads for drilling two 0.125-in. holes 1.100 in. apart in the adapter, Fig. 14, and two 0.10 holes 0.413 in. apart in the cap, Fig. 13. The output from this machine for the adapter, which is made of steel, is 5 per min., or 300 per hr.; and for the brass cap, 7 per min., or 420 per hr.

Both the adapter and the cap are centered, as are the plugs previously mentioned. The feed is actuated by a hand lever in conjunction with a rack and pinion. The machine occupies a floor space of 24x30 in. and is 5 ft. 10 in. in height. Its net weight is about 450 lb.

The press shown in Fig. 15 was designed for closing the metal around the needles in the percussion needle plug, Fig. 11, and the cap, Fig. 13. It is of the crank and plunger type, with a safety clutch and brake.

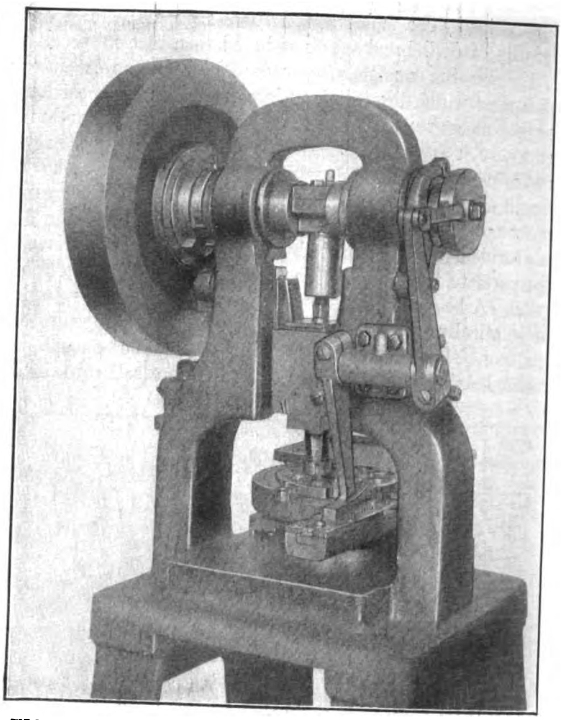


FIG. 15. STAKING NEEDLES IN CAPS AND PERCUSSION NEEDLES

It is equipped with a special dial feed operated by the crankshaft of the press. The dial plate of the cap has eight stations and, for the percussion needle plug, 12 stations that carry locating dies in which the assembled cap and needle or percussion needle plug and needle are placed by the operator. The percussion needle plugs are automatically ejected, but the caps have to be removed by the operator.

As originally designed the output for the caps was 40 per min., or 2,400 per hr. and 50 per min., or 3,000 per hr. for the percussion needle plug.

It has seemed best to the users, however, to use but one operator per machine, reducing the production to 500 per hr. on the needle plugs and to 250 on the caps. The machine has a floor space of 21x23 in. and is 5 ft. in height. Its net weight is 500 lb.

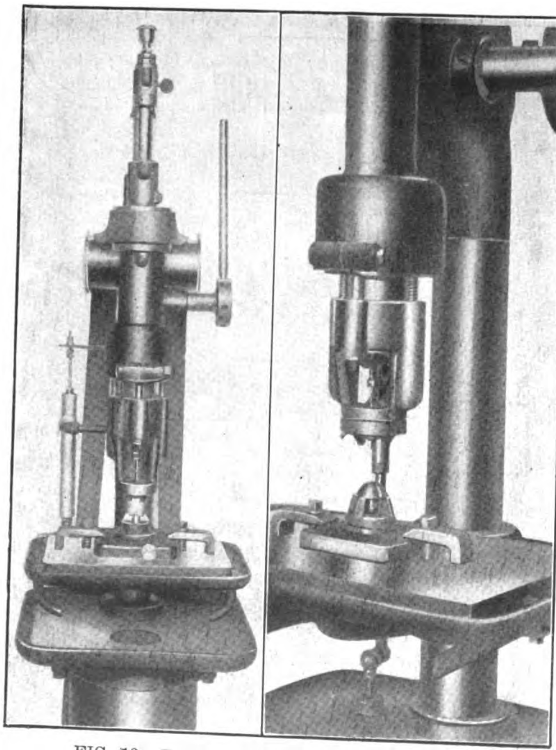


FIG. 12. DRILLING ADAPTERS AND CAPS

Preparation of Pure Iron and Iron-Carbon Alloys

A report on the preparation of pure iron and iron-carbon alloys has been prepared by the United States Bureau of Standards and is given in Scientific Paper No. 266 of the publications of that bureau.

It is shown that previous work on the iron-carbon diagram is unsatisfactory because of the great uncertainty of chemical composition of the materials used. It was therefore thought necessary to produce a series of alloys of great purity to form the basis of a redetermination of the diagram at the Bureau of Standards.

The general method pursued consisted in melting electrolytic iron with sugar carbon in magnesia crucibles. The electrolytic iron was prepared from ingot iron anodes in a chloride bath, with or without the use of porous cups.

Letters from Practical Men

Two Spiral Broaching Jobs

A few years ago, broaching in its simple forms was considered a ticklish operation, while a glance at the illustrations Figs. 1 and 2 gives an idea of the liberties which may be taken with this class of work under present conditions.

Referring to Fig. 1, an adaption of a lathe to broaching a keyway in a bushing is shown. These bushings were required in small quantities and the keyway had to be an accurate spiral.

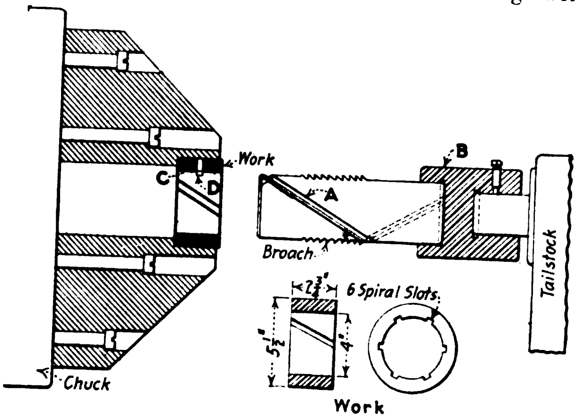


FIG. 1. BROACHING SPIRAL GROOVES IN A LARGE HOLE ON A LATHE

To accomplish this a number of short broaches of slightly increasing diameter were used, one of which is shown in position; and in these broaches a spiral slot *A* was cut.

The work is held in special chuck jaws, as shown, which give clearance in the back to permit the broaches to go through the work. By throwing in the back gears with the bolt that connects the gears to the pulley locked up for direct driving, the spindle of the lathe is locked so that it will not revolve. Over the tailstock spindle a sleeve *B* is placed. In the center of the work to be broached a hole *C* is drilled, and in this hole is driven a pin *D*. For broaching, the shank of the broach is placed in the sleeve *B*, the teat of the broach is guided by hand into the hole of the work, while the slot *A* is caused to engage the pin *D*. Then by turning the handwheel on the end of the tailstock the broach is forced through the hole in the work and made to revolve as the spiral groove travels along the pin. Thus the keyway is a true spiral, following the groove. Each broach will follow the path of its predecessor, as the broach teeth are cut with due regard to their relation with the groove. It is necessary on this work to remove the part from the chuck after each broach has been passed through, in order to withdraw the broach.

A similar job accomplished on a standard type of broaching machine is shown by Fig. 2, the work being smaller and made in large quantities with two spiral keyways cut in it. The piece is mounted in the bushing at *A*, while two broaches are drawn through it—namely, roughing and finishing. The arrangement of the tools for this operation is as follows: In the bushing *A* is placed the guide pin *B*. The shank of the broach *C*, with the work slipped over it, is pushed through the work bushing and gripped by the pin *D* in the broach holder *E*. The work is now held by hand against the work holder and is prevented from turning by the sides *F*. The machine is started and draws the broach through the work, the spiral twist being obtained as the groove necessarily follows the line of the pin.

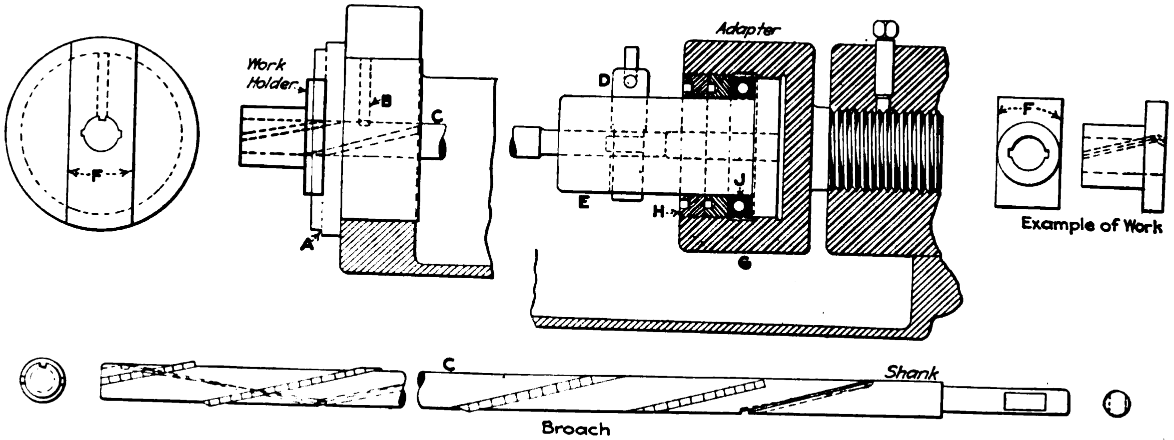


FIG. 2. A GENERAL BROACHING JOB ADAPTED TO STANDARD MACHINERY

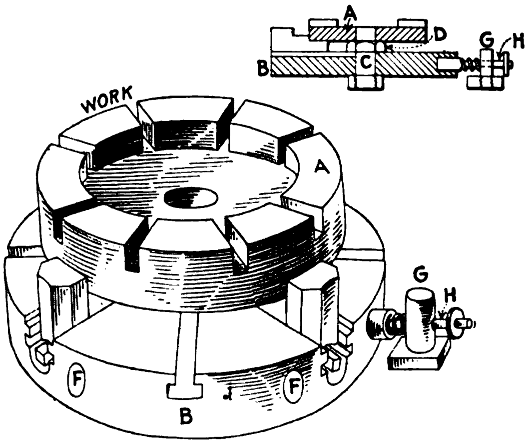
As there is no means of allowing the broach to twist in these machines, an adapter is provided. It consists of the broach holder *E* in the adapter *G*, two check nuts *H* and a ball bearing *J*. All these parts are mounted on the drawbar of the machine in a manner similar to that employed for holding broaches on ordinary broaching machines.

M. Henry.

Pawtucket, R. I.

Neat Milling Fixture

In the illustration at A is shown a machine part in which it is desired to mill eight slots. A horizontal milling machine is used, and the work is mounted on a three-jaw universal chuck B so that the top of the jaws is below



A NEAT MILLING FIXTURE

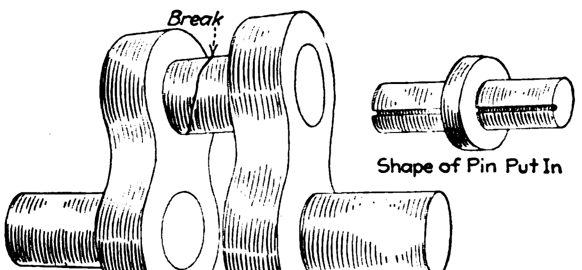
the cutting line. In one of the T-slots in the milling-machine table is placed a head, into which the bolt C is lightly screwed so that it cannot move. On this bolt the chuck is placed and clamped down by means of the nut D, with sufficient allowance to permit the chuck to be rotated about C.

Four holes F are accurately drilled in the side of the chuck. A pin G is screwed up tight in the nut, which is also placed in the same T-slot in the table. The shouldered pin H is put in a hole drilled in the pin G. One end of H fits into the holes drilled in the chuck and locks the chuck and work in position for milling two slots. Then the end of the pin H is removed from the chuck, which is rotated by hand until the end of the pin fits into the next hole, locating the work accurately for milling two more slots. This operation is repeated until the work is finished. W. C. Makley.

Birmingham, Ala.

Crankpin Repair Job

A while ago a forged crankshaft about 5 in. in diameter was brought to our small shop with the crankpin broken. As this shaft was the main drive of the mill, it was imperative that something be done at once. To get



A CRANKPIN REPAIR JOB

a new one forged would take at least several weeks, so it was decided to put a pin through the broken crankpin.

Each half of the shaft was put in the lathe, the broken ends of the pin faced off true and the cheeks centered. We had no horizontal boring machine, so the work was done on a heavy drill press. The shaft was strapped to the box table and also securely tied to the column with a block and bolts. After a hole had been drilled and rough-bored to about 3 in., the work was trued up with a dial indicator, by the surface that had been faced off in the lathe, in order to bring the boring bar parallel with the axis of the shaft. A finishing cut was taken and a generous fillet made. The center of each cheek was used to lay off a shallow keyway in the hole, to hold the parts in line when assembling.

It was necessary to have a collar on the pin to make the cheeks the right distance apart, as about an inch had been removed from the pin in the lathe. Keyseats cut directly in line on the fits of the pin held the parts in line. The collar was made $\frac{1}{32}$ in. larger than the crankpin, to correct any errors in centering the boring bar.

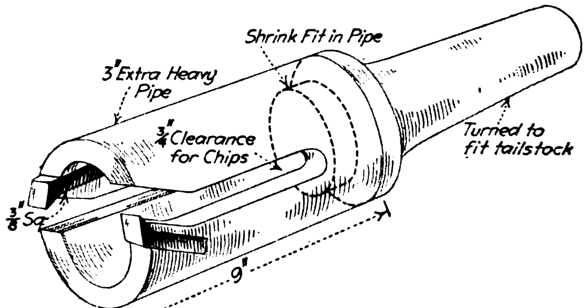
The job was pressed together; and when swung in the lathe, it was out less than $^1/_{64}$ in. The journals were trued, and the collar was filled level with the crankpin, thus finishing the job.

It will be seen that this method of repair weakened the shaft very little, for practically all the thrust came on the crankpin proper, as the function of the pin we put in was merely to hold the shaft rigidly together.

Memphis, Tenn. James Ellis.

Making Lignum-Vitae Bushings

Some time ago I had to make quite a number of lignum-vitæ bushings, $5\frac{1}{4}$x$4\frac{9}{16}$x5 in. long. The method of making these bushings was to drill a 2-in. hole and bore out to size. This seemed both a waste of material



MAKING LIGNUM-VITAE BUSHINGS

and time, so I made the tool shown in the accompanying illustration. It worked satisfactorily, as it saves time, and the center piece may be used to make smaller bushings. Thomas Mulligan.

Winfield, L. I.

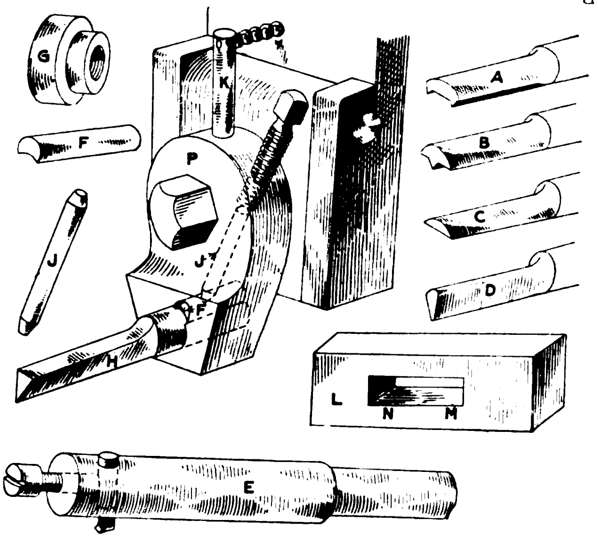
A Tool Holder for Internal Shaping Work

The illustration shows a tool holder that can readily be made to fit any shaper. After the tool post has been removed from the clapper box, the nut G is inserted in its place; and by means of a capscrew the holder P is clamped in position. Several sizes of the nuts G, to fit the various shapers, should be kept on hand.

The cutting tool is held in place by means of the setscrew, which presses the hardened pin J, pressure being transferred from there to F, which has also been hard-

ened, and then to the tool H. The pin K, which is a drive fit in the holder, serves as a means of applying a spring or piece of rubber between the clapper box and head, thereby assuring a steady cut.

A heavy tool holder that can be used in cutting keyways and other heavy work is shown at E. The tools A, B, and C are useful for cutting a rectangular slot, such as is shown in L. The tool B is first used for removing



DETAILS OF TOOL HOLDER FOR WIDE RANGE OF INTERNAL SHAPING

the stock from N to M. Then the tool A is used from N to the corner and from M to the other corner, but the actual corner is shaped with C.

With this tool holder one can shape within $\frac{1}{16}$ in. of the vise. This holder can also be used successfully on work that might project above the clapper box. By means of a socket wrench the setscrew can always be regulated for adjusting the tool. Other features are compactness, rigidity and simplicity. L. E. OLSEN.

Schenectady, N. Y.

Annealing Chains

Considerable discussion has recently arisen as to the advisability of annealing steel and iron chains after they have been in service for a reasonable length of time. In the past it has been considered necessary to anneal chains after they have been in constant use for one year, in order to remove the hardening effect caused by the overstrain or overload that all chains are subject to.

Such overstrain changes the physical properties of the metal, and this alteration may continue for a month, gradually developing greater hardness and decreasing the power of elongation until the metal obtains a permanent set. In this hardened condition the chain is more liable to fracture by shock when a load is suddenly applied or quickly arrested during its descent. If the process of annealing is properly carried out, the metal reverts to its former state as regards ductility, but is generally reduced in ultimate strength.

In addition to hardening, the metal of a chain deteriorates through repeated loading. This result is known as "fatigue," the effect of which cannot be removed by any process of annealing.

The question of whether or not a chain requires to be annealed depends largely upon the material of which the chain is composed and the nature of the work it performs. For example, the heavy hoisting chains used in connection with traveling cranes should be annealed, or "fired," at least once a year, as such a process thoroughly cleans the chain and enables a proper inspection to be made, when excessive wear or the presence of any flaw can easily be detected.

Hoisting chains supplied with chain hoists are usually made of special steel, having greater fatigue-resistance properties than iron chain, and are rarely subject to the severe treatment given to the hoisting chain of a crane or to portable sling chains in general use. Therefore, they should not be subjected to any annealing, or firing, treatment.

The methods applied in some instances in annealing chains have certain disadvantages. The best known is "close annealing," wherein the chain is placed in a gas- or oil-fired muffle furnace, heated to redness and then allowed to cool slowly.

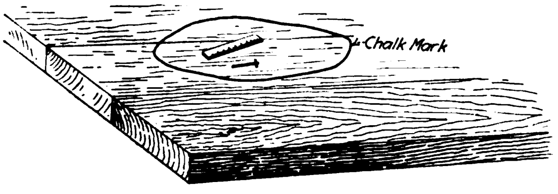
Another successful method is to use an ordinary reverberatory furnace, such as is used for heating plates. If neither of these appliances is available, a very simple and effective way of annealing is to place the chains to be treated over a bar that has been fixed at a given distance from the ground. Then they are covered entirely with a wood fire, which is allowed to remain in position until the ashes are cold. Oak wood is preferable for this purpose, as it is free from sulphur and phosphorus and does not affect the metal injuriously.

If the process of annealing, or firing, is to be successful, one important feature must be considered; namely, the entire mass must be heated uniformly not higher than 1,400 deg. F. and allowed to cool slowly, when very satisfactory results will be obtained. G. H. PLAINE.

Hartford, Conn.

Keeping Track of Small Tools

When using several tools on the bench at once, the fine-measuring tools and small scales can be easily kept separate and in a known place by simply drawing a chalk



METHOD OF KEEPING TRACK OF FINE TOOLS

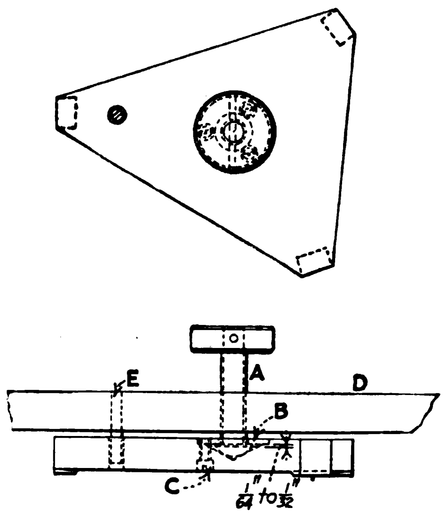
mark around a section of the bench, as shown in the illustration. Always placing the tools inside this line protects them from damage or loss. C. ANDERSON.

Worcester, Mass.

Fastening Clamping Screw to a Large Clamp

The illustration shows a good method for fastening a clamping screw to a large clamp. At a point exactly in the center of the clamp is drilled and counterbored a recess, as shown, to fit around the point of a screw A and washer B. The hole in the washer is drilled a trifle larger

than the screw diameter. There should be from 1/64- to 1/32-in. clearance between the bottom of the washer and the back of the rounded head on the screw. The washer is held fast by the screws *C*. The screw *A*, washer *B* and screws *C* are assembled on the clamp. Then the screw



CLAMPING SCREW FOR LARGE CLAMP

is screwed up in the lid of the jig *D*, after which the knurled head is assembled and pinned to the screw shank. The pin *E* holds the clamp in its right position.

Dayton, Ohio A. M. BOWYER.

The Originator and the Copier

It is always a disconcerting experience to find that designs which were evolved after trouble and difficulty have been annexed without acknowledgment by a competitor. In such cases the feeling of resentment runs high; and even if patent rights are not in question, the aggrieved party has a desire to bring the culprit to justice. There is, however, a crumb of comfort in the reflection that no copy, however close, can equal an original. This much, at least, is a recognized retribution upon dishonesty no less than upon legitimate imitation devoid of fraudulent intent.

The ethics of the subject are obscure. Evolution and improvement are gradual matters. The new of today is the commonplace of tomorrow and is out of date after the passage of relatively short periods of time.

In the matter of patents the state recognizes not merely the inventor's rights, but the question of public service. Protection is afforded for a limited term in return for disclosure of improvement. It is questionable, on the whole, if even patent protection, subject as it must always be to legal revision and confined as it is to narrow limits, is as valuable as is usually assumed. The majority of valid commercial patents are in restraint of trade and are obtained with this single end in view. Those that are of basic character return as a rule very little to their originator. It is reputation, after all, that counts, and this is apt to rest with the progressive firm that is known to originate. Mere copying is detestable to a creative mind, which can usually discover other and equally successful methods of securing the results desired.

National characteristics, like British partiality in favor of solidity and durability and American fondness for simple ingenuity, influence design. It is difficult to act outside of fashion, tendency and tradition. The habit of industries to localize themselves may be cited. It may be assumed that the tendency of like things to get together has a bearing on the question of imitation.

Some things once original are now simply matters of good practice, and resemblance is by no means necessarily imitation. Practice has evolved many standard means of achieving certain results, and such means are based upon origination of past periods.

Little in the way of mechanical invention is basic in the sense that scientific discovery is original, whatever the commercial returns in the former case. Details may be and are improved upon, but the opportunities for radical departure in the mechanical world are rare. This statement is not to deprecate the average invention, but is to say that revolutionary discoveries are far from common. Even when the basic is concerned, reduction to practice is a long and tedious process of evolution, and standard practice is usually the mean between competitors' work.

Modern design in an engineering sense is more selective than creative. First principles are involved in only a few cases; practice in the average commercial tool or machine is rather a settled matter, and we are all so heavily in debt to any predecessor that imitation in this sense is the order of the day.

It is a penalty imposed upon deliberate theft of ideas that imitation is bound to be late in the field. This fact alone affords some measure of protection to honest effort and progressive thought. Reputation follows experimental and original work and is usually found coupled with honest workmanship and first-class, careful system. Its worth can scarcely be over-estimated, and its reward is sure.

Tooting, S. W., England. A. L. HAAS.

Fractions, Decimals and Millimeters

Having frequent need to compare the millimeter with both the decimal and common fractions of an inch and

FRACTIONS AND DECIMALS OF INCH WITH MILLIMETER EQUIVALENT

Fraction of Inch	Decimal of Inch	Millimeters	Fraction of Inch	Decimal of Inch	Millimeters
1/64	0.015625	0.3968	33/64	0.515625	13.0966
1/32	0.03125	0.7937	17/32	0.53125	13.4934
3/64	0.046875	1.1906	35/64	0.546875	13.8903
1/16	0.0625	1.5875	9/16	0.5625	14.2872
5/64	0.078125	1.9843	37/64	0.578125	14.6841
3/32	0.09375	2.3812	19/32	0.59375	15.0809
7/64	0.109375	2.7780	39/64	0.609375	15.4778
1/8	0.125	3.1749	5/8	0.625	15.8747
9/64	0.140625	3.5718	41/64	0.640625	16.2715
5/32	0.15625	3.9686	21/32	0.65625	16.6684
11/64	0.171875	4.3655	43/64	0.671875	17.0653
3/16	0.1875	4.7624	11/16	0.6875	17.4621
13/64	0.203125	5.1592	45/64	0.703125	17.8590
7/32	0.21875	5.5561	23/32	0.71875	18.2559
15/64	0.234375	5.9530	47/64	0.734375	18.6527
1/4	0.25	6.3498	3/4	0.75	19.0496
17/64	0.265625	6.7467	49/64	0.765625	19.4465
9/32	0.28125	7.1436	25/32	0.78125	19.8433
19/64	0.296875	7.5404	51/64	0.796875	20.2402
5/16	0.3125	7.9373	13/16	0.8125	20.6371
21/64	0.328125	8.3342	53/64	0.828125	21.0339
11/32	0.34375	8.7310	27/32	0.843750	21.4308
23/64	0.359375	9.1279	55/64	0.859375	21.8277
3/8	0.375	9.5248	7/8	0.875	22.2245
25/64	0.390625	9.9216	57/64	0.890625	22.6214
13/32	0.40625	10.3185	29/32	0.90625	23.0183
27/64	0.421875	10.7154	59/64	0.921875	23.4151
7/16	0.4375	11.1122	15/16	0.9375	23.8120
29/64	0.453125	11.5091	61/64	0.953125	24.2089
15/32	0.46875	11.9060	31/32	0.96875	24.6057
31/64	0.484375	12.3029	63/64	0.984375	25.0026
1/2	0.5	12.6997	1	1.0	25.3995

not finding these equivalents in any handbook, I have compiled the table herewith, which I believe will prove useful.

New York City. A. ELTING.

Discussion of Previous Question

Job-Hunting Technical Unions

The statements in the article by J. Spaander, page 431, are not altogether pleasant reading, but are unfortunately more true than they ought to be. The only inconsistent note is where he speaks of the American engineer as too much given to shifting from place to place and then tells of his own 10-year wanderings in Europe, Asia, Australia and America. This shifting has its advantages, however, and I do not believe it is as bad a trait as he pictures.

There can be no doubt about the standing of engineers abroad being better than it is in this country. In Russia, in some cases at least, they rank with certain special layers in the social layer-cake, one of my friends being in the "duke" class and his assistant in the next lower layer, whatever that may be. None of us are anxious for the titles, but most of us would like the respect and the coin of the realm that go with them.

I have discussed this problem in England with both employers and engineers, and the general impression I gathered was that the engineer was there looked upon more as a physician and the case left in his hands. This attitude was apparently due to the fact that the client was either too much engrossed in other business to bother with his engineering work or that he felt he knew nothing of it and left it all to the engineer, just as he would if he called in a doctor to cure the measles.

In this country the average employer is perhaps more of a mechanic than in the older countries, this being probably due to a larger number having come up through the shop than in any other country. And those who do not know about engineering matters fondly imagine that they do, which may be even worse. The engineer should undoubtedly stand for the best engineering practice against the opinions of those who lack training; but when these same individuals happen to be the ones who handle the check-book it is not always easy to maintain one's position.

I cannot agree that the fault is entirely with the engineer, although I am not attempting to excuse him altogether. The general public has much to do with his standing on such matters as may be called public engineering. When the public can be made to see that its good tax money is being wasted by political henchmen who pose as engineers and demands that real engineers be employed, there will be considerable improvement in this direction. This situation is fortunately coming about in many sections of the country and seems bound to grow. With the increasing appreciation of the value of the engineer to the community and the country will come the raised standing of his profession to a par with that of the physician and surgeon.

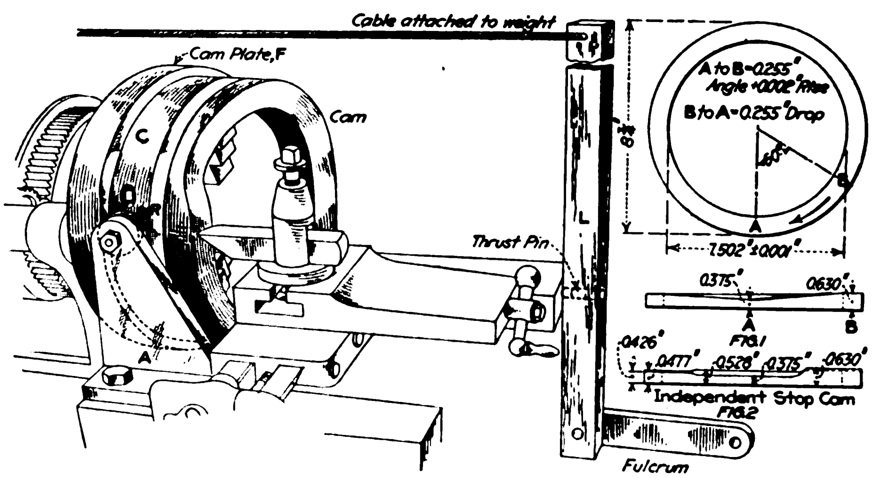
It is important that the engineer himself bear this in mind and be not content with his present standing. On the other hand, he must not become too much impressed with his own importance, but remember that we have little to do with the intelligence with which nature endows us, and that every man must give service according to his ability, if he plays the game fairly.

New York City. FRANK C. HUDSON.

Machining Gear Roller Faces

On page 1085, Vol. 43, was described an excellent method of turning face cams on the lathe. This article was very interesting to me, as we had several hundred cams of the type shown in Fig. 1, to be made at once. They are independent stop cams for the turrets of hand screw machines, and six points, 60 deg. apart, locate the stop finger for each position of the turret. We had been making these cams on the miller, as shown in Fig. 2, chucking them on the dividing head, milling the high point first, then raising the table 0.051 in. for each of the five remaining points. This practice meant turning the dividing head 40 turns by hand for each cam, besides raising the table five times. The best time possible by this method was 20 min. each.

This process was discarded for the method shown in Fig. 3, which proved to be a very satisfactory manufacturing proposition. The cam is held in the 12-in. three-jaw universal chuck C, fastened to the cam plate F, which is threaded to fit the spindle nose of the lathe. This cam plate is about 15 in. in diameter and is recessed about 3/4 in. deep to a diameter slightly larger than the outside diameter of the universal chuck. The chuck is centered by the boss on the back, fitting in a counterbore in the plate F.



FIGS. 1 TO 3. CAM TURNING ON A MANUFACTURING BASIS

The angle plate A, doweled to the carriage of the lathe and held down by two bolts, carries a roller R riding on the cam face. The feed-rack pinions in the apron are disengaged, and the carriage moves back and forth, following the contour of the cam, the roller being forced

against the cam by a weighted lever *L* bearing on the carriage.

This construction was adopted after trying out various springs and was found to be more positive, as it maintains a steady and constant pressure on the cam roller and gives much more uniform work. The work was run 30 r.p.m., so the entire carriage had to "drop back" 0.255 in. in $\frac{1}{3}$ sec., requiring considerable weight.

The power crossfeed was used, reversing in the apron, while the thickness was set by the graduations on the compound rest. A roughing and finishing cut produced the necessary finish. The time for this operation, floor to floor, is slightly under 7 min.

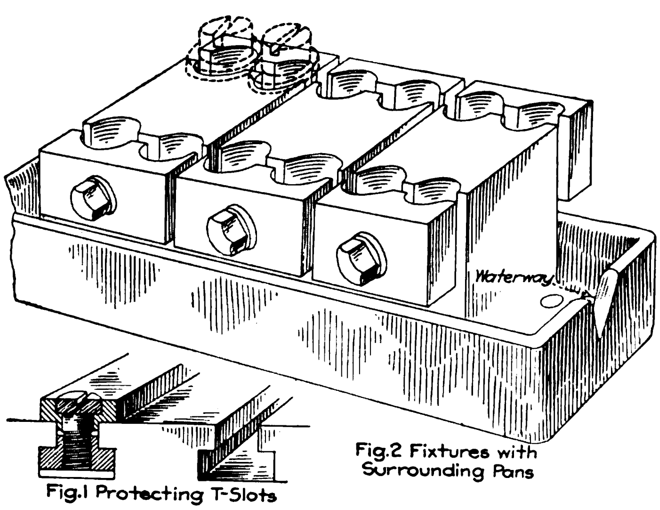
The method of making the master cam plate is deserving of mention. The head is too small to be obtained on the miller without special gearing, so the plate is finished-turned in place on the lathe and a slot cut across the cam face the depth of the low point. A $3\frac{1}{4}$ thread gives a lead of 0.051 in. in 60 deg., so the rise is cut with this thread, the error being less than 0.0015 in. The drop is marked off, roughed down in the shaper and finished by filing, the total time for making the cam plate being about 12 hr. H. B. McCRAY.

Charles City, Iowa.

Making Effective Protectors for Machine Ways

I agree with the article on page 1128, Vol. 43, which says, "Any means that will increase the life of a machine tool or prolong its accuracy and usefulness should be carefully considered."

The usefulness of an effective protector for the machine ways is self-evident, but to me the spring window-



MAKING EFFECTIVE CHIP PROTECTORS

shade contrivance has its disadvantages. For simply keeping chips and dirt out of T-slots a plain strip of the section shown in Fig. 1, held in position by cheese-head screws, is much easier. Although taking more time to arrange, it is not necessary to handle the strips very often, and they give the operator the free use of his table while protecting its surface when heavy or rough castings are being constantly taken on and off.

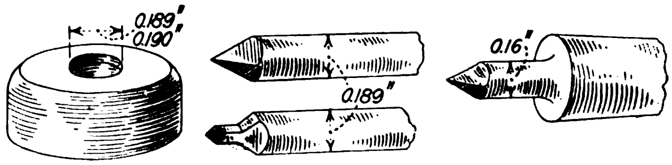
A more common device is a sheet-metal tray in which the jig or work is placed. If a jig is used, a slot is cut in the bottom of the tray to allow the registering pins or tongues on the jig to enter the table. When designing a milling jig, I always try to embody the tray idea in the casting itself, as in Fig. 2. Any extra cost incurred in the pattern and casting is balanced, or justified, in the stiffer casting obtained. The web all around lends strength to the casting in addition to confining the chips to one slot in the table. P. JAMES.

Surrey, England.

Grinding-Operation Kink for Hardened Rollers

On page 185 I notice a grinding kink by W. L. Conklin. It reminds me of a job of similar nature that, to my way of thinking, was handled in a more efficient manner.

Five hundred hardened-steel rolls 0.185 in. in diameter and 2 in. long were called for. A piece of 0.189-in. drill



DRIVING ROLLS BY SQUARE CENTER

rod was cut off to length. Then a bushing was made with a 0.189-in. to 0.190-in. hole in it and slipped on the rod. With a center punch ground four-sided we prick-punched one end of the rod and centered the other end with a small center drill.

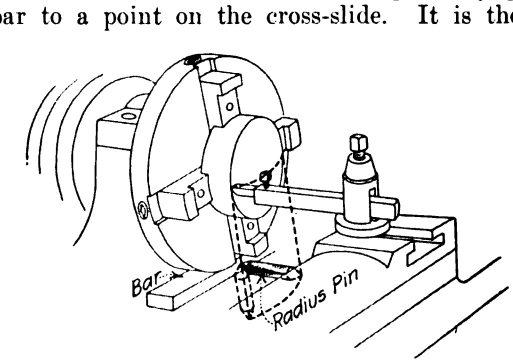
The rolls were then hardened, and when ready to be ground, a center of the grinder was turned down to 0.16 in. and squared on the end to fit the prick-punch square in the rolls. In this way the headstock center revolved the work, which was more efficient than a soldering iron.

Arlington, R. I. GEORGE P. BREITSCHMID.

Turning a Small Radius

On page 865, Vol. 43, was an article on "Turning a Small Radius."

The same principle may be used for convex curves by clamping a bar to the lathe bed between the cross-slide and the headstock, so that the radius pin may go from this bar to a point on the cross-slide. It is then only



TURNING A CONVEX RADIUS ON FACEPLATE WORK

necessary to see that in setting the pin the points where this engages and the point of the tool are in the same vertical plane, the tool in this case being started at the outer diameter, as is also the case in turning a concave radius as described in the preceding article.

Detroit, Mich. GEORGE H. CHENEY.

Manufacturing Rifle Cartridges

The article on page 289 of the *American Machinist* brings to my attention an operation that, as described, is far from being possible. Even if it were, it would be a very poor manufacturing operation. I refer to the following paragraph:

> Cartridges are loaded with many different charges, such as black powder, semismokeless, dense smokeless and the like. These charges differ so much in characteristics—amount used, density, rapidity of combustion, chamber pressure, etc.—that a number of different primers must be provided. Therefore the primer hole, which is pierced through the head of the cartridge during the indenting operation, is of a great variety of sizes, depths and shapes. Tools for this operation will stand up for some 1,000,000 or more cases, with proper care. The only lubricant used is a little lard oil on the punch occasionally.

I also do not agree with that portion of the article which deals with the indenting and piercing in one operation, for the simple reason that in indenting the head of a cartridge the metal is forced down and is flowing before the indenting punch. If it were possible to carry a piercing punch in conjunction with the indenting punch, my experience leads to the belief that the indenting punch would force the metal around the piercing punch in such a way that it would be impossible to strip the shell without breaking the punch.

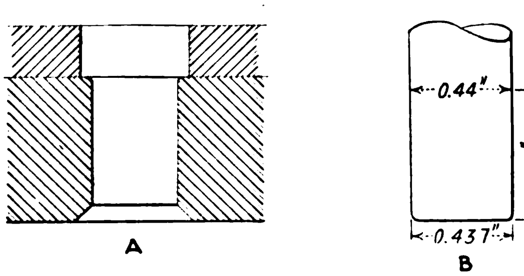
Moreover, the fact that experience has shown how difficult and heartrending it is to try to pierce metal that is thicker than the diameter of the piercing punch makes it hard for me to believe it possible to perform this operation successfully.

As for the machine that does all the operations as stated—I am from Missouri. GEORGE DINGER.

New York City.

The timely article by G. R. Smith, in Vol. 43, page 881, which I read with much interest, calls to memory a few little kinks I used on similar work where large quantities were manufactured, which resulted in a saving in tool steel and time.

The redrawing dies, made as shown at *A*, had a sharp edge at their bottom for stripping, which did away with



SELF-STRIPPING DIE AND TAPER PUNCH USED IN RIFLE CARTRIDGE WORK

the spring detent stripper and enabled us to shrink the dies three times before discarding them as useless.

The shrinking was done by using a shallow pan of water deep enough to reach within $\frac{1}{8}$ in. of the drawing surface of the hole, then heating the die to a cherry red and rolling it in the pan of water until cooled, afterward annealing it and working it over in the regular way.

I have found that the dies will shrink about 0.009 in. the first time and from 0.007 to 0.005 in. the second and third times, but on the fourth shrinking I could obtain no results that warranted the expenditure of time and money.

The punches, as shown at *B*, were straight to within 1 in. of the drawing end, which was made from 0.002 to 0.003 in. small, tapering back to the required size. This made stripping easy.

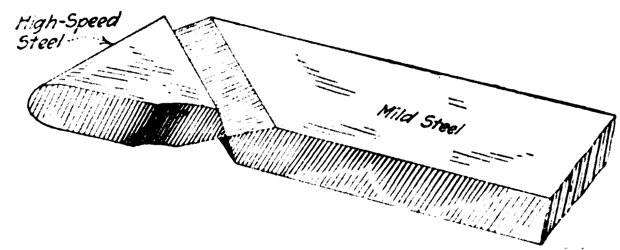
These punches and dies were made for drawing brass shells of 0.044-, 0.380-, 0.320-, 0.300-, and 0.250-in. diameter. Lard oil was used as a lubricant.

St. Louis, Mo. JAMES S. GLEW.

Methods for Making High-Speed Steel Go Farther

Methods similar to those described on page 165 have already been adopted at the Puget Sound navy yard. Our high-speed steel scraps consisted of all sorts of short ends. Owing to the high price of steel we decided to try oxyacetylene welding to utilize the ends on a mild-steel shank. We prepared for the weld as shown herewith and have turned out lathe, shaper and planer tools that give entire satisfaction.

The high-speed points were cut with a hot set and ground to the proper shape, the welding edges being



TOOL PREPARED FOR WELDING

beveled toward the center at about 45 deg. The shank was made in the same way and the weld made with an ordinary steel-welding rod. We figured that making the weld at an angle of 45 deg. from the base would give the welded point a better support from the end of the shank and reduce the stresses at the weld.

The first tool made cost about 35c. excluding the somewhat doubtful value of the high-speed scrap used for the point. Later tools, of course, cost less. After a heavy test lasting an hour on nickel steel, this first tool showed no signs of distress and the cutting edge was still in excellent condition. G. A. HASTINGS.

Puget Sound, Wash.

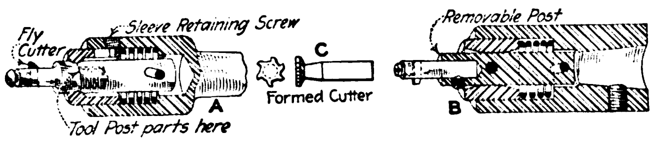
Neat Recessing Tool for Percussion Caps

Mr. Nowalk's article on page 208 showing an eccentric type of recessing tools brings to mind my experience with this and other types of recessing tools, which may be of interest. For recessing the threaded end of percussion pellet hole for steel bodies for the British No. 100 detonator, we found it necessary to design a more rigid tool than was used in the brass bodies.

I first designed a tool substantially as shown on page 208, using the same lead of spiral, but cutting it only 90 deg. of the circle. This gave me the recess required—namely, $\frac{1}{32}$ in., the tool post being $\frac{1}{32}$ in. off center of the body.

We found in practice that this tool was not rigid enough when used on high-speed drills, owing to its length from the drill spindle and on account of the tool post rotating off center. I then designed the tools shown herewith, which are doing satisfactory work. They are simple in construction, more rigid in operation and have the advantage of running in balance, and they allow the use of a larger post to enter the hole.

Both tools shown are substantially the same in principle of operation, but in tool *A* the post is made in two parts,



RECESSING TOOL FOR HIGH-SPEED DRILLS

with a circular groove formed central with the joint where they screw together. The sleeve, which rides on the jig bushing when the tool is in place for recessing, is formed on the inside diameter to fit freely in the groove in the tool post, acting as the fulcrum and its support.

In tool *B* the post is pivoted in the sleeve, as shown, this sleeve being relieved to allow the tool post to rock when thrown over by the cam groove at its bottom end. The pin in the cam groove passes through the body, being located on the center line of tool and riveted in place.

The construction of both tools is clearly shown.

I have shown a small fly cutter held in place by a screw in the end of the tool post. The cutter is made from $\frac{3}{32}$-in. drill rod and is cheaper to make than a formed cutter, with the advantage of setting to the diameter required after grinding.

When the recess is formed in the bottom of the hole, as described in Mr. Nowalk's article, I prefer to use a formed cutter with four or more cutting edges, as shown at *C*. This obviates the necessity for the operator to set the cutting edge exactly in line with the movement of the tool post and gives more wearing surface than the one lip tool. JOHN J. EYRE.

Boston, Mass.

The Machinists' Strap

It gives me great pleasure to find that my ideas of things are shared by so eminent a man as John E. Sweet. When I read his remarks about the farmers' lever and its fulcrum and the machinist and his straps, I went out into the shop where I am in charge and checked up some straps I have had for years, to find, as I expected, that they agreed with the proportions laid down by Professor Sweet.

And now I should like to express a few ideas about straps. We are in agreement as to the lengths from bolt to work and from bolt to block. It is also important, if one is to get the best results, to see that the strap is parallel to the platen on which the work is being held. Inattention to this results in work being distorted, insecurely held and in the breakage of bolts.

The end of the strap that engages with the work should bear level upon it; that is, it should have a surface bearing, not a point, or line, one. To obtain this, packing should be properly prepared of a height equal to the thickness of the job instead of using any old piece of junk from the scrap pile, with irregular surfaces that besides being unsuitable for the job in hand leave their mark on the plane surface of the platen. Where a job is coming through in quantities, it is an easy matter to provide straps embodying in themselves the right height of packing block.

With regard to the straps made by bending a square bar in the middle, I have a number of these and find that they stand up very well, if made of tool steel, ¾ in. square, bent to pass a ¾-in. bolt and of a length, when bent, of about 7 to 8 in. F. R. MANN.

London, England.

Painting Small-Shop Products

Mr. Van Deventer's interesting article on painting small-shop products, in the *American Machinist*, page 183, encourages me to offer a few views on the painting of machine-shop tools.

Architects and engineers have done everything in their power to make the modern factory a healthful, well-lighted, clean place. White walls and ceilings are now the rule, with about 6 ft. of wainscoting of some darker color, say green or brown. How attractive a new shop looks until the machines and equipment are installed! Then we see a mass of dirty, black, moth-eaten units.

Why not finish the machines in keeping with the rest of the building? Finish them white. Finish them white from "stem to stern," except those parts that must necessarily be of polished metal or which are used in actual contact with the work, as chuck jaws, miller tables, ways, lathe centers, etc. Parts that are subject to handling, such as pedals, belt-shipper levers, hand levers, etc., could be finished with a tough coat of porcelain enamel of the kind used on plumbing fixtures. The better grades of this material will not crack off even when subject to the abuse of careless employees. Tools that are subject to heat could not be painted pure white, but could be finished in aluminum paint, which will stand severe heat. This color would blend very well with the general scheme of the shop.

Of course, the objection will be raised that the machines will become stained with oil and look worse than if finished in a dark color. The remedies are better prevention against oil leakage, which is a possibility. Incidentally, in certain classes of tools the ball bearing offers a good solution of this trouble. It goes without saying that the coolant can be properly taken care of.

There is no excuse for dirt in any form in the machine shop. But what is to be gained by all this expense and trouble? First, better work—better because more reflected light will be thrown on the work, which will be of tremendous help to the operator, and the work will stand out in sharper relief, which is also an aid to the eyesight. If you do not believe in the principle of reflected light, just arrange a drop-light over a table top of dark color. Then superimpose a piece of white paper and notice the difference. And last, there is the psychological effect on the operator and everyone concerned. The effect gained is the same as with a finely finished precision instrument—the men will handle the machines with more care, keep them cleaner and do better work with them.

Bridgeport, Conn. W. BURR BENNETT.

[The machinery of the printing plant of the Hill Publishing Co. is finished in white enamel, this practice dating back a number of years.—Editor.]

Editorials

Machine-Tool Descriptions

In one of its aspects the editorial last week on "Copying Machine Tools" brings up the question as to what kinds of machines and appliances are eligible for notice in the department of the *American Machinist* headed "Shop Equipment News." The policy in regard to these descriptions has been in force for many years and is easily and simply stated.

Like every other part of the editorial pages, this department is maintained for *American Machinist* readers and for no other purpose. The readers are interested in every new machine, device and appliance that can be used in machinery building. They have the right to expect that the journal they read will provide them with information about all these things. This the *American Machinist* tries to do. During the last five years 2,139 such items have been printed—an average of over eight each week. This is an unparalleled record.

The test that is applied to each one of these items when it is received for editorial consideration is this: Is the machine or appliance offered a new or improved machine-shop product? That is, is it new to the manufacturer who has produced it? It is not expected that it is necessarily new in principle or mechanism.

It is obvious that any other interpretation would be impossible. Radically new bits of mechanism in the machine-tool field are very hard to find. Every time a lathe is produced with a cross-slide the invention of Maudsley is being copied. Every time a manufacturer designs a turret for a turret lathe he is harking back to the original ideas of Howe and Stone. We might go through many, if not most, of the mechanisms in daily use and such as are shown each week in the "Shop Equipment News" section of the *American Machinist* and name the men who originally developed the devices.

But the readers of the *American Machinist* are not interested in priority or historical credit; they do want to know what machines and appliances can be procured today to carry on their work. Thus the descriptive matter sent by the machine builders is accepted and printed as coming from reputable sources. This confidence is practically never betrayed.

Trade Education in Danger from Its Friends

Vocational education, in common with so many other projects, is in serious danger of disaster at the hands of its friends. Those who believe that it is important to know what to avoid will welcome the report prepared by the National Society for the Promotion of Industrial Education and published by the United States Department of Labor in Bulletin No. 162. The subtitle—Miscellaneous Series No. 7—describes it better, as it is about as miscellaneous a collection of data as we have seen, some of it being excellent information, but much of it being seemingly far outside the realm of a practical survey. The bad feature of this survey is that it will tend to discourage practical surveys, which are so much needed in many cities.

It is difficult to see just why a survey of the industry of a city should be a cyclopedia of those industries, why it should go into minute details of how each operation is performed and just what each tool is used for. Of course it makes a very impressive-looking report; but the same material can be found in the cyclopedia, and it is a fairly safe bet that this pamphlet came from that source. This statement does not mean that a survey should be superficial, but that it should deal with the real fundamentals or underlying principles of the industry rather than with its history in the cyclopedia sense, as in this case.

Taking the metal industries, we find 17 establishments reported, with a total of 4,924 men. The machine shop receives careful attention, all the types of machines being described in dictionary language and occasional gratuitous advice thrown in as to certain machines not being as fully used as they should be. This is about the only trade, however, for which specific recommendations as to school training are given. Nearly all the rest have to be content with a suggestion for more general education.

The bulletin recommends, however, a so-called elementary industrial education that, from the outline given, would be more comprehensive than the apprenticeship now in force in most shops. This step is highly desirable; but it must be remembered that, after such a course, no boy is going to be content with the old form of apprenticeship, either physically or financially. No boy who has absorbed half that is suggested will dote on sweeping the shop for three months at $3 per week.

The ever-changing phases of modern shop practice make proper vocational or industrial training more difficult each year, but they also emphasize the importance of suitable prevocational education. Whether the vocational, or trade, school is to increase, or whether it is to disappear in favor of the shop school, the prevocational teachings of the elementary grades become equally, if not even more, important. This need is particularly clear when we see, in this as in every other report, that the boys and girls begin leaving school in large numbers at 14 years.

The great danger is that people will become disgusted with vocational and other surveys that only put out voluminous reports containing encyclopedia information, but which do not point out how the children can be taught to fit into the industries of their locality. And as it is by no means certain which of these industries will present an opening when the children leave school, their training must be broad enough in fundamentals to be of assistance in whatever line may be open.

This condition is the great educational problem of the day, and a few have seen light and are working toward it. But the problem is made more difficult by both individuals and societies that only succeed in producing at large expense voluminous reports, which may make a show of great activity, but do not point out constructive methods.

Catalogs and Circulars for South America

Like business letters, all catalogs, circulars and publicity matter intended for South American customers must be in the language of the country—Portuguese for Brazil, Spanish for the rest of the continent. The piece of business literature printed in English promptly finds its last resting place in the waste basket. The only exception is when the matter reaches Englishmen or North Americans who are in executive positions in South American shops. But these men are so few in number that their preference for English does not weaken the force of the general rule.

In style and arrangement every bit of business literature intended for South America must be explicit, prepared in great detail and profusely illustrated. The regular type of catalog issued in this country is of little service there. It does not give enough information. The tendency here is to condense everything. We say it is written for the busy man. We realize that the reader will have a more or less intimate knowledge of what is being written about.

But in South America conditions are different. The reader there does not have the extensive mechanical knowledge possessed by executives in North American shops. He does not object to taking time to read long detailed descriptions; in fact, he likes to do so. He wants to know everything that can or should be said about the machine or appliance in which he is interested and does not wish to have points left to his imagination or to interpretation from his general knowledge.

For the reason that illustrations are a universal language that does not need translation or interpretation the cuts in catalogs and circulars are of prime importance. They must be used in profusion. They should show not only the general exterior features of a machine, but should also exhibit the interior working details and even give the details of individual pieces. Every machine, every variation of a machine and every part of every machine should be given an individual number, which should appear on the illustrations. These numbers can also be used as references in the descriptive matter and provide an excellent means of conveying information from the southern customer to the northern builder.

This method of designating machines and parts has been worked out by a few of our industries in great detail, notably in shoe-machinery building. Thus the principles of applying such a system in catalogs and circulars are fully established. The method possesses no experimental features and can be easily adopted by every machinery builder who is reaching out for foreign trade.

Supporting and explaining the many illustrations, there must be detailed text, describing every minute feature of the construction, operation and workmanship of the machine. It is impossible to say too much. When an order must travel 3,000 or 4,000 miles before it can be accepted and filled, the one who makes it out wants certainty.

No cross-references or marginal notes or footnotes are permissible in any business literature intended for South America. Better repeat a thing a dozen times than cross-reference once. If this seems like a burdensome requirement, just remember that, if you fail to understand an order received from South America, four months must elapse before you can receive a reply to your letter of inquiry, straighten out the order and make shipment. Four months is a long delay, may easily lead to dissatisfaction and finally result in no business.

In addition to numbering every machine and every variation of a machine, each one of the assembled units should be provided with its own code word. For instance, if a given size of lathe can be furnished with a cone drive, single-pulley drive or motor drive, each one of these three combinations should not only have its own reference number, but also have its individual code word. Do not ask your prospective South American customer to combine code words in order to specify a machine with particular attachments. Do all this work yourself and arrange your code in the simplest manner possible. In addition to coding machines and assembled units, it is also wise to code some of the principal parts that may have to be ordered for replacement. This feature will mean a large amount of detail work in preparing your business literature—but it is a kind of preparation that pays.

The order blank is practically unknown as a bit of business literature sent by builders to prospective customers in the United States, but a blank of this kind should always be included with every piece of descriptive matter sent to South America. It should be carefully planned and divided into columns or sections, each one calling for specific information in regard to the machine or appliance that is wanted. In general, the headings should be these: Serial number; code word; description; number wanted; net and gross weight, in both English and metric units; general dimensions, in both English and metric units. The serial number, code word and description form a triple check upon the customer's requirements. Catalogs and circulars should also specify net prices. Never quote a list and string of discounts. They are confusing at home and doubly so abroad.

The matter of obtaining a satisfactory translation from English into Spanish or Portuguese may look like a serious difficulty to North American manufacturers. This need not be the case. First, prepare everything in the simplest, clearest, most straightforward English that can be written, taking care to avoid unusual expressions or colloquial and shop names for machine parts, operations and the like. (In passing, it is worth while to point out that it is a pity that there are no standards in technical English for the names of common machine parts and shop operations.) When the original matter has been carefully prepared in this fashion, it is not difficult to obtain a satisfactory translation from some native South American. Three things that cannot go wrong are the illustrations, the serial numbers and the code words. These three form the backbone of the means of identification in a customer's order. One of their good points is that they do not have to be translated.

As a rule, business literature sent from European countries fulfills all the foregoing requirements. However, the quality of the mechanical production of the English and German catalogs and circulars is not nearly so good as that which prevails in the United States. The illustrations are cheaper in kind, the paper is inferior in quality, and the general appearance is unattractive. But all the essential information is there, and that feature is far more important than the one of appearance only. There have been cases where a South American buyer turned to his catalog from England to help in interpreting one from Cleveland, Ohio.

Shop Equipment News

Hobbing Thread Miller

The illustrations show a thread miller manufactured by the Taft-Peirce Manufacturing Co., Woonsocket, R. I. This firm has acquired the manufacturing and selling rights in the United States for this machine, which was originally developed by J. Archdale & Co., Ltd., Birmingham, England.

The machine uses, when milling either internal or external threads, a cutter the threads of which have no lead. This cutter is of practically the same width as the length of thread to be cut, and one complete revolution, with a slight over-travel to insure a perfectly finished thread, completes the machining operation. It will thus be seen that the machine is well adapted for rapid production. It is designed for threads of relatively short length, and the work produced shows a high degree of accuracy.

The part to be machined is held in a self-centering chuck designed to meet its special requirements. The handwheel at the rear of the machine, when tightened, draws back the mechanism on which the work is mounted, thus holding it securely. The work is rotated by a five-step cone pulley placed on a jackshaft at the rear of the machine through bevel and worm gearing. The cone pulley is driven from a countershaft, thus giving the machine five feed changes.

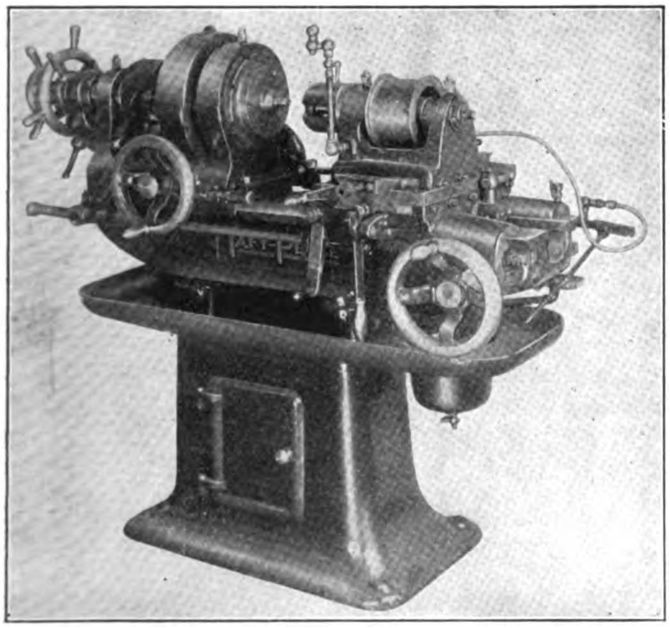


FIG. 1. HOBBING THREAD MILLER

Capacity, internal or external threads, maximum, 4½ in. in diameter, 1½ in. long; minimum, 1 in. in diameter, 1 in. long; length of bed, 3 ft. 10 in.; longitudinal traverse of cutter, 12 in.; transverse traverse of cutter, 6 in.; diameter and width of cutter pulley, 5⅝x5¾ in.; size of bearings in work head, front, 6⅞x4 in. long; size of bearings in work head, rear, 2⅛x2⅓ in. long; distance between countershaft bearings, 15 in.; floor space occupied, 5 ft. 11⅛ in. by 3 ft.; approximate weight, 1,000 lb.

The pitch of the thread being cut is determined by a short detachable guide screw keyed on the tail end of the work spindle. The guide screw engages a nut—also detachable—that is carried by the bracket mounted on the headstock. As the work is rotated, the spindle moves longitudinally forward in its bearings by means of the guide, screw and nut, and in this manner the lead is obtained on the thread being milled.

The cutter spindle is also driven from an overhead countershaft that provides three changes of spindle speed.

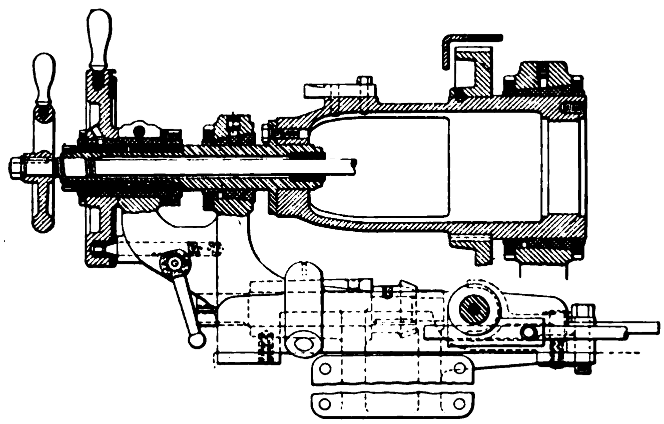


FIG. 2. DETAILS OF WORK-HEAD MECHANISM

The cutter headstock is mounted on a compound slide. The headstock is adjusted transversely by a screw, and a dead stop is provided. After the cutter has been once set for any particular work, it needs no further adjustment until some other class of work is to be threaded. An additional transverse slide is provided under the cutter headstock, which is moved by a lever, bringing the cutter into its working position, after which it latches automatically.

The latch is automatically released by a cam after the thread has been milled on the work, and at the same instant the cutter is withdrawn and the feed motion stopped. As a safeguard, before any thread can be milled it is necessary to draw the work spindle back a distance equal to the pitch of the thread. This is done by the larger handwheel at the end of the machine. However, before this can be performed, a locking pin must be withdrawn by the lever shown under the handwheel. It operates by means of a pinion meshing in rack teeth cut on the pin.

After the handwheel has drawn the work spindle back the correct distance, a spring forces back the locking pin into a tapered hole in the handwheel. The work is then placed in the holding chuck. The cutter slide and cutter are returned to their correct working position by the lever shown in a vertical position under the cutter head. This position is equal to the depth of the thread to be machined.

Another lever, which is alongside of the first one, then drops into a slot in the slide and frame, and the head is locked securely for the milling operation. The machine is now ready for the thread-milling operation. In Fig. 2 are shown details of the work-head mechanism.

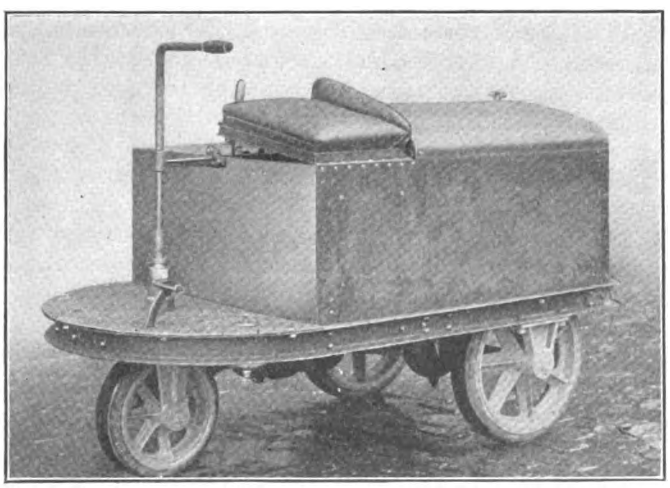
Electric Shop Tractor

In designing the electric shop truck shown in the form of a tractor, the aim is to avoid tying the motor up for long idle periods while the body is being loaded or unloaded. In the tractor form the power unit can be utilized with a minimum of idle time, inasmuch as it can be readily detached from the load-carrying units and put on other work while the loading or unloading of trailers goes on.

The frame of the truck is made of channel iron, riveted and welded. Every moving part has a ball or roller bearing. Power is supplied to the Westinghouse motor by a 250 ampere-hour capacity battery located directly over the rear wheels, thus providing the necessary weight for traction without any surplus or dead-load being carried. The battery space has been designed to accommodate any standard tray, permitting the installation of any battery selected. The motor is of the heavy-duty type, ball bearing throughout, and possesses a 200 per cent. overload capacity. All moving parts are accessible without the use of tools.

The controller gives three speeds forward and two reverse. It is completely exposed for inspection by raising the hinged seat to the left of the controller handle. The handle is automatically locked when the driver leaves his seat.

Power is transmitted direct from the motor to the rear axle through a worm gear. The load on the rear axle is carried mainly on two outward roller bearings. The two rear wheels and the steering wheel are fitted with solid rubber tires. The front wheel is supported by a steel fork, mounted on cup and cone ball bearings, and is turned by a hand lever directly attached.



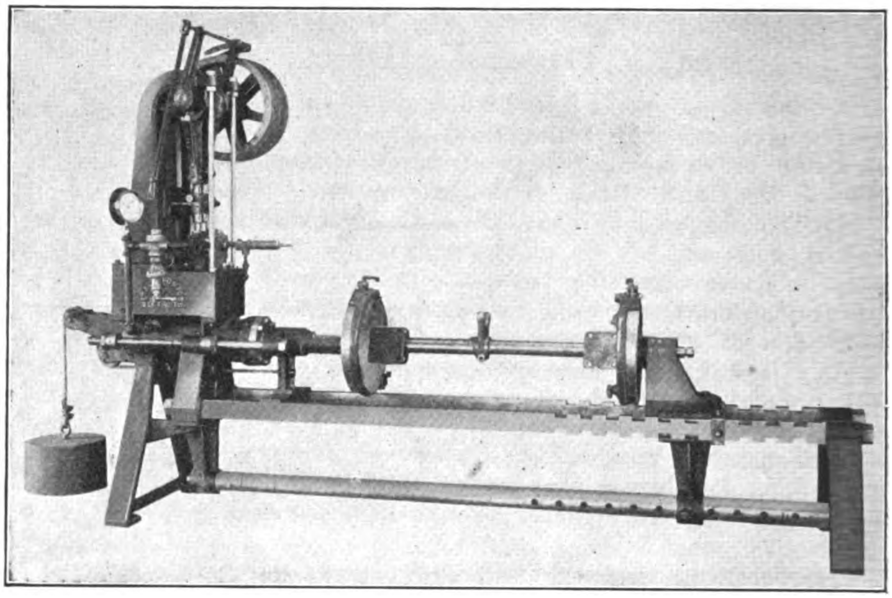
ELECTRIC SHOP TRACTOR

Length over body, 71 in.; width over body, 39 in.; floor to top of driver's seat, 38 in.; floor to top of platform, 19½ in.; turning radius of outside wheels, 46 in.; turning radius of machine, 57 in.

The truck is made by the Mercury Manufacturing Co., Chicago, Ill.

Hydraulic Assembling Press

The press illustrated is shown forcing a brake drum onto an automobile rear axle, but it is adaptable to various pressing and assembling jobs. An especial feature is its quick action, and it is very useful where accuracy and speed are essential. The actual time on the work shown was less than 3 min. from floor to floor.



SELF-CONTAINED HYDRAULIC ASSEMBLING PRESS

Capacity, 20 tons; stroke, 18 in.; ram diameter, 5 in.; speed of ram forward, 5 ft. per min.; pump, Metalwood duplex special hydraulic bronze; speed, 200 r.p.m.; diameter of plungers, 1¼ in.; height of ram center from floor, 34 in.; equipped with 1-in. Metalwood single-lever quick-operating valve and also ¾-in. relief valve; maximum work length of this size, 7 ft.; minimum work length, 3 ft.; floor space, 34 in. by 13 ft. 6 in.; weight, 5,400 lb.

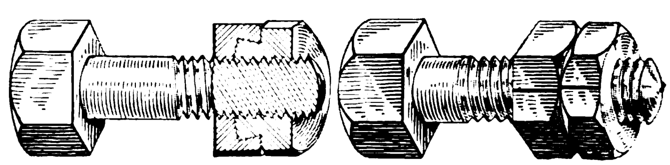
While specific figures are given for a certain size, this machine can be made with a length of bed to suit working conditions. A specially designed safety valve makes the machine foolproof with regard to overpressure, so that if the operator neglects to stop the pumps, no harm is done at any time. A counterweight returns the ram to starting position as soon as the pressure is released.

This machine is made by the Metalwood Manufacturing Co., Detroit, Mich.

Safety Locknut

The illustrations show one of the latest arrivals in the field of safety locknuts. It will be observed that a double nut is provided, one of which constitutes the lock.

The two nuts are placed on the bolt together; but when the securing nut has reached the desired point, the upper locking-nut can be further revolved to a limited degree.



SAFETY LOCKNUT

This is accomplished by providing the lower face of the locknut with a lip which slips into a circumferential recess on the upper part of the first nut, the joint being of the dovetail type. There is a distinguishing mark on the two sections to indicate when the thread on each side is in alignment, and the nut can then be removed as a whole.

By screwing down the top nut a little more, however, a crossthread is obtained, which contracts the lip of the upper nut and thereby produces a circumferential grip, rendering the whole impossible of removal.

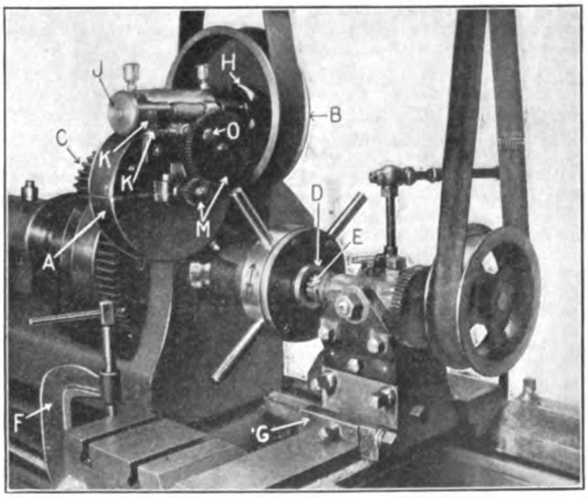
The two nuts are permanently connected and may be rotated separately with a spanner, but cannot be pulled out of engagement with one another. In course of manufacture the lower nut is first drilled and then recessed on the upper face for about half its depth and with the walls of the recess sloping inward. The upper nut is turned with a parallel-sided spigot on its under surface and is drilled with a taper hole. The two parts are then held together by hydraulic pressure while a drift is pressed through them. Thus the spigot is swollen out until it fills tightly the cavity in the under nut. The combined nut is then tapped through with a continuous thread, and in this condition a gage line, half on each nut, is stamped on one of the six flat faces.

The locknut is known as the "Vislok" and is the product of Vislok, Ltd., 3 St. Bride's House, Salisbury Square, London, E. C., England.

Thread-Milling Attachment

The thread-milling apparatus shown is adapted for use on a regular engine lathe. In the case *A* is a bronze worm gear driven by pulley *B*. On the worm-gear shaft there is a pinion gear *C* that engages with the large gear on the cone of the lathe, giving the spindle a backward rotation, as indicated by the arrow.

The piece *D* to be threaded is held in the chuck by a collapsible collet. The cutter *E* is carried in to the full



THREAD-MILLING ATTACHMENT

length of the thread to be cut, being located by moving the carriage up against the stop *F*. The cutter is then brought in to the full depth of the thread by placing the cross-slide against the stop *G*. Next, the clutch *H* is thrown in by pulling the handle *J* to the front, thus allowing the stops *K* and *K* to engage. This starts the spindle rotating.

After the spindle has made about $1\frac{1}{10}$ revolutions, which are governed by the gear ratio *M*, the stop *K* is automatically thrown out by the knock-off pin *O*, and the milling of the thread is complete.

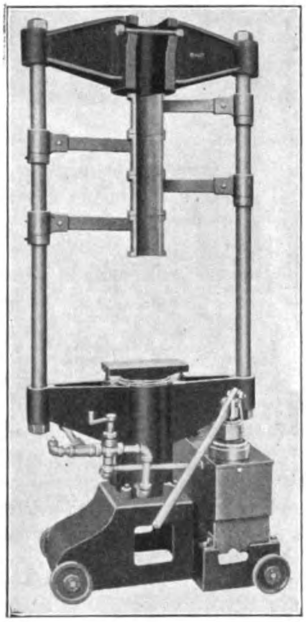
The lathe is geared up as regularly for thread cutting. The cutter is made not as a hob, with spiral grooves, but with straight grooves. The action of the carriage gives the proper pitch of the thread. The apparatus as illustrated is adapted for cutting an 8-pitch Whitworth standard thread in the ogive of a 70-mm. shrapnel shell.

The attachment is a recent product of the New England Butt Co., Providence, R. I.

Hydraulic Arbor Press

The wide range of the arbor press shown is expected to make it well adapted for general machine-shop use.

The movement of the ram is unusually rapid, eight strokes of the pump handle raising the ram 6 in. When heavy pressure is reached, the large piston of the double-differential pump is automatically knocked out and heavy pressure up to 30 tons is produced by the small piston of the pump, which moves the ram at the rate of 1 in. for seven strokes of the pump handle. The V-gap in the crosshead allows shafts and axles to extend up any distance. The ram is provided with two coil springs that return it quickly into the cylinder when the release valve is opened. The press is made of any capacity up to 75 tons and of any desired width between strain rods or distance between top of ram and crosshead. It can be made portable or stationary and can be equipped with power when so desired. The stroke of the ram is 10 in. The machine is the latest addition to the line made by the Lourie Manufacturing Co., Springfield, Ill.



HYDRAULIC ARBOR PRESS
Capacity, 30 tons; width between strain bars, 30 in.

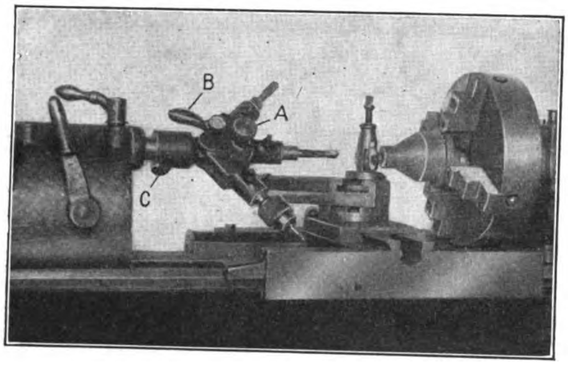
Lathe Turret Head

The lathe turret shown was designed to meet the requirements of toolrooms and machine shops where all kinds of manufacturing are done and where a screw machine is not at hand.

The turret can be put in working position just as quickly as an ordinary lathe center or chuck. It can be turned to any angle without endangering the operator, because the tools are all in one line and do not stick up. The clamping handle is entirely exposed and free. The smallest size is the toolroom bench-lathe size, which is as light as a standard drill chuck, weighing only a little over $1\frac{1}{2}$ lb.

The adoption of three tools in the turret head was based on the experience of the builder in finding that the great bulk of the usual run of work can be made on three settings.

The turret swings only to cover the three or four settings of the tools. To change the tool position, all that is necessary is to pull the knurled knob *A*, as soon as the tool is in position, the plunger will automatically locate the tool in proper line. The clamping handle is shown at



LATHE TURRET HEAD

B, and *C* is the clamp screw to hold the turret on the tail spindle. By using a taper plug, one tool will serve for a number of lathes.

The turret head is a recent product of Charles Eisler, 43 Dodd St., Bloomfield, N. J.

Crane Controller

The Cutler-Hammer Manufacturing Co., Milwaukee, Wis. has recently developed a rope-operated crane controller designed especially for intermittent speed-regulating duty. The control is by means of a rope passing over a sheave at the right of the controller. The rope is run over the sheave from the floor.

I-Beam Trolley

A detachable form of I-beam trolley, designed for use on tracks not having open ends, is a late product of the Chisholm & Moore Manufacturing Co., Cleveland, Ohio. The construction is such that a hinged arrangement permits quick application or removal of the trolley.

Allied Machinery Co. Absorbed

An important step in the machine-tool activities of the American International Corporation was effected in the absorption of the Allied Machinery Co. of America.

The Allied Machinery Co. was formed some four years ago for the purpose of assisting the manufacturers of machine tools in this country to place their goods in foreign markets. The company has been engaged in selling machine tools in Europe, and it is understood that the American International Corporation is formulating plans to expand its machine-tool business and rapidly develop its selling organization.

The company has at present offices and showrooms in Paris, Petrograd, Zurich and Turin. Its branches in Austria and Hungary are closed for the present, on account of inability to ship goods. It will be recalled that Charles E. Carpenter, who is at present in Europe, has been general manager of the Allied Machinery Co. for the past few years.

NEW PUBLICATIONS

PRACTICAL PERSPECTIVE—By Frank Richards and Fred H. Colvin. Fifty-eight 4⅜x6⅞-in. pages; 64 illustrations; cloth bound. Norman W. Henley Publishing Co., New York City. Price, 50c.

This is the fourth edition of a little book that shows how isometric perspective can be used by practical men in every-day work. Nothing confuses many men more than the regular three-view drawings, and they are, at times, very confusing to even experienced mechanics. But an isometric sketch shows the blacksmith exactly what you want to have forged and is equally useful to the pattern maker. Tool draftsmen are using this style of drawing to some extent, and it has many advantages for the work. It will be found useful in many places and is well worth the little time necessary to become proficient in it.

FIVE HUNDRED PLAIN ANSWERS TO DIRECT QUESTIONS ON STEAM, HOT WATER, VAPOR AND VACUUM HEATING. By Alfred G. King. Two hundred and fourteen 6x9-in. pages; 127 illustrations; cloth bound. Published by the Norman W. Henley Publishing Co., New York City. Price, $1.50.

While this book is intended for apprentices and steam fitters, the treatment of the subject matter is so clear and complete that it should prove valuable to anyone interested in the various systems of heating. Heat-generating apparatus seems somewhat slighted, the greater part of the book being devoted to the other parts of the heating systems. The first chapter deals briefly with chimneys, fuels, heating boilers and with their trimmings and settings. This section has not the clearness and completeness which seem to be present elsewhere. For example, we are told that boilers are rated by their horsepower, but the next answer defines horsepower as work required to raise 33,000 lb. 1 ft. per min. The value of the book would seemingly have been increased if a better description of heating boilers had been included. But this sort of information may not be needed by steam fitters. At any rate, the rest of the book is excellent. The elementary theory and the practical construction of heating systems are described. Simple rules are given for determining the sizes of valves, piping and radiators. The advantages claimed and the apparatus required for the systems mentioned in the title are all adequately considered. Few photographs are used, but many line, section and perspective drawings clearly supplement the answers to the questions.

ENGINEERING THERMODYNAMICS—By J. A. Moyer and J. P. Calderwood. Two hundred and three 5¾x9 in. pages; 70 illustrations; indexed; cloth bound. John Wiley & Sons, New York City. Price, $2.

In the introductory chapter the general scope of thermodynamics is outlined, and the important engineering units are defined. The simplest imaginable example of heat engine is taken as that which has for its working substance a long rod of brass, which is heated and cooled and arranged to operate as the pawl of a ratchet wheel. Some actual form of heat engine used as an example in the introductory chapter would prove of greater value in interesting the student in the subject matter.

The laws of perfect gases, including the derivation of formulas for the various thermal lines, are clearly treated in Chapters II and III.

The application of the laws of gases to gas cycles is incompletely discussed in Chapter IV, which has the misleading title, "Cycles of Heat Engines." In this chapter are considered only the Carnot and the regeneration air-engine cycles. No mention is made here or in any other part of the book of the various internal-combustion engine cycles, including the Lenoir, the Otto, the Brayton and the Diesel. In a textbook on "Engineering Thermodynamics" some space should be devoted to the analysis of the possible and practical heat-engine cycles using gas.

One chapter is devoted to the properties of steam and to the use of steam tables. This chapter is very clear, but somewhat incomplete.

The chapter on the properties of steam is followed by one on "Practical Applications of Thermodynamics to Thermal Machinery." This title is somewhat vague. The subject matter of this chapter includes the fundamentals of air and vapor refrigerating machines as well as compressed-air machinery. This chapter is inserted between the chapters on the properties of steam and of the steam-engine cycles. A chapter of this type near the end of the book and with a title "Refrigeration and Compressed-Air Machinery," would be more suitable.

Chapter VII is devoted to entropy of perfect gases and of steam, and this is followed by a chapter on the "Practical

Steam Expansions and Cycles." The first part of this chapter is devoted to steam expansions and to the Rankine cycle.

This is followed by the application of the temperature-entropy diagram to the analysis of the steam engine. The authors then work out problems on the efficiencies of various heat engines. All the engines in the problems given operate under dissimilar conditions, making a comparative study of the merits of different types impossible. Some attention is also given in this chapter to Hirn's analysis.

The last chapter is devoted to the subject of flow of fluids through orifices and nozzles. The various chapters include many well-selected and practical problems.

In general, the book is clearly written, but the attempt to make this treatise brief resulted in the omission of important details. A somewhat more careful arrangement of the subject matter and the addition of the modern internal-combustion engine cycles would serve to add to the value of this book.

PERSONALS

E. P. Worden, formerly of Fred M. Prescott Steam Pump Works, Milwaukee, has been appointed chief engineer of Henry R. Worthington, Harrison, N. J.

Robert G. Nye, for the past few years associated with the Buffalo Forge Co., Buffalo, N. Y., in various capacities, has resigned as factory manager to accept a similar position with the Alberger Pump and Condenser Co., Newburgh, N. Y.

W. R. Noxen who has been connected with the Davis-Bournonville Co. since its organization in 1908 has been appointed manager of the Chicago office, succeeding W. S. Schoenthaler, transferred to the general offices in Jersey City.

R. A. Lewis has become general manager of the Lehigh plant of the Bethlehem Steel Co., succeeding W. Frank Roberts who has been elected vice-president of the company. Mr. Lewis was formerly assistant general manager of the Saucona plant.

P. P. Bourne, formerly chief engineer of Blake & Knowles Steam Pump Works, East Cambridge, Mass., is again associated with the International Steam Pump Co. in connection with special engineering work located at the main office, 115 Broadway, New York.

H. Ulmer has become superintendent of the welding department of the Jersey City shops of the Davis-Bournonville Co., succeeding F. J. Maeurer who has been appointed to take charge of the company's newly established demonstrating and welding plant in Chicago.

A. B. Hazzard, for a number of years general manager of the J. Morton Poole Co., and more recently associated with the Hall Switch and Signal Co., Garwood, N. J., has accepted the position of engineer of equipment with the Amalgamated Machinery Co., with headquarters at 71 Broadway, New York, N. Y.

A. V. Wadsworth for many years foreman in the shops of the National Transit Co., Oil City, Penn., and for the past four years general superintendent of the Buckeye Traction Ditcher Co., Findlay, Ohio, has accepted the position of general manager of the Dayton Pipe Coupling Co., Dayton, Ohio.

OBITUARY

Edward T. Betts, vice-president and treasurer of the Betts Machine Co., Wilmington, Del., died at his home in that city on Feb. 27. Mr. Betts was 60 years of age and of late years took an active interest in civic affairs.

John C. Hooven, one of the founders, and since its organization president, of the Hooven, Owens, Rentschler Company, Hamilton, Ohio, died on Mar. 1 after a brief illness. As the president of this engine-building firm for over 35 years Mr. Hooven became a well-known figure in the engine-building world and as a designer of the Corliss engines of which his company made a specialty he established a reputation for exceptional mechanical ability. Mr. Hooven was a native of Ohio, having been born in Montgomery County in 1843. His early business years were spent in agricultural implement building in association with his father and brother. This led to the establishment of his own business for the manufacture of portable engines and saw mill machinery and in 1880 he was instrumental in the organization of the firm of which he remained president for so many years. Four sons are all associated with the business.

CATALOGS WANTED

L. Rinkel, 3511½ Jefferson Ave., E., Detroit, Mich., would like catalogs from manufacturers of machine tools and machinists' small tools.

Laciny Bros., 2524 N. 25th St., St. Louis, Mo., who are opening a new plant, to be operated as a copper, brass and sheet-iron works, will be in the market for lathes, drill presses, vises, taps, dies, sheet-metal cutters, small tools, measuring instruments, etc., and would like catalogs from manufacturers.

BUSINESS ITEMS

Following out its newly established policy of selling direct in the U. S. the Landis Tool Co., Waynesboro, Penn., announce the following appointments: For New York and Eastern New Jersey, W. G. Neven; New England States, M. G. Dunbar; Pennsylvania, Maryland and Virginia, T. G. Shearer.

The Charles A. Strelinger Co., Detroit, Mich., are breaking ground for the erection of a six-story building at the corners of Larned, Randolph and Bates Streets, to house their business. It will be a warehouse, general office, salesrooms, and machine-tool demonstrating plant and is very close to their present location. Floor space about 100,000 sq.ft. The plant will be ready for occupancy Oct. 1, 1916.

FORTHCOMING MEETINGS

A course of free lectures on military engineering will be given under the auspices of a committee representative of the four national engineering societies, by Captains Robins, Coiner and Ardery, Corps of Engineers, U. S. A. This course will be under the direction of Major-Gen. Leonard Wood and is designed to assist those who desire to enter the engineering battalion which will be formed at Plattsburg next summer. All engineers interested in preparedness will be welcome, but attendance at these lectures does not imply obligation to subsequent camp duty. Through the cordial attitude and coöperation of the United Engineering Society, the auditorium of the Engineering Societies Building has been placed at the disposal of the army officers. These lectures will be given weekly, having begun on Feb. 14, under the following divisions:

March 20, 1916—The selection, laying out and preparation of camps and cantonments; the service of general construction; and the special services, including all public work of an engineering nature which may be required in a territory under military control.

March 27, 1916—The construction, operation and maintenance of railways under military control and the construction and operation of armored trains.

American Society of Mechanical Engineers. Spring meeting, April 11-14, New Orleans, La., Calvin W. Rice, secretary, 29 West 39th St., New York, N. Y.

American Society for Testing Materials. Annual meeting June 27 to July 1, 1916, Hotel Traymore, Atlantic City, N. J. Edgar Warburg, secretary, University of Pennsylvania, Philadelphia, Penn.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Wednesday each month. J. A. Brooks, secretary, Brown University, Providence, R. I.

New England Foundrymen's Association. Regular meeting second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. Secretary, R. H. Barnes, Taylor Instrument Companies, Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. J. H. Warder, secretary, 1735 Monadnock Block, Chicago, Ill.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Technical League of America. Regular meeting second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York, N. Y.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points indicated:

	Mar. 10, 1916	One Month Ago	One Year Ago
No. 2 Southern foundry, Birmingham	$15.00	$15.00	$9.50
No. 2 X Northern foundry, New York	19.75	19.75	14.25
No. 2 Northern foundry, Chicago	18.50	18.50	13.00
Bessemer, Pittsburgh	21.45	21.45	14.55
Basic, Pittsburgh	19.20	18.45	13.45
No. 2 X, Philadelphia	20.00	20.00	14.25
No. 2 Valley	18.50	18.25	13.00
No. 2 Southern, Cincinnati	17.90	17.90	12.40
Basic, Eastern Pennsylvania	19.50	19.50	13.50
Gray forge, Pittsburgh	18.45	18.45	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger from jobbers' warehouse:

	New York				
	Mar. 10, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Steel angles, base	2.95	2.60	1.85	3.00	2.90
Steel T's, base	2.95	2.65	1.90	3.00	2.90
Machinery steel (bessemer)	2.95	2.60	1.80	3.00	2.90

Steel Sheets—The following are the prices in cents per pound from jobber's warehouse:

	New York				
	Mar. 10, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
No. 28 black	3.50	3.50	2.60	2.95	3.10
No. 26 black	3.40	3.40	2.50	2.85	3.00
Nos. 22 and 24 black	3.35	3.35	2.45	2.80	2.95
Nos. 18 and 20 black	3.30	3.30	2.40	2.75	2.90
No. 16 blue annealed	3.75	3.45	2.30	2.75	3.30
No. 14 blue annealed	3.70	3.35	2.25	3.35	3.20
No. 12 blue annealed	3.65	3.30	2.20	3.30	3.15
No. 28 galvanized	5.65	5.50	4.00	5.25	5.25
No. 26 galvanized	5.35	5.20	3.75	4.95	4.95
No. 24 galvanized	5.20	5.05	3.55	4.80	4.80

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot:

	Black		Galvanized	
	Mar. 10, 1916	One Yr. Ago	Mar. 10, 1916	One Yr. Ago
¾- to 2-in. steel butt welded	74%	81%	57½%	72½%
2½- to 6-in. steel lap welded	73%	80%	56½%	72½%
Diameter, In.				
¾	2.99	2.20	5.35	3.50
1	4.42	3.40	7.91	5.20
1¼	5.98	4.60	10.70	7.00
1½	7.15	5.50	12.79	8.40
2	9.62	7.40	17.21	11.15
2½	15.80	12.20	25.45	18.60
3	20.65	16.10	35.57	24.20
4	29.43	22.90	50.87	34.50
5	39.96	29.60	68.82	40.70
6	52.84	38.40	91.08	52.80

Bar Iron—Prices are as follows in cents per pound at the places named:

	Mar. 10, 1916	One Month Ago
Pittsburgh, mill	2.40	2.15
New York	2.60	2.25
Warehouse, New York	2.90	2.55
Warehouse, Cleveland	2.25@2.50	...
Warehouse, Chicago	2.90	...

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-sized orders the following quotations hold:

New York	List price
Cleveland	List price
Chicago	List price

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York	$4.50
Cleveland	4.80
Chicago	3.60

In coils an advance of 50c. is usually charged.

METALS

Antimony—Chinese and Japanese brands are quoted as follows in cents per pound for spot delivery, duty paid:

New York...... 44c. Cleveland.... 50c. Chicago.... 44¾c.

Copper Bars from warehouse sell as follows per pound:

New York .... 39.5c. Chicago .... 37.25c.

Miscellaneous Metals—The present New York quotations in cents per pound, with a comparison of a month and year ago, are as follows:

	Mar. 10, 1916	One Month Ago	One Year Ago
Copper, electrolytic (carload lots)	27.25	27.00	14.87½
Tin	55.00	41.25	45.00
Lead	6.75	6.25	3.95
Spelter	19.50	19.50	11.50
ST. LOUIS			
Lead	6.75	6.10	...
Spelter	18.00	19.50	...

	New York				
	Mar. 10, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Copper sheets, base	35.00	33.00	19.75	36.00	34.00
Copper wire (carload lots)	35.00	33.00	16.50	....	36.00
Brass rods, base	37.00	38.00	16.25	40.00	35.00
Brass pipe, base	41.00	43.00	19.00	44.00	42.00
Brass sheets	37.00	38.00	16.25	40.00	35.00
Solder ½ and ½ (case lots	31.00	26.00	31.25	31.25	28.00

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York		
	Mar. 10, 1916	One Month Ago	Cleveland
Copper, heavy and crucible	23.00	21.50	26.00
Copper, heavy and light	22.00	21.00	25.00
Copper, light and bottoms	19.00	18.00	22.00
Lead, heavy	5.25	5.00	6.00
Lead, tea	4.75	4.50	...
Brass, heavy	14.00	13.50	21.00
Brass, light	12.00	11.00	...
No. 1 yellow rod brass turnings	14.00	13.00	13.00
Zinc	14.00	12.50	17.00

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	31.50	32.00	32.50	33.00	36.00
¼ to 5/16	31.25	31.75	32.25	32.75	35.75
⅜ to 1⅞	31.00	31.50	32.00	32.50	35.50
1 15/16 to 2⅞	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3 7/16	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3½ to 3 15/16	32.25	32.75	33.25	35.75	36.75
Squares					
3 1/16 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4 15/16	33.00	33.50	36.00	36.50	37.50
5 to 6 15/16	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places indicated:

	New York	Cleveland	Chicago
Best grade	55@60	57.00	55@60
Commercial	25@30	22.50	25@30

SHOP ACCESSORIES

Nuts—From warehouses at the places named, the following amount is deducted from list price:

	New York	Cleveland	Chicago
Hot pressed square	$3.00	$3.70	$4.00
Hot pressed hexagon	3.20	3.80	4.20
Cold punched square	3.00	3.50	4.00
Cold punched hexagon	3.75	4.25	5.25

Semifinished nuts sell at the following discount from list:

New York .... 70% Cleveland .... 70 and 10%

Tap Bolts—The discount from list at warehouses is as follows:

New York .... 20% Cleveland 30%

Wrought Washers—From warehouses at the places named the following amount is deducted:

New York....$4.50 Cleveland....$6.25 Chicago......$6.50

At this rate the net prices follow:

Diameter, In.	New York	Cleveland	Chicago
5/8	$9.50	$7.75	$7.50
3/4	7.70	5.95	5.70
7/8	6.90	5.15	4.90
1	6.00	4.25	4.00
1 1/4	5.20	3.65	3.30
1 3/8	4.70	3.15	2.90
1 1/2	4.60	3.05	2.80
1 3/4	4.50	2.95	2.70
2, 2 1/4, 2 1/2, 2 3/4	4.30	2.85	2.50
3, 3 1/4	4.50	2.95	2.70
3 1/2	4.70	3.25	2.70
4, 4 1/4, 4 1/2	5.00	3.25	3.00

For cast-iron washers the base price per 100 lb. is as follows:

New York.... $2.50 Cleveland.... $2.25 Chicago.... $1.90

Carriage Bolts—From warehouses at the places named the following discounts from list hold:

	New York	Cleveland	Chicago
3/8 by 6 in. and smaller	60%	65 and 5%	65 and 10%
Larger and longer	50%	50 and 15%	60 and 5%

Length, In.	New York 1/4	New York 1/2	New York 3/4	Cleveland 1/4	Cleveland 1/2	Cleveland 3/4	Chicago 1/4	Chicago 1/2	Chicago 3/4
1 1/2	$0.40	...	...	$0.33	...	...	$0.32	...	...
2	.44	...	...	.36	...	...	.35	...	...
2 1/2	.48	$1.63	$4.25	.40	$1.39	$3.61	.38	$1.26	$3.23
3	.52	1.77	4.50	.43	1.50	3.82	.41	1.34	3.42
3 1/2	.56	1.91	4.75	.47	1.62	4.05	.44	1.35	3.61

Bolt Ends—Fair-sized orders of bolt ends with hot-pressed nuts from warehouses sell at the following discounts from list:

New York		50%
Cleveland	small sizes	50%
Chicago	large sizes	20%
		60 and 10%

Turnbuckles—From warehouses at the places named the following prices prevail:

	New York	Cleveland	Chicago
Smaller than 1 1/4-in. diam.	40%	50 and 10%	...
1 1/4- up to 2-in. diam.	30%	40%	...
Size			
1/2	$0.27	$0.21	$0.28
3/4	.38	.29	.32
1	.53	.40	.44
1 1/2	1.05	.90	.83
2	1.86	1.59	1.75

These prices are for buckles having right and left stub ends with turnings between the heads measuring 5 1/2 in.

Rivets—The following are the base quotations from warehouse for fair quantities:

	New York	Cleveland	Chicago
Steel 7/16 and smaller	65%	60%	60—10%
Tinned	65%	60%	60—10%*

*An addition of 3.5c. per lb. is usually charged.

For button heads 3/4, 7/8, 1 in. diam. by 2 in. to 5 in. sell as follows per 100 lb.:

New York.... $4.50 Cleveland.... $3.00 Chicago.... $3.25

Cone heads, same sizes:

New York.... $4.60 Cleveland.... $3.00 Chicago.... $3.35

	Extra per 100 Lb.
1 1/4 to 1 3/4 in. long, all diameters	$0.25
5/8 in. diameter	0.15
1/2 in. diameter	0.50
1 in. long and shorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

Coach or Lag Screws—For fair-sized orders from warehouses at the places named the following discounts hold:

New York	65%
Cleveland	60, 10 and 5%
Chicago	70 and 10%

Machine Bolts—For fair-sized orders from warehouses at the places named the following discounts hold:

	New York	Cleveland	Chicago
3/8 by 4 in. and smaller	60%	65 and 10%	70%
Larger and longer up to 1 in. by 30 in.	50%	50 and 20%	60 and 10%

Length, In.	New York 1/4	New York 1/2	New York 1	Cleveland 1/4	Cleveland 1/2	Cleveland 1	Chicago 1/4	Chicago 5/8	Chicago 1
2	$0.71	$1.93	$8.00	$0.56	$1.54	$6.40	$0.54	$1.29	$5.76
2 1/2	.74	2.06	8.45	.58	1.65	6.76	.56	1.48	6.08
3	.78	2.19	8.90	.61	1.75	7.12	.58	1.57	6.40
3 1/2	.81	2.32	9.35	.64	1.86	7.48	.60	1.67	6.73

Copper Rivets from warehouse sell at the following rate:

New York	25% from list
Cleveland	List price
Chicago	10% from list

Nails—Wire nails f.o.b. Pittsburgh sell at $2.40; galvanized, 1 in. and longer, $4.40, and shorter, $4.90. These prices are to regular customers and delivery is made at the mill's convenience. From warehouse wire and cut nails sell as follows:

New York.... $2.90 Cleveland.... $2.85 Chicago.... $2.60

MISCELLANEOUS

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire

3/8, 11/32, 5/16, 1/4, 7/32, 3/16	8.50
No. 8, 5/32 and No. 10	9.25
1/8	10.00
No. 12	11.00
3/32, No. 14 and 1/16	12.00
No. 18	14.00
No. 20	16.00

Special Welding Steel

1/8	33.00
5/32	30.00
3/16	28.00

Cast-Iron Welding Rods

1/4 by 19 in. long	22.00
3/16 by 12 in. long	26.00
3/8 by 19 in. long	20.00
1/2 by 21 in. long	20.00

Vanadium Wire in Coils or Sticks

1/16	15.50
3/32	15.00
1/8	14.00
5/32	12.00
3/16 and larger	11.00

Seamless Drawn Tubing—The base price per pound from warehouse is as follows:

	New York	Cleveland
Brass	41c.	42c.
Copper	42c.	43c.

For immediate stock shipment the following quotations are in effect:

Diameter, In.	Copper New York Mar. 10, 1916	Copper New York One Year Ago	Copper Cleveland	Brass New York Mar. 10, 1916	Brass New York One Year Ago	Brass Cleveland
3/4 to 2 1/2	45.00	22.00	42.00	43.00	19.00	43.00
3	45.00	22.00	42.00	43.00	19.00	43.00
3 1/2	46.00	22.00	42.00	44.50	19.50	43.00
4	47.00	23.50	43.00	45.50	20.00	44.00
4 1/2	49.00	24.50	45.00	47.50	21.00	46.00
5	51.00	25.50	47.00	49.50	22.00	48.00
6	52.00	28.50	49.00	50.50	25.00	50.00
7	54.00	30.50	49.00	52.50	27.00	50.00
8	56.00	32.50	53.00	54.60	29.00	54.00

Tin Plates—The following prices are in effect from warehouses at the places named:

Coke tin plate, 14x20:	New York	Cleveland	Chicago
100 lb.	$5.00	$4.87 1/2	$4.65
I. C. 107 lb.	5.15	5.05	4.80

Terne plate, 20x28:

Base Weight	Net Weight	Coating	New York	Cleveland	Chicago
100 lb.	200	8	$9.00	$8.60	$8.30
I. C.	214	8	9.30	8.90	8.80
I. X.	270	8	11.30	11.10	13.10
I. C.	218	12	12.00	10.10	10.30
I. C.	221	15	13.00	10.90	11.25
I. C.	226	20	13.50	12.20	12.20
I. C.	231	25	14.25	13.40	15.30
I. C.	236	30	15.50	12.40	15.30
I. C.	241	35	17.00	15.60	16.00
I. C.	246	40	19.00	16.60	16.55

Zinc Sheets—The following prices in cents per pound prevail:

Carload lots, f.o.b. mill 25.00

	New York	Cleveland	Chicago
In casks	26.00	26.25@26.50	30.00
Broken lots	26.50	26.50@26.75	34.00

Cotton Waste—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	10.00@12.00	11.00@15.00	11.00
Colored mixed	7.00@ 9.00	7.00@10.00	10.50

Sal Soda sells as follows per 100 lb.:

New York .... $1.25 Cleveland $1.62 1/2
Chicago $1.85

Roll Sulphur in 360-lb. bbl. sells as follows per 100 lb.:

New York.... $2.25 Cleveland.... $2.60 Chicago.... $2.85

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Feb. 19	Feb. 26	Mar. 4	Mar. 11
Prompt furnace	$3.25@3.75	$3.00@3.50	$3.50@3.75	$3.50@3.75
Prompt foundry	3.75@4.25	3.75@4.25	3.75@4.25	3.75@4.00

Linseed Oil—These prices are per gallon:

	New York	Cleveland	Chicago
Raw in barrels	$0.81	$0.84	$0.81
5-gal. cans	.91	.94	.86

Boiled, it is 1c. per gal. higher.

White Lead, dry and in oil, in cents per pound sells as follows:

100-lb. keg	9.50
25- and 50-lb. kegs	9.75
12 1/2-lb. keg	10.00
1- to 5-lb. cans	11.50

Red Lead, dry, in cents per pound sells as follows:

100-lb. keg	9.50
25- and 50-lb. kegs	9.75
12 1/2-lb. keg	10.00

In oil, the price in cents per pound is as follows:

100-lb. keg	10.00
25- and 50-lb. kegs	10.25
12 1/2-lb. keg	10.50

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

The contract has been awarded for the construction of a 1-story, 30x35-ft. garage at Cambridge, Mass., for Horsum & Co., Soden St., Cambridge. Estimated cost, $16,000.

The Gardner Auto Co. plans to construct a 2-story, 60x100-ft. garage at Gardner, Mass.

We have been advised that the G. Haarmann & Co., Inc., manufacturer of structural iron, is constructing a 1-story, 48x73-ft. addition to its plant on Commercial St., Holyoke, Mass. Noted Mar. 2.

The O. & J. Machine Co., Manufacturer of labeling machines, has leased a factory on Gold St., Worcester, Mass., and will install new machinery.

The Farist Steel Co. will rebuild its plant at Bridgeport, Conn., which was recently destroyed by fire with a loss of $350,000. Noted Mar. 2.

Plans have been prepared for the construction of a plant on Mill River St., Hamden, Conn., for the Regal Silver Co.

The Pratt & Whitney Co., Hartford, Conn. will build an addition to its small tool department.

The Rowe Calk Co. will construct a 2-story, 50x70-ft. factory at Hartford, Conn., for the manufacture of drop forged horse shoe calks.

Plans are being prepared for the construction of an addition to the plant of the Excelsior Needle Co. on Field St., Torrington, Conn.

The contract has been awarded for the construction of a 58x200-ft. factory at Waterbury, Conn., for the Eastern Brass and Ingot Co. Noted Mar. 9.

The Scovill Manufacturing Co. has awarded the contract for the construction of a 4-story, 50x300-ft. addition to its plant at Waterbury, Conn. Noted Nov. 11.

MIDDLE ATLANTIC STATES

Fire, Feb. 29, destroyed the plant of the Weborg Spring Bed Co., Willard St., Jamestown, N. Y. Loss, $10,000.

Plans are being prepared by Anton Pirner 2069 Westchester Ave., New York, N. Y., for a 2-story garage on Williamsbridge Rd., New York, N. Y. (Borough of Bronx) for Alexander D. and Robert Manson, 2079 Westchester Ave. Estimated cost, $12,000.

H. L. Brittain, 154 Nassau St., New York, N. Y. (Borough of Manhattan) has awarded the contract for a 3-story garage on Bedford Ave., New York (Borough of Brooklyn). Estimated cost, $20,000.

William Strang has awarded the contract for a 2-story garage at Atlantic and Underhill Ave., New York, N. Y. (Borough of Brooklyn). Estimated cost, $15,000.

Plans are being prepared by Charles Stegmayer, Arch., 168 East 91st St., for a 4-story garage and stable on Lawrence St., for Cushman's Sons, Inc., 517 West 59th St., New York, N. Y. (Borough of Manhattan). Estimated cost, $50,000.

Bids will soon be received for a 3-story garage on 102d St., for J & C Fischer, Inc., 417 East 28th St., New York. (Borough of Manhattan).

The Norma Co. of America, 1790 Broadway, New York, N. Y. (Borough of Manhattan) has awarded the contract for a ball bearing factory. Estimated cost, $300,000. Noted Feb. 3.

Plans are being prepared by Andrew Schiller, Corona, for a 2-story garage at 25th St. and Banta Ave., Elmhurst, New York, N. Y. (Borough of Queens) for Robert G. Lake, Lake St., and Albertus Ave., Corona. Estimated cost, $10,000.

The National Chain Co., 517 West 45th St., New York, N. Y. (Borough of Manhattan), contemplates an addition to its factory at 8th and 10th St., College Point (Borough of Queens).

Plans are being prepared by H. D. Phœnix, Arch., Union Bldg., for a 1-story garage for William A. Bissell, 109 South State St., Syracuse, N. Y. Estimated cost, $15,000.

Plans are being prepared for a 1-story factory for the Ludlum Steam Pump Co., Watervliet, N. Y. Edwin Corning, Pres.

Plans are being prepared for a factory at Bloomfield Ave. and Grove St., Bloomfield, N. J., for the Eastern Tool Co. Estimated cost, $18,000. Noted Oct. 28.

The Jankins Mfg. Co., Bloomfield, N. J., manufacturer of castings, will build an addition to its foundry on Farrand St., Bloomfield.

Edward A. Zusi, Newark, N. J., will build a brass foundry on Adams St., Newark.

Plans are being prepared for a 2-story reinforced-concrete machine shop and brass foundry for the Vitaphone Co., Plainfield, N. J. Estimated cost, $40,000. W. C. Simpson is interested.

The Oradell Garage and Machine Co., Ridgewood, N. J., has been organized to operate a comm[illegible] garage.

The Board of City Commissioners, Trenton, N. J., will build a garage and repair shop at the municipal colony. Klemann & Fowler, Arch.

Contract has been awarded for a 2-story commercial garage and machine shop on North Broad St., Trenton, N. J., for Roger Henry. Estimated cost, $10,000.

The Minerva Garage, Inc., West Hoboken, N. J., has been organized to operate a commercial garage on Clinton Ave., West Hoboken.

The Lukens Iron and Steel Co., Coatesville, Penn., will build a plate mill. Estimated cost, $2,000,000.

The Ingersoll-Rand Co., Easton, Penn., manufacturer of machinery, will build an addition to its plant.

The Grove City Body and Manufacturing Co., Grove City, Penn., will build a factory for the manufacture of automobiles and jitney busses.

Stiffel & Freeman Safe Co., Lititz, Penn., will build a factory for the manufacture of safes.

The Summerhill Tubing Co., 4th St., Norristown, Penn., will build a new factory.

The Hale & Kilburn Co., Philadelphia, Penn., manufacturer of furniture, has awarded the contract for a 1-story addition to its factory for the manufacture of war munitions. Estimated cost, $6,000. Noted Jan. 6.

The Splitdorf Electrical Co. will build a 5-story reinforced-concrete manufacturing building at Philadelphia, Penn. Monks & Johnson, 78 Devonshire St., Boston, Mass., Arch.

Plans have been prepared by Herman Muller for a 2-story brick and reinforced-concrete factory addition for the Wicaco Screw and Machine Works, Inc., 625 Wood St., Philadelphia, Penn.

The Asbestos Protected Metal Co., Pittsburgh, Penn., will build 3 factories in Ambridge, Penn.

Fire, Feb. 29, destroyed the shovel factory of the Hubbard & Co., Pittsburgh, Penn. Loss, $130,000.

Whitaker-Glessner Co., Pittsburgh, Penn., will build new open hearth furnaces.

Carl F. Boker, 63 East 74th St., New York, N. Y., has purchased the Cyclops Steel Works, Titusville, Penn., and will enlarge the plant.

SOUTHERN STATES

The Disappearing Metal Shutter Co., Norfolk, Va., recently incorporated, plans to build a plant.

C. S. James and associates plan to construct a steel plant at Chattanooga, Tenn., to include hydroelectric development. Estimated cost, $2,000,000.

MIDDLE WEST

Bids will soon be received for the construction of a 2-story, 35x80-ft. factory at Cincinnati, Ohio, for the Cincinnati Lathe and Tool Co. Estimated cost, $20,000.

The Edgemont Machine Co., Cincinnati, Ohio, is in the market for equipment for building transmission machinery.

Bids will soon be received by Zettle & Rapp, Arch., 607 Johnston Bldg., Cincinnati, Ohio, for the construction of a 1- and 2-story factory for the R. K. Le Blond Machine Tool Co., Cincinnati. Estimated cost, $100,000.

The Stacey Manufacturing Co., manufacturer of gas holders and oil tanks, will construct an addition to its plant in Elmwood Pl., Cincinnati, Ohio.

We have been advised that work will soon be started on the construction of a garage and repair shop in the downtown district of Cincinnati, Ohio, for the Wray-Chase Motor Service Co. Estimated cost between $750,000 and $1,000,000. Noted Mar. 2.

The Arth Brass Aluminum Casting Co. will build a brass foundry at 1372 East 33rd St., Cleveland, Ohio.

The Cleveland Metal Products Co. will construct an addition to its plant at 1141 Ivanhoe Rd., Cleveland, Ohio. Estimated cost, $20,000.

H. S. French has awarded the contract for the construction of a garage at East 35th St. and Payne Ave., Cleveland, Ohio.

The Lampson & Sessions Co., manufacturer of bolts, nuts, etc., will construct an addition to its plant at 2188 Scraton Rd., Cleveland, Ohio.

The Edgemont Machine Co. will construct an addition to its plant at Dayton, Ohio.

The Lima Locomotive Corporation will enlarge its plant at Lima, Ohio.

The Ogontz Motor Car Co. will establish a factory at Sandusky, Ohio.

We have been advised that work will soon be started on the construction of a plant at Toledo, Ohio, for the Toledo Speed Wrench and Tool Co. The company is in the market for milling, polishing, D. D. grinding machinery, shafers and lathes. J. S. O'Connell is Pres. and Gen. Mgr. Noted Feb. 10.

Plans are being prepared for the construction of an addition of 6 mills to the plant of the Wheeling Steel and Iron Co. at Yorkville, Ohio.

The Disappearing Metal Shutter Co. plans to build a plant at Youngstown, Ohio.

Plans are being prepared for the construction of a 2-story, 50x150-ft. garage at Garrett, Ind., for S. D. Johnson & Son. Estimated cost, $10,000.

The Fairbanks-Morse Electric Manufacturing Co. plans to construct an addition to its plant at Indianapolis, Ind. Estimated cost, $10,000. R. F. Fleming, Mgr.

Alexander Metzger, 4280 North Meridian St., Indianapolis, Ind., will build a 1-story garage at 926 North Penn St., Indianapolis. Estimated cost, $15,000.

Bids are being received for the construction of an addition to the plant of the National Malleable Casting Co., 546 Holmes Ave., Indianapolis, Ind. Estimated cost, $20,000. Noted Mar. 2.

Plans are being prepared for the construction of a 1-story, 50x327-ft. foundry at Kokomo, Ind., for the Kokomo Brass Works.

Plans are being prepared for the construction of a 1-story, 130x207-ft. garage, repair and machine shop for J. N. Williams at Kokomo, Ind.

The Electric Steel Co. is constructing an addition to its plant at Buchanan, Mich.

Bids will soon be received for the construction of a 1-story, 60x155-ft. brass foundry and machine shop at Detroit, Mich., for the Marx Brass Foundry. Noted Mar. 9.

Plans are being prepared by Preston, Brown & Walker, Arch., 849 David Whitney Bldg., Detroit, Mich., for the construction of a 4-story, 70x74-ft. manufacturing building for the Sewell Cuchion Wheel Co. at Detroit. Estimated cost, $40,000. H. J. Sewell, 1300 Gratiot Ave., Detroit, is Pres.

The Grand Rapids Steel Furniture Co. plans to construct an addition to its plant at Grand Rapids, Mich.

The contract has been awarded for the construction of an addition to the Corwith plant of the Crane Co., manufacturer of pipe fitting and brass goods, at Chicago, Ill.

Plans are being prepared for the construction of a 96x100-ft. factory for the Electric Furnace Co. at Chicago, Ill. Estimated cost, $35,000.

J. M. Farwell will construct a 1-story garage at 4058 Broadway, Chicago, Ill. Estimated cost, $10,000. J. Ahlschlager & Son, Arch.

Foot Bros., manufacturer of gears, 210 North Carpenter St., Chicago, Ill., will construct a 5-story, 75x100-ft. addition to its plant at Chicago. Estimated cost, $75,000.

W. E. Gehring, Chicago, Ill., will build a 1-story garage at 2100 South Wabash Ave., Chicago. Estimated cost, $10,000.

The Illinois Steel Co. will construct a 1-story garage at 1653 McHenry St., Chicago, Ill. Estimated cost, $14,000. L. E. Ritter is Arch.

The contract has been awarded for the construction of a 2-story, 100x150-ft. factory at 642 North Kedzie Ave., Chicago, Ill., for J. H. Rosberg, 2028 Rice St., Chicago, for the manufacture of metal specialties. Estimated cost, $30,000. Noted Mar. 2.

Plans have been prepared for the construction of a 2- and 4-story addition to the factory of the Pfanstiehl Electric Laboratory at North Chicago, Ill. Carl Pfanstiehl is Pres. Noted Dec. 23.

Bids are being received for the construction of a plant at Waukegan, Ill., for the Ogren Motor Works. Estimated cost, $150,000. Noted Feb. 17.

Robert Christian, Burnett, Wis., contemplates constructing a 2-story, 64x80-ft. garage and repair shop at Beaver Dam, Wis.

The Gardner Machine Co. plans to construct an addition to its plant at Beloit, Wis. L. Waldo Thompson is Secy.

Herman J. Furstnow plans to build a garage on Court St., Fond Du Lac, Wis.

Plans are being prepared by W. E. Reynolds, Arch., 109 South 11th St., Green Bay, Wis., for the construction of a 2-story, 40x80-ft. addition to the garage of the Lucia Bros. Motor Car Co., 218 North Adams St., Green Bay, Wis.

The Simmons Manufacturing Co., manufacturer of wire mattresses and iron beds, plans to construct an addition to its plant at Kenosha, Wis.

The Scanlan-Morris Manufacturing Co., manufacturer of steel hospital and office furniture and surgical instruments, is constructing a plant at Madison, Wis.

Plans are being prepared for the construction of a 75x45-ft. machine shop and foundry at Manitowoc, Wis., for the Wisconsin Aluminum Foundry Co. B. Dalwid is Gen. Mgr. Noted Feb. 3.

The Laursen Automatic Pump Co., Eau Claire, Wis., has purchased the plant of the Globe Iron Works at Menomonie, Wis., and will improve same and install new machinery.

Plans are being prepared for the construction of a garage and repair shop at 51st St. and National Ave., Milwaukee, Wis., for the Carter Auto and Machine Co. Estimated cost, $10,000.

The Claus Automatic Gas Cock Co., 2601 Vliet St., Milwaukee, Wis., has purchased a site on Keefe Ave., Milwaukee, and plans to construct a 1-story foundry and machine shop. Estimated cost, $20,000.

Plans are being prepared by the Federal Engineering Co., 219 Stephenson Bldg., Milwaukee, Wis., for the construction of a 1-story, 60x120-ft. garage on Milwaukee St. and a 1-story, 70x140-ft. garage at Mineral Spring Rd. and Downer Ave., Milwaukee, Wis. Estimated cost, $15,000 each.

Bids are being received for the construction of a 1-story, 45x100-ft. garage for Gotlieb Hummel, 3316 Burleigh St., Milwaukee, Wis.

Preliminary plans are being prepared for the construction of an addition to the plant of the Kempsmith Manufacturing Co., manufacturer of machine tools, at Milwaukee, Wis. Paul Thomas is Gen. Mgr.

Plans are being prepared for the construction of a 2-story garage for Charles A. Krause, 37th Ave.e and Burnham St., Milwaukee, Wis.

Bids are being received for the construction of a 1-story, 70x140-ft. garage for Richard Mohros at Milwaukee, Wis. Estimated cost, $12,000.

The Pelton Steel Co. will establish a foundry at Chicago Ave. and Elliott Pl., Milwaukeee, Wis.

Plans are being prepared for the construction of a 2-story, 140x200-ft. plant for the Wisconsin Iron and Wire Works, 186 East Water St., Milwaukee, Wis. Estimated cost, $50,000. George H. Norris is Pres. Noted Jan. 13.

The Townsend, Kinney & Metcalf Co. contemplates constructing a 2-story, 66x80-ft. garage and repair shop at Reedsburg, Wis.

The Automatic Cradle Manufacturing Co. plans to construct a 3-story, 83x150-ft. addition to its plant at Stevens Point, Wis.

The Dicke Motor Car Co., Manitowoc, Wis., will establish a garage and repair shop at Two Rivers, Wis.

WEST OF THE MISSISSIPPI

Plans being prepared for a 1-story garage at Anthon, Iowa, for Lewis Bros. Estimated cost, $10,000.

The Tri-City Ry. Co., Davenport, Iowa plans to build machine and car repair shops at Rock Island, Iowa. Estimated cost, $80,000. J. G. Huntoon, Davenport, is Vice-Pres. and Gen. Mgr.

P. Arnold, 820 Pearl St., Joplin, Mo. will build a 1-story garage. Estimated cost, $15,000. Austin Allen, Frisco, Bldg., Joplin, is Arch.

James Gleason, 418 West 9th St., Kansas City, Mo., will build 5 garages in Kansas City. J. H. Turtle, 603 Ridge Bldg., Kansas City, Mo., is Arch.

The St. Louis Frog and Switch Co., will build a corrugated iron and steel addition to its plant at Wellston, Mo.

WESTERN STATES

The Citizens' Club, Chehalis, Wash., will establish a plant for the manufacture of motor trucks.

The Colfax Mfg. Co., Colfax, Wash., manufacturer of concrete mixers, sack pilers, etc., recently increased its capital stock to $25,000 and will enlarge its plant. D. W. A. Mitchell is Pres.

The Elliott Bay Yacht and Engine Co., Seattle, Wash., will construct a shipbuilding plant in Seattle. Estimated cost, $250,000.

The International Harvester Co., Spokane, Wash., will build a garage and motor repair shop. Estimated cost, $15,000. M. W. Weeks is Gen. Agt.

The Electric Steel Foundry Co., 24th and York St., Portland, Ore. contemplates eenlarging its plant.

The Willamette Iron and Steel Works plans to construct a shipbuilding plant at Portland, Ore.

The Western Pipe & Steel Co. contemplates building a new plant at Los Angeles, Calif.

CANADA

Fire, Feb. 27 damaged the plant of the Record Foundry and Machine Co. at Moncton, N. B. Loss, $100,000.

The Canada Car and Foundry Co., 120 St. James St., Montreal, Que., will rebuild its foundry and machine shop at Montreal, recently destroyed by fire. Noted Feb. 24.

The Canadian Hoskins, Ltd., Sandwick St., Walkerville, Ont., contemplates purchasing machinery for the manufacture of wire goods. Estimated cost, $10,000. R. H. Cunningham is Mgr.

GENERAL MANUFACTURING

NEW ENGLAND STATES

The Great Northern Paper Co. contemplates constructing a factory at Bangor, Maine. Charles W. Mullen, Bangor, is interested.

The Great Northern Paper Co. contemplates constructing a factory at East Millinocket, Maine.

We have been advised that the plant of Proctor Bros. & Co. at Rochester, N. H., which was recently destroyed by fire will be rebuilt. Noted Mar. 2.

Plans have been prepared for the construction of an addition to the plant of the Peerless Knitting Co. at Boston, Mass. (Mattapan). Estimated cost, $50,000.

Charles A. Browne, West Bridgewater, Mass., and associates plan to establish a factory at Bridgewater, for the manufacture of leatherboard.

Work will soon be started on the construction of a 4-story factory on Barthel Ave., Gardner, Mass., for Carlson Bros. for the manufacture of store fixtures and furniture.

The Manomet Mills Co., New Bedford, Mass., will build a mill, for the manufacture of yarns. Estimated cost, $1,000,000.

The contract has been awarded for the construction of a 2-story, 36x114-ft. addition to the plant of the Warren Cotton Mills at West Warren, Mass.

The Hope Mill, manufacturer of shirting, plans to build a weave shed at Hope, R. I. Estimated cost, $300,000.

MIDDLE ATLANTIC STATES

The De Silva Rubber Co., Inc., 310 East 75th St., New York, N. Y. (Borough of Manhattan) has awarded the contract for a 2-story factory on Harris Ave. Estimated cost, $15,000.

The Isco Chemical Co., Niagara Falls, N. Y., will build a plant on Royal and Union St. Estimated cost, $300,000.

The Rochester Folding Box Co., 10 Commercial St., Rochester, N. Y., contemplates building a plant. L. W. Gerew is Gen. Mgr.

Will & Baumer Co., Syracuse, N. Y., manufacturer of beeswax, has awarded the contract for the construction of a factory. Noted Feb. 3.

William T. Baker, Jersey City, N. J., manufacturer of putty and kindred products, will build 2 reinforced-concrete additions to his plant on Suydam Ave., Jersey City.

Plans are being prepared for a new factory on Avenue R for the American Synthetic Dyes Co., Newark, N. J. Estimated cost, $25,000.

Block & Co., Brooklyn, N. Y., will build a factory on Vesey St., Newark, N. J., for the manufacture of chemicals.

The Essex Specialty Co., New Providence, N. J., manufacturer of fire works, whose plant was recently destroyed by fire, will rebuild at once. Noted Mar. 9.

We have been informed that the silk mill which is being constructed at 448 East 18th St. by the Samuel J. Aronsohn Silk Co., Paterson, N. J., will require about $250,000 worth of machinery. George R. Myers, Supt. Noted Feb. 17.

Plans are being prepared for a 4-story silk mill and power house for F. C. Reinhardt, 98 Belmont Ave., Paterson, N. J.

Plans being prepared by M. N. Shoemaker, 772 Union Bldg., Newark, for a 4-story silk mill on Straight St., Paterson, N. J., for Dunlop Bros., New York, N. Y. Estimated cost, $100,000.

Plans being prepared for factory at West Milford, N. J., for the Butler Chemical Co., 1790 Broadway, New York, N. Y. Estimated cost, $20,000.

Martin Bros., Edgebrook, N. J., will build a plant for the manufacture of concrete tile, pipe etc., at Yardville, N. J.

The Imperial Glass Co., California, Penn., will build a new factory.

The New Stanley Analine Chemical Co., Lock Haven, Penn., will build a new dye plant on Myrtle St.

F. I. Hartman plans to build a silk mill at Middleburg, Penn.

The Air Reduction Co., Philadelphia, Penn., has awarded the contract for a 1-story factory at Germantown and Sedgley Ave. Estimated cost, $25,000. Noted Feb. 3.

The Pennsylvania Optical Co., Philadelphia, Penn., will construct 2 new factory buildings. H. L. Miller is Gen. Mgr.

The Swiss Cleaners and Dyers Co., Philadelphia, Penn., will construct a plant at 5th Ave. and Broad St.

Ernest Cobole will construct a silk mill at Williamsburg, Penn.

The Kurdle Packing Co., 2931 Taylor St., Baltimore, Md., has awarded the contract for a 1-story addition to its plant. Walter M. Gieske, 65 Gunther Bldg., Baltimore, Md., Arch.

The Mutual Chemical Co., 1348 Block St., Baltimore, Md., will build a 2-story addition to its plant. Estimated cost, $6,000.

Plans are being prepared for a plant at Curtis Bay, Md. (Baltimore post office), for the Davison Chemical Corporation, South and German St., Baltimore. Estimated cost, $250,000.

SOUTHERN STATES

The Durham Hosiery Mills Co., Goldsboro, N. C., will build a new manufacturing plant.

The Mt. Airy Furniture Co., Mt. Airy, N. C., will construct an addition to its plant.

E. S. Bruner and W. C. Wolfe, Orangeburg, S. C., George W. Bailey, Paterson, N. J., and T. V. Hill, Emporia, Va., are interested in the organization of a company to establish a veneer plant at Orangeburg. Estimated cost, $50,000.

C. F. Holberg, Lee Hand, H. H. North and R. B. Perkins, Senola, Ga., have organized a company with a capital of $75,000 to establish a duck mill at Senola.

The Mexican Chili Parlor, Gadsden, Ala. contemplates building a cannery.

The contract has been awarded for the construction of a cotton gin at Lake Charles, La., for J. S. Thomson and J. D. Carter.

The Casey-Hedges Co., Chattanooga, Tenn., manufacturer of boilers and plumbers cast iron supplies, will build an addition to its plant.

The Kingsport Pulp Corporation, Kingsport, Tenn., recently incorporated, will build a new pulp mill. Estimated cost, $350,000.

MIDDLE WEST

The contract has been awarded for the construction of a cooling and distributing plant at East 117th St. and Kinsman Rd., Cleveland, Ohio, for the Tellings-Belle Vernon Co. Estimated cost, $15,000.

The Western Reserve Rubber Co. plans to construct a plant in East Akron, Ohio.

The contract has been awarded for the construction of a 3-story, 32x75-ft. factory at Norwood, Ohio, for the Cincinnati Rubber Manufacturing Co. Estimated cost, $25,000. Noted Feb. 17.

Swift & Co., Union Stock Yards, Chicago, Ill., has awarded the contract for the construction of a 3-story, 56x108-ft. packing plant at Toledo, Ohio.

The Indiana Public Elevator Co. has awarded the contract for the construction of a grain elevator at Indianapolis, Ind. Estimated cost, $500,000.

The contract for the construction of a factory at Tipton, Ind., for the McIntosh Broom Co. has been awarded.

The Wabash Cabinet Co. will build additions to its plant at Wabash, Ind.

The Michigan Carton Co., manufacturer of cartons and containers, will build a 1-story, 109x120-ft. factory at Battle Creek, Mich.

The Manistee Manufacturing Co., manufacturer of furniture, plans to construct an addition to its plant at Manistee, Mich.

The contract has been awarded for the construction of a 1-story, 60x66-ft. factory at Clearing, Ill., for the Clearing Building Material Co. Estimated cost, $4,000.

WEST OF THE MISSISSIPPI

The Clinton Sugar Refining Co. plans to build an addition to its plant at Clinton, Iowa.

The Oskaloosa Vitrified Brick Co. will issue $50,000 bonds for enlarging and improving its plant at Oskaloosa, Iowa.

Plans being prepared by C. H. Patsche, Arch., for a 1-story addition to the plant of Fairmount Packing Co., Fairmount, Minn.

Contract for 3-story plant for the Lowell Bleacheries, 3907 Laclede Ave., St. Louis, Mo., has been awarded. Noted Feb. 24.

The Clanton Lumber Co., Shreveport, La., will build a box factory at Hamburg, Ark.

The Dixie Broom Works, recently incorporated, contemplates building a factory at Hope, Ark. L. W. Rogers is interested.

The Quachita Power Co., Little Rock, Ark., contemplates building a cotton duck mill.

The Ben D. Schaad Machinery Co., Little Rock, Ark., manufacturer of plate glass, gravel roofing, vestibules and elevators will remodel its building at 301 East Markham St., Little Rock.

S. Saxe, Boston, Mass., contemplates constructing a tannery at Denison, Tex. Estimated cost, $150,000.

L. T. Lewis, Fletcher, Okla., will reconstruct its cotton gin at Floydada, Tex.

The Cheek-Neal Coffee Co., Houston, Tex., contemplates building an addition to its plant. Estimated cost, $100,000.

F. M. Newton, Jacksonville, Tex., will build a broom factory.

The Texas Cotton Mills, McKinney, Tex., will enlarge its main structure and dye house. Park A. Dallas Co., Atlanta, Ga., Engr.

Edward Dawson has purchased the cotton gin of Hubbell, Slack & Co., Mission, Tex., and will enlarge same.

The North Loop Gin Co. will build a cotton gin at San Antonio, Tex. Conrad Pape is interested.

The Independent Gin Co., Sinton, Tex., will build a cotton gin at Sinton. J. A. Bartlett, Pleasanton, is interested.

The Solms Farmers' Gin Association has been organized with capital of $12,000 and will build a cotton gin at Solms, Tex.

CANADA

The St. Maurice Paper Co. has awarded the contract for the construction of a factory at Cap Magdeleine, Que. Noted Mar. 9.

The Northumberland Paper and Electric Co. plans to rebuild its plant at Campbellford, Ont., which was recently destroyed by fire. Noted Mar. 2.

Plans are being prepared for the construction of woolen mills at Lindsay, Ont., for Horne Bros., Windsor St., Lindsay. Alexander Borne is Mgr.

The Martin Corrugated Paper Box Co., will build a plant at 353 Pape Ave., Toronto, Ont., to replace the one recently destroyed by fire. Estimated cost, $16,000.

The McLagan Furniture Manufacturing Co., 93 Trinity St., Stratford, Ont., will construct an addition to its plant at Stratford.

Work will soon be started on the construction of a plant at Calgary, Alta., for the J. C. Boyle Packing Co. Estimated cost, $1,000,000.

The Vancouver Creosoting Co. will build a plant at North Vancouver, B. C. Estimated cost, $100,000. J. C. Storey, Engr.

Classified Advertising

The Classified Advertising section appears on pages 168, 169, 170, *of this issue and will in future appear in the same relative position in the paper.*

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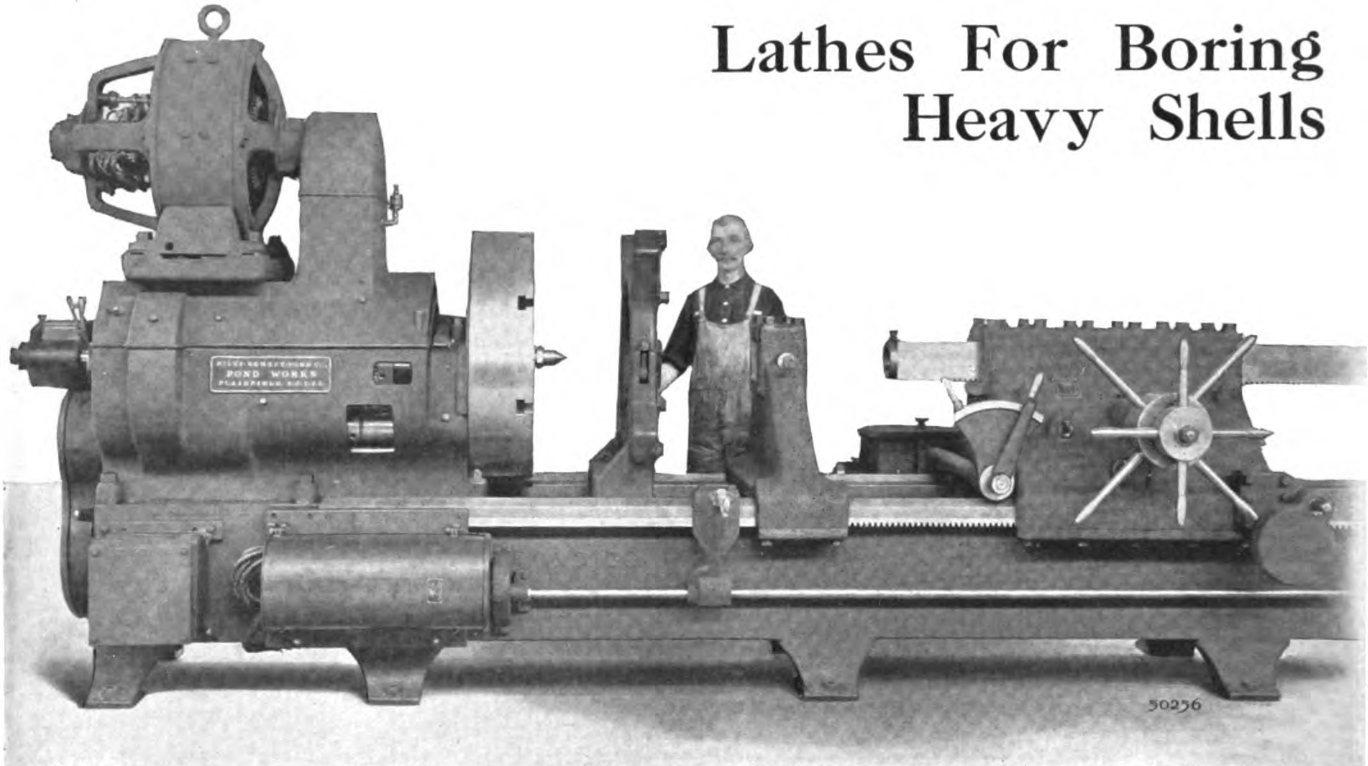
For Short Delivery

Lathes For Boring Heavy Shells



36" Heavy Lathe with boring tailstock.

All Steel Gears

Lathes are equipped throughout with steel gears and are driven by 20-hp. motors. Rear end of spindle is provided with a special thrust bearing of heavy construction to take the end thrust due to boring large holes.

Boring Tailstock

The boring ram is forged steel 6 in. square, and has a very long bearing in the tailstock. The ram feed is driven from the feed shaft, at the rear of the bed, through worm and worm wheel giving a smooth motion for boring. By means of two levers, four feeds can be obtained without changing any gears. These levers are attached to the tailstock and hence are always in a convenient position.

Supports for Work and Boring Ram

A steady rest is provided to support the shell or other work. There is also furnished a special rest to support the end of the boring ram. This rest moves along the bed with the ram as it feeds.

Specifications, Delivery, Prices, etc., Promptly Furnished on Request.

Niles-Bement-Pond Co.,

111 Broadway, New York City
25 Victoria St., London, S. W.

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VOLUME 44 — MARCH 23, 1916 — NUMBER 12

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WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormsy processes, protected by United States patent issued June 22, 1915, and another pending

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This includes the English Edition. None sent free regularly, no returns from news companies, no back numbers.

If I Knew You and You Knew Me*

IF I knew you and you knew me,
'Tis seldom we would disagree;
But never having yet clasped hands,
Both often fail to understand
That each intends to do what's right,
And treat each other "honor bright."
How little to complain there'd be
If I knew you and you knew me.

Whene'er we ship you by mistake,
Or in your bill some error make,
From irritation you'd be free
If I knew you and you knew me.
Or when the checks don't come on time,
And customers send us nary a line,
We'd wait without anxiety,
If I knew you and you knew me.

Or when some goods you "fire back,"
Or make a "kick" on this or that,
We'd take it in good part, you see,
If I knew you and you knew me.
With customers two thousand strong
Occasionally things go wrong—
Sometimes our fault, sometimes theirs—
Forbearance would decrease all cares;
Kind friend, how pleasant things would be
If I knew you and you knew me.

Then let no doubting thoughts abide
Of firm good faith on either side;
Confidence to each other give,
Living ourselves, let others live;
But any time you come this way,
That you will call we hope and pray;
Then face to face we each shall see
And I'll know you and you'll know me.

*Reprinted from a circular sent out by H. W. PETRIE, Ltd., Canada

Making Wire Automobile Wheels with Demountable Rims

By Ethan Viall

SYNOPSIS—The wire automobile wheels described in this article are of a special type and differ considerably from others of the same class. The process of making these wheels is described from start to finish, though only major operations are illustrated.

One big difficulty in the way of using wire-spoked wheels has been the tendency of the spokes to crystallize and break after a certain amount of use. Those who have even ridden a bicycle for any length of time will recall the spokes that had to be replaced occasionally, even though no accident was the cause. Another difficulty where wire wheels have been used on automobiles has been the collecting of dirt and mud on the inside of the rim, caused by the wide, flat rim and the size and position of the spokes and nipples. Of course, this collecting of mud is true to some extent with the wooden-spoked wheels, but to a far less extent on account of the "ridge" on the rim in which the spokes are set, which is comparatively narrow and affords less lodging surface.

Demountable rims have been common for use with wooden wheels, but with wire wheels it has been the general practice to carry an extra wheel instead, or else depend on changing tires as punctures developed. With the type of wire wheel described in this article the tendency of the spokes to crystallize has been minimized. The inside of the rim closely resembles that of a wooden wheel, with consequent lessened dirt lodgment, and the rim is demountable and interchangeable, making it unnecessary to buy and carry an entire extra wheel for quick repairs on the road.

This type of wheel is made by the Spranger Rim and Wheel Co., Detroit, Mich., and a glance at Fig. 1 will show the close resemblance of the rim section to that of a wooden wheel. The rim consists of two principal parts: One is the channel in which the spokes are held; and the other is the rim proper, which holds the tire. It is this double construction that gives practical freedom from spoke troubles. The channel is heavy and tightly laced to the hub by the spokes. The shape of the channel and the method of lacing are such that the springy, vibratory movement of the spokes while the wheel is running under stress is largely eliminated. This is also greatly assisted by the fact that the rim itself takes up most of the tire

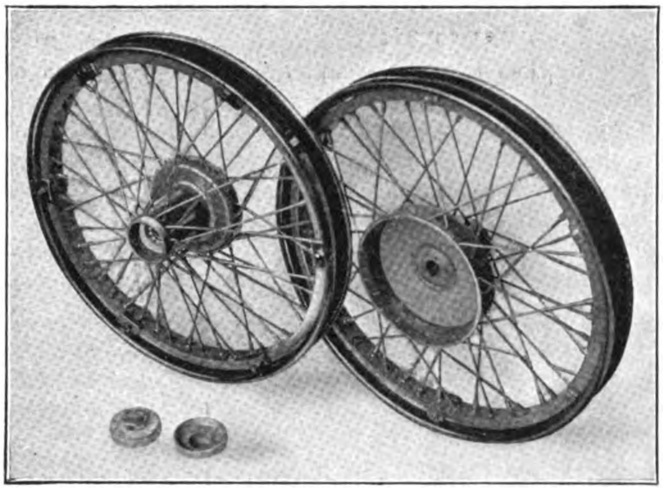


FIG. 1. WIRE AUTOMOBILE WHEELS WITH DEMOUNTABLE RIMS

movement, which owing to the method of attaching, does not affect the channel to any extent.

At present the rims are not made by this company, but are purchased already shaped and welded from one of the big steel companies. They have to be sized and otherwise finished, however. The channels are made from the straight stock, which is first cut to length, shaped in regular circle rolls and the ends fitted and welded. The welding is done in the type of butt welder shown in Fig. 2. This machine was made by the F. L. Jacobs Co.,

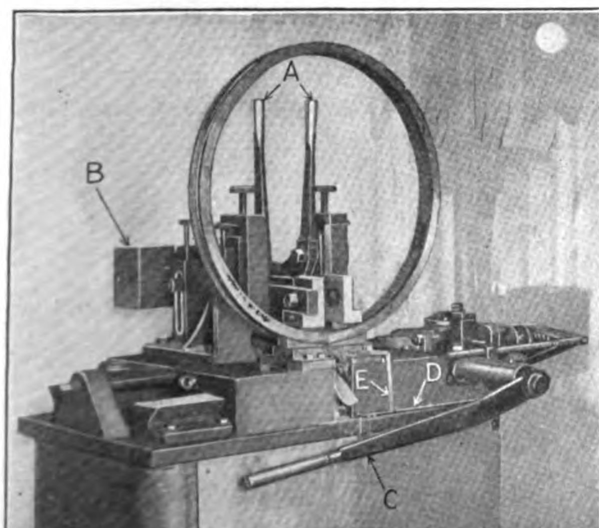


FIG. 2. ELECTRIC BUTT WELDING CHANNELS

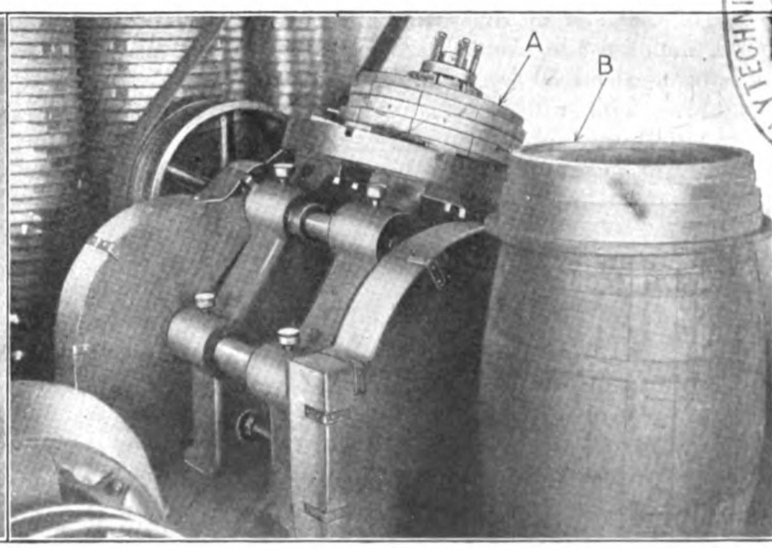


FIG. 3. STRETCHING AND ROUNDING MACHINE

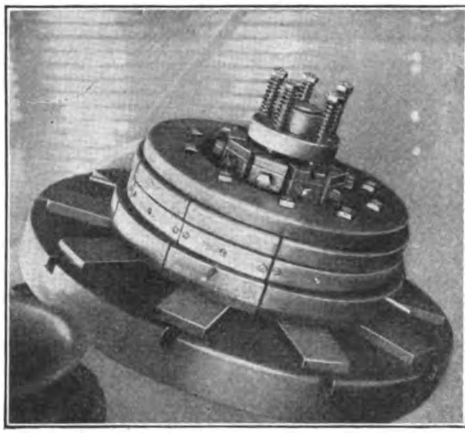


FIG. 4. A CLOSER VIEW OF THE STRETCHING HEAD

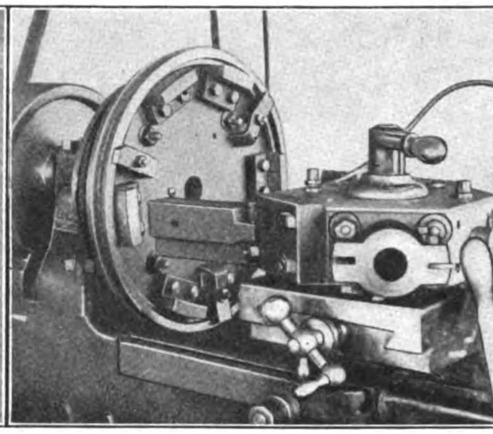


FIG. 5. TRUING THE CHANNEL EDGES IN A LATHE

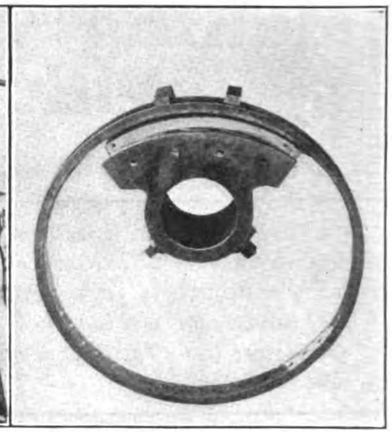


FIG. 6. SPOKE-HOLE DIE AND CHANNEL

Detroit. The two work-clamping jaws are operated by means of the levers *A*, which act eccentrically on the tops of the jaw bars. On being released the jaws are raised by means of weights *B* on the rear ends of the bars. Ample adjusting arrangements are provided for various sizes of work.

The right-hand movable slide is operated by means of a hydraulic cylinder with a quick-return release, which is operated by the lever *C*. This arrangement makes it easy for the operator to force the channel ends together as much as needed. A scale *D* and a pointer *E* on the jaw slide show him how much movement to give, to produce the right diameter of rim. In the particular example shown, standard 2-in. channels are being welded, the time taken being about 30 sec. each, at an estimated cost of ½c. each. This will be recognized as a fine record.

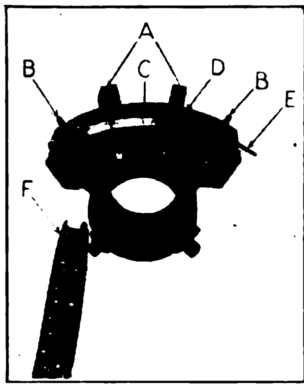


FIG. 7. DETAILS OF SPOKE-HOLE DIE

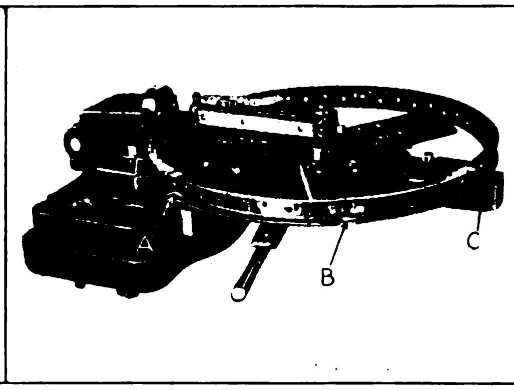


FIG. 8. PUNCH AND INDEXING FIXTURE FOR LUG SPACES

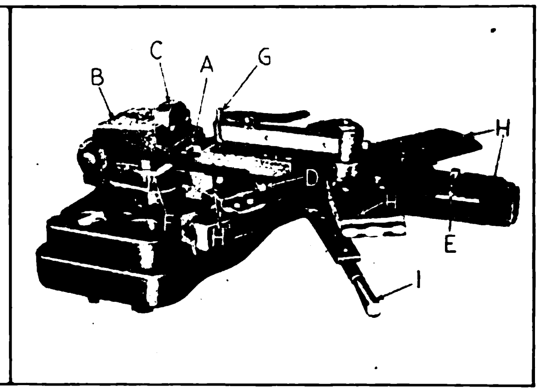


FIG. 9. DETAILS OF PUNCH AND INDEXING FIXTURE

Neither the rims as received nor the welded channels are either round or of exact size, so they must be worked in a special stretching machine to remedy their faults. The stretching machine used, shown in Fig. 3, is made by the Charles Grotnes Machine Works, Chicago. It is a back-geared powerful machine, and the rim and channels are both sized on it. They are placed over the expanding head *A*, the jaws of which work out and in. As the jaws move, the operator turns the work so that it is kneaded to size and perfectly rounded. The movement of the jaws is comparatively slow, and in some cases the work has to be stretched so as to increase it ¼ in. or more. Test gages for different diameters of channels and rims are shown at *B*. A closer view of the expanding head, with its reciprocating jaws, is shown in Fig. 4. These jaws are operated by crank and toggle movements.

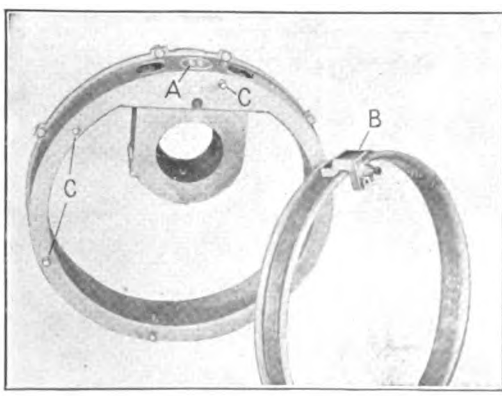


FIG. 10. DIE AND FIXTURE FOR LUG RIVET HOLES IN RIM

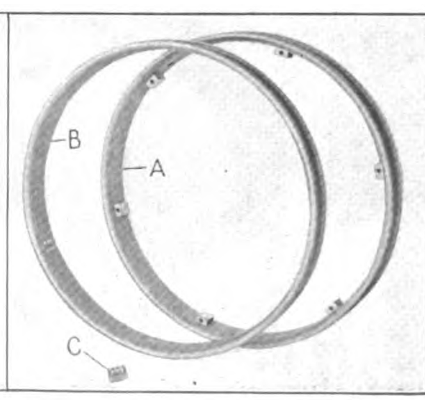


FIG. 11. RIMS WITH AND WITHOUT LUGS

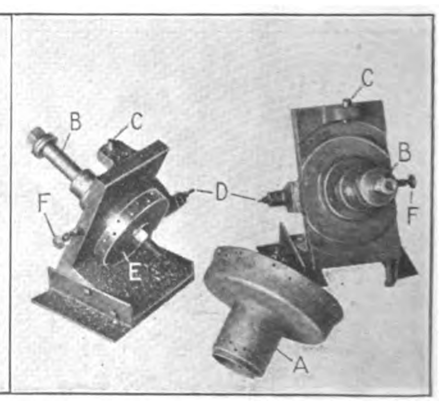


FIG. 12. HUB SPOKE HOLE DRILLING FIXTURES

After being sized and made perfectly round in the stretching machine, the channels are chucked on a special faceplate, as shown in Fig. 5, and the outside edges of the channel are trued and rounded, which makes the channels true, outside and in.

The holes for the spoke nipples are punched in the channels in a horn press, with an ordinary punch and the die shown in Fig. 6. This same die is shown more in detail in Fig. 7. The channel to be punched is placed under the stripping guides *A* and against the pins *B*. The holes are punched through at *C*. The spacing is done by means of the pin *D*. This pin is spring-backed, so that it is pressed down while the first hole is punched. The punched hole is then moved along until the pin will enter it, which gives the correct distance for the next hole, and so on. Slight adjustment for this spacing pin is provided by mounting it in a slotted carrier. An adjusting screw *E* is used to get the exact distance needed. It will be seen from the punched channel at *F* that the holes are staggered. This result is obtained by punching one row of holes that are in line and then turning the channel around and punching the other row.

An Indexing Punch Fixture

Places in the sides of the channels for the rim lugs to enter are punched out in the indexing fixture, shown in Fig. 8. The places punched out are shown at *A, B* and *C*. Six places are punched out of each channel. This fixture, with the channel removed, is shown in Fig. 9. As the places are punched from inside the channel proper, the punch *A* is an extension one carried in a hinged block *B*. A bumper is carried in the press ram, which hits the piece *C* and forces the punch downward. As the ram rises, the hinged block and punch are forced upward by a spring. An arm is provided on the fixture for each place to be punched. The channel is placed over these arms and is located so that the punched places will be in correct relation to the valve and spoke holes, by means of pins *D* and *E*, which enter the spoke holes previously punched. Stripper hooks *F* prevent the channel from being carried upward by the punch.

The work is indexed for the six positions by means of the latch at *G* and bushed holes *H* in the different arms. The entire indexing mechanism and channel holder are carried on a slide operated by lever *I*. By using this lever the fixture is run back from the punch for the insertion or removal of the work. When in working position, the slide is locked by a latch device.

There are six lugs placed on the inside of each rim. They are held to the rim by six rivets each. The rivet holes in the rims are punched out in a horn press, using the fixture shown in Fig. 10. The die proper is shown at *A*. The valve hole is previously punched in the rim, and this hole is used as a locating point for the placing of the rivet holes. A special clamp *B* is slipped over the rim, and a pin is pushed down through a hole in it into the valve hole in the rim. The setscrew is then tightened, the pin removed and the rim placed over the die frame. There are six pins *C* in the frame, and a notch in the rim clamp fits over these pins in turn, as the rim is moved around to the different punching positions.

A rim with a set of lugs in place is shown at *A*, Fig. 11. One without the lugs is shown at *B*, and a lug with rivets in place is shown at *C*. The lugs are riveted to the rim in a multiblow riveting machine.

Spoke holes in the hubs are drilled in the type of fixture shown in Fig. 12. One of the hubs is shown at *A*. This is placed over the center pin *B* and held in place by washers and a nut. The drill bushing is shown at *C*. As a hole is drilled, the work is indexed for the next by means of the spring-pin *D* and the spotted disk *E*. As the holes are staggered, the fixture is provided with a shift pin at *F*, by which both the work and the indexing disk are shifted over for the second line of holes. Different fixtures are used for the various sizes of hubs and also for opposite ends of the same hub.

Photostatic Reproduction

By Samuel Crane Williams

The reproduction of blueprints, pen and pencil sketches, maps, excerpts from books, contracts and specifications was more or less difficult up to a year or two ago, but with the introduction of the photostat, or commercial camera, the process has become exceedingly easy and, for the kind of work accomplished, comparatively cheap. Although yet in its infancy, its adoption by the Government and by industrial corporations that are also large users of the blueprinting process has led the author to believe that the photostat has a field of its own which the blueprint cannot touch. Consequently, the cost data given herewith, derived from the experience of a concern that makes on an average of 190 to 200 copies per day by this process, may be of interest.

Before going into the cost of production, a word as to the method of making copies might be of general interest. The photostat works similarly to an enlarging camera. The object to be copied (enlarged or reduced) is placed upon a horizontal board with a glass top. Two mercury-vapor tubes parallel to the length of the board and on each side illuminate the object strongly. The rays from these lamps are reflected from the object through a right-angle prism and photographic lens, the image striking a sheet of sensitized paper. After having been properly exposed, this sheet of paper is cut from the roll and dropped automatically into a tray of developing solution. It is next drawn out of this tray and placed in a fixing bath of hypo. If the print is satisfactory, it is then washed for 15 or 20 min. and hung up to dry; or if needed urgently, it may be dried between blotters and then ironed out with an electric iron.

The finished photograph will have its blacks and whites reversed; that is, it will be a negative the same as a film or plate. If it is desired to have the blacks and whites the same as in the original, a copy of this negative—a positive—must be made. If several copies of the same original are to be made, it is more economical to make one negative and the rest positives, as the negatives require more developer, owing to the greater amount of chemicals to be removed. If the object to be photographed is small enough, one-half the lens may be closed off and the image taken on a half sheet. If the object is too large to go on the board at one time, it may be taken in sections and the sections pasted together when dry. This pasting and matching take considerable time, a skillful boy being able to trim and match a four-section sheet, requiring three matches, in about 15 min.

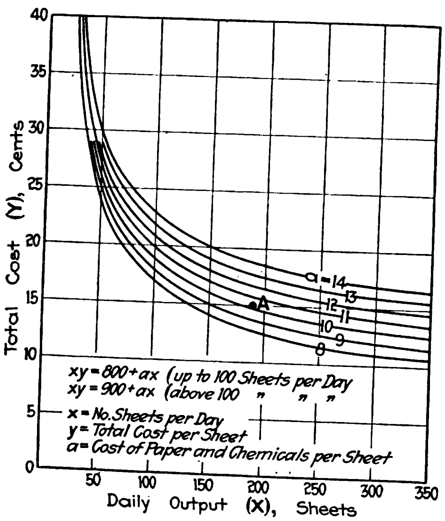
A large amount of our work is two-section work on drawings, and the reproduction of specifications. We get

three sheets of these, slightly reduced, upon a full-sized sheet 18x13 in. With a first-class operator and two expert boy trimmers we are able at maximum capacity to turn out 350 full-sized sheets in an 8-hr. day, but this rate cannot be kept up. A good average output from this size of machine would be about 300 full-sized sheets a day and could be kept up indefinitely.

Preparing Cost Data

In preparing these cost data the subject was attacked from two different angles—as a business investment, pure and simple, requiring the soliciting of work, and also as an adjunct to another business, in which case the work is unsolicited. The first condition does not interest the average user and will not be considered here.

In either case the total cost per sheet multiplied by the number of sheets in a given period is equal to the total overhead charges for the same period plus the cost per



COST OF PHOTOSTATIC REPRODUCTION

sheet for chemicals and paper multiplied by the number of sheets. Thus if we let

y = Total cost per sheet;
x = Average number of sheets per day for a month's work;
a = Cost per sheet for chemicals and paper;
K = Overhead charges per day;

then

$$xy = K + ax.$$

In this equation x and y are variables, while a and K are constants, the value of the former depending upon the cost of chemical and paper, and the value of the latter depending upon the size of the machine used and the number of operators.

In arriving at a value for a the following notation is used, with the costs in cents:

Let

b = Cost of paper per sheet;
c = Cost of chemicals per sheet;
d = Cost of sodium carbonate per pound;
e = Cost of sodium sulphite per pound;
f = Cost of hypo per pound;
g = Cost of citric acid per pound;
h = Cost of powdered alum per pound;
i = Cost of hydroquinone per pound;
j = Cost of photol per pound;
k = Cost of potassium bromide per pound.

By test we have found that 6 per cent. of every roll of paper is thrown out for wrong exposure, weak chemicals, joints in the roll, etc., so that in figuring the cost of paper per sheet this loss is taken into account. Although each finished sheet is 18 in. long, there is 1 in. of paper that is unexposed each time, so that we consider the actual length of each sheet as 19 in. The length of each roll is 350 ft., and the cost per sheet works down to

$$b = \frac{(cost\ per\ roll) \times 19 \times 100}{350 \times 12 \times 94}$$

The figure 94 per cent. should be determined by experiment in any case, as an inexperienced operator can waste a great deal of paper. With paper costing $16.50 per roll the price per sheet, using this formula, would be

$$b = \frac{1{,}650 \times 19 \times 100}{350 \times 12 \times 94} = 7.95c.$$

On the same test that determined the amount of paper wasted per roll we found that six mixings of developer and fixing bath were necessary per roll of paper. This is equivalent to 35 full-sized sheets for each mixing of developer and fixing bath. The formula which we use in making up these chemical solutions gives us the following:

$$c = \frac{96d + 80e + 256f + 8g + 8h + 16i + 2j + k}{256 \times 35}$$

The prices of chemicals have increased considerably since the war, owing to the fact that the most important ones are produced in Germany only and hence are very hard to obtain. The huge demand occasioned by the rapid growth of the motion-picture industry has also caused the price to go up. At the time of preparation of this article the various chemicals are selling at as high a rate as they will probably reach, because manufacturers in this country are beginning to produce them. The prices paid in New York in December, 1915, were as follows:

Chemical	Price per Lb.
Sodium carbonate, d	$0.08
Sodium sulphite, e	.10
Hypo, f	.025
Citric acid, g	.75
Powdered alum, h	.10
Hydroquinone, i	7.75
Photol, j	18.00
Potassium bromide, k	5.00

Substituting these prices in cents in our formula, we get $c = 2.16$c.

With a value of $b = 7.95$c. and $c = 2.16$c., a would equal $7.95 + 2.16 = 10.11$c. In plotting the curves, a is given for 8, 9, 10, 11, 12, 13 and 14c., which will take care of all likely fluctuations in price of paper and chemicals.

If we assume that there are 300 working days a year, the value of K can be taken as 900 and can be reduced to 800 when the average output is less than 100 sheets per day, as then the services of the boy can be dispensed with.

A graphical representation of these costs is given. During the month of December our outfit made an average of 190 sheets per day, with chemicals and paper costing 10.11c. per sheet, which from the curve gives a total cost of 15c. per sheet.

Carbonizing Small-Shop Steels

BY JOHN H. VAN DEVENTER

SYNOPSIS—Carbonizing is the first step in casehardening. Unless this part of the work is done with a knowledge of the principles involved, the final result will be uncertain. This article gives an explanation of the action of carbonizing processes as applied to both low- and high-carbon steels.

Out in the woods of North Carolina, ten miles from the nearest populated point, a gang of men were converting pine trees into rough lumber. For this purpose they used axes and a portable sawmill outfit run by a side-crank engine such as is commonly found in these migrating lumber camps. One day the boiler, which was rather inclined to bad attacks or spasms, delivered an unusually large gob of water through its discharge pipe to the long-suffering engine cylinder just at the time that the saw was biting its way through a pugnacious pine knot. The combination of circumstances was too much for the crosshead pin of the engine.

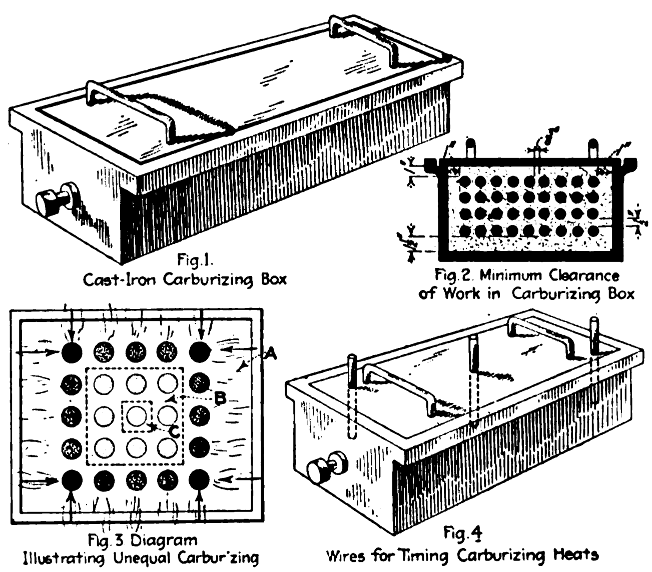
"I don't see what made the darn thing break," said the lanky North Carolinian who acted not only as boss of the outfit, but also as master mechanic. Indeed the fracture, to one who was not experienced in such matters, would appear to be a good one. Still, it was evident that something must have been wrong with the pin, for by all expectations the cylinder head should have gone before this part of the apparatus gave away.

To get at the real reason for this mishap, which meant the loss of many dollars and a shutdown of many days to this lumber camp, let us go back to the factory in which this crosshead pin was made and see how the work was done. If the lanky lumber-camp boss could go along with us and also see what caused the accident, I am sure that he would be more particular in the future in buying an engine and possibly willing to pay enough to avoid the junk that is frequently offered.

In the shop that built this engine the aim was not so much to give service as it was, to put it crudely, to find suckers. The idea was to produce an engine at the lowest possible cost, sell it at a price that would be an inducement much greater than quality and not worry too much about what happened to it after it was in use. One of the safeguards of this policy was the knowledge of many ways by which a skillful correspondent can make defects of construction appear as errors in operation.

To make the descriptive matter as imposing as possible, such items as charcoal-iron castings, hammered babbitt bearings and casehardened pins were described at length, although as a matter of actual fact the nearest that any charcoal got to the iron was in the fire used in drying the skin of the mold, and the only hammering that the bearings received was that due to the pounding of the rod after the engine was in service. As for the casehardened pins, the blacksmith took them under his wing after they were fully machined, heated them up in his forge, sprinkled a little cyanide of potassium over their surfaces, turned them around in the fire once or twice, to get the same effect as is obtained by basting chickens, and then plunged them into a cold brine solution. This procedure did make the outer skins of these pins very hard, but it left the inner core extremely coarse-grained and weak. The pin could not be touched with a file and might appear to be a very long-wearing product, but was brittle and weak. If it had really been wise on the subject of carbonizing and casehardening, this firm could have avoided this feature and also reduced the cost of carbonizing the crosshead pin—getting a high-grade result for less money.

Casehardening divides itself into two parts—carbonizing and quenching. A great many people think that the quenching must be done at the same heat as that at which the piece is carbonized. This idea is entirely wrong, and these two processes can be regarded as separate operations; in fact, in this article I will stick to the carbonizing part of it as closely as possible and save the quenching for another time.



FIGS. 1 TO 4. CARBONIZING BOXES AND DETAILS ILLUSTRATING THEIR USE

There are four different reasons for casehardening, and they must be considered in connection with the way of doing it. The first is to secure a hard surface—maximum hardness to resist wear without shock. Again, a piece may be casehardened for the purpose of securing stiffness, thus reducing the likelihood of the stretching of light sections while at the same time allowing the use of cheap machinery-steel stock. A third purpose is to secure colors on certain classes of work. The fourth, which is possibly the least understood in most shops, is that of securing a hard cutting edge, not only on low-carbon steels, but also on tool steels.

These different purposes are secured by the proper selection of the carbonizing material in which the articles are packed and of the bath in which they are quenched.

The general practice of carbonizing is as follows: The articles are placed in cast-iron boxes surrounded by materials that will give up carbon when heated. These boxes and their contents are next heated through, beyond the critical point of the steel involved (see page 447) and are allowed to soak at this temperature for a length

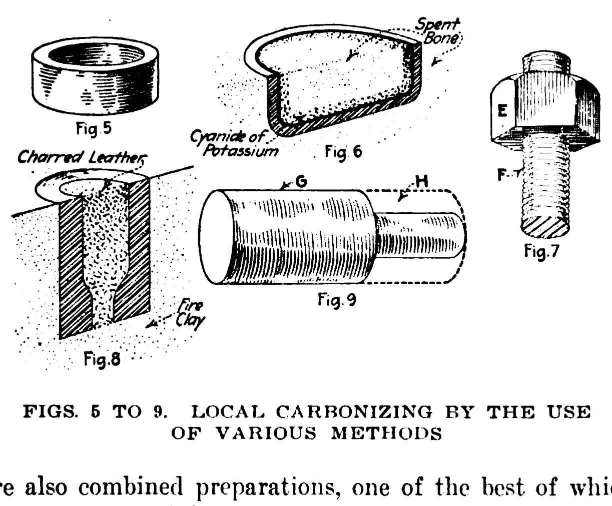
of time depending on the depth of case wished. A convenient box for this purpose is shown in Fig. 1.

There are certain precautions to be taken in packing a box of this kind. In the tug-of-war to absorb whatever free carbon is released by the heated carbonizing material, cast iron has a much stronger pull than has steel. As a result, if the pieces are placed too near the cast-iron walls of the containing box, these walls will get the benefit of the carbon to the detriment of the pieces. Fig. 2 shows a cross-section through a casehardening box and gives the minimum clearances for the articles with relation to each other and to the walls and bottom of the box.

The casehardening box must not be too large, especially for light work that is run on a short heat. The reason for this is shown in the diagram in Fig. 3. When a box of this kind is put into a furnace, it heats from the outside toward the center, taking from one-half hour to an hour and a half to heat through uniformly, depending upon the liveliness of the fire. If the contents of such a box are dumped after a short heat, the pieces on the outside rows will have been at the carbonizing heat much longer than those nearer the center of the box, the result being a much greater gain in carbon in these outer pieces, as illustrated by the sectional shading in Fig. 3.

The temperature to be used for carbonizing depends on the amount of carbon already in the steel to be treated. This temperature must be above the critical point of the steel; and if you know its carbon contents, you can obtain this point from the table on page 447. Low-carbon machinery steel containing from 15 to 20 points carbon is commonly used for this purpose, and such steels must be heated to between 1,650 and 1,750 deg. F. The more carbon that there is in the steel to start with the slower it will be in taking on additional carbon and the lower is the temperature required. In ordinary casehardening, the outer surface of steel has its carbon increased from 15 or 20 points to 80 or 85 points. Tool steels may be carbonized as high as 250 points, but this amount is a maximum and is seldom, if ever, required.

The materials used for carbonizing are many. Among the most common are wood and bone charcoal, ground or crushed bone, charred leather, horns and hoofs. There



FIGS. 5 TO 9. LOCAL CARBONIZING BY THE USE OF VARIOUS METHODS

are also combined preparations, one of the best of which is a mixture of barium carbonate, 40 per cent., and charcoal, 60 per cent. This mixture gives a rate of penetration which is from 10 to 20 per cent. faster than that of charcoal, bone or leather. Fig. 10 shows the penetration of this mixture on ordinary low-carbon machinery-steel stock over a range of 2 to 12 hr.

Each of these different packing materials has a different effect upon the work in which it is heated. Charcoal by itself will give a rather light case. Mixed with raw bone it will carbonize more rapidly, and still more so if mixed with burnt bone. Raw bone and burnt bone, as may be inferred, are both quicker carbonizers than charcoal, but raw bone must never be used where the breakage of

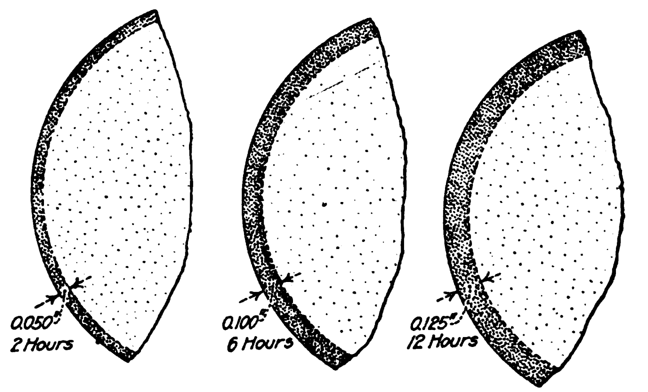


FIG. 10. ORDINARY CASE PENETRATION IN LOW-CARBON STEEL FOR VARIOUS HEATS

hardened edges is to be avoided, as it contains phosphorus and tends to make the piece brittle. Charred leather mixed with charcoal is a still faster material, and horns and hoofs exceed even this in speed; but these two compounds are restricted by their cost to use with high-grade articles, usually of tool or high-carbon steel, that are to be hardened locally—that is, "pack-hardened." Cyanide of potassium and prussiate of potash are also included in the list of carbonizing materials; but outside of carbonizing by dipping into melted baths of these materials, which I will describe later, their use is largely confined to local hardening of small surfaces, such as holes in dies and the like.

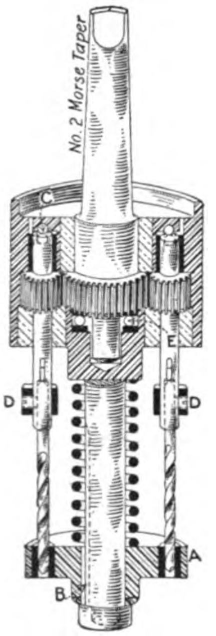
One of the advantages of hardening by carbonizing is the fact that you can arrange to leave part of the work soft and thus retain the toughness and strength of the original material. Figs. 5 to 9 show ways of doing this. The inside of the cup in Fig. 5 is locally hardened, as illustrated in Fig. 6, "spent" or used bone being packed around the surfaces that are to be left soft, while cyanide of potassium is put around those which are desired hard. The threads of the nut in Fig. 7 are kept soft by carbonizing the nut while upon a stud. The profile gage, Fig. 8, is made of high-carbon steel and is hardened on the inside by packing with charred leather, but kept soft on the outside by surrounding it with fireclay. The rivet stud shown in Fig. 9 is carbonized while of its full diameter and then turned down to the size of the rivet end, thus cutting away the carbonized surface. Pieces of this kind are of course not quenched and hardened in the carbonizing heat, but are left in the box to cool, just as in box annealing, being reheated and quenched as a second operation. In fact, this is a good scheme to use for the majority of carbonizing work of small and moderate size. Sometimes it is wished to harden a thin piece of sheet steel halfway through, retaining the soft portion as a backing for strength. Material is on the market with which one side of the steel can be treated; or copper-plating one side of it will answer the same purpose and prevent that side becoming carbonized.

Neat Multiple Drill Head

By P. Baldus

A good construction of a multiple drill head is shown in the accompanying illustration. The design is of the four-spindle type.

The drill-head body is turned from a bar of 3-in. diameter cold-rolled steel and carries the jig plate *A*, which is held in line with the four spindles by the key *B*, which permits it to slide up and down the central stem of the head without getting out of line. The compression spring which surrounds the central stem bears on a shoulder at the top and on the jig plate *A* at the bottom; its function is to return the jig plate to its extreme downward position. A collar on the end of the stem prevents the jig plate being pushed off the end. When twist drills with right hand twist are used the spindle of the drill press must be reversed. A bar, not shown, projects at right angles from the body and prevents it from turning with the work. Where the holes are spaced far enough from the center it is quite feasible, with a powerful drive, to make these heads with a larger number of spindles. The drill thrust is taken up by the ball bearings *C*. The drills are held by the headless setscrew *D* and driven by a slot in the spindle. The thrust of the driver is taken up by the ball bearing *E*. This head has been in use for a year and is giving good results.



NEAT MULTIPLE DRILL HEAD

Old Universal Hand Shaper

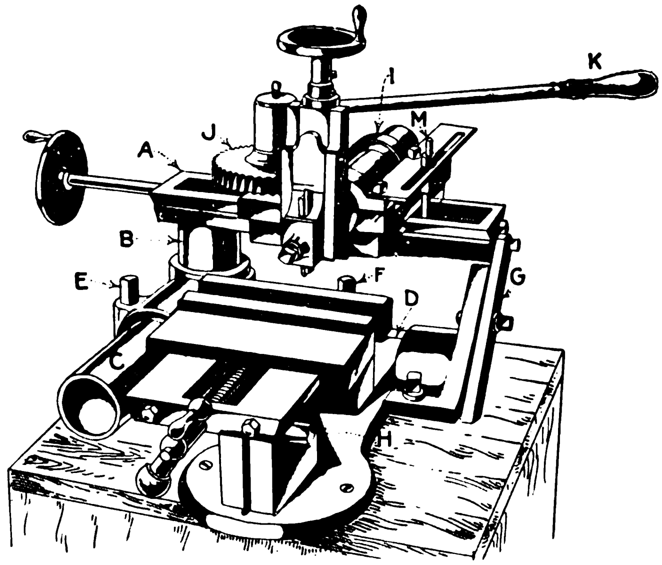
By C. O. Hyde

The hand shaper shown has been in use for a good many years and is now in the shop of the Spranger Rim and Wheel Co., Detroit, Mich. There is no nameplate on it to indicate the maker, but the simple ingenuity of the design is worthy of comment. There is practically no position or angle of stroke that cannot be obtained with it. Originally it was used in the making of steel stamps.

The basis of the various position adjustments is a series of round arms. The ram carriage is placed on a crossrail that is supported by a round arm *B*, set into a circular clamp in the end of the arm *C*. The clamping bolt is at the back and cannot be seen from the front, though its position will be readily understood. The arm *C* runs through a clamp in the end of the arm *D* and is locked by means of the bolt *E*. The arm *D* is run through a clamp on the back of the machine and is locked by the bolt *F*.

The brace *G* can be used to support the crossrail in the various positions, except when it is swung around on the arm *B*. The vise, too, is carried on a round support and may be swung around in a circle and locked in the different positions by the bolt *H*. The clapper block and vertical tool slide are carried on the end of a round arm *I*, which may be adjusted similarly to the other arms.

The ram is actuated by a gear *J* and a rack on the side of the ram slide, the hand-operating lever being shown at *K*. The crossrail feed is worked by the hand-



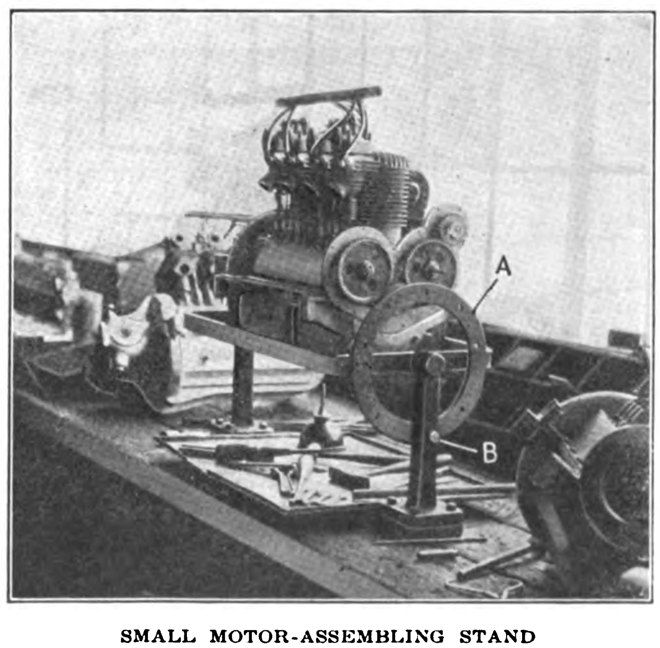
AN OLD UNIVERSAL HAND SHAPER

wheel *L*, or by the adjustable trip *M*, which operates an automatic feed in either direction. The whole machine is well made and in good condition, considering its long use.

Small Motor-Assembling Stand

By V. E. Mason

The bench stand shown is used in assembling Henderson motorcycle motors and is very simple and convenient. The upright brackets are made of cast iron, but the remainder is of heavy strap iron. Crosspieces hold the motor in place, so that it may be tilted in either direction, permitting easy access to all parts. It is held in different positions by the holes drilled in the circular end piece *A*, into which the pin *B* is inserted.



SMALL MOTOR-ASSEMBLING STAND

Drilling and Milling Work for Press Details

By Robert Mawson

SYNOPSIS—Owing to the fact that the number of these printing presses manufactured is comparatively small, many of the jigs used are designed to accommodate a number of different detail parts. The jigs are made with pin-headed binding screws so that the parts may be quickly placed in and removed from the tool.

The two-sheet rotary printing press made by the United Printing Machinery Co., Woonsocket, R. I., was illustrated and described on page 58. Some of the jigs and fixtures used in its manufacture were shown on pages 56, 138, 232, 318 and 408. In this article four other details used on the same press are taken as the subject, the tools, jigs and fixtures used for their machining being described.

By the application of pin-headed binding screws the necessity of using a wrench in the insertion and removal of work is obviated, while the rapidity with which the jigs can be operated is correspondingly increased.

For locating surfaces V-blocks are used where a circular contour obtains on the piece and stop pins are used in the case of flat surfaces.

The production of the jigs and fixture shown, in the drilling, milling and reaming operations, has met commercial requirements and the accuracy of the work indicates high-grade small-tool construction. The four parts machined are representative machine-shop products.

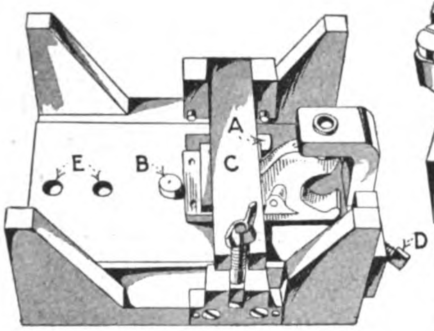


FIG. 2

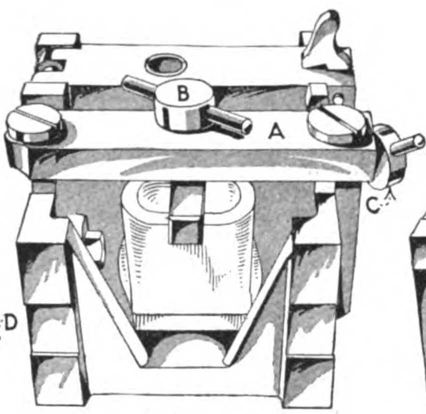


FIG. 4

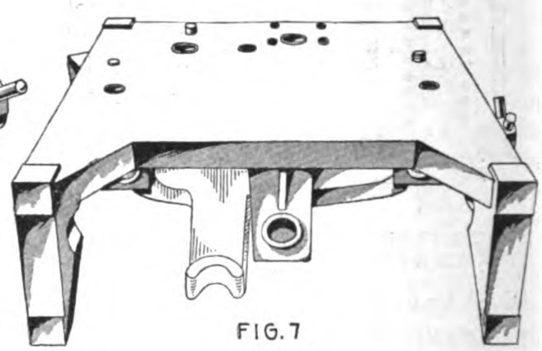


FIG. 7

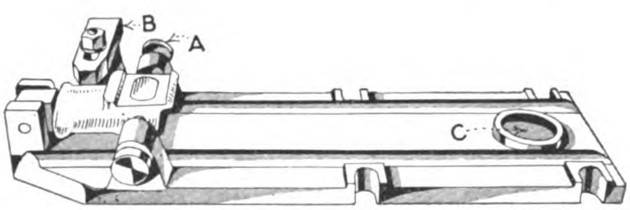


FIG. 5

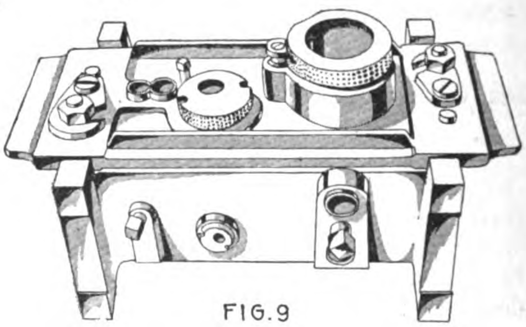


FIG. 9

JIGS AND FIXTURES USED IN MANUFACTURING A PRESS, WITH WORK SHOWN IN POSITION

FIGS. 2 AND 2-A

Operation—Drilling holes in jogger-blade support, Fig. 1. The rough casting is located by the steel plate A, pin B and the V-block in the cover C. The block in the cover and pressure on screw D hold the casting securely. This jig is used for several different parts. By changing the pin B into the holes E it is utilized as a locating surface.

Holes Machined—Four No. 19 drilled and one $\frac{11}{32}$-in. drilled. The latter hole is tapped with $\frac{3}{8}$-in. U.S.S. threads with the casting removed in a later operation.

FIGS. 4 AND 4-A

Operation — Drilling and reaming form-roller socket bracket, Fig. 3. The rough casting is placed in the jig and the cover A swung back. A clamp operated by the pin-headed screw B locates the part in one direction. The pin-headed screw C pushes the casting back against an adjustable screw, thus locating it in the other direction.

Holes Machined—One $\frac{1}{2}$-in. spot drilled and reamed, one $1\frac{31}{32}$-in. drilled and reamed $\frac{7}{8}$ in.

FIGS. 5 AND 5-A

Operation—Milling slot in form-roller socket bracket, Fig. 3. The casting is located on a $2\frac{7}{8}$-in. pin that fits into a reamed hole. Screw A and strap B hold the piece securely. The fixture is located on a plug in the miller table that fits into the hole C.

Surfaces Machined—Slot and sides, using a 3-in. end mill operating at 55 r.p.m. with a feed of 0.02 in. per revolution.

FIGS. 7 AND 7-A

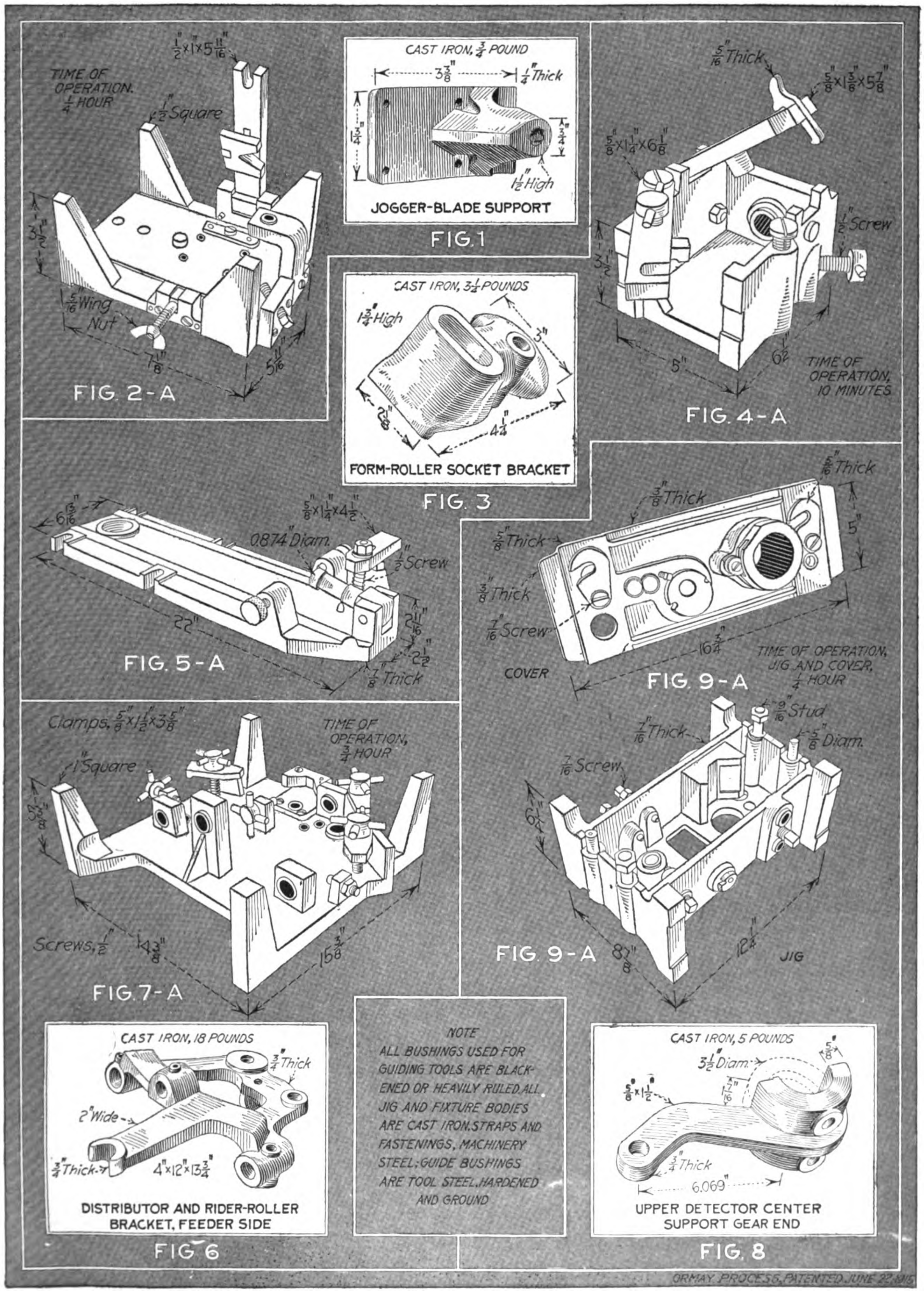
Operations—Drilling and reaming holes in distributor and rider roller bracket, Fig. 6. The milled casting is located against a V-block and an adjustable screw, being forced against them with pin-headed screws. Three straps are then tightened onto the piece to hold it securely. The jig is swung over, resting on four legs when drilling.

Holes Machined—Three $\frac{7}{8}$-in. spot drilled and reamed, two $\frac{1}{2}$-in. spot drilled and reamed, two $\frac{33}{64}$-in. drilled, one $\frac{5}{16}$-in. drilled. The $\frac{5}{16}$-in. hole is later tapped with $\frac{3}{8}$-in. U.S.S. threads with the piece removed from the jig.

FIGS. 9 AND 9-A

Operations—Drilling and reaming upper detector center support, Fig. 8. The casting is made with a tie-bar, as shown by the dotted lines. It is located in the jig by a V-block and adjustable screws being forced against them with setscrews. The cover is then dropped over the jig, located by dowels and held in place with swinging clamps.

Holes Machined—One $1\frac{63}{64}$-in. drilled and reamed 2 in., one $\frac{39}{64}$-in. drilled and reamed $\frac{5}{8}$ in., and two $\frac{1}{2}$-in. spot drilled and reamed. The other bushings shown in the jig are used in machining other details.



DETAILS OF JIGS AND FIXTURE USED IN PRESS MANUFACTURE

A Recessing Tool

By E. V. Allen

The Henderson Motorcycle Co., Detroit, Mich., uses on its machines a mechanical filter with a brass body that has a hole in it that must be bored and recessed, or chambered, a short distance from the outside. The holding jig and recessing tool are shown in working position in Fig. 1. The casting is clamped in the jig, and then the

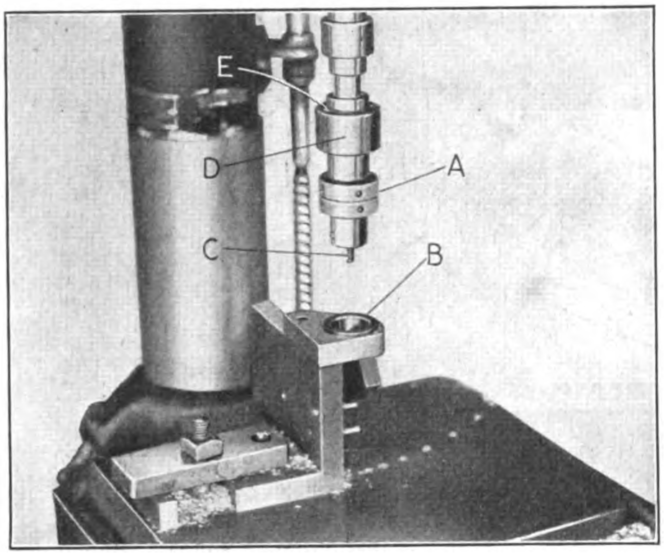


FIG. 1. RECESSING TOOL IN A DRILLING MACHINE

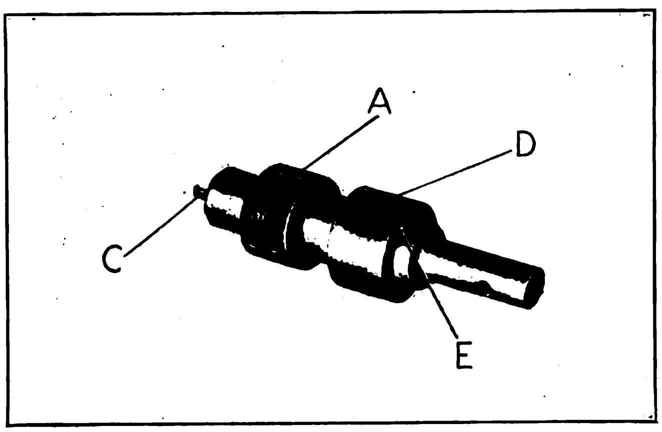


FIG. 2. THE RECESSING TOOL ALONE

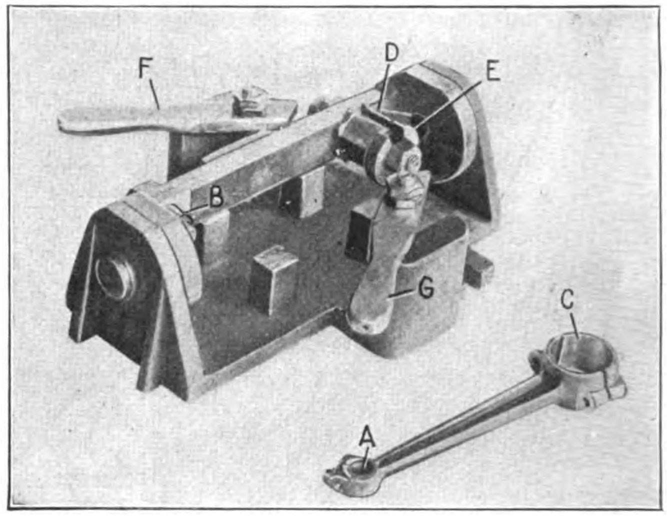
tool is run down until the adjustable collar stop *A* is in contact with the top of the bushing *B*. The hooked recessing cutter *C* is fed to the work by lifting the sleeve *D*, which forces the pin *E* inward and, through it, the end of the cutter outward.

The tool is shown out of the machine in Fig. 2, with the parts given the same letters. This view will give a good idea of the way the tool is made, as everything is shown except the pivoting of the cutter shank, which can easily be imagined.

Cap-Splitting Fixture

The Caille Perfection Motor Co., Detroit, Mich., makes a small portable boat motor for making any common rowboat into a motor boat. The number of these motors produced is of course not to be compared with the quantities produced by most of the automobile factories. For this reason the tools and jigs must be designed with a view to interchangeable production without too much expenditure.

The fixture used for splitting connecting-rod caps, here shown, is a good example. The connecting-rod is first bored and faced, then placed in the fixture with the hole



A CAP-SPLITTING FIXTURE

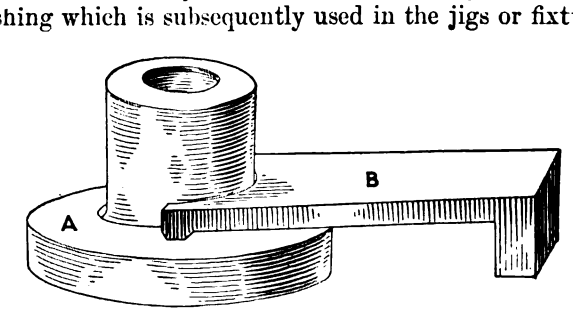
A over the pin *B* and with the hole *C* over the pin *D*. The slotted washer *E* makes the locking on of the connecting-rod an easy matter. One side of the cap is then cut through with a milling saw, the holding cradle being held down in position by the lever *F*. The cradle is next swung over on its trunnions and locked down by the lever *G*. This brings the other side of the cap upward, where the same saw can be used to split it off the connecting-rod.

A Simple Method of Locating Buttons for Tool Work

By J. H. Bondreau

The following method is good for jig and fixture work and should be of service in the tool room:

The buttons *A* are of tool steel—hardened and ground all over. Generally the holes are the body size of the bushing which is subsequently used in the jigs or fixtures.



LOCATING BUTTONS FOR JIG WORK

With the aid of the strap *B* the button can be located at any desired point and securely held while drilling and reaming the hole.

The buttons are especially handy when the size of the hole permits the use of interchangeable bushings for drilling and reaming small holes, as it can be done with the buttons clamped securely in position.

Manufacturing British 18-Pounder High-Explosive Shells--VI*

By E. A. Suverkrop

SYNOPSIS—In the final government inspection the shells are subjected to a very rigid examination. In it all the gages that have previously been used in the examination of the shells are again made use of. Besides gaging, the interior of the shell is examined to see that the surface is smooth and that the varnish entirely covers it. Then follow painting, packing and shipping.

Having passed the final inspection the shells are trucked to the painting department, which is in a separate building, shown in the illustration, Fig. 65, and also, in part, in Fig. 66, which gives a view of the boxing and shipping departments. Located in this same building and shown at A, Fig. 65, is a bank of cutting-off machines for cutting the bar stock into machining blanks for the 18-pounder high-explosive shells. Storage room is also provided here for the shell boxes and benches and for other facilities for packing and shipping the shells when they are finished. A spur line of track from the railway enters the building at one end.

The painting machines are very similar to those used in the shops of the Canadian Allis-Chalmers Co., with the exception that they are driven by friction cones mounted on shafts instead of being belt driven from small individual motors. The arrangement of the friction-driven painting machine is shown in Fig. 67. A single motor and a system of shafts and friction cones drive the six painting machines in this department. At A is a shaft that is driven from a small motor. At B are the friction cones, and at C, on the end of the vertical shaft from the friction cones B, is the painting machine, or turntable. A small vertical flange is provided on the upper surface of the turntable, to retain the shell and prevent it from being thrown off. The priming coat is white and is made up from the following ingredients in the proportions given:

Dry zinc oxide, free from lead, 9¾ lb.; boiled linseed oil, free from lead, 1¼ pints; terebene, free from lead, 1¼ pints; spirits of turpentine, 1½ pints. It is of the utmost importance that the ingredients employed in the manufacture of paints for high-explosives shells be entirely free from lead. The reason for this was given in the series of articles on the 4.5 high-explosive shell; but as that series may not be readily accessible, it is as well to reiterate the explanation here. Lyddite, with which these shells are loaded, is one of the explosives into the manufacture of which picric acid enters. Picric acid in combination with certain other elements, one of which is lead, forms what are called unstable compounds; that is, should the picric acid in the lyddite come in contact with lead in the paint, the resultant compound, picrate of lead, would be subject to spantaneous explosion.

The actual work of painting is done by boys in the following manner: Referring to Fig. 67, a boy takes a shell D from the truck tray and places it on the turntable C of the painting machine. The paint is applied with an ordinary flat brush E about 2 in. wide, which is dipped into the paint and traversed up and down over the body of the shell, which rotates with the turntable. Care is exercised to keep the paint from getting on the copper band and also to keep the film of paint from being too thick, as the painted shells must later pass through a ring gage.

As the boys finish the painting, others take the shells carefully and stand them on their noses on the bench F (shown at D, Fig. 65). When in this position, shown at G, Fig. 67, the bottom of the shell base is painted with the priming coat. Again the shells are carefully lifted, so as to remove as little of the paint as possible, and stood nose down, as shown at H, in the hot cupboard. The position of this cupboard is shown at E, Fig. 65. It is of wood, and at the bottom is a steam-heating coil. Above this are several sheet-steel shelves perforated so that the heat from the coil at the bottom can circulate freely through the whole cupboard. Each compartment will accommodate an entire series. The shells are stood in the cupboard as close as they will go without touching. They remain there till they are dry, which under normal conditions takes about an hour. The cupboards are provided with doors on both sides, so that the boys who put on the second coat of paint can take the shells direct from their own side.

The finish-painting department F, Fig. 65 shown also in Fig. 68, where the second coat is applied, is laid out in exactly the same manner and has the same equipment

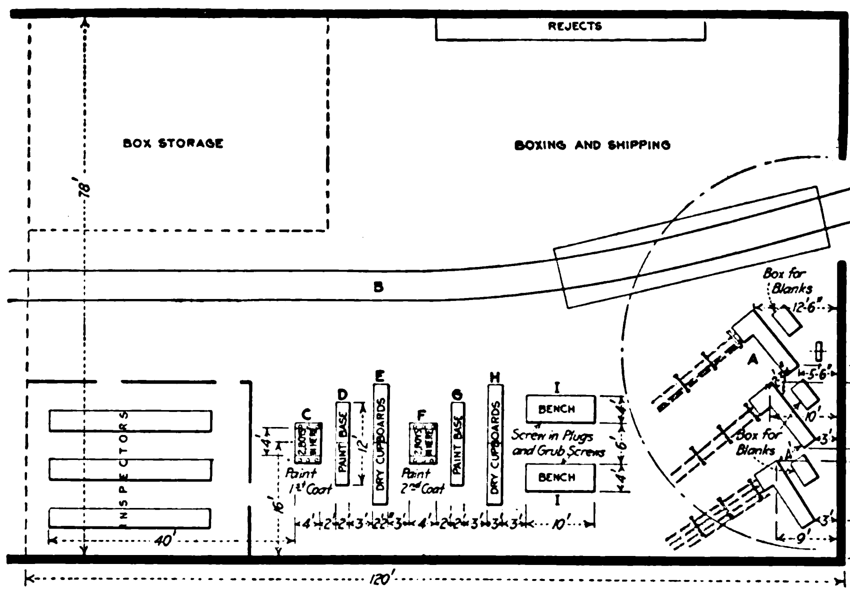


FIG. 65. NORTH END OF PAINTING AND SHIPPING DEPARTMENT

*Previous installments appeared on pages 1, 45, 145, 221 and 353.

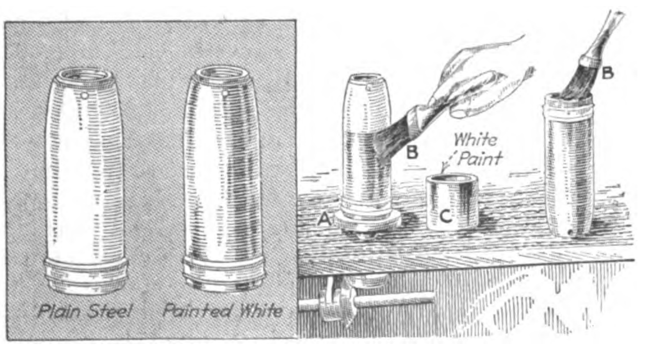
FIG. 66. BOXING AND SHIPPING DEPARTMENT FOR HIGH-EXPLOSIVE SHELLS

as the one shown at *C*, Figs. 65 and 67, for the first coat. The paint used for the second coat on the 18-pounder high-explosive shell is yellow. It consists of dry Oxford yellow stone ocher, 8½ lb.; boiled linseed oil, free from lead, 1¼ pints; terebene, free from lead, 2½ pints; spirits of surpentine, 1½ pints. It is applied in exactly the same way as the first coat, with this exception: The first-coated shells are taken by a boy, who places them on the turntable of the painting machine, as shown at *A*, Fig. 68. He then takes the gage *B*, which is made of steel; and hooking the end *C* over the top of the shell, he scribes two parallel lines an inch apart around the body of the shell, as shown at *D*. These lines are made by two pencils *E*, which go through holes in the long member of the gage *B*. After the yellow paint has been applied to the parts of the shell above and below the lines *D*, a band of green paint is applied between them. This green band of paint signifies that this is the 18-pounder *high-explosive* shell and not the 18-pounder *shrapnel*.

At *F* in Fig. 68 is shown a finished shell painted yellow, with the distinguishing green band *G* about the center of its length. At *H* are shown a number of finished-painted shells and at *I* the drying cupboard into which they will subsequently go. The bases of the shells are also painted with the second coat, which is applied in exactly the same manner as was the priming coat to this part of the shells.

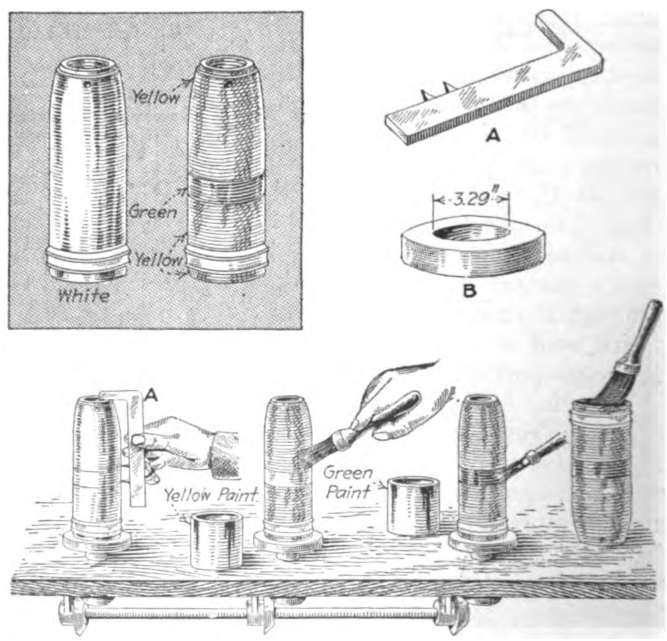
Six boys on first-coat painting will average 15 series in 10 hr.—that is, 2,750 shells in 10 hr., or approximately 46 shells per boy per hour. A record run was made by the 6 boys, and they succeeded in painting 247 shells (approximately a series) in 10 min., which would be equal to 247 shells per boy per hour.

On the second-coat painting, owing to the extra work necessary because of the green band, 8 boys are employed, and on this work the 8 boys will average the same as the 6 on the priming coat—15 series in 10 hr. A record



OPERATION 38: PAINTING THE PRIMING COAT

Machines Used—Motor-driven turntables A.
Tools and Accessories—Benches and drying cupboards; flat paint brush B; paint pot of white paint C.
Gages—None.
Production—Six boys, 15 series (2,750 shells) in 10 hr.
References—See Figs. 65 and 67.



OPERATION 39: FINISHING COAT AND GREEN BAND

Machines Used—The same as in operation 38.
Tools and Accessories—The same as in operation 38, except that the paint for the body is yellow and for the band green. A narrow brush is used for the band.
Gages—Gage A for position of the green band; ring gage B over painted body.
Production—Eight boys, 15 series (2,750 shells) in 10 hr.
References—See Figs. 65, 68 and 69.

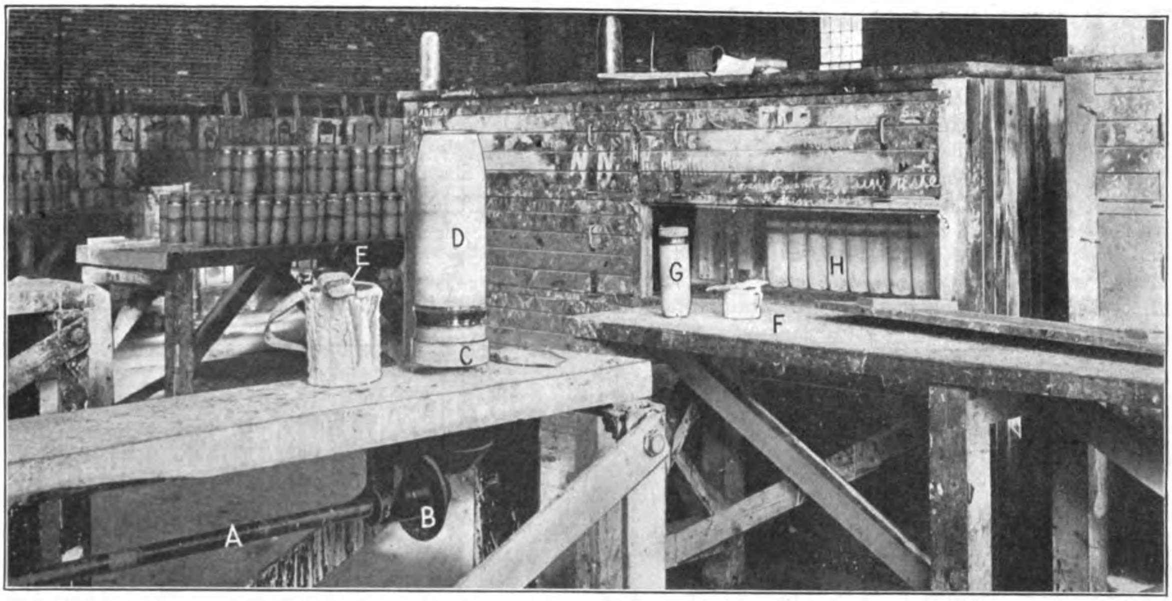


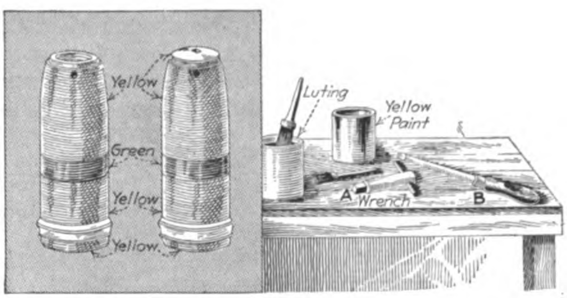
FIG. 67. PAINTING DEPARTMENT IN WHICH THE PRIMING COAT IS APPLIED

run was also made by the 8 boys on the second coat; they painted a series in 17 min., or about 105 shells per hour per boy. The drawing, Fig. 69, shows the official location of the green band on the shell body.

After the second coat is thoroughly dry, the shells are taken to the bench, *A*, Fig. 70, to have the plugs *B* and fixing screws *C* inserted. Formerly the caps, or plugs as they are also called, were made of brass; but with copper and zinc at their present prices (approximately 22c. per pound) this metal is too expensive. The object of the plug is merely to act as a stopper to retain the explosive and protect the nose and fuse-hole thread from injury. When the shell arrives at its destination, the artilleryman unscrews the plug and throws it away; he then screws the fuse in its place in the nose of the shell. Plugs are now made of cast iron; and to prevent their rusting, they are plated with zinc, copper or nickel. Two shapes of plugs are in common use; these are shown in Figs. 70 and 71, the one at *A*, Fig. 71, being the same as those shown at *B*, in Fig. 70. The one at *B*, Fig. 71, is fitted with a wooden gaine *C*. This wooden gaine fits a cylindrical recess in the lyddite explosive charge, which later accommodates the steel gaine that is screwed into the adapter in the fuse.

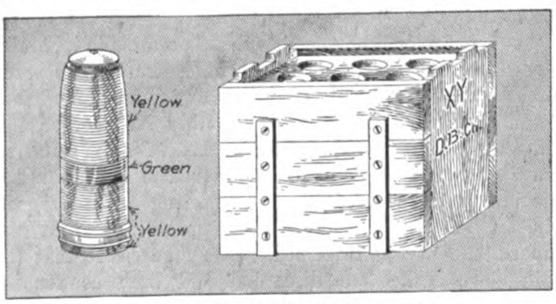
Before leaving the subject of wooden gaines, it will be well to recount some of the troubles experienced by the manufacturers of cast-iron plugs into which wooden gaines are to be fitted. These cast-iron plugs are bored, concentric with the thread on the outside, for the reception of the large end of the wooden gaine. The hole in the plug is about 1¼ in. in diameter, 1 in. deep. The large part of the gaine is required to be a snug push-fit in this hole. When the gaine is pushed to the bottom of the hole, a $\frac{3}{16}$-in. hole *D*, Fig. 71, is drilled through the plug and gaine at right angles to their axes and about ⅝ in. from the face of the plug. Into this hole a steel pin is driven, to prevent the gaine from being accidentally pulled out. The pin is made shorter than the diameter of the plug, so that, when driven into the hole, both of its ends are below the bottom of the thread on the outside of the plug. Obviously, if they were not, the plug could not be screwed into the fuse hole.

The wooden gaines are usually made of beechwood. After being turned on a back-knife lathe, they are given



OPERATION 40: LUTE AND SCREW IN PLUGS AND FIXING SCREWS AND PAINT THE PLUG

Machines Used—None.
Tools and Accessories—Square-end wrench A; screwdriver B; luting and yellow paint; paint brush; luting brush.
Gages—None.
Production—See operation 41, as this is a part of that operation.
References—See Figs. 70 and 71.



OPERATION 41: PACK AND SHIP

Machines Used—None.
Tools and Accessories—Cases holding six shells each; screwdriver.
Gages—None.
Production—Twenty men can screw in plugs and fixing screws, paint tops of plugs, put in cases 3,220 shells and screw down the case lids ready for shipping. This work is under the supervision of a man from the Canadian Inspection Co.
References—See Figs. 66, 70 and 71.

a coat of shellac varnish, as required by the specifications. Unfortunately, a great number of the manufacturers of wooden gaines did not appreciate that there is considerable difference between making wooden gaines and turning wooden tenpins for children. They did not realize that the wood for gaines should be well seasoned and absolutely dry; that after turning, it should not merely be given a coat of varnish, but should be thoroughly impregnated with some substance that would make it absolutely impervious to moisture. Wood that is not protected in this manner will shrink or swell with every change in the atmosphere, but the hole in the cast-iron plug into which the gaine is fitted does not alter. The experience of one manufacturer of cast-iron plugs may be of interest.

The weather, just before the reception of the wooden gaines, had been very wet for several days. When the inspectors went over the gaines with a standard plug, it was found that only a small percentage were small enough to enter the hole in the plug and that there were none too small to pass inspection. The plugs that failed to go into the hole in the standard plug and were therefore too large were put into a bag under the bench at the close of the day. Beneath this same bench, but against the wall, was a steam coil that was kept hot all night, so that the shop would be warm for the boys in the morning.

The next morning one of the inspectors accidentally picked up one of the rejected gaines from the bag of discards below the bench, tried it in a plug and found that it was a good fit. He then tried another and another, and all of them either fitted or were too small for the standard plug. He then tackled the inspector who had discarded the plugs and accused him of rejecting perfectly good plugs. The fuss assumed such proportions that the superintendent was informed. One man swore that the gaines which he had discarded had been condemned because they were "a mile" too big. He said the other inspector had mixed the bags so as to get him "in bad." The other one was just as positive that he had not mixed the bags, but had accidentally discovered that the first inspector did not know enough to push a perfectly fitting gaine in the hole in the standard plug. And to prove his words, this inspector took one of the gaines from the bag, pushed it into the standard, and handed it to the superintendent.

On the bench near them was a small pool of soda water, where one of the machine hands had been filling a squirt can. The superintendent drew the gaine out of the plug and, without being observed by the inspectors, stood it large end down in the pool of soda water. While it stood there for a couple of minutes, he talked to them about their differences. When the gaine had had time to soak in some of the water, he picked it up, wiped it with his hand and asked the man who had previously pushed it into the plug to do so again. But it had swelled so much in the two minutes it had been in the water that it would not go in. I have in my possession one of these gaines. It was far too large to go into the plug when I first got it, but is now $\frac{3}{32}$ in. smaller than the hole in the plug. Half a minute in water at any time will swell it so that it is too large to enter the hole in the plug.

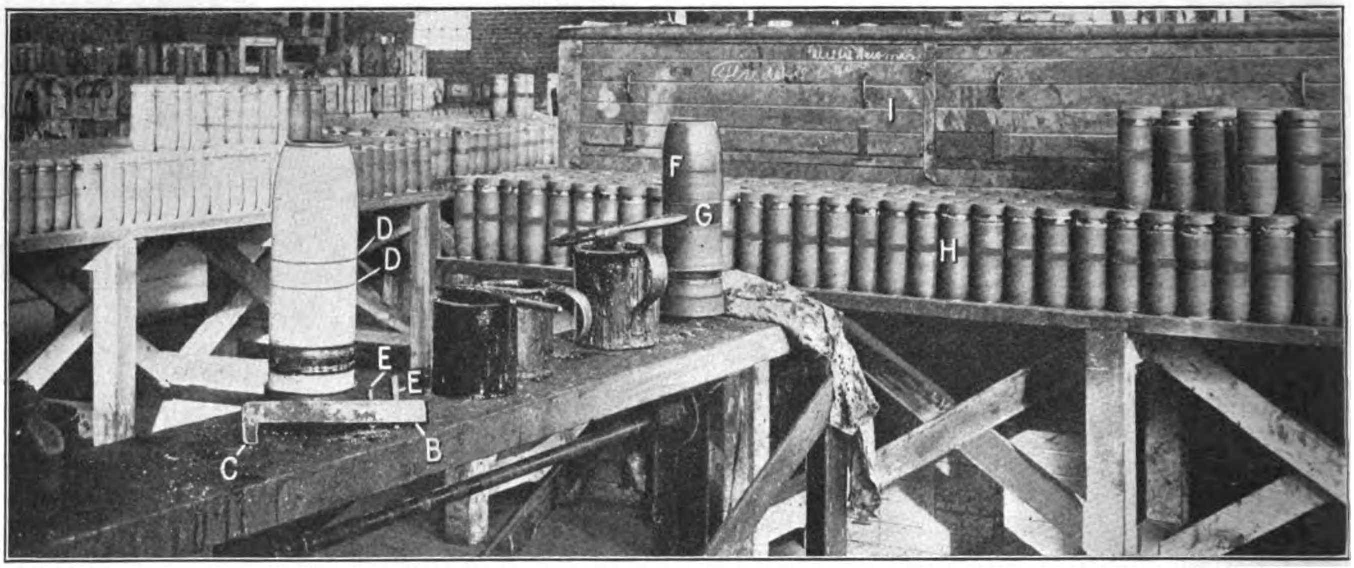


FIG. 68. THE SECOND-COAT PAINTING DEPARTMENT FOR APPLYING IDENTIFYING FINISH

The small grub screws in the nose of the shell are called fixing screws. They are $\frac{1}{4}$ in. in diameter, and their function is to hold the plug from turning and to prevent its being lost. After the plug is removed and the fuse screwed into the nose of the shell, the fixing screw is tightened down on it. It may be necessary to have a fixing screw for the plug, although even that is doubtful; but it is difficult to imagine the necessity for a fixing screw for the fuse. The fuse screws into the nose with a right-hand thread, the rifling of the barrel is right hand, and all the forces at and after the moment of discharge would tend to screw the fuse tighter into its seat in the nose of the shell.

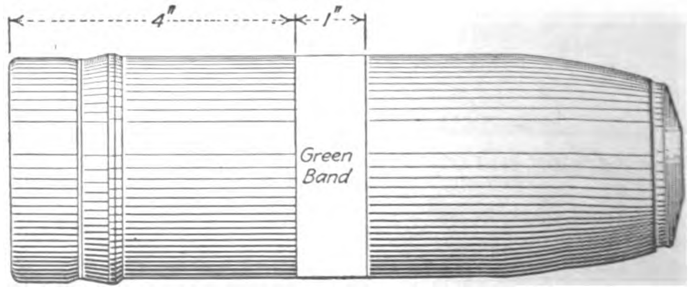


FIG. 69. LOCATION OF GREEN BAND

The plugs are screwed in with the wrench *D*, Fig. 70, which fits a square hole in them. The grub screws are put in with a screwdriver. There is a leather washer *E*, Fig. 71, between the nose of the shell and the flange of the plug. Both the fixing screws and the plugs are luted with the Government luting compound.

The luting consists of 80 parts of whiting and 21 parts of oil, both by weight, kept fluid by heating. The materials must be of the finest quality. The oil is 20 parts vaseline and 1 part castor oil, well mixed before it it added to the whiting. The vaseline is to be a genuine mineral-oil residue, without any foreign mixture. It should have a flash point not below 400 deg. F., a melting point not below 86 deg. F. and be free from solid mineral matter. The castor oil must be genuine. The whiting is to be of the quality known as "Town Whiting" and is to be free from moisture.

The luting must be thoroughly mixed, plastic and free from lumps. If on examination of a sample of 10 per cent. of the invoice, it is found that the sample does not comply with the specification, all the material invoices will be rejected without further examination. The luting may be inspected during the manufacture by, and after delivery will be subjected to test and to the final approval of, the chief inspector, Royal Arsenal, Woolwich, or an officer deputed by him.

With the plugs luted and screwed home and the fixing screws set up tight, the shells are ready to pack. A good idea of what the shell boxes are like can be had by referring to Fig. 70. At *E* is shown a box already packed and closed for shipping. It will be noticed that the letters VJ appear on the front near the lid. This is the series symbol; that is to say, six shells of series VJ are in the box. Below this symbol is D. B. Co., signifying the manufacturer—the Dominion Bridge Co.

The upper box has the shells in it, but the cover for it is at *F*. The two daubs of black paint on the face of this box show that it has been used twice before and that two series symbols have been painted out. In the bottom of each box is a board similar to that shown at *G*, except that the board for the bottom of the box has holes in it of sufficient size to accommodate the bases of the shells. The holes in *G* are coned to fit the noses of the shells. At *H* are shown the heavy steel straps on the boxes. As six shells are packed in each box, it takes 41 boxes to accommodate a series of 250 shells, leaving four shells over, which have to be taken care of in subsequent series. After the boxes are filled with shells, one of the Canadian Inspection Co.'s men superintends the screwing down of the lids.

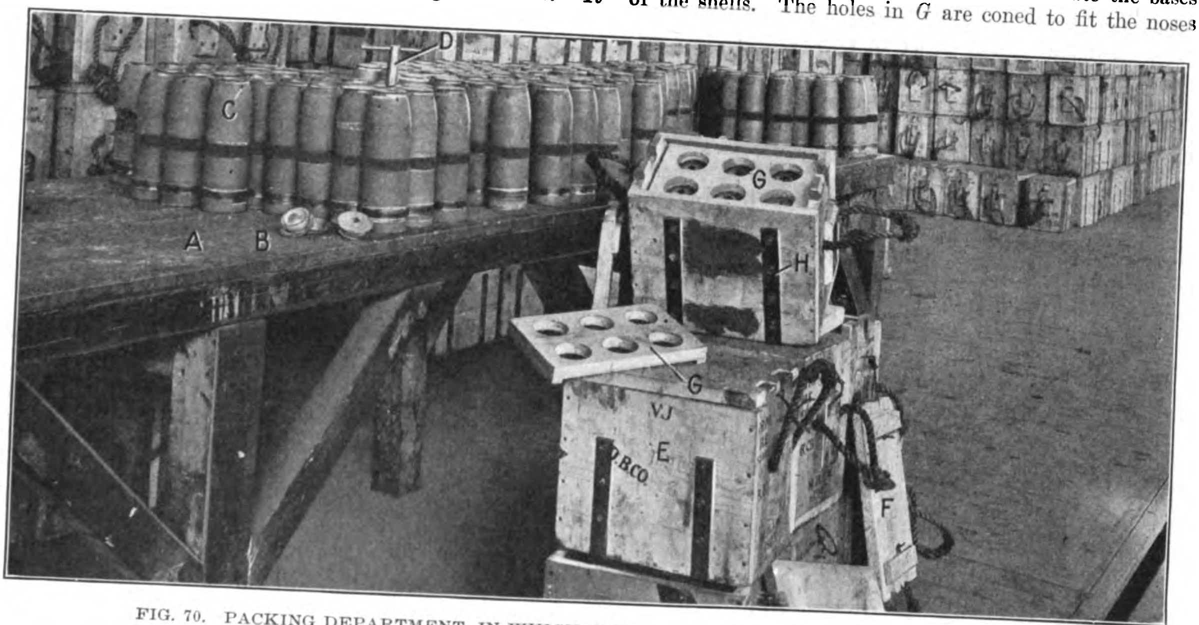


FIG. 70. PACKING DEPARTMENT, IN WHICH PLUGS AND GRUB SCREWS ARE ASSEMBLED

Each shell box lid is held down by four screws. The work of preparing the shells for packing (by screwing in the plugs and fixing screws, painting the tops of the plugs, putting the shells in the boxes and screwing down the lids) is done by a gang of men, the number varying with the amount of work going through the shop at the time. A statement of actual performance will, however, aid the reader in forming an idea of the time necessary to do the work. On an occasion when 20 men were engaged on the work, 3,220 shells were packed ready for shipping in 5 hr., equal to 32 shells per hour per man.

When the lids are screwed down, the boxes are loaded in cars. This work is also done under the supervision of one of the Canadian Inspection Co.'s men. The ordinary box-car holds 540 boxes, each containing six 18-pounder shells.

In conclusion I would like to say a few words regarding two elements which have been of vital importance to the smooth working of shell production in this shop.

There is splendid team work on the parts of the officials and the employees of the company, and real coöperation

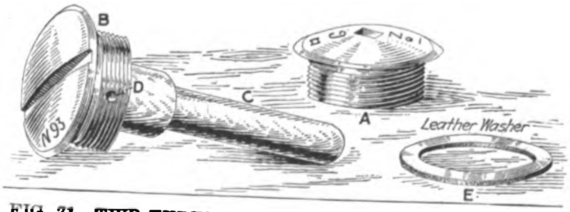


FIG. 71. TWO TYPES OF PLUGS AND A WOODEN GAINE

One is also favorably impressed by the absence of friction between the works representatives and the Government inspectors.

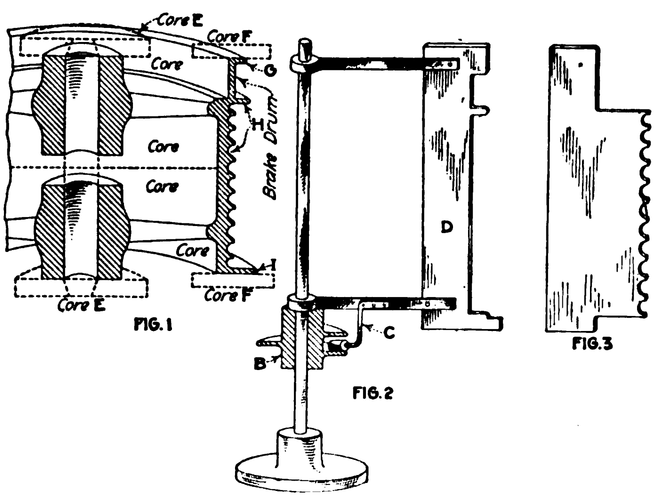
Loam Sand Mold for Winding Drum with Grooves

By Alfred W. Cookson

An interesting problem that will perhaps present difficulties to the average foreman will be found in molding a winding drum for a hoisting machine, with grooves to retain the rope in proper position.

A sectional view of such a casting is shown in Fig. 1. The rope grooves are in the form of a screw thread on the surface of the drum. The center stake is set in the usual way, but care must be taken to set it solid and true. In place of the collar ordinarily employed to support the sweep arm a casting *B*, Fig. 2, is used, and a roller and the arm *C* are provided. The casting *B* is a hub of suitable diameter and length, with a projection in the form of a screw thread, cast on the outer surface at right angles to the center line.

This projection must be of the same pitch as the required pitch of the grooves on the drum. The casting



METHOD OF MOLDING A WINDING DRUM

shown is bolted to the center stake in its proper position at the beginning of the job, and the projections must form a path for the roller for one complete revolution plus about 20 deg. A stop must be provided at each end, to keep the roller from running off the end of the screw thread, or cam, but still letting it go far enough to overlap the starting point of the sweep and make a smooth job.

Considering the mold as built up in the usual way and ready to sweep up, the sweep shown at *D* in Fig. 2 is attached, and all parts are swept, except the diameter where the grooves are to be.

The sweep, shown in Fig. 3, is then attached in such position that the first groove on the sweep will be at the point where the rope end will fasten to the drum, and the roller at one or other of the stops on the cam.

Observe that Fig. 1 shows the bottom diameter of the brake drum larger than the rope drum. This is the usual practice; but if a casting must be made with this part smaller than the brake drum, an additional sweep will be required to finish this part after the grooves have been finished and the second sweep removed.

One complete revolution of the groove sweep will finish up the complete screw thread on the drum mold, but care must be used both in making and setting this sweep, or the grooves will not match.

The arms and shaft bosses are made in cores, and a sweep will have to be provided to set them. A core box for one-half of one arm is all that will be necessary, this being made with a joint between the arms—six cores to the circle for a six-arm drum and eight cores for an eight-arm drum.

The cores must be made of the proper depth to be placed one above the other and make the hubs the correct length. A core *E*, Fig. 1, must be provided to support the upper and lower ends of the hub core. If the hub projects outside the rim of the drum, it will be necessary to set a ring core *F*, Fig. 1, under the flange, both top and bottom. If the flanges *G*, *H* and *I*, Fig. 1, are high enough to make it unsafe to form them on the sweep, patterns can be made and placed in the mold; but it must be remembered that they draw in and that the joints will have to be cut to allow for this.

Safety in the Pattern Shop

By J. J. Eyre

In these days, when "Safety First" is the watchword heard everywhere, it behooves the wise pattern maker or machine woodworker to look over his department.

Are the circular saws kept sharp, or are they allowed to be used until it requires a man's strength to push a board through and at the same time hold it down on the table? Does the saw gage clear, or does it bind the work against the back of the saw in pushing the saw across? I have seen serious accidents, which could have been avoided, result from the neglect of these two things.

Are the new safety (?) cylinder heads on the planer properly cleaned in the knife seat when the knives are changed? I have seen the heads of several of the screws broken off and the cap and knife thrown against the planer bed (which fortunately saved the workman), because the seat was not clean when the knife was tightened in place. Hardwood chips were packed between the joints, forcing the knife up and breaking the screws.

Realizing the danger of workmen slipping while pushing a piece of work over the machine, I recommended the placing of rubber mats 1/4 in. thick by 2x4 ft. at all planers and saws in the department.

I also had safety cylinder heads put on all the planers. They were a decided improvement over the old square heads, but I found that they were not foolproof. One day my machine man, while putting new knives in the planer, was called away, and before leaving neglected to tighten the bolts on one of the blades. A workman started the machine, and immediately that 24-in. blade entered upon a rapid journey—in sections. Fortunately, no one was hurt. I might have been justified in discharging the machine man; but he was a conscientious workman, and I felt that we had both learned the need of being more careful.

One of my boys, who had the knack of acquiring things, came in one morning with several "Safety First" and "Watch Your Step" stickers. I do not know what he intended to do with them, but I persuaded him to change the wording to "Watch Your Paws" and shellacked the stickers on the saws in a prominent place.

Some Recent Developments in Tool-Steel Testing--II*

By Edward G. Herbert†

SYNOPSIS—The experiments and results of Captain Denis, of the French artillery, are discussed. Curves are shown giving important relationships between cutting speed, metal removed, hardness and toughness, and temperature. Tests on stellite are also described.

The other investigator whose work bears directly on the subject of tool durability is Capt. M. Denis, of the French artillery. Captain Denis carried out his experiments at the Puteaux arsenal, where a tool-steel testing machine is installed. He has described his work in a remarkable article contributed to the *Revue de Metallurgie* of January, 1914. It is possible to give here only a brief résumé of this work.

The task Captain Denis set himself was to establish exact relations between the testing-machine conditions and those of the workshop, so that it should be possible after making a speed curve on the tesing machine to predict with certainty the behavior of a given tool steel under any combination of workshop conditions—cut, speed, etc.—when cutting any class of material, hard or soft steel, cast iron, bronze, etc. It should also be possible to say with certainty what speed would give the longest life to the tool, what speed would give the greatest output per hour and how many cubic centimeters of metal the tool would remove under any particular set of working conditions before becoming so blunt as to require sharpening. This task Captain Denis claims to have accomplished after his extended analyses and comprehensive series of tests.

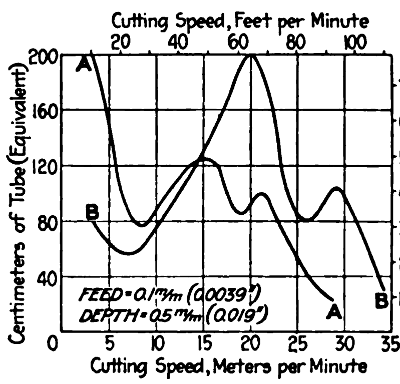


FIG. 7. LATHE TESTS
A = carbon steel; B = H. S. steel

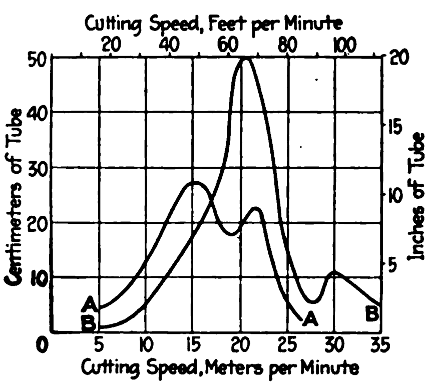


FIG. 8. TESTING MACHINE TESTS
A = carbon steel; B = H. S. steel

Of the actual procedure adopted in carrying out the experiments we have rather scanty particulars. The tests were made on a single-pulley lathe having 8 speeds and 30 feeds. The cutting was done dry and was apparently continued until the tool failed. The durability of the tool was measured by the amount of work done and not by the duration in time. In this respect the tests correspond with those made by Professor Poliakoff and those on the testing machine, but differ from the well-known tests made by Mr. Taylor and other experimenters, who have measured the durability of their tools in time and not in output of work.

It is important to keep this difference in view when making comparisons, since the results of the two methods of measuring durability are very different, though mutually convertible by calculation. Thus, two tools that failed after doing exactly equal amounts of work—the one at 30 ft. and the other at 60 ft. per min.—would, according to Captain Denis' method, be accounted equal in durability, since their output was the same.

According to the time-durability method the former would be accounted twice as durable as the latter, since the work, being done at half the speed, would naturally take twice as long. The adoption of either method is merely a matter of convenience, though in actual practice it is perhaps not always realized that a speed which wears out the tool quickly is more economical than a slower speed which gives the tool a longer life, but accomplishes only the same amount of work between each grinding. From this point of view the measurement of durability by output rather than by time has much in its favor.

The first step in Captain Denis' investigation was to make speed-durability curves from the same tool, first in the lathe, then in the testing machine. The lathe tests were made on a bar of steel of 156,000 lb. per sq.in. tensile strength, very homogeneous and heat-treated by quenching in water at 825 deg. and tempering. The feed was 0.1 mm. per revolution and the depth of cut 0.5 mm., giving a chip area approximately equal to that of the standard cut on the testing machine. A square-nose tool was used, having a cutting angle of 75 deg. and a clearance of 6 deg. The cutting was done dry.

The speed durability curves produced on the lathe are given in Fig. 7, in which *A* is the curve of a carbon steel and *B* that of a high-speed steel. The same steels were then tested on the testing machine under standard conditions. The machine was one of the original type (it has since been brought up to date), and water was used.

The resulting curves are given in Fig. 8. A comparison of the two sets of curves shows a remarkable similarity and important difference. The lathe tests show a decline in durability as the speed was raised from 3 to 7.5 m. per min., this feature being entirely absent from the testing-machine results.

Particular interest attaches to this falling durability at very low speeds, because it corresponds with results that the present writer obtained when investigating the variations of hardness and toughness of hardened tool steel at varying temperatures, the investigation being made by breaking specimens of steel supported on knife-edges in an oil bath. The experiments were described in the *American Machinist* ("Influence of Heat on Hardened Tool Steel"), Vol. 37, page 47, and two of the resulting

*Previous installment appeared on page 419.
†Director, Edward G. Herbert, Ltd., Manchester, Eng.

curves are reproduced in Figs. 9 and 10. In each case there was a decline in the calculated durability (hardness and toughness) between the temperatures of 20 and 70 deg. Every attempt to confirm this fall in durability at low cutting temperatures by cutting tests on the testing machine has failed, but the cutting test on the lathe shows it quite clearly.

To return to Captain Denis' experiments. Having made speed-durability curves from the same steel on the testing machine and on the lathe, the material and the area of cut being practically the same, and having found that the form of curve produced was almost identical, his next step was to make a series of lathe tests on a different material with a much heavier cut. The material chosen was an ordinary mild steel of 42 kg. (60,000 lb. per sq.in.) tensile strength, and the cut was 0.5x5 mm. bronze. Some of the resulting curves are given in Figs. 11 to 15. All these curves were made from lathe tests using a feed of 0.5 mm. and a depth of cut of 5 mm. In each case the points of maximum and minimum durability were compared with the corresponding points on the testing-machine curve. Fig. 8 and a diagram of correspondence were constructed as before, from which it was possible to find the lathe speed corresponding to any testing-machine speed for each of the 12 materials tested on the lathe. This diagram of correspondence is given in Fig. 16 and is intended to be used under practical conditions as follows:

Suppose it is required to find what speed will give maximum durability to a given tool when cutting gun metal of Brinell hardness 170. The tool, or a sample of the same steel similarly hardened, is tested on the tool-

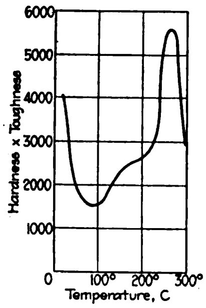


FIG. 9. BREAKING TESTS—CAR. STEEL

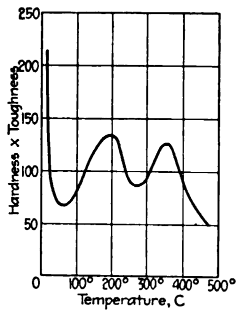


FIG. 10. BREAKING TESTS—H. S. STEEL

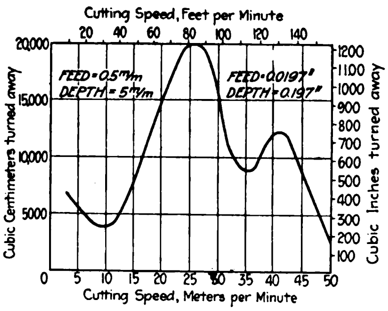


FIG. 11. BREAKING TESTS—SOFT STEEL

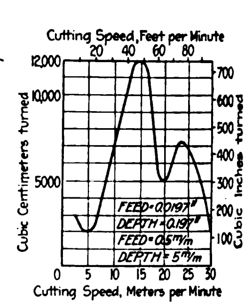


FIG. 12. LATHE TESTS ON HARD STEEL

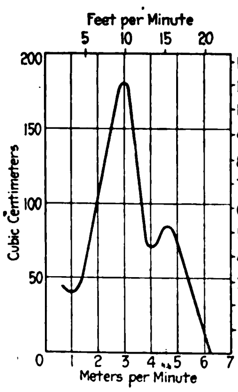


FIG. 13. LATHE TESTS ON TEMPERED STEEL

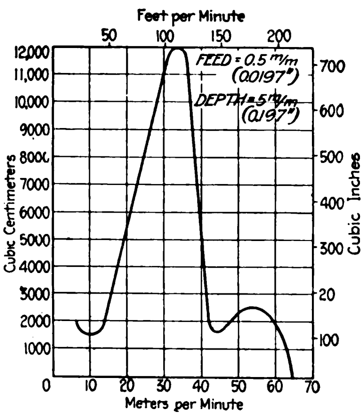


FIG. 14. LATHE TESTS ON CAST IRON

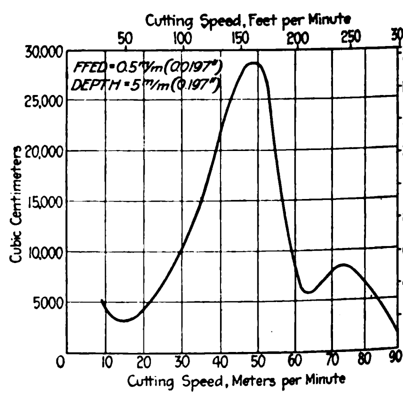


FIG. 15. LATHE TESTS ON BRONZE

(about 1/50 feed and $\frac{3}{16}$ in. depth of cut). The speed-durability curve produced is given in Fig. 11.

It is similar in form to that produced on the testing machine (Fig. 8), but the corresponding peaks and hollows occur at considerably higher speeds. Thus the first maximum occurs at 26 m. on the lathe and at 20 m. on the testing machine. By comparing the points of maximum and minimum durability on the two curves he was able to construct a diagram of correspondence, or double scale of speeds, from which he could read off the lathe speeds corresponding to any testing-machine speed.

The same process was gone through with lathe tests on steel bars of various compositions (the tensile strengths being 60, 70, 85, 105 and 115 kg. per sq.mm.), a nickel steel, various qualities of cast iron and three kinds of steel testing machine, and the speed that produces maximum durability is observed. This speed, say 22 m. per min., is found on the scale at the bottom of the diagram. A vertical line is drawn from this point, cutting the diagonal line for gun metal at point A. A horizontal line is drawn through A, cutting the vertical scale at 38. Then 38 m. per min. is the speed that will give this particular tool its maximum durability when cutting gun metal with a feed of 0.5 mm. and depth of cut 5 mm. Thus the diagram serves to connect the standard cutting conditions of the testing machine with the standard cutting conditions adopted for the lathe tests (feed 0.5 mm., depth 5 mm.), and it only remains to find a connection between these standard lathe conditions and any set of cutting conditions.

This problem was already solved by the "cube law of cutting speed." According to this law, "For constant durability the cutting speed varies inversely as the cube root of the product of feed by area of cut"

$$\left(V_2 = V_1 \sqrt[3]{\frac{f'a'}{f_2 a_2}}\right)$$

This law was discovered and published by me in 1909 and appeared in the *American Machinist* ("Relation of Cutting Speed, Feed, Depth of Cut"), Vol. 32, Part I, page 1063. Several investigators claim to have subsequently arrived at it independently, and it has been verified and

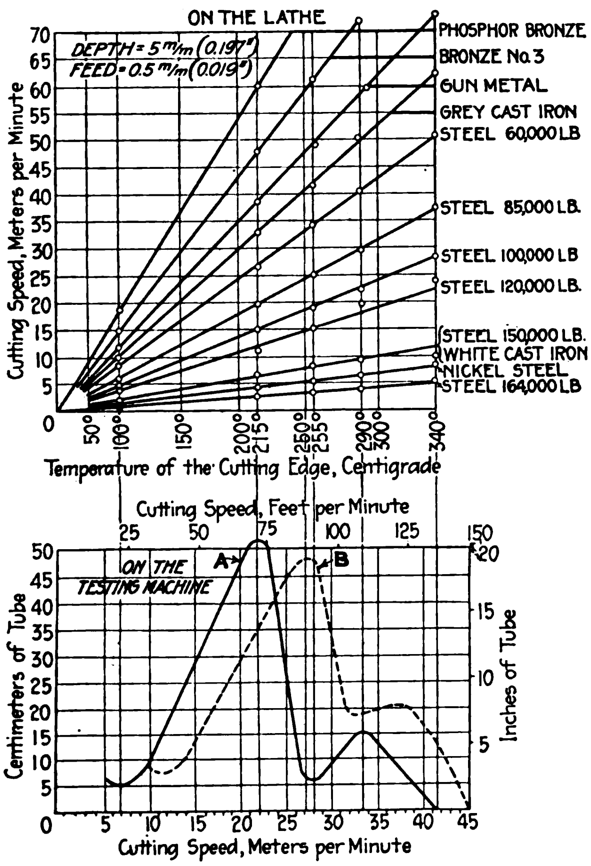


FIG. 16. DIAGRAM OF CORRESPONDENCE

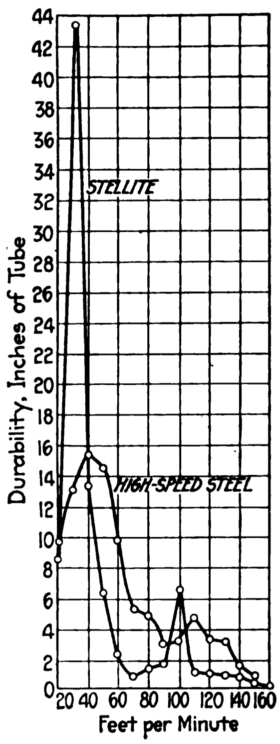


FIG. 17. MACHINE TESTS

fully established by the results of many carefully conducted experiments carried out by eminent experts from Fred Taylor onward.

Captain Denis has used the cube law as the final link between the testing machine and the diverse cutting conditions of the workshop, and in order to facilitate its application he has embodied it in an ingenious slide rule that is now manufactured by Messrs. Huré, of Paris. By the use of this instrument it is a simple matter to find the correct cutting speed for any feed and depth of cut, when once the correct speed for the standard cut has been found by the process described.

This résumé does not by any means exhaust Captain Denis' article. He has worked out an elaborate set of tables and diagrams for finding from a preliminary test on the testing machine, not only the volume of any class of material that a given tool will remove under any combination of cutting conditions and the length of time it will continue cutting before it requires grinding, but also the most economical speed to employ, having regard to the calculated time durability of the tool and the time occupied in sharpening it. Of these elaborations it must suffice to say here that they are based on reasoning which is as logical as it is ingenious and that the results arrived at appear to be in accordance with one's experience of tools in practice. The article will repay careful study in the original (it is of course written in French), but it appears to be open to criticism under two heads:

First, as to the experimental basis of the whole investigation: Captain Denis would have inspired greater confidence in the remarkable results set forth, if he had vouchsafed a more detailed account of the manner in which the tests were carried out. For instance, the number of critical speeds indicated in his numerous speed-durability curves is more than 30. A critical speed is one at which a definite peak or hollow occurs in the curve, and obviously, tests must have been made at these 30 speeds and probably a great many more; but there is nothing to indicate how these speeds were obtained on a single-pulley lathe having 8 speeds. Of course, they could easily be obtained by using bars of different diameters, or the lathe may have been driven by a variable-speed motor; but no information is given on this point.

Again, the curves in Figs. 11 to 15 and many others not here reproduced are all of an extraordinarily uniform character. Experiments on the testing machine have shown that a given tool does not usually produce the same shape of curve when tested on such different materials as semihard steel and brass, yet Captain Denis shows a long series of curves produced on the lathe on materials ranging from semihard steel to cast iron, mild steel and brass; and all these curves are almost exactly similar in shape to the curve produced on the special steel tube in the testing machine. The questions present themselves: How many observations were made for each of these curves? Did the results all lie on the curve; and if not, what degree of divergence was experienced? The value of the results depends absolutely on the correctness of the experimental methods employed, but of these we are given no account.

Another criticism relates to the utility of the elaborate diagrams and tables for calculating the correct cutting speed for any particular work. The importance of a knowledge of correct cutting speeds is beyond question. The process by which Captain Denis proposes to find it is, first, to make a speed curve of the tool steel on the testing machine (this involves making tests at 10 or 15 different speeds); second, to observe which of these speeds gives the best durability and to find by means of the diagram of correspondence, Fig. 16, the corresponding speed for a lathe tool cutting dry with 0.5 mm. feed and 5 mm. depth of cut on the kind of material that is to be machined; third, by means of the special slide rule or the cube formula to find the corresponding speed for the traverse and cut that it is proposed to use.

The workman will then set his lathe to the nearest speed available and go ahead. He will be working under

ideal conditions, if his tool is tempered exactly like the specimen used for the speed curve, if his tool angles are the same as those used by Captain Denis in his lathe tests, if he is cutting dry (as Captain Denis did) and if the material he is cutting is exactly similar to that used by Captain Denis. If there is a variation in any one of these factors, his speed will be wrong and he will have to reduce or increase it according to the behavior of his tool. In short, he will have to set his speed at last by observing how his tool stands up to the work in hand, as he would have done if no preliminary tests had been made.

This criticism does not imply that Captain Denis' work is of no value. On the contrary, his work is of great practical value; but it may be questioned whether he has not mistaken the true function of the testing machine, or at least laid undue stress on a function that it can hardly perform, owing to the great number of variable factors involved in fixing the correct speed of a given tool on a given job.

The chief utility of the testing machine is in comparing the cutting qualities of various steels, or of the same steel subjected to various hardening processes. We may, for instance, require two tool steels—one for the rapid removal of stock with heavy cuts and the highest possible cutting speed and the other for form tools that must keep their edge for a long time under comparatively light cuts at moderate speeds. A comparison of a series of speed curves will show that one steel, hardened in a particular way, has a very high, and a wide range of, durability under "blue-chip" or "red-hot chip" conditions. This steel will be chosen for heavy roughing work. Another steel, differently hardened, produces a speed curve showing exceptional durability under low-temperature cutting conditions. This is the steel for a forming and finishing tool.

In making such investigations Captain Denis' work will be most useful, since it enables us, working backward from any representative workshop cut and speed, to find the corresponding testing-machine speed and to select a steel that gives a high, and a wide range of, durability in that part of its speed curve.

Tests on Stellite Cutting Tools

A recent example of the use of the testing machine may be of interest—the testing of stellite. Particular interest attaches to this material, because it contains no iron; and it might be anticipated that its speed curve would show some characteristic feature peculiar to itself and that some of the features common to all kinds of tool steel would be absent from the stellite curve.

Fig. 17 reproduces a curve taken from a stellite tool and one from a very good quality of high-speed steel. Contrary to expectation, the general form of the curve is the same in each case. In particular the rise in durability as the speed increases from 20 ft. per min. is seen to be common to stellite and to steel. The outstanding feature of the stellite curve is the extraordinarily high durability at the rather low speed of 30 ft. per min. No steel that has been tested up to the present time has approached this durability at the same or any other speed. At only one other point does the stellite rise above the steel—at 100 ft. At the red-hot chip speeds—130 ft. and upward—its durability is nil. Stellite is used in practice at speeds much higher than 130 ft.; but as previously explained, the cutting conditions on the testing machine are such as to generate a very high temperature at moderate speeds. What inference is to be drawn from this result? Stellite would appear to be unsuitable for heavy roughing work and not especially suitable for any very high-heat cutting, though capable of standing up as well as, or better than, a steel tool under some blue-chip conditions of cutting. It might be expected to show extreme durability, far surpassing that of a good high-speed steel, under conditions that produce only a moderate amount of heat (a light cut at high speeds with coolant, or a moderate cut at fairly slow speeds). When cutting cold, it is not especially durable.

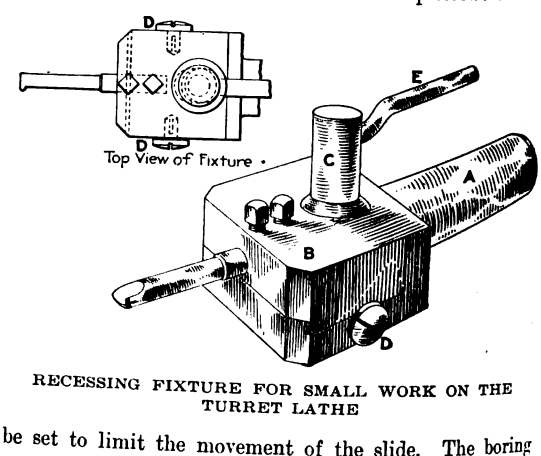
It is not altogether easy to say how far these conclusions agree with the published descriptions of stellite tests. Some of the statements appear to be contradictory and others somewhat indefinite, though there is a fairly general agreement that stellite is very durable when used with light cuts at high speeds.

In my own experience stellite has been used chiefly in turning cast-iron pulleys 16x3¼ in., with a traverse $^1/_{40}$ in. and a cut about ⅛ in. deep. The work was done at 68 ft. per min. At this speed a good high-speed steel tool required grinding three times for each pulley, whereas the stellite tool turned six pulleys without grinding, showing an advantage of 18 to 1 in favor of the stellite. At the next lower lathe speed—40 ft.—both tools stood up a long time, with a decided advantage in favor of the stellite. The next higher lathe speed was 104 ft., which was too high for both stellite and steel.

Recessing Fixture for the Turret Lathe

By Charles W. Oviatt

The illustration shows a turret-lathe fixture for recessing small work. The shank *A* is made to fit the turret. The slide *B* travels crosswise, operated by an eccentric on the lever stud *C*. The stop-screws *D* can



RECESSING FIXTURE FOR SMALL WORK ON THE TURRET LATHE

be set to limit the movement of the slide. The boring or recessing tool, of any shape with a round shank, is held in the slide by two screws.

By setting the slide against one stop-screw the tool will enter the hole in the work without touching. Then by operating the lever *E* and bringing the slide *B* over to the other stop-screw, which is set as required, the recess is cut by moving the turret slide forward the length of the recess to be machined.

Opportunity for Machine Tools in Holland

By Ludwig W. Schmidt

SYNOPSIS—Although machine tool manufacture in Holland has developed in recent years the market still remains a foreign one. Direct result of the war has made itself felt with every prospect that the demand for machine tools will continue after hostilities cease. Suggestions are given for American manufacturers.

During the last year the exports of American machine tools to Holland have risen from an average of about $80,000 a year to nearly $200,000. This increase has been regarded as a sign that Holland was supplying Germany with American machine tools; but this claim can scarcely be upheld, seeing that in normal years Germany used to send to Holland machine tools of a value of about $800,000. This comparison shows that, even if America has been able to send nearly three times as many machine tools as in former years, the country must still be considerably behind its usual requirements.

All indications point to the fact that Holland will soon have to begin to buy again in larger quantities, as she is able to take care of a certain percentage of the required machine tools and the present equipment is said to be deteriorating rapidly. Industry has been unusually busy and consequently needs more machines than under normal circumstances. Holland has been cut off for some time from her ordinary supplies of practically all classes of industrial goods. England, Germany, Belgium and France used to take care of a very large part of the industrial needs of the country, but none of them is able to do so now to any great extent. Consequently, Hollandish manufacturers have been compelled to attend to these necessities themselves. This situation has put increased pressure on all classes of industrial enterprise, which has been still further increased, owing to the fact that Holland has to provide for her colonies as well. Those also were accustomed to buy largely outside of Holland.

Prosperity in Dutch industry is not evenly distributed; while some branches have been fairly busy, others have suffered. As far as can be seen, it seems that most of the machine shops, especially the larger ones, have been doing well and most likely will do so during the remainder of the war. The Government, anxious to be prepared for all eventualities, has given larger orders to the few firms in the country able to make armaments, and the state of preparedness that has been necessary during the last 18 months has been reflected in many ways in the business of the machine-building industry.

It is therefore not surprising that Dutch buyers of machine tools are turning to the United States for supplies; and since the foundation of the Oversea Trust, shipments have been more easily arranged. All goods can be consigned to that body, by which they are forwarded to the respective owners under a guarantee that they are not sent to Germany.

Holland has a number of machine-tool manufacturers, of whom some have made a considerable name for themselves, mainly in the building of certain of the newer types of machines. With these they have begun effectively to combat American, English and German competition in their own market. They have even been able to carry the war into the home of their former aggressors by exporting to the neighboring markets. Today one finds Dutch machine tools in France, Germany, England, Belgium and in the Northern European countries. At the same time they have found a very considerable market at home, where the increasing needs of the machine-building industry opened a good field. Dutch machinery builders have shown themselves generally very active during the last few years. The success of one of the leading motor cars in London, for instance, has created a good sale for such motor cars in that market.

The biggest users of machine tools in Holland are the large engineering works in and round Rotterdam, of which some are excellently equipped, having in several cases a considerable number of American machine tools. Many of those plants are said to have been exceptionally busy during the last months. The shipbuilding industry is using heavy types of machine tools in which the American industry cannot compete so easily as the English and the German, the two latter having cheap means of transport—an essential for the supply of that class of machines. A well-known Scotch firm is doing a great deal of business in such lines, and of course the Rhenish-Westphalian machine builders have worked that market thoroughly.

Foreign Machine Tools in Holland

Generally speaking, it is astonishing how large the foreign participation is in the machine-tool supply to Holland. Passing through the larger plants, one frequently sees machine equipments of quite a modern style being made up out of German, English, American, French, Belgian and home-made machines of all descriptions. The newer machines, as a rule, are German, American or Dutch. Many plants have recently made a cleaning up and have renewed a large part of their equipment. But there are still firms of standing which are working with a rather mixed assortment of different types and different ages. This condition, however, may change rapidly after the war. It is said that the Dutch manufacturer is well able to see the value of the newer and speedier machines, but that his conservative and saving disposition will not allow him to replace an old and trusted lathe while it is still able to do work. So business is slow, and success comes only to him who waits.

This characteristic will work during normal times to the disadvantage of the American manufacturer and to the advantage of the neighbor supplier. The English and German manufacturers find it easy to work Holland. The market is not large, and it is easily visited either from England or Germany. A machine can be supplied nearly at once when desired, and there is not much difficulty with regard to repairs. Spare parts can be obtained easily and without large cost. All these things favor the

home manufacturer or his near-by competitor. On the other hand, the American machine is not always on hand when needed; and even if it can be sold from stock either by an English or a continental agent, the sale is not always as pleasing for the buyer as when he receives a brand-new machine from the shop.

Those difficulties in the way of American sales are increased at present, owing to the war. Dutch manufacturers and buyers of machine tools apparently have a good deal of complaint to make about American makers. The first claim is that they cannot get attention quick enough. This is not the fault of the American manufacturer, but of the interruption of the ordinary postal service, which affects, as well, telegraphic communication. Prices or price offers are frequently changed, or offers are made under the condition that they can be changed if the situation alters. As this contingency arises nearly every week, business is seriously affected. American manufacturers do not want to give the credit the manufacturers are accustomed to. Finally, machines, if ordered, do not arrive in time. This is quite a long list of complaints, and it could be extended from letters received by American exporters.

These disadvantages acting against the American machine-tool manufacturer and his business in Holland are considerably counterbalanced by the fact that the Dutch machine user is very much in need of machines and consequently is inclined to be less critical and less ready to stand on his rights. In fact, it appears that the American-Holland machine business could be considerably larger, if only the American makers were able to fill orders. As it is, business is freakish, falling off in one month and increasing rapidly in another, as has been the case already during the first year of the war. The reason for this is most likely that shipments collect in New York or other places and that it takes some time before arrangements for their release are made.

The immediate future of the business seems to depend largely upon the economic conditions in Holland. If they remain as they are, demands from that country ought to increase again during the coming months; but it seems that the Dutch industry is feeling very much the influence of the war in the form of financial pressure. Difficulties have increased of late, owing to trouble in obtaining raw materials from outside Europe in consequence of the English blockade of Germany.

What will be the condition of the business in machine tools in Holland after the war is not very easy to predict. Of course, the German manufacturers will return to the market when the war is over, as the relations between the two countries have remained quite satisfactory. Nevertheless, it is expected that American machine tools will be sold in a larger percentage to Holland after the war than before. Besides that, the importance of Rotterdam as a trading port between Europe and the United States may increase considerably, which would affect as well its shipbuilding and engineering industries.

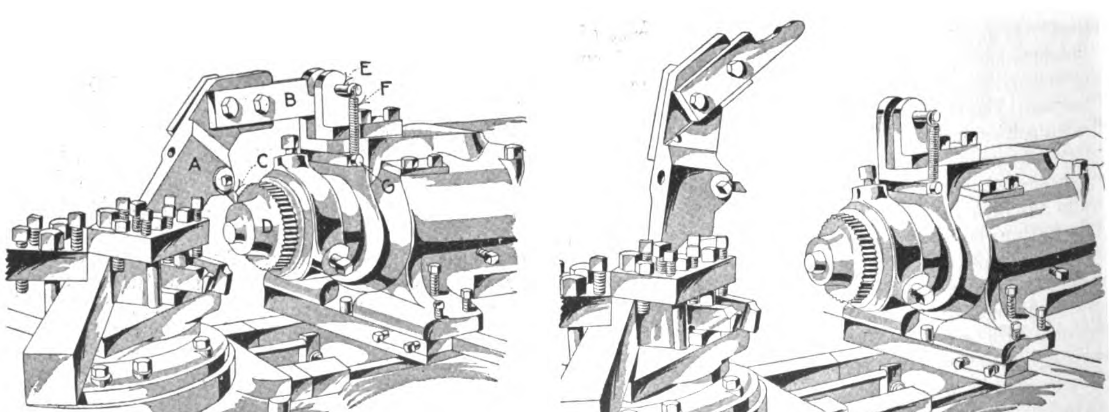
At the moment it might pay well to keep in touch with affairs in Holland. English, as a rule, is well understood there, so that American catalogs can be used with advantage. German is also spoken generally in that country; but it is doubtful whether the use of German lists would be an advantage just now, owing to the fact that the country seems to be somewhat split in the distribution of sympathies for the belligerent nations. It would be a great advantage, if offers could be made accompanied by price quotations. Owing to the rather slow and frequently interrupted postal service, it is further advisable to answer letters immediately.

Turning Profile on Pulley in Turret Lathe

A pulley-turning method is here shown that can be applied to numerous other similar jobs. The device is used in the shop of the Disco Electric Starter Co., Detroit, Mich., for turning and crowning a small pulley that is cast integral with a gear of larger diameter.

The gear is placed over a plug on the nose of the lathe spindle and is held in position by a split washer and a draw-in rod. The arm *A*, Fig. 1, is carried in a hinged bracket on the turret. A master form *B* is bolted to the end of the arm, to guide the cutting tool *C* as it is fed over the pulley *D*. The master form is cut into the upper side of the steel piece just opposite the pulley crown. This master form is pressed up against the hardened-steel pin *E* by a pin that is forced upward by a spring *F* and a lever *G*.

The shape and placing of the various parts will be better understood by referring to Fig. 2, where the arm is shown thrown back out of position.



FIGS. 1 AND 2. FIXTURE FOR TURNING AND CROWNING PULLEY ON THE TURRET LATHE

Special Shell and Fuse Drilling and Tapping Machines--II*

SYNOPSIS—This article shows a somewhat unusual use of 10 drilling heads on a turret in two planes, as well as a three-spindle tapper and a light drilling lathe, both of which have interesting features.

Fig. 16 shows a semiautomatic 10-spindle drilling, reaming, bottoming, counterboring, grooving and tapping machine for fuse bodies. It completely finishes five holes in the fuse body, which is shown in Fig. 17.

The operations are drilling, reaming and bottoming the bottom detent hole *A*, drilling the top detent hole *B*, drilling, reaming and counterboring the centrifugal bolt hole *C*, drilling and counterboring the needle cap check screw hole *D* and drilling, reaming, bottoming, grooving and tapping the percussion-pellet hole *E*—a total of 14 distinct cuttings for the five holes.

These fuse bodies are of brass forgings, so that they are very tough and hard and require a reduction both in cutting speed and feed per revolution of the drills. Taking common brass as a base, the cutting speed had to be reduced one-half and the feed per revolution two-thirds. Under these conditions an output of 35 to 40 finished bodies can be produced per hour.

The tooling spindles are arranged in two groups—seven on the faceplate *F*, Fig. 18, lying radially around the horizontal axis of the machine, and three on the turret *G*, Fig. 19. The top, rear and bottom spindles on the faceplate are in couples, 3 in. apart, and identical, as each pair operates on the same holes in the fuse body. The spindles in each of the three pairs nearest to the faceplate, upon which they are mounted, are the inner spindles and correspond to the inner position of the fuse-body holder *H*. The three outer spindles likewise correspond to the outer position of the holder. The front spindle *I* on the faceplate is single and is operated by hand. The three-arm turret *G* is mounted upon a compound saddle; the main saddle *J* is used only to shift the turret *G* to either its inner or outer working positions, the subsaddle *K* being for feeding only. This subsaddle can be fed either by hand or by power.

The fuse body is chucked in the machine by an internal threaded holder *H*, which is integral with the main, or shifting, saddle *J*. The externally threaded end of the fuse body is screwed tight into the holder *H*, Fig. 18, to a depth of four threads. The fuse body is operated on in either its inner or its outer position. The top inner spindle L, Fig. 19, drills the centrifugal bolt-hole *C*, which is reamed and counterbored by the outer spindle *M*, the mate of *L*. The rear inner spindle *N* drills the bottom detent hole *A*, which is reamed and bottomed by *O*, the mate of *N*. The bottom inner spindle *P* drills the needle cap check screw hole *D*, and *Q*, the mate of *P*, counterbores the hole. The front single spindle *I* drills the top detent hole *B*.

The first spindle *R* on the turret drills the percussion-pellet hole *E*; the second spindle *S* reams, bottoms, counterbores and grooves it, and the third spindle *T* does the tapping. The first spindle is provided with a receding steadyrest *U*, to provide means for accurately starting the drill. The second spindle is equipped with a special combination reaming, bottoming, counterboring and grooving tool *U*, the grooving being done after the tool has come to its stop by depressing a small lever *W*. No starting bushing is used, as the tool follows accurately into the previously drilled hole. The third spindle is equipped with a Jarvis reversible tapping chuck *X*.

The drilling of the fuse body, which utilizes the three inner spindles on the faceplate and the first spindle on the turret, is done with a power feed having a quick return and automatic knockout. The power feed can be thrown in or out at any time. While the power feed is in action, the operator drills the small top detent hole *B* by means of the push-drilling spindle *I* at the front of the machine

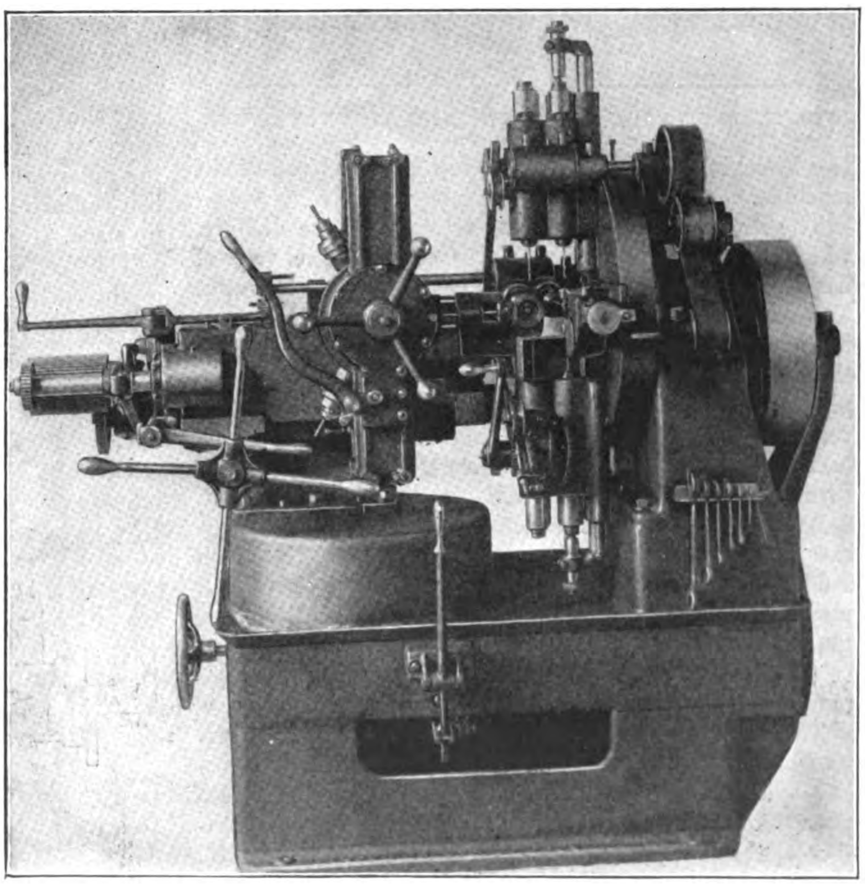


FIG. 16. TEN-SPINDLE DRILLING MACHINE WITH TWO TURRETS

*Previous installment appeared on page 465.

on the faceplate *F*. All the drilling is done while the main, or shifting, saddle *J*, which carries the fuse-body holder *H*, and the turret saddle *Y* are in their inner working positions. All the other cuttings, such as reaming, bottoming, counterboring, grooving and tapping, are done in the outer working position.

The three outer spindles *M, O, Q* on the faceplate *F* have a rack-and-pinion hand-lever feed, also an adjustable screw stop for varying cutting depths. The second and third spindles *S, T*, on the turret *G*, have a rack-and-pinion feed operated by a four-arm spider wheel *Z*. They also each have an independently adjustable feed stop.

The fuse body is chucked in holder *H*, while the turret *G* and the main saddle *J* are in the outer position. By means of a compressed-air tube the operator first frees of chips the internally threaded part of the fuse-body holder *H*, steadyrest *U* on turret *G* and drill-guide bushings *A2*. The fuse body is then screwed firmly to its seat in the holder *H*. The turret *G* is unlocked by a hand lever *A3* and turned by a triple-arm lever *A4* so as to bring the drilling spindle *R* into the line of action; the subsaddle *Y* is also locked to its feeding cam *A5*. The operator advances the main saddle *J*, carrying the holder *H* and subsaddle *Y*, with turret *G*, to the inner working position by a bell-crank lever *A7* and link *A8*, which

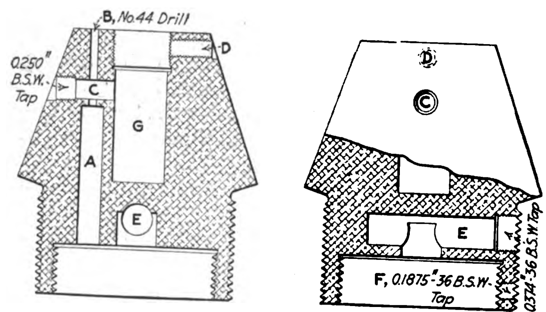


FIG. 17. FUSE BODY FOR BRITISH NO. 100 GRAZE FUSE

is self-locking and located at the top left-hand end of the machine.

The machine is now properly set to start the drilling, which is done by simply pulling outward the vertical hand lever on the front of the bed near the operator. The drilling being automatic, the operator uses his spare time in drilling the top detent hole *B* by hand-feeding the drilling spindle *I*, located at the front on the faceplate *F*. Should a drill break or any other need arise, the operator can instantly stop the power feed by throwing back the starting lever. Means are also provided for returning all the drilling spindles to their starting point.

After the drilling is done, which is fully automatic excepting the starting, the operator returns the main saddle *J* to the outer position. The fuse body is now in position to bring the three spindles *M, O, Q* into action, the feeding being done by a hand lever at the lower front of the faceplate, which acts on the three spindles simultaneously.

The operator then unlocks the turret subsaddle *Y* from its feed cam *A5*, turns the turret *G* so as to bring the second spindle *S* into the line of action and feeds it into the work to its stop. He then cuts the groove and chamfers the hole by depressing the small hand lever *W*, attached to the combination tool *V*, and backs it out of the work. He next turns the turret *G* so as to bring the tapping spindle *T* into line, advances the tap to the work, follows the tap to the stop, allows the tap holder *X* to unclutch itself, then backs up the turret, which causes the tap holder *X* to reverse and back the tap out of the

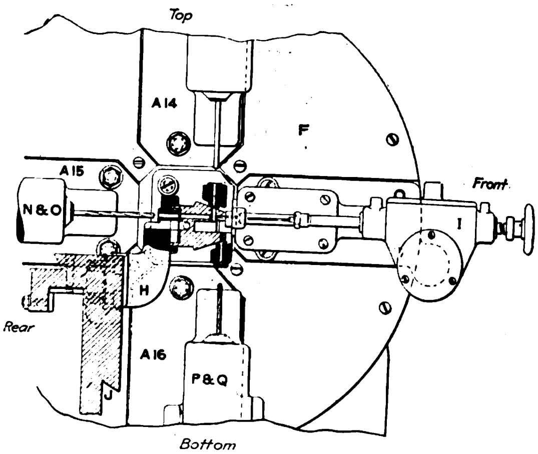


FIG. 18. DETAILS OF THE DRILLING HEAD

hole. The fuse body is now completely drilled and is removed by unscrewing from the holder.

The outer construction of the machine can be plainly seen, but the mechanism that controls the speed of the cutting spindles and the power feed is of interest. The drive is of the single-belt type, the driving pulley being 18 in. in diameter for a 4-in. belt, which revolves upon a stationary shaft and is integral with a pulley at the outer end that drives the feed. A fabroil gear on the inner end drives all the cutting spindles through a pair of spur gears mounted on the outer ends of shafts that carry the two main endless-belt driving pulleys. The cutting spindles are driven by spiral gears, the driving spiral-gear shafts *A9* extending to the rear of the machine and carrying pulleys lining up with the two endless-belt driving pulleys, between which are idle pulleys to give proper belt contact. A belt tightener is also provided for taking up slack.

The rear driving spiral-gear shaft extends to the rear of the turret and makes connection to the turret spindle through bevel and spiral gears, the driver of which is

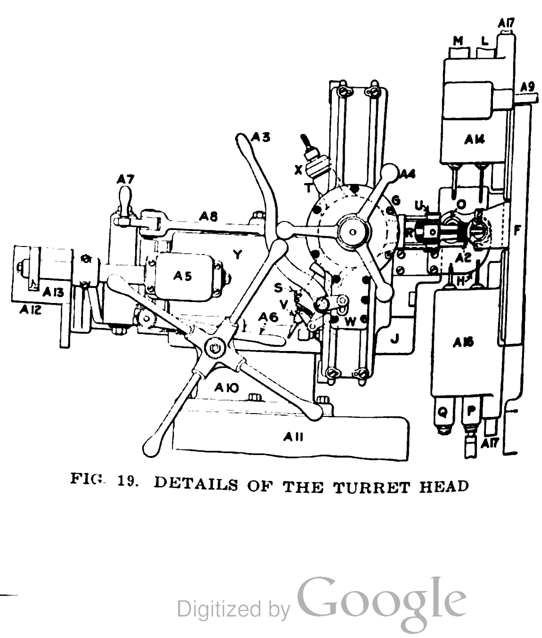


FIG. 19. DETAILS OF THE TURRET HEAD

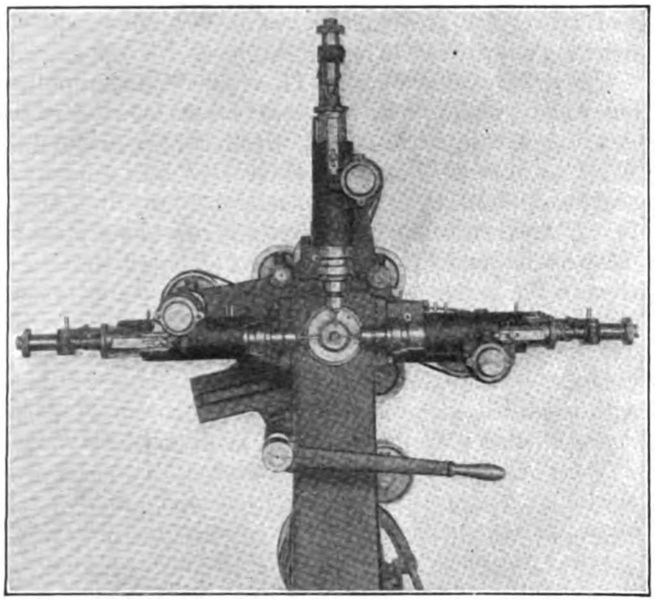


FIG. 20. THREE-SPINDLE TAPPING MACHINE

a slip gear, to allow for the shifting of main saddle J and the feed of subsaddle Y. All cutting spindles are driven at their practical cutting speeds.

The turret G and the saddles J Y are mounted upon a standard $A10$ that is bolted to the dome projection $A11$ at the left of the bed. At the rear of standard $A10$ is mounted the main horizontal shaft, carrying on its left a spur gear that meshes through a long intermediate gear $A12$ with a traveling gear $A13$. This operates the helical-screw cam $A5$, which actuates the feed of the turret subsaddle Y. This cam is provided with a locking mechanism operated by the hand lever $A6$, whereby the turret G can be fed either by hand or by power. Each of the three spindle heads $A14$, $A15$, $A16$, on the faceplate F, is provided with a feed yoke $A17$, and rollers are mounted upon their inner ends. These rolls engage with segment cams that are fastened at about quarterly intervals to a large rim gear lying inside, and concentric with, the faceplate. The front, or hand, push-feed spindle I at the front has no feed connection to this gear.

The large rim gear in the faceplate is actuated by a spur gear mounted on the right-hand end of the main feed shaft located at the rear of standard $A10$. All cutting spindles having power feed are operated by this shaft. Inside of the dome projection $A11$ on the left of the bed is mounted a 20-in. drum cam on a vertical shaft. This cam is actuated by a combined worm gear and roll clutch, and an automatic knockout is arranged so that the cam can make only one revolution at a time. The cam gives, first, a quick advance of the drills, a cutting feed and a quick return.

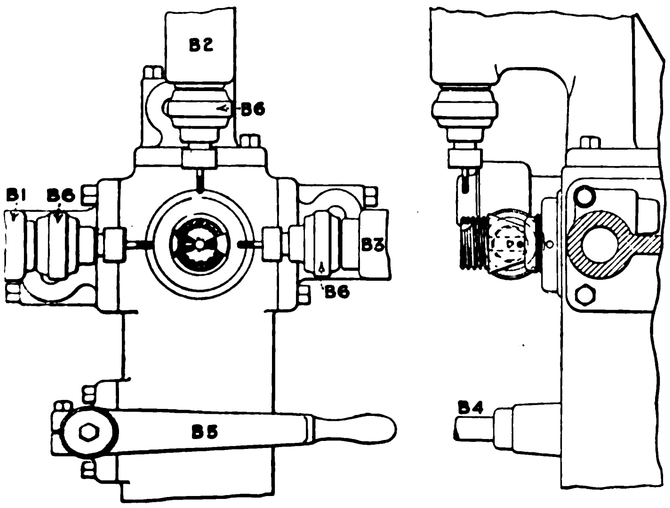


FIG. 21. DETAILS OF THREE-SPINDLE TAPPER

The wormwheel runs free on the camshaft and only operates the cam when the operator throws in the roll clutch in starting the power feed. On the rear of the cam is mounted a vertical slide carrying a roll engaging with the cam. Extending up on this slide is a rack meshing into a gear on the main feed shaft. It can be seen that all drill power feeds are actuated by the drum cam.

The wormwheel meshes into a worm mounted upon a shaft running the entire length of the bed and extending out at each end. The right end carries a pulley belting to the driving pulley mounted integral with the main driving pulley. A handwheel is used on the left end, so that the cam can be run backward in case of drill breakage.

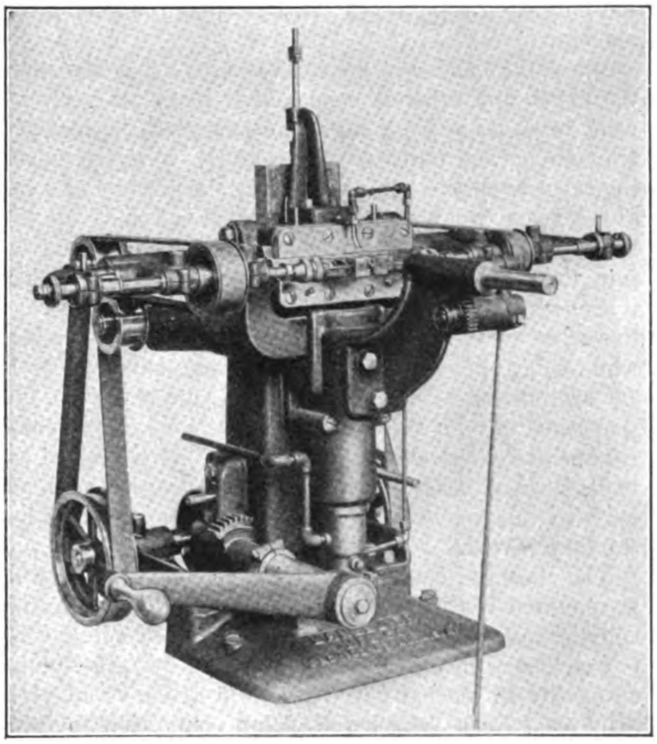


FIG. 22. DRILLING THE CROSS HOLES IN PERCUSSION PELLET

The machine covers a floor space of 3 ft. 9 in. by 6 ft. 1 in. and is 5 ft. 8 in. in height. Its weight is 3,900 lb.

The three-spindle multiple tapping machine, Figs. 20 and 21, simultaneously taps the three holes in the fuse body. The output with a skilled operator is about 6 completely tapped fuse bodies per minute, or 360 per hour. The holes tapped include the needle cap check screw hole D, Fig. 17, which is made by the right-hand spindle; the centrifugal bolt hole C, by the left-hand spindle; and the adapter check screw hole F, by the top spindle. The body is chucked by a pneumatically operated expanding arbor fitting into the graze-pellet hole G. It is located by means of a stationary pin in the chuck that enters the top detent hole B. This arrangement brings all the three holes to be tapped in line with their respective spindles $B1$, $B2$, $B3$. The expanding arbor exerts a drawing-in effect that seats the body firmly. This arbor is fully automatic and requires no attention whatever from the operator.

At the rear of the machine, on the same center as the expanding arbor, is located a cylinder to which the piston rod of the expanding shell of the arbor is attached. The tapered arbor is fixed, the shell being drawn over it to expand it. To the cylinder is attached a piston valve that is operated by a small lever mounted on the rear end of the hand-feed lever shaft *B*4, shown at the front of the machine.

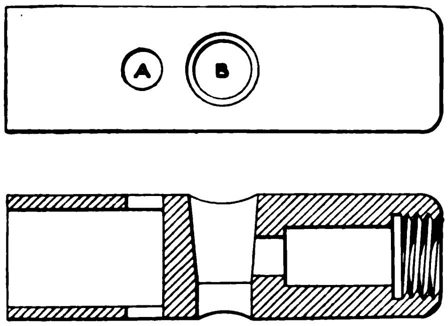


FIG. 23. PERCUSSION PELLET FOR GRAZE FUSE

When the hand-feed lever *B*5 is in the position shown, the expanding arbor is open and is ready to receive the work to be tapped. A slight movement of the feed lever from its normal position will instantly cause the expanding arbor to close. In manipulating the machine the operator takes a fuse body by the threaded end and puts it on the expanding arbor, turns it until the locating pin falls into the previously drilled top detent hole *B* and holds it there until he starts the hand-feed lever *B*5. This causes the arbor to tighten instantly on the work and holds it while being tapped. The three tapping spindles *B*1, *B*2, *B*3 are advanced to follow the taps into the work until they come to their stops. The instant the tapping chucks *B*6 unclutch themselves, the hand-feed lever *B*5 is fed back to its normal position. The expanding arbor, with feed lever in this position, is open, and the tapped fuse body can be removed.

The machine consists of a circular base upon which is mounted a vertical column of U-section, with three spindle heads *B*1, *B*2, *B*3, attached. Each spindle head is provided with a feed yoke, connected by racks, pinions and gears to the hand-feed lever *B*5 at the front of the machine. Each yoke has a clamp connection to its respective spindle. This clamp connection permits the spindles to be set for different tapping positions. The tapping spindles run in nonrevolving sliding sleeves that carry the driven gears, a Jarvis reversible tapping chuck *B*6 being attached to the inner ends. The driving spiral-gear shafts on each tapping head extend to the rear of the machine and carry pulleys over which runs an endless belt, driven by the tight and loose pulley shaft at the rear and bottom of the U-column. Intermediate idle pulleys are provided to give ample belt contact, and a belt-tightener pulley is also used. Each spindle has its separate adjustable feed stop. The machine occupies a floor space of 45 in. by 30 in. and is 59 in. in height. Its net weight is 1,400 lb.

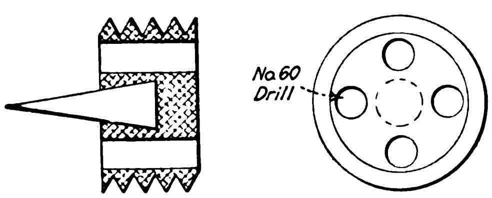


FIG. 24. PERCUSSION NEEDLE PLUG

The drilling machine, Fig. 22, is for drilling simultaneously and from opposite sides a 0.095-in. to 0.105-in. hole *A* through both walls of the rod-brass percussion pellet, Fig. 23, at a single handling. It also drills the combination straight and 10-deg. taper hole *B*, 0.191 in. to 0.185 in. by 0.155 in. to 0.145 in., midway of the same piece and 0.205 in. away from the first hole. These holes are too close to the center distance to be both handled at a single operation from one side only, by a regular multiple drill. The brass pellets, Fig. 23, are 0.320 in. to 0.312 in. in diameter by 1.080 in. long. In actual tests one machine, with unskilled operator, maintained an output of about 5 pieces, drilled with the two holes mentioned, per minute.

The work-holding fixture is a vise built as a part of the machine, so that the operator has merely to insert the blank pellets, drilled end first, between the jaws of the fixture. He then depresses the foot-treadle wheel to send the locking plunger forward against the outer end of the blank and to bring it into proper drilling position. Then he raises the hand lever at his left, to feed both spindles and their tools toward the piece from both sides at the same time. As the spindle-feed lever is elevated, an air valve automatically opens, letting compressed air of about 45 lb. pressure into the pneumatic cylinder at the center of the machine. This air pressure acts against the under side of the cylinder piston, forces it upward and at the same time forces up a U-shaped yoke fastened to the top side of the piston. As this movement takes place, the two inner edges of the yoke, which are tapered, draw in two jig-jaw slides, closing them firmly on the work.

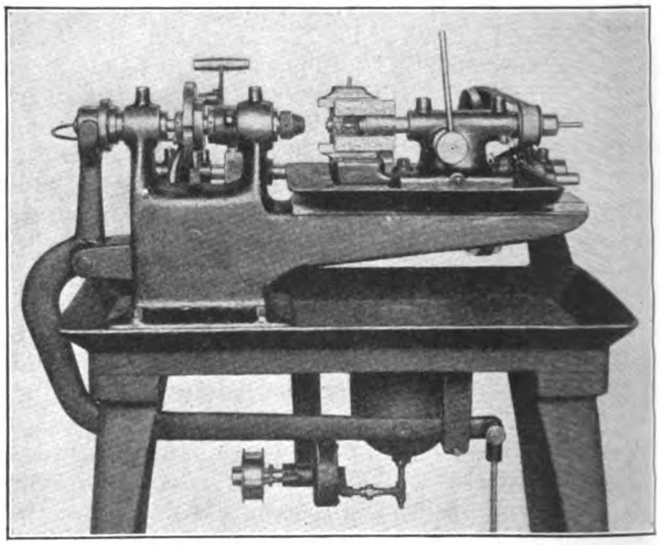


FIG. 25. MACHINE FOR DRILLING PERCUSSION NEEDLE PLUG

After the drilling operation is complete, the feed lever is lowered, the air valve shutting off automatically. At the same time the work-holding jaws spread apart and the drilled pellet is ejected by a spring. The exhaust air from the work-operating cylinder is piped up to blow away any chips, after every piece is ejected. These jaws are thus kept thoroughly cleaned, and all pieces fit snug. The drilling spindles are tapered on their inner ends to fit the sockets of the No. 1, either Jacobs or Skinner chuck for drills up to $\frac{7}{32}$ in. in diameter. Their outer ends run in sleeves with 2-in. endwise adjustment, a...

ing means of easily maintaining the proper depth of taper in the combination hole and also of compensating for the shortening of the straight drill by grinding.

The spindle for the combination straight and tapered drill runs at 2,436 r.p.m. and the spindle for the 0.095 tc 0.105 drill at 3,350 r.p.m. Spindle-driving pulleys are 1¼ in. in diameter by 1⅜-in. face and run on projections of the phosphor-bronze spindle bushings inserted in the spindle frames, thus eliminating all belt tension from the spindles themselves and permitting them to run practically as floating spindles. The bench space occupied is 33 in. by 26 in. by 28 in. high. The weight of the machine is approximately 400 lb.

Light-Drilling and Indexing Lathe

For drilling the four holes in the percussion needle plug, Fig. 24, the drilling lathe, Fig. 25, is used. The output obtained is 4 completely drilled pieces per minute, or 240 per hour. The percussion needle plug is of brass, and the drill a No. 60 0.040-in. stock twist drill with special temper. It is drilled at a speed of 6,000 r.p.m.

The drilling is done by a light sensitive spindle running in a feed sleeve, which is fed by the hand lever, shown at the front of the tailstock. On the chuck end of the sleeve is a sliding steadyrest that travels in a guide. The steadyrest is provided with a drill bushing that supports and accurately starts the drill. In drilling, the steadyrest is fed up until it stops against the piece being drilled, while the drill continues on and performs the drilling.

The spindle pulley runs on a sleeve clamped into the rear end of the tailstock and drives the drilling spindle by means of a keyed collar fastened to the pulley, insuring a sensitiveness that is desirable when drilling very small holes. The drilling spindle is driven by a 1-in. endless canvas belt from a countershaft fastened to the back of the machine. A belt tightener is provided. The headstock is a casting with an extending slide upon which the tailstock can be adjusted to its proper drilling position. The spindle is provided with a four-notch index wheel that is actuated through a ratchet and pawl by a hand lever, so as to bring successively each of the four holes in the percussion needle plug into line with the drilling spindle. The spindle is locked in its drilling position by a lever located at the rear of the indexing wheel.

The tailstock is adjustable crosswise, like a lathe, to accomplish this. The spindle is also provided with a spring chuck that is opened by means of a sliding thimble connection on the left end of the spindle. The thimble is actuated by the long bent lever that passes underneath the table and that is connected to a foot pedal by a link rod. The chuck is closed by a heavy compression spring when the operator removes his foot from the pedal. The work, after being drilled, is automatically ejected by a sudden jet of compressed air, provided by a small special shut-off valve that is opened only during the interval that it takes to move the index wheel. The valve is connected to the spindle by a single brass tube. The floor space required is 3 ft. 1 in. by 2 ft. 7 in., and the machine is 4 ft. 2 in. in height. Its net weight is 500 lb.

The machines herewith described are made by the Langelier Manufacturing Co., Providence, R. I., and indicate the possibilities of shell production in the use of specialized tools as opposed to the adaptation of regular machining equipment.

Two Different Mold Dies for a Radiator Cap

By Gustave A. Remacle

The two mold dies shown herewith are the product of two different shops, and while they both produce a radiator cap of similar form the dies themselves differ in construction and are operated in a different manner. The only noticeable dissimilarity in the product of the dies is that the product of the single die has a double fin at *A* and *B*, Fig. 1, while that of the multiple die has only one fin at *A*.

The parts *A* and *B*, Fig. 2, were turned in the lathe and the outside milled. The hole *B* was bored to the finished size and the plug inserted as shown. This plug was inserted to facilitate milling the grooves. After

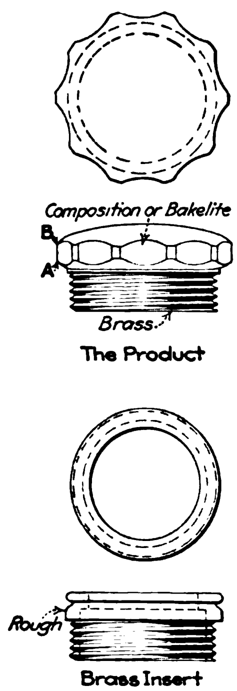


Fig.1

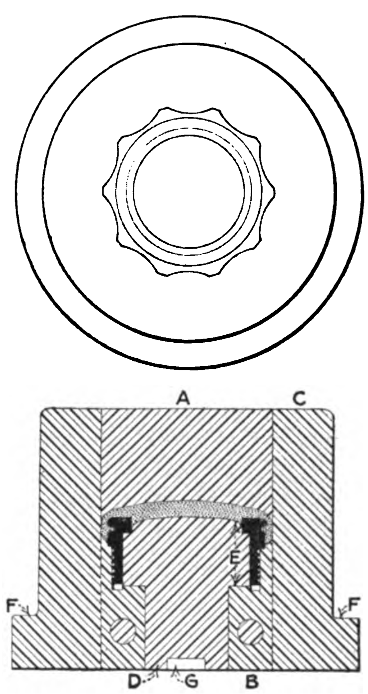


Fig.2

FIGS. 1 AND 2. MOLDING THE RADIATOR CAPS

having been milled to size, the piece was parted in the proper place and the pieces worked separately. The cavity in the force which forms the top of the product was machined to shape. The bottom force was next placed on a plug arbor which had been turned, and ran true in the lathe and was machined internally and on the face to the finish size and shape. When machining the chase or shell *C* as much metal as possible was removed while the piece was in the lathe. One of the forces was then placed over the hole and the form marked off. The hole was then machined to the line in the slotting machine and filed to fit the forces. The plug *D* was finished to size at all points except *E*, which was made the finish size plus the distance desired between the top of the plug and the top force. The chase *C* had $\frac{1}{32}$ in. surplus stock on each face, which was left to allow the piece to be machined so that the bottom would be square to the hole and the proper space would exist between the top force and the plug when the top of the force was flush with the top of the chase. The bottom force was then doweled in position in the chase, the force being set in so that a light cut from the bottom of the chase brought the force flush. With the bottom

force doweled in position, the plug and top force were inserted and the whole placed between centers in the lathe and machined all over to finish size. The chase was then hardened and drawn.

In operating the die the plug was set in place with the brass insert, the powdered compound poured into the die, the top force inserted and the die set under the

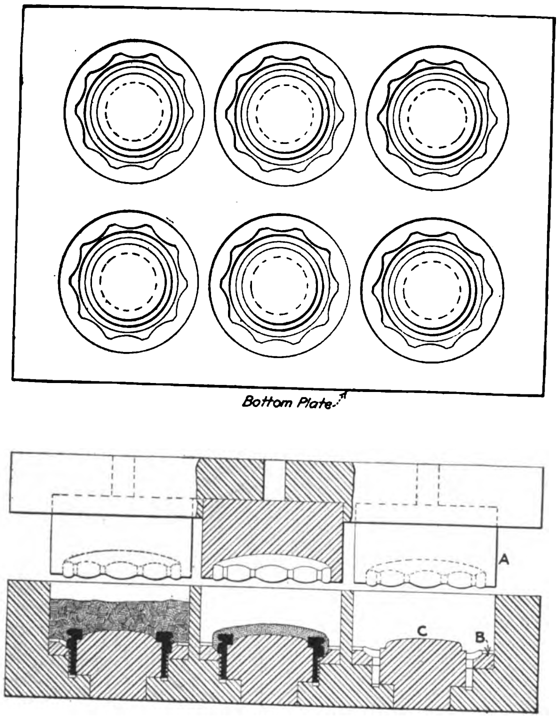


FIG. 3. MULTIPLE MOLD DIE

press. During the preceding operations the die rested upon a bench and was quite hot, the operator's hands being protected by heavy gloves. This die is not equipped with a steam plate, but is heated and cooled by the steam plate of the press. When ejecting the product the die was turned upside down in the press and placed upon a fork, points F resting upon the fork. A knockout pin was placed at E and the plug, product and top force pressed out.

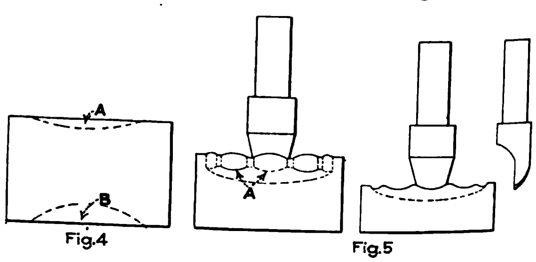
After the top and bottom plates had been planed to size, they were clamped together and the six ½-in. holes drilled and reamed through both plates. As these holes were used to locate the plates upon the faceplate of the lathe when machining the seats, it was observed that they were drilled and reamed squarely. A locating plug in the head of the lathe located the plates while machining the seats, and no trouble was experienced when the die was assembled, as the forces in the top plate line up correctly with the openings in the bottom plate.

The impressions in A and B, Fig. 3, were hubbed in a powerful hydraulic press and are of machine steel. Three hundred tons' pressure was needed to make the impressions in the forces. The chase B is of such size as will resist the terrific strain occasioned by C trying to spread under pressure. The hub is turned and milled as shown, care being exercised to have A and B concentric, also that the surface is highly polished and the corners rounded. It is imperative that these corners be rounded; otherwise a hubbing operation of this sort upon cold steel would prove a failure, as a result of the metal tearing at the sides. At Fig. 4 is shown the blank ready for hubbing. A is the surface which is to be impressed and is polished. Surface B is roughed out as shown. This cavity is filled by the descent of the stock while pressing.

There is a difference between hubbing in a press and hubbing under a drop hammer, inasmuch as a polished hub under the hammer will produce a polished impression, regardless of the finish on the surface being hubbed, while under the slow action of the press it is necessary that both the hub and the surface being impressed be polished. After the pieces have been hubbed they are machined in the lathe. The hub is trued in the chuck of the lathe and the pieces placed upon it, the tail center holding the pieces against the hub while they were being machined. It is desired to have the fin occur on the corner of the product. In order to obtain this result the hubbed pieces were milled with fly cutters as shown at Fig. 5. A templet was made to correspond with the form A and one of the fly cutters, using the templet to gage. This male cutter was then used to make the female cutter. Both cutters were applied as shown.

When assembling, the top forces were first screwed and doweled in place. The bottom impressions were then laid in their seats and the top plate, with forces brought down into its working position in the bottom plate. In this manner the bottom impressions are located so that they may be screwed and doweled in proper relation to the top forces.

As regards the superiority of one of these dies over the other, I will allow readers to form their own conclusions. In the construction of the single die about 60 hr. were consumed, while for the construction of the multiple die, including the steam and insulator plates and knockout arrangement, 400 hr. were necessary to complete the job. The multiple die will produce six radiator caps per 10 min., while six single dies being



FIGS. 4 AND 5. TWO DIFFERENT DIES FOR PRODUCING A RADIATOR CAP

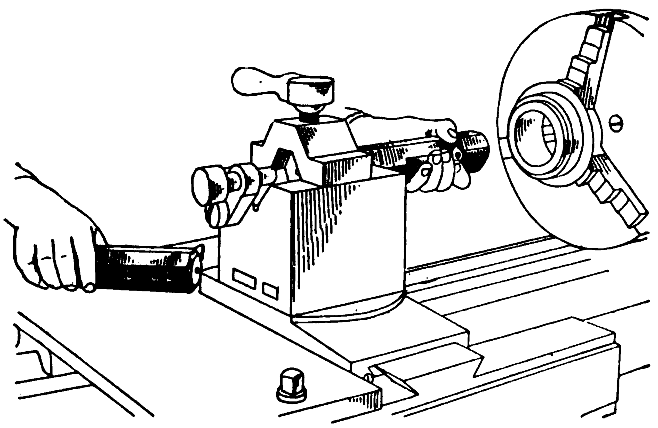
operated simultaneously by a single operator will produce six caps in 20 min. The multiple die is more readily heated and cooled than the single die, and the product is automatically ejected, thus accounting for the difference in the time required for producing the caps. A valuable feature of the single die, however, is that when repairs are necessary only one or two are tied up, whereas a breakdown on the multiple die would bring the production to zero while repairs were in progress. Also if six single dies are not quite enough to produce the desired number of pieces per day, one or two additional dies may be made, while if it is desired to increase the production in the case of the multiple die another die would mean doubling the capacity.

Letters from Practical Men

Rigid Boring-Tool Holder for the Lathe

The illustration describes a boring-tool holder for an engine lathe. This differs from the usual practice, inasmuch as the bars are made of rectangular instead of cylindrical stock.

The regular tool-post support is removed and the cast-iron V-block substituted. The gib is then screwed tightly to the cross-slide and the crossfeed handle removed, so as to make the V-block permanent. One corner of the rectangular bar is flattened for the purpose of clamping with a screw. The bars are then placed in the V-block and centered by placing a drill in the chuck, after which the corners are turned off to give clearance for the various



RIGID BORING-TOOL HOLDER

sizes of holes. The cutters are inserted diagonally with clamping and adjusting screw. In straight holes two bars are used—one for roughing, the other for finishing.

The bars are also made for holding taps, drill and dies, and they make very good substitutes for turret heads, with the advantage of being much more rigid.

Schenectady, N. Y C. K. Tripp.

A Simple Hand-Operated Bending Tool

The illustration, Fig. 1, shows a machine part made of No. 27 (0.016 in.) cold-rolled steel. The blanking and perforating are done in the usual manner on a power press, the two bends being made by the hand fixture, as shown by Fig. 2. Fixtures of this character are of more than usual interest at this time, on account of the great amount of work being required of power tools and because no set-up is required and the work is done by unskilled labor.

Referring to the bending fixture, *A* is a cast-iron base, milled on the bottom with two *L* cuts for holding in a bench vise. It is bored to contain the spring pin *C*. Screw *F* and stud *J* (which has gear teeth milled in it) are also milled dovetailed to admit the bending anvil *DE*, while another dovetail acts as the sliding surface for bending part *I*. This part, it will be noticed, has a rack milled on the bottom and carries a tool-steel anvil *M*. *A* is also milled to contain *B*.

The part *B* is also of tool steel and acts in the same capacity as the lower die in the press tool, while *DE* acts as a punch, the two making the first bend. After the

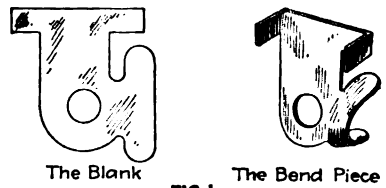


FIG. 1

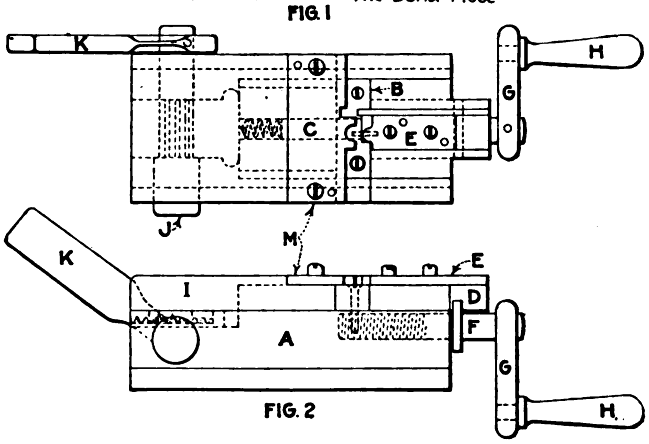


FIG. 2

A HAND BENDING FIXTURE

first bend is completed, *I* is carried forward by means of handle *K*, *E* acting as the lower die and *M* as the upper. In this way the second bend is made.

The spring pin *C* exerts a constant pressure on the piece to be bent, not only holding it while being bent, but freeing it from *B* when *DE* is returned to the starting point. George P. Breitschmid.

Arlington, R. I.

Oil-Ring Difficulties

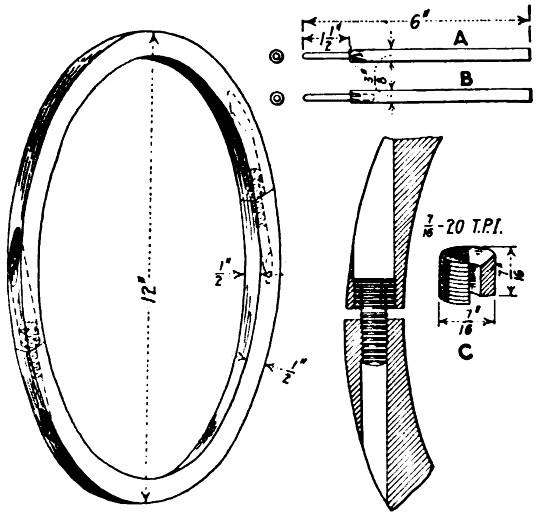
The illustration shows a job which would not be difficult in a well-equipped shop, but was so in the small shop where I was once employed, as the equipment was old and worn and there was no miller.

The rings were for oiling an 8-in. shaft and had to be fastened together, as shown, after the shafts were in place. They were first cut in two, the ends filed flat so that they would come together square, and then the halves were strapped to an angle plate and spotted for drilling. The tap holes and body size holes were put in without trouble; but when the rings were turned over to be counterbored for the screw heads, the trouble began.

Owing to the necessary length and small diameter of the pilot and the play in the drill-press spindle, the counterbore would hardly begin to cut before it would cramp and break. First, one like that at *A* was tried without success, as the pilot would break; and then one

like that at *B*, with the pilot left soft; but this would break out the side of the cutter.

I was about to give up in despair, when it occurred to me to drill through in the same way as for the smaller holes—with a drill large enough for the screw heads. This was done. Having a fine thread tap that would make a good thread in these holes, I tapped them and



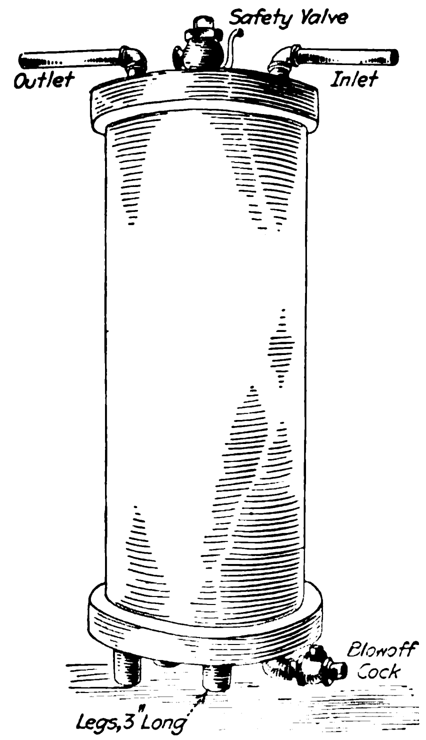
A SIMPLE METHOD OF DRILLING OIL RINGS

made plugs, as shown at *C*, with the countersink in the end, screwed them in tight, and the trick was done. Simple, wasn't it? But I didn't think so at the time.

Ilion, N. Y. HAROLD E. GREENE.

Air Tank Made of 14-In. Pipe

The illustration shows a simple but practicable air tank that we installed in a local garage. It is composed



AIR TANK MADE OF 14-IN. PIPE

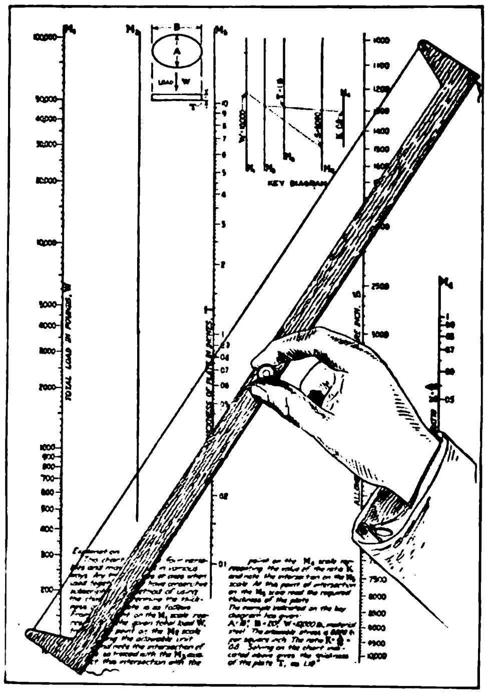
of a piece of 14-in. iron pipe 14 ft. long, with a cap on one end and a coupling on the other. A plug was made for the coupling, with four small legs about 3 in. long, to clear the blowoff cock and also to screw the plug in tight. The tank is stood on end.

The inlet and outlet for air are on the top. By placing them in this way we get pure air free from oil and water, which settle at the bottom, where a blowoff cock is placed to clean the tank. This also keeps the air lines clear.

Fresno, Calif. W. R. SCOTT.

A "Reader" for Alignment Charts

Herewith I illustrate my scheme for reading alignment charts with a black thread instead of with a straight-edge. I whittled down a cheap wooden rule as indicated, split two corners a trifle to hold the ends of the thread,



HANDY READER FOR ALIGNMENT CHARTS

put the thread in place and added a button for holding, to make the "reader" still more convenient.

I can work more quickly with this reader, as I can see both sides of the thread at the same time and no time is lost is shoving back and forth. Besides, I believe it to be more accurate, for the thread is placed "directly on top" of the mark, just as with a cross-hair on a slide rule. The finer the thread the better. N. G. NEAR.

Brooklyn, N. Y.

Repairs to Scored Air Hammer

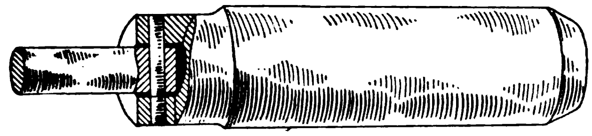
An air hammer was recently sent to the shop on trial. Either through lack of sufficient oiling or by foreign particles finding their way into the cylinder its walls and the plunger were badly scored.

Small particles of metal were embedded in the plunger and cylinder walls, gripping the plunger so that it had to be driven out. To return the hammer to the manufacturer in that condition was out of the question, and the fact that we badly needed the hammer set me thinking.

Removing the plunger and scraping the high spots off the plunger and cylinder removed the embedded particles of metal. To grind the plunger to the cylinder, I con-

structed out of odds and ends about the shop a universal socket and soldered it to the plunger. Then I rigged a couple of sash pulleys over my vise bench and hung a small portable drill from a strong cord, with a counterweight on the other end to balance it. With this arrangement I ground the plunger into place.

I fastened into the chuck of the drill the end of the rod of the universal joint to which the plunger was



REPAIR TO SCORED AIR HAMMER

soldered. By inserting the plunger, applying plenty of oil and a little flour of emery, starting the drill and working the plunger up and down in the cylinder I secured a good fit. A. H. YOCH.

Hazleton, Penn.

Machining the Form on Shells

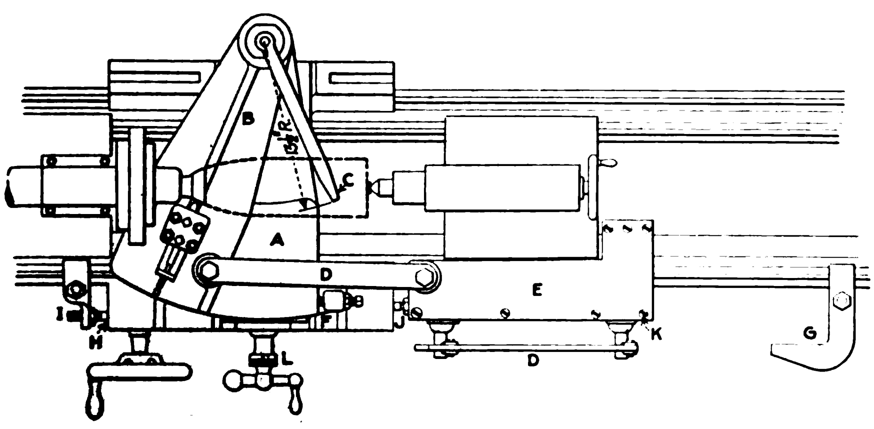
The illustration shows a lathe attachment for turning 4.5-in. shells. This outfit employs the old principle of radius and center often used on machine tools for special jobs and is giving excellent results, as it is designed to produce a continuous power feed over the entire shell and is also provided with an automatic knockout so that the operator need give the job no other attention than replacing the shells. The rig always comes to a stop when the shell is finished, thus making it possible for one man to run several lathes on this operation.

The main casting *A* is fitted to the cross-slide of the lathe carriage and has the cross-slide nut and screw attached for adjusting the cutter to the diameter of the shell. The swinging arm *B* carries the cutter. The small gage *C* is used for setting the cutter to the correct radius after each grinding and may be swung out of the way when not wanted. It is interesting to observe that the shape of the cutter in this outfit does not affect the shape of the finished shell. Hence the grinding need not be done by skilled help.

The operation is as follows: After placing the shell on centers, the nut on the auxiliary carriage *C* is closed by moving the link *D* to the right. The carriage *E* and the arm will then advance until the profile is turned and the arm strikes the stop *F*, when the main carriage will be fed along to turn the straight part of the shell, after which *D* will strike the knockout *G*. The operator removes the shell and runs the main carriage back to the stop *H*, pulls the carriage back to the stop *J*, as shown, and the cycle is completed.

When the device is used, the lead-screw nut is removed from the lathe carriage and fitted into the auxiliary carriage at *K*. H. P. HOAG.

Brantford, Canada.

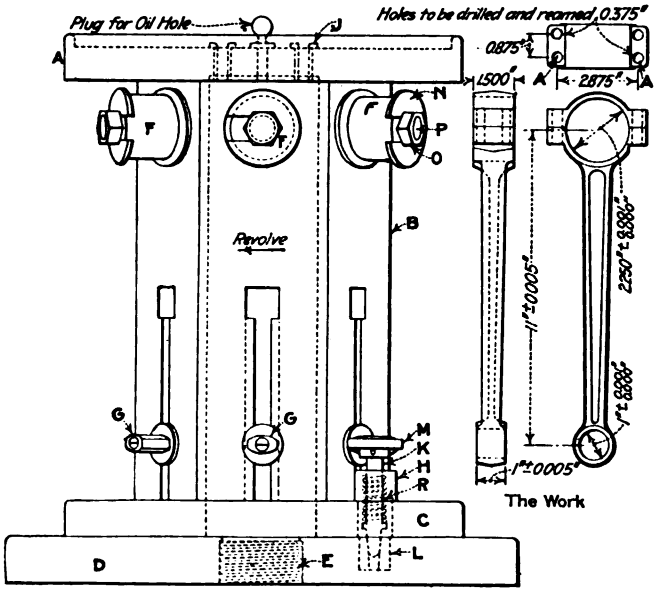


LATHE ATTACHMENT MACHINING THE FORM ON SHELLS

Continuous Drilling

Nowadays we hear a great deal about continuous milling, but very little of continuous drilling, which is of equal, if not more, importance.

The accompanying illustration shows a jig that is in use at the Detroit Motor and Machine Co., of Detroit. It comes close to accomplishing the desired end—continuous drilling. The jig is used on a 10-spindle Fox



CONTINUOUS DRILLING JIG

multiple press, of which eight spindles are used—four for $^{23}/_{64}$-in. drills and four for $3/8$-in. reamers.

A glance at the illustration will show that the upper plate *A*, which carries the drill and reamer bushings, is secured to the column *E*, which in turn is fastened to the lower plate *D*. This is also the index plate, *D* being rigidly held to the drill table. The trunnion *B* is fastened to the plate *C*, which carries an index pin *K*, and both revolve on the column *E*.

In starting to use this jig the operator places a connecting-rod on an idle face of the trunnion *B*, applies the washer *N* and tightens the nut *O* by means of a socket wrench. He then indexes the jig once, which brings the rod under the drill bushings, lowers the drill head and throws in the feed. While the drill is in operation, he places another rod on the next face of the trunnion. With every indexing a rod is taken off with four holes drilled and reamed.

It will be seen that, with the exception of lowering and raising the head, the operation is continuous, as

the operator removes the drilled rods and places undrilled ones while the drills and reamers are feeding through. Therefore, he has not many wasted intervals.

The raised rim on the upper plate *A* retains the cooling compound and is kept flooded, so that the liquid flows down the drills and reamers by gravity.

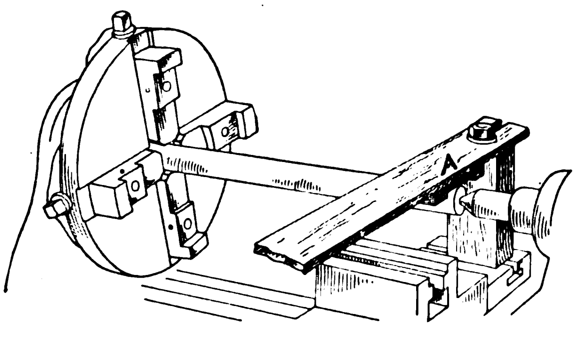
The T-slots were placed in trunnion *B* to make the jig as nearly universal as possible by taking care of any changes in rod length. The upper plugs *F* are also easily removable, to accommodate changes in the diameter of the bore. If there should be any change in the location or number of holes in the rod, the plate *A* could be removed and a suitable one made and put on.

The lower plugs *G* are made oval, to reduce the time of putting the rod in the jig. The large end of the connecting-rod is not split until after the rod is drilled.

Detroit, Mich. J. M. OLDHAM.

Good Way To File Shafting

Rig up the lathe as shown, using a 2x6-in. plank, 3 or 4 ft. long. Shim up with two or three layers of sheet rubber on felt, as at *A* Take two large files that are first broken in the middle of their length, making



METHOD OF FILING SHAFTING

four pieces, which must all be ground to about the same length. The illustration shows how this is done.

Put on the carriage feed and bear down on the end of the plank, at the same time moving it to the right and to the left to get different points on the files to work. For the same reason its position should be changed on the fulcrum bolt. Raise and tap the plank occasionally, to free the filings. M. JACKER.

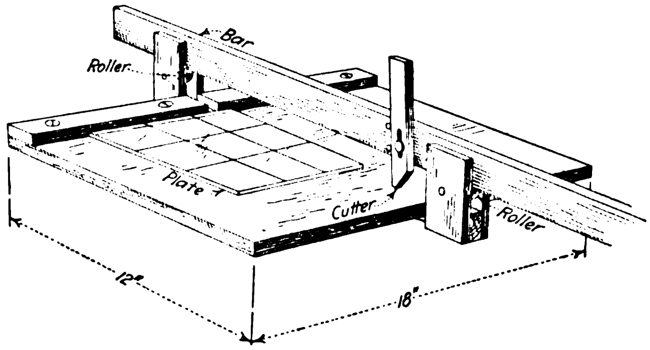
Stockton, Calif.

Glass-Cutting Experience

In trying to cut up several hundred old photograph plates into 1x3-in. strips for microscope slides, it was found that a white diamond point did not cut the surface so that the edges would break away in an even line, but left a jagged edge. The longer the point was used the worse the breaks became, until it was impossible to get the strips off without breaking a great many.

The glass plates were placed on a flat board 12x18 in. in size, having a squaring ledge at the back and lines for gaging the size of the strip. The cutter was held in an adjustable head secured to a traveling bar, the bar being guided by two upright pieces at the edges of the board and at right angles to the squaring ledge. As the bar was pushed across the board, the diamond point came in contact with the surface of the glass and scored it across.

It was decided to remove the diamond and try something else. An ordinary hand glass cutter with a knife-edged roller cutter was clamped to the bar and a few plates scored. The results was very satisfactory, as the



A GLASS-CUTTING BOARD

strips would in some cases break away by their own weight and the edges were smooth and straight, needing very little grinding to finish them ready for use.

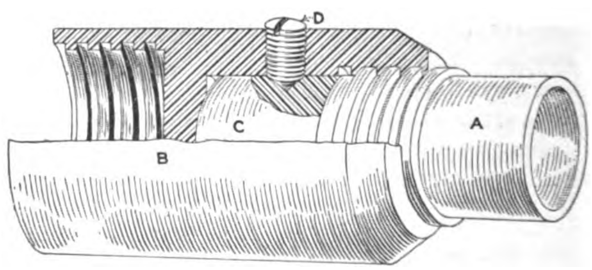
The diamond was from a finger ring and was mounted in a holder just the reverse of the ring setting, leaving a fine uniform point exposed to the work. The rollers are bought at any hardware store, but they must be sharp to give the best results. GEORGE G. LITTLE.

Rochester, Minn.

Boring Jig with Thrust Releasing Stop

In the accompanying illustration *A* represents a bushing threaded at one end on the outside and having a hole drilled and reamed from the opposite end, but not quite through the piece. On that account it was decided to hold the bushing by the threaded portion in machining the bore. After this operation it was difficult to remove it from the jig until a special holder was made.

In the illustration *B* represents the body, which screws on the spindle of the lathe and is threaded at the opposite end for holding the work. At *C* is shown a sliding stop block fitting inside of the holder and held in position by the hollow setscrew *D*.



BORING JIG WITH THRUST RELEASING STOP

It is evident that, although the pressure of the cutting tools may cause the bushing to tighten considerably against the stop block, this pressure will be removed as soon as the setscrew *D* is loosened slightly. Then the machined part can be unscrewed by hand. When this screw is again tightened, the stop is set properly for the next casting. R. R. CORNELL.

Providence, R. I.

Discussion of Previous Question

Face-Forming Tool for a Lathe

With reference to Mr. Hutchins' comment on the face-forming tool for a lathe, page 387, Vol. 44, I wish to say that the device really is practical and has successfully finished eight such pieces as are shown in the illustration. These pieces were parts of molds for producing distributor heads.

The rough dimensions of the tool were 8x2x½ in. The rough dimensions of the piece being tooled were 1⅞ in. extreme in depth by 3½ in. in diameter. The amount of cutting surface on this tool had reached the limit for one of such dimensions, a larger cutting surface requiring a sturdier tool.

Contrary to Mr. Hutchins' views, the tool is of little value for roughing, being used only for finishing. There was, however, a tendency to dig in a little, causing a slightly rough surface, if pushed too hard. All forming tools will dig in somewhat and produce a poor surface, if pushed too hard or improperly lubricated. The serious digging in of any tool—that is, digging in so deep that it breaks—is caused by its being improperly held in relation to the work. As an example, a parting tool so placed in a machine that spring in the tool will result in its advancing toward the work will cause it to chatter, dig in and break, even if it presents only $\frac{1}{16}$ in. of cutting surface to the work, while a similar tool presenting 2 or 3 in. of cutting surface, if properly placed and held in relation to the work, will remove a thin shaving chip without trouble.

It should be noticed that the tool is inclined in such a manner that it has a tendency to spring away from the work. A good lathe was used, and two wedges, of wood, were tapped under the chuck while it was in motion, thus causing the spindle to bear against the top of the bearing. The wedges, together with the inclination of the tool, eliminated all danger of chattering or digging in, such as would cause breakage of the tool. As is necessary with all forming tools, this one possessed a very keen cutting edge. The tool was hardened all over and drawn to a straw color at the cutting edge and blue elsewhere. The lathe was run at the slowest speed.

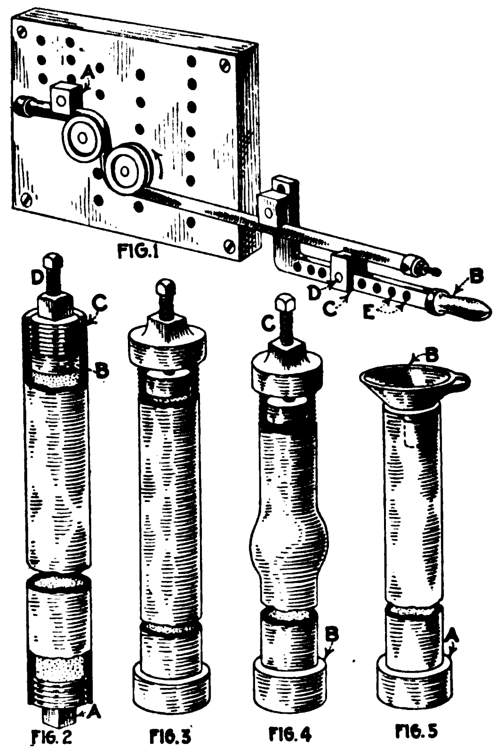
Newark, N. J. GUSTAVE A. REMACLE.

Bending Small Tubes Without Rosin Filling

I noticed with much interest the article by A. R. Nemour, on page 118. The method described is not an easy way of bending pipes, but quite complicated, so far as I can see. It must take some pains, accuracy and time to bend a spring to the required diameter so that it will fit inside a pipe and then, after it has been bent to the complicated shape, to take it out of the pipe. I do not see how the spring can be used a second time. If it can be used only once, the bending will be quite expensive; and I believe the process is also very slow.

As A. R. Nemour states in his article, experiments are necessary to get the size, the temper and the thickness of wire to be used. This requirement certainly would make a special job very expensive, and I do not think that a spring can be removed at all if the pipe has more than one bend or has some complicated curvature of bend.

Some time ago I had a number of pipes to bend. They were of different sizes and materials, also of various shapes. Some had intricate bends, and a number of different sizes of curves. The following description shows how the work was performed quickly and with little skill with a simple tool.



BENDING SMALL TUBES WITHOUT ROSIN FILLING

In Fig. 1 is shown the bending tool, with a pipe bent in position. This tool was used for bending every imaginable shape of pipe, with various diameters and of different materials. It is made of a cast-iron plate, with a number of holes, and stop block *A*, which is shaped to fit the radius. By changing the roller positions in the different holes different shapes of bends can be obtained. For short pipes an extension lever *B* was used, with blocks *C* of the same style as block *A*. The pin *D* is interchangeable in the holes *E*, to get various leverages, in order to bend short pipes more easily.

A detail of the bending equipment is shown in Fig. 2. This is a regular pipe plug *A*, for one end of the pipe to be bent, a plunger *B* and a plug *C*, which has a long adjustable screw *D* in the center. In bending a pipe all the preparation necessary is to plug one end, fill the pipe with fine dry sand, then plug the other end and com-

press the sand by the plunger and adjusting screw. In Fig. 3 is shown the same arrangement, but with a threaded collar, as shown, which is at times preferred.

In Fig. 4, at *A*, is shown a special shape that I have bent by this method, using sand and the device already mentioned. If such a shape is required, the pipe must be heated just at that point, as shown at *A*, and pounded on a hardwood block at the end *B*. After a little pounding, the screw *C* is gradually compressed until the desired form is obtained. In this case more than one heating is required, depending entirely on the shape. Such shapes can be quickly bent without any special arrangements.

In Fig. 5 is shown a pipe ready to be filled. The end *A* is plugged up, and in order to fill with sand quickly, a funnel *B* is used. The bending of pipes is done in the following way: After the sand is poured in, the pipes are plugged and the plunger made tight, as described. The bending is very simple and rapid. In bending rough pipes they must be heated at the bending point, and the sand can be compressed tightly. Seamless tubing is also heated for bending, and the sand is compressed a little more lightly than in rough pipes. Hard copper or brass tubing is heated in the same way as rough tubing; the sand should be compressed only lightly.

For soft copper or brass tubing no heating is required, if the bend is not too complicated, and the sand is to be compressed slightly. It is well to pound the tubes on a hardwood block when they are filled, in order to get a solid body of sand. Then very little adjustment is required.

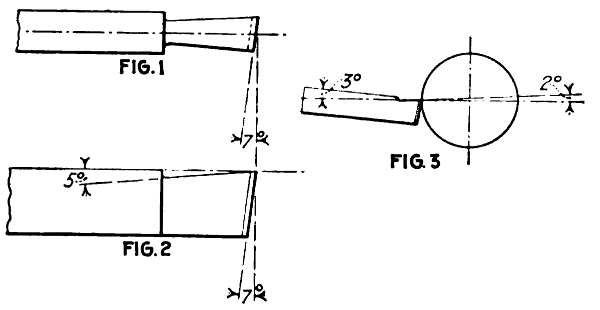
It is important to have the sand really dry before the pipe is heated. If the sand is not dry enough and both ends are plugged, it may cause trouble—either cracking the pipe or blowing out the plug. With the method just described, pipes up to 4 in. in diameter, of different materials, have been bent at a reasonable cost and in a satisfactory manner. CHARLES EISLER.

Bloomfield, N. J.

Cutting Off Steel in the Lathe

In the *American Machinist*, Vol. 44, page 294, Mr. Remacle describes a method of grinding and setting parting tools for cutting off steel. While indorsing all Mr. Remacle says, I have something to add.

In our experience with cutting-off tools, not only in the lathe, but in various automatics as well, we have



GRINDING AND SETTING CUTOFF TOOLS

long since learned to pay strict attention to angles and so to design all tools that they may be readily reground without changing the original angles. Now, while Mr. Remacle's idea removes some of the trouble caused by chatter, digging in, etc., we have found that a cutting-off tool ground and set as in the drawing will work exceptionally well and at higher speeds and feeds.

In Fig. 1 is shown a parting tool, in plan. The 7-deg. rake gives the tool a chance to enter the stock gradually and not all at once. This arrangement diminishes chatter and acts also as a "brake"—so to speak—against digging in.

Fig. 2—the tool in elevation—shows a clearance of 7 deg. and a top rake of 5 deg. This 5 deg. enables us to follow a setting practice pretty much like that described by Mr. Remacle, only we have definite angles. With the shank of the tool set at a 3-deg. center line, Fig. 3, we are using a 2-deg. top rake at the cutting edge, when the latter is set at the center of the work being cut off, because 3 deg. and 2 deg. give our original rake—5 deg.

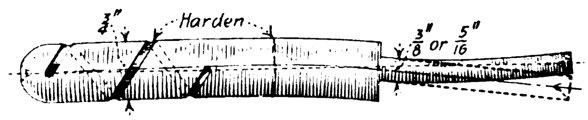
A tool-post wedge of 3 deg. should be used and the tool set to a stop, so it cannot be set wrong. All grinding should be done on top of the tool only and to a gage.

As Mr. Remacle states, the cutoff tool often is disappointing; but maybe if we paid a little more attention to grinding and setting, we should all be happier, including the neglected, unfortunate cutting-off tool.

Plainfield, N. J. J. B. MURPHY.

Grinding Die-Setting Pins

I believe that Mr. Kirchmer's article on page 205 describes the best grinding kink that has come to my notice, but why not use the stem in connection with the friction drive, even though a dog is not required? A stem 2 or $2\frac{1}{2}$ in. long provides a means by which a pin, badly distorted in hardening, may be thrown into line, when without it the pin might not grind clean all



GRINDING DIE-SETTING PINS

over. I intend to use this combination on the next set of pins. Of course, the stem and butt end of the pins are left soft, only the working part being hard. The stem center should be reamed before grinding, to insure a good bearing. W. J. WELLS.

Brooklyn, N. Y.

Cutting Downward in the Lathe

The editorial on page 255 was very interesting to me, as it brings to my mind an instance where it was almost necessary for me to cut downward.

The job was to cut the centers out of some machine-steel pieces about 8 in. square by $1\frac{1}{4}$ in. thick, the holes to finish about 3 in. in diameter. I found it impossible to tighten the bearings enough to keep the work from chattering and the cutter from "hogging" and breaking off, when it was right side up, so I turned it over and cut back of the center with the lathe running forward.

The trouble stopped immediately; and I think that, besides holding the spindle down in the bearings, another reason for the better action is that, if the cutter tends to stick or dig in, the extra force serves to throw the tool out of the work rather than into it, as the fulcrum is

in a different place, which I think is shown more clearly in the sketches.

In cutting upward, the points *A*, Fig. 1, become the fulcrums. If there is any tendency for the different members of the tool carriage to part at the points *B*, as is nearly always the case to some extent, the cutter swings forward into the work on radii from the points of fulcrum.

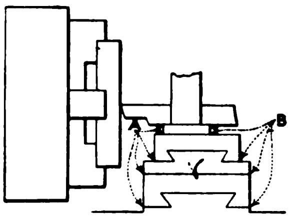


FIG. 1. POINTS OF FULCRUM WHEN CUTTING DOWNWARD

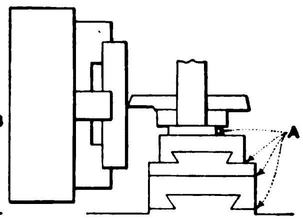


FIG. 2. POINTS OF FULCRUM WHEN CUTTING UPWARD

In Fig. 2, cutting downward, the points of fulcrum are at *A*, which causes the cutter to swing from the work on radii from these points, thus relieving it.

In cutting off work on centers or in the steadyrest I have found the same scheme to work better than cutting upward, the same reasoning with regard to the point of fulcrum being applicable. HAROLD E. GREENE.

Ilion, N. Y.

Correcting Inaccurate Spacing

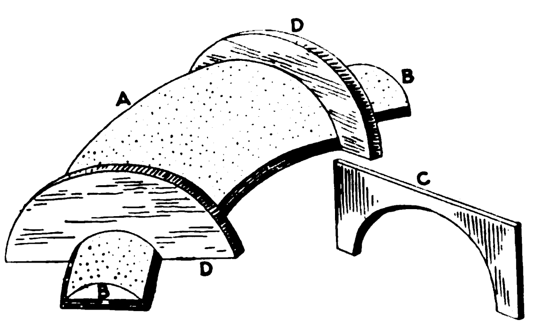
To correct the center distance between the holes *A* and *B* in the illustration on page 360, Vol. 44, one would either have to broach the inside edge of both holes or make the broach 0.0004 in. larger than the original size of the hole and broach the inside edge of the hole *A*. By making the broach 0.0002 in. larger the holes would still be 0.0001 in. too far apart center to center.

Chicago, Ill. HENRY SWINDELLS.

Economical Patterns for Temporary Work

I cannot agree with either Mr. Francisco, page 1129, Vol. 43, or Mr. Parker, page 165, in regard to the methods they use. I think a better and a quicker way to make a temporary pattern of this kind is as follows:

Cut out a body form *A* with the two core prints *BB* on a jig saw, from any thickness of board. Then cut out the two flanges *DD*, of any thickness desired, and attach them to this form. Lay the form on a flat surface and cover it with plaster of paris. While it is green, use the former *C* by drawing it over the form *A*, the sides of which will make a guide. Use a smaller form for the core prints. Form *C* is made from sheet metal about $\frac{1}{16}$ in. thick.



ECONOMICAL METHOD FOR TEMPORARY PATTERNS

This operation completes one-half of the pattern, and the other half is made similarly. The same method is used in making the core-box form. When finished, shellac and oil the form, then cover it with plaster of paris to make a good solid core box.

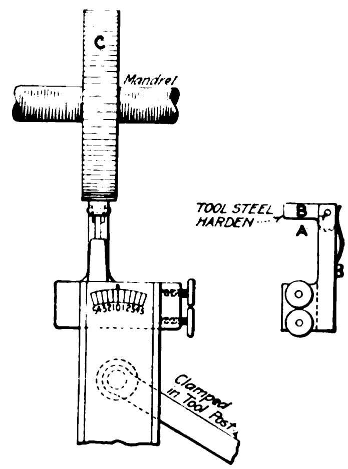
A 4-in. elbow pattern and core box of this description have been made in less than 5 hr. A. E. HOLADAY.

Naugatuck, Conn.

Gage for Testing Cutters

Mr. Smith, on page 732, Vol. 43, describes a gage for testing the truth of milling cutters. Experience on a similar subject prompts me to describe another simple method of testing the truth of cutters, gears or anything presenting an irregular surface.

It was essential that the circular form *C*, which is somewhat similar in construction to a gear, should run dead true. The indicator shown was the only one available for the job, and the contact point was too small for the broken surface of the form. By applying the adapter as shown, so that part *B* butts against the contact point of the indicator and presents a plane surface to the form, the forms were readily tested. Pin *A* was made a good fit to part *B*, thus preventing lost motion.



A GAGE FOR TESTING CUTTERS

Newark, N. J. GUSTAVE A. REMACLE.

Federal Aid for the Promotion of Vocational Education

An editorial on page 345, on the subject of Federal aid for vocational education, contains several statements on which I should like to see further discussion. Reference is made to the corporation school, and it is stated that its advocates claim that such a school is the only proper method of training for the mechanical trades. I should like to be permitted to bring out one or two arguments that rather question that statement.

I can readily see that, given a city in which there existed both a corporation school and a trade school, a boy passing through the corporation school would be of more value to that particular firm than the boy who had passed through the trade school; but I question very strongly whether this would apply when it came to the question of employment in a different shop carrying on an entirely different line of work. I may not be right about this, but it is the impression that I have formed from both personal experience and observation.

Then, too, there is the coöperation plan, as carried out in Fitchburg, Mass. I believe that this is an excellent scheme for vocational training in a city where there are enough manufacturers who are willing to coöperate to the extent that they do in Fitchburg. It makes a fine method for the boy, because he is working for wages and getting his education at the same time. The cost to the community is small. But here in my opinion is the weak spot of the system: It is open only to a selected group of boys, who have reached their second year in the high school, which on the average means that they are at least 16 years of age. Statistics show that the big majority leave school at 14 years of age, owing to the economic pressure, which I assume means that whatever they can earn will be very welcome at home.

Neither plan outlined makes any provision for the 14-year old boy. Is this right? From a great many standpoints I believe that it is; but at the same time, what is to become of this boy? Many parents can be induced to send him to a trade school for two or three years, but to ask them to continue to support him until he is 18 or 19 years of age is requiring more than they are willing to do.

While corporation and coöperation schools are good for the places that have them, what about those communities which have boys, but no schools of the aforementioned type? This is the place, it seems to me, where the public vocational school can do the most good, because a boy should not be deprived of the privilege of getting a trade education simply because there did not happen to be in his town any large manufacturing concern that was broad enough to inaugurate such a system.

The following statement, "We strongly believe that it is fully as essential to have the boy know why he performs each operation as to learn how to do it, both from the viewpoint of making him a better workman and to give him an added interest in his work," pleases me, because it is in a sense an indorsement of the method which is followed to a great extent in the Massachusetts schools and which, I believe, will turn out broader workmen—young men with a better idea of what they are trying to do—than if they learn by performing one operation on a great number of duplicate parts. By making one piece complete from start to finish, the reason for each operation and the logical sequence that must be followed cannot help but be impressed on the apprentice. And at the same time he not only learns how to manipulate his machines as may be required, but he gets a broader insight into his work, owing to the better conception of the piece as a whole.

In regard to the question how much a boy should be taught in the vocational school, there is a great difference of opinion. We must recognize the fact that there are a great many of us born to occupy the lower positions—limited to such by the amount of brains given us at birth. Whether or not a little training will enable such a one to step up to a higher position in the wage scale is a question I am unable to answer to my own satisfaction. Whether it would pay a community to spend money in training boys to become machine operators is also an open question; but I do feel that such training, if given, should have a well-defined limit, to be determined solely by the financial side of the question. That is, we should have a predetermined wage, and it should be held unprofitable for a community to train its boys to occupy positions paying less than that wage. Just what that amount should be, I will leave for some financial expert to figure; but surely it should be well above the wage of the day laborer, who gets his job whether he has had any preliminary training or not. Yet this may be a very unscientific statement to make in view of what scientific management has been able to do in increasing efficiency.

Personally, I believe that these shops should give as broad a training as it is possible for boys of that age (14 to 17) to absorb and benefit by. The shopwork should be uptodate and as thorough as it is possible to make it, while the technical side of the training should be equally as good, though it must first be practical. Later on, if there is time, it might go into the theoretical side.

It had never occurred to me than in training boys to be machinists it would be of any advantage to them to understand forging and woodworking. I had always felt that even the three years allowed to the machine shop were hardly enough, and yet I have talked with several machine-shop foremen lately who have voluntarily expressed such a belief, stating that it would tend to develop broader and more capable men.

On further questioning, while one or two differed, it was the general consensus of opinion that the shops in which the machinist was allowed to touch the fire were very few and far between, and as for permitting him to venture into the pattern shop, that was unheard of. Now these men are practical everyday machinists working at their trade; while they may not be able to give any good logical reason for their belief, it is very evident that for some reason which they are unable or unwilling to express they hold firmly to it. BURTON A. PRINCE.

Westfield, Mass.

Wanted--Data on Drill Wear

One who has had experience in the drilling department of a machine shop has no doubt been puzzled by the action of twist drills. Among a number of these taken from the same package one may stand up for three or four hundred holes without the need of regrinding, another need attention after half that amount of work has been accomplished and still another fall down after drilling a comparatively few holes.

Comparatively little information has been published on the life of twist drills, and the articles that have appeared lack uniformity. In commenting on the desirability of such data a correspondent submits the following example:

How many inches in depth should be drilled between each grinding or sharpening of a high-speed drill about 1 in. in diameter; material drilled, 40 carbon steel; speed, 400 r.p.m.; rate of feed, 3 in. per min.?

Authentic records on the life of twist drills should prove especially timely.

Editorials

Code of Factory Lighting

The code of lighting for factories, mills and other work places, prepared by the Illuminating Engineering Society, was discussed on the evening of Mar. 14 at the joint meeting of the New York section of the society and the New York section of the American Society of Mechanical Engineers. This is the first time the code has received general discussion. The articles of the code and an explanation of the purpose behind its preparation were published in the *American Machinist,* Vol. 43, p. 547.

The trend of all the discussion was favorable to the code and emphasized that it is a piece of pioneer engineering work that promises good to employer and employee alike, if its provisions are used as a basis for state laws or commission regulations. Only a few points were touched upon as possibly needing changes or improvements. But the attitude of the manufacturer toward the code is of some concern, although the Commissioners of Labor of the States of New Jersey and Pennsylvania were quoted as saying that in their opinion there would be no difficulty whatever in enforcing the laws or regulations that might be framed in keeping with its provisions. They believe that manufacturers will welcome something of this nature. As a matter of fact, improvement in factory lighting has received considerable attention in the technical press during the last five or six years, and much has already been done by way of installing better artificial lighting systems and better lamps during that period.

In spite of the improvements made by progressive shop managers there are many manufacturers who still provide in their factory buildings so low a standard of illumination and so poor a quality of light distribution that their employees are subjected not only to the risk of serious accidents, but to the hazard of permanent injury to their eyesight. A corrective force is now arising in public interest and opinion, and regulation such as is aimed at by the initiators of this code will undoubtedly soon come into effect in many states. As a matter of good business it is wise for manufacturers to provide more and better illumination than any standard likely to be enforced as a minimum requirement in any state, and the well-informed, progressive shop owner and manager will favor the wise regulation of industrial lighting and not oppose it.

But this favorable attitude is not the only one that the manufacturer should take. Even if there is no intent to favor any particular interest on the part of those who are intrusted with the duty of framing such regulations, there is a danger that unwise requirements may put manufacturers to unnecessary hardship without accomplishing any beneficial purpose, unless every engineering aspect is carefully and properly considered. Judging from other fields, the general practice will be for the state to assume the authority for such regulation, although matters of this kind are sometimes governed by municipal ordinances.

We face here, as in all such things, the possibility of many different sets of legal requirement or commission rules. The advantages of uniform practice are obvious; and it is fortunate indeed that, before industrial lighting has been surrounded by a maze of irreconcilable rules, the Illuminating Engineering Society has come forward with this code.

Its requirements will affect the manufacturer in the financial management of his plant, the mechanical engineer in installing and operating shop equipment, and the workman in regard to his personal safety, physical well-being and earning capacity. These men, taken collectively, have the right to insist that such a code shall justly safeguard the three following interests: The physical well-being of everyone against accidents and impairment of eyesight; the productive capacity of everyone, by indicating from expert experience the minimum amount of illumination necessary for manufacturing and all other processes; the competitive position of manufacturers, by imposing uniform requirements upon everyone engaged in the same line of business.

The *American Machinist* believes that the code has been drawn to cover these three interests and bespeaks for it the hearty support of manufacturers in every state where it is proposed to make use of it as a basis for state law or commission rules.

Shipping Documents for South America

The North American manufacturer who embarks in South American trade should realize at the outset that foreign business is transacted in a manner entirely different from that used in domestic transactions. Shipping from Illinois to Argentina is a far different procedure from sending a machine to Michigan. In the first case the manufacturer has to deal not only with his customer, but also with the United States Government, the Argentine Government, the railroad company and the steamship company. In the second case his dealings are only with the railroad company and his customer. There are many more parties interested in the foreign transaction than in the home traffic.

Unless the machine builder does a very large export business and maintains his own foreign department, it it wise for him to introduce still another party into the transaction of shipping from, say, Illinois to South America. This addition is a reliable export agent or forwarder. While his coming counts one more in the dealings, it simplifies the work of the manufacturer by placing numerous details in the hands of one who is experienced in their handling.

Like everything else, there are good, bad and indifferent forwarders, and manufacturers, before making permanent connections with export agents or forwarders, should investigate carefully the standing and past services of the prospective agent, precisely as they would act in making

any other business arrangement. Such an export agent should be located at the port of departure, which in the case of machinery destined for South America means New York. He should be empowered to act for the shipper in all matters dealing with foreign business.

The agent, when first engaged, sends to the manufacturer bills of lading, certificates of origin of merchandise (for Argentina), consular invoices (for Brazil) and the shipper's export declaration. These papers are sent in the form of blanks and specimens properly filled out. He may even offer suggestions in regard to packing, for the North American manufacturer is notorious the world over for improper, insufficient boxing and casing. All machinery for South America should be packed in extra-heavy boxes, in which every part should be securely braced and all fragile articles protected by padding at the corners and along the edges. The boxes, or cases, should be bound by iron bands. When such a box or case is being designed, it should be remembered that it is more than likely it will be dropped from the derrick of a steamer in some South American roadstead into a lighter tossing about in a heavy sea. Some careful manufacturers, especially the Germans, take the precaution to provide extra-large cases with rope slings, thus assuring safe hoisting means for each package. This practice might well be imitated by North American manufacturers.

After the machine builder has properly boxed his machinery in keeping with these general instructions or the instructions of his forwarding agent—not forgetting to mark his cases properly—he sends the machinery to New York, at the same time mailing to his export agent the consular invoices, bills of lading and his draft drawn to his customer's order. In case the manufacturer is selling on credit he fills out this draft with the amount and for the term specified. In case he is selling "cash against documents" he leaves the amount of his draft blank. The export agent fills in the proper amount by adding to the manufacturer's price his own shipping charges. Where the manufacturer's draft is drawn for payment on credit, as 90 or 120 days, it is customary for the export agent to make out his own sight draft on the customer to cover the shipping charges and send on both drafts with the shipment.

The export agent also arranges the certification of the consular invoice, bill of lading, insurance and cartage. The fees and expenses for these items, when added to the amount of the manufacturer's invoice, make up the total cost of the goods to the foreign buyer.

All the documents, when finally prepared by the export agent, are sent forward on the same steamer that carries the goods and are addressed to the customer's bank in South America. It is customary for the agent to ship in his own name, to avoid the formality of exhibiting his power of attorney when taking oath before the consul. It is absolutely essential that all these documents be properly prepared and forwarded on the same steamer that carries the merchandise. Otherwise, the customer is compelled to pay a fine for delay in claiming his goods at his own custom house, with the exception of Brazil, where he can file a bond guaranteed to produce the documents within 90 days. There have been cases where fines of this nature, caused by delay in the mails, have been so heavy that the customer has refused to accept the goods, putting the North American manufacturer to trouble and expense in recovering his property.

While it is true that some of the large railroad companies will accept the responsibility of handling shipments clear through to South American countries, they have to go through the same forms as the one outlined for the export agent. It is evident that the relationship between manufacturer and agent can be much closer than between the manufacturer and the railroad company. Furthermore, the reliable export houses usually have connections in every principal port of South America and can facilitate the transshipment of goods to interior points.

There are some exporting houses that buy from the manufacturer direct, paying him in cash, and assume their own responsibility for shipping, and collecting from their customers. Generally speaking, however, the manufacturers who have been best pleased with their foreign business have either acted through a branch office or through a reliable export agent. The charges for the agent's services are not excessive and are paid for by the customer, as already explained. The service is evidently well worth all that it costs.

Another way in which the agent can help his client is by keeping posted in regard to the changes in customs or shipping regulations in South America. There are many of these requirements today, as shown by a helpful pamphlet issued by the Bureau of Foreign and Domestic Commerce at Washington, D. C. It is entitled "Consular Regulations of Foreign Countries" and costs 10c. As an illustration of some of these matters, all goods shipped to South America destined for interior points should be marked "En transito para ——." In the blank space should be filled in the name of the destination. Translated, this means, "In transit for ——." As another example, all cases destined for Brazil should have both the net and the gross weight marked on the outside in kilos, not in pounds.

Using Two Loading Stations; Drilling Speeds

There are two noticeable features in connection with the special shell and fuse machines illustrated in this and the preceding issue. One is the use of two vacant stations—one for loading and the other for unloading. This practice provides for the employment of two operators in case the speed of the machine is too great for one operator.

The other is the specific information in regard to drilling small holes by revolving both the work and the drill, in connection with the steel gaine and the brass graze pellet. The steel gaine, with its drill of only 0.031 in., is run at 800 r.p.m. in an opposite direction to the drill, which has a speed of 4,500 r.p.m., giving a total equivalent drill speed of 5,300 r.p.m. In the brass work, however, the drill speed is a third higher and the work speed 50 per cent. more—6,000 and 1,200 r.p.m. respectively, or a total of 7,200 r.p.m.

These speeds are evidently the result of much experimenting, and the relation between the drill and the work speeds is of particular interest. Here is a subject that has not had the study that might well be devoted to it, partly because of the lack of incentive and partly because we seldom seem to have the time. The drilling of ordinary holes is more of a problem than we are apt to think, and doubly so when the holes are many diameters deep.

Shop Equipment News

Special Lathes for Making Large Shells

The demand for lathes suitable for the rapid production of heavy shells and the success of single-purpose machines for use in that work have led the Root & Van Dervoort Engineering Co., East Moline, Ill., to design and build a line of such machines.

The machines are excellent examples of simplicity of design combined with great strength and rigidity. The headstock is the same on all the lathes, the bed, carriage and feed being suited to the work to be done. The spindles are of cast iron, hollow, to allow either 8-in. or 9.2-in. shells to be held inside by air-controlled collet chucks for boring. The bearings are also of cast iron, of ample size, as can be seen from the dimensions, the front being 14 in. and the rear $7\frac{1}{16}$ in. in diameter, with a total spindle length of $40\frac{1}{8}$ in. They are driven by a 4-in. double belt with gear ratios of 6 to 1 and 8 to 1. These can of course be changed, should others be desired.

Two sizes of pedestal lathes are made—one with a bed 4 ft. 5 in.; the other, 2 ft. longer. These are for cutting the band groove and trimming the end to weight. The lathe for boring and turning has a 10-ft. bed and is supported at the outer end. It has a regular carriage, with a large feed screw and rack, stops for the tool slide, trips for the feed and other conveniences, such as an open-side tool post of heavy design, not shown.

The illustrations show these lathes as set up in a shop for manufacturing shells rather than for exhibition. Fig. 1 shows the chain feed and special three-screw chuck.

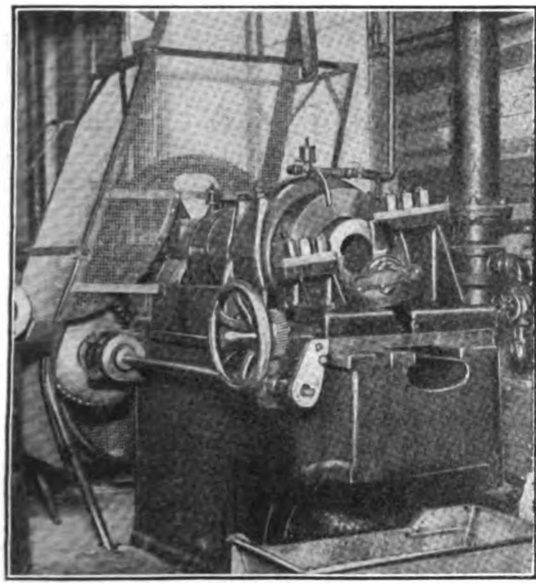


FIG. 1. CUTTING-OFF MACHINE

Spindle bearings, front, $14 \times 8\frac{5}{8}$ in.; rear, $7\frac{1}{16} \times 7\frac{1}{8}$ in.; length of bed, 4 ft. 5 in.; belt, 4 in. double; gear ratio, 8 to 1; weight, 4,500 lb.

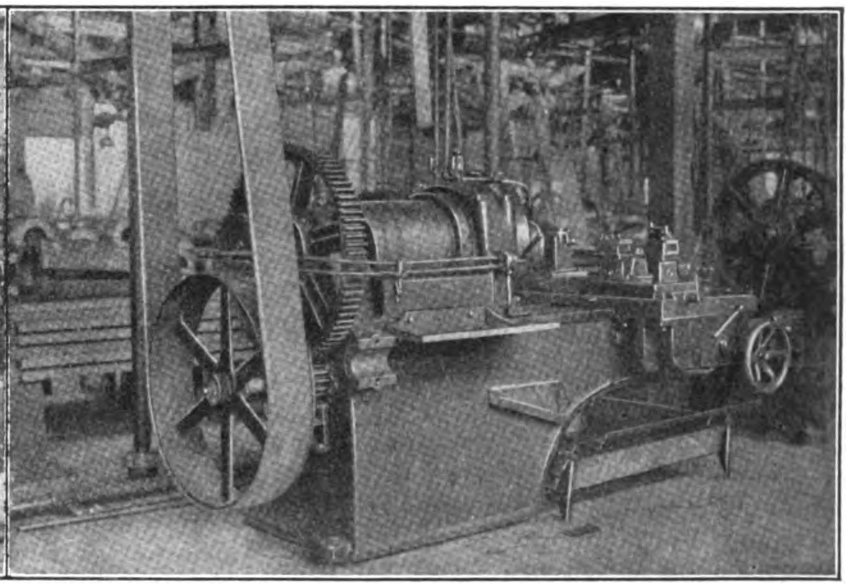


FIG. 2. LATHE FOR TURNING BAND GROOVE

Spindle bearings same as Fig. 1; length of bed, 6 ft. 5 in.; air chuck; belt, 4 in. double; spindle cast iron in cast-iron bearings; special turret and back tools; gear ratio, 6 to 1; weight, 4,800 lb.

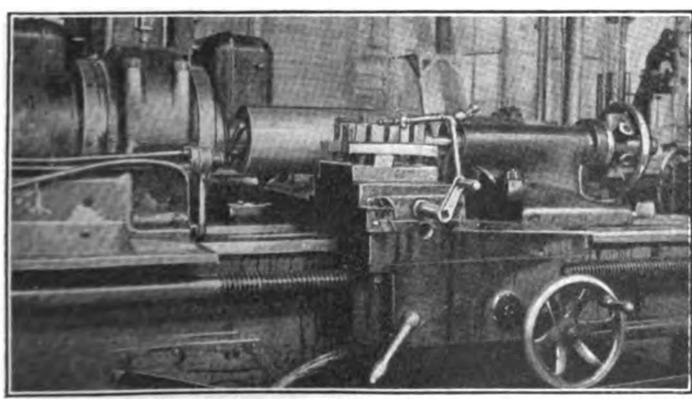


FIG. 3. TURNING OUTSIDE OF SHELL

Spindle and gear ratio same as Fig. 2; special expanding mandrel; length of bed, 10 ft.; weight about 7,500 lb.

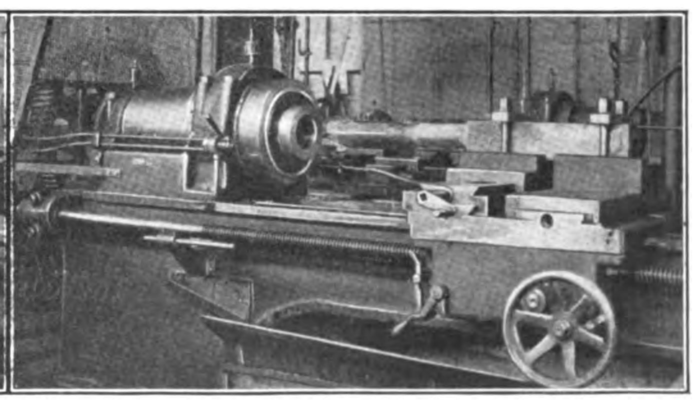
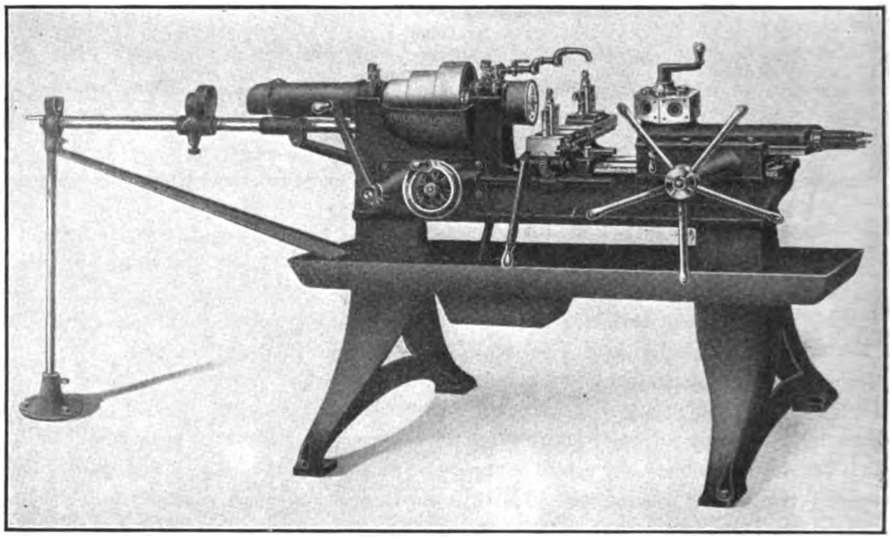


FIG. 4. BORING LATHE

Spindle and gear ratio same as Fig. 2; no tailstock; bed and weight approximately same as Fig. 3

A special carriage is shown in Fig. 2, for cutting and waving the band groove. This illustration also shows the air pipes and valves for the chucks and gives a good idea of the driving gears. Fig. 3 is a close view of the turning lathe, to show the tailstock, in which the handwheel is stationary and is also provided with holes for a bar, if necessary. It gives a good idea of the spindle bearing, the mandrel screwed into the spindle and the four-bolt tool post. The open side is supplied if preferred. Fig. 4 shows the boring lathe with a bar in place and a shell in the chuck. It also illustrates the carriage control and trip. This line is really more than a number of lathes. It is rather a method of large-shell manufacture for which machines and special tools have been worked out and can be supplied ready to begin production. It will be noted that in each of the machines illustrated especial attention has been given to securing rigidity of cutting tool support and the avoidance of light and complex parts or attachments. This has resulted in increased pulling power.



MILLHOLLAND NO. 2 SCREW MACHINE

Bar-stock capacity through auto-chuck, 1 in.; swing over bed, 13½ in.; swing over cutoff, 6 in.; cutoff travel, crossfeed, 5½ in.; cutoff, longitudinal, 9 in.; diameter holes in turret, 1¼ in.; center of holes in turret to top of slide, $2\frac{3}{8}$ in.; diameter of hexagon across flats, 7¼ in.; greatest distance end of spindle to turret, 15 in.; width of drive belt, 2¾ in.; friction pulleys on countershaft, 12x4 in.; speed of countershaft for steel, 230 r.p.m.; for brass, 560 r.p.m.; hole in spindle, $1\frac{3}{32}$ in.; thread on spindle nose, 3¼ in.; diameter, 8 pitch; net weight, 1,275 lb.; crated, 1,450 lb.; boxed for export, 1,650 lb.; measurement, boxed, 72 cu.ft.

Light Automatic Screw Machine

The machine shown, which is built by the W. K. Millholland Machine Co., Indianapolis, Ind., embodies many of the features of the previously described product of this company, but is much lighter.

The headstock and bed are cast solid, with a heavy web connecting the front and back bearings. This construction enables the machine to perform heavy work without chatter or vibration. The bearings are die-cast under hydraulic pressure. The spindle is made of high-carbon, hammered steel, with large-size bearings accurately ground and fitted. The automatic chuck is telescoped into the spindle nose, reducing the overhang to less than 3 in. from the face of the front bearing and less than 1¼ in. from the end of the spindle.

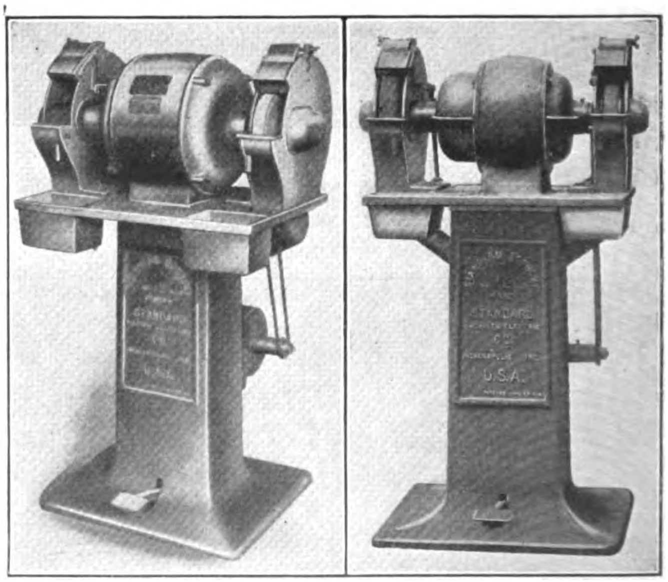
By drawing the hand lever toward the operator the stock is automatically fed forward, and by pushing the lever back the automatic chuck grips the stock and simultaneously centers it to run true. The collets are removable and interchangeable and can be supplied to hold round, square or hexagon stock. All parts of the chuck mechanism are hardened, and they are ground on the bearing points, making them almost indestructible. Special collets can be supplied to hold castings or forgings.

The turret mechanism is automatic in its functions, the indexing and stops being entirely automatic in their action. The turret is hexagon in shape, drilled and tapped to hold special fixtures besides the tools that fit in the tool holes in the faces. The stops on the turret are quickly and accurately adjusted for any desired length. The cutoff slide is provided with a lever cutoff, but a screw feed can be furnished, if desired. The longitudinal adjustment of the cutoff carriage has a device for accurate multiple-shoulder cutting.

The oil pan is made from heavy-gage sheet steel. The oil pump delivers a full stream of coolant while running in either direction. Special turret tools will be designed and supplied for any class of work for which the machine is suited. A standard set of tools can be furnished, if specially ordered. A double friction countershaft accompanies each machine.

Two Motor-Driven Grinders

The grinders here shown are of two types—alternating- and direct-current motor driven. Fig. 1 shows the alternating-current and Fig. 2 the direct-current type. They are made by the Standard Machine and Electric Co.,



FIGS. 1 AND 2. ALTERNATING- AND DIRECT-CURRENT GRINDERS

Motor, 3 hp., 3 phase, 60 cycle, 220 or 440 volt; maximum size of grinding wheel, 12x2 in.; wheel collars, 5½x1¼ in.; length of arbor, 26 in.; diameter of arbor where wheel goes, 1¼ in.; floor to center of arbor, 39 in.; base, 20x23 in.; speed, no load, 1,800 r.p.m.; speed, full load, 1,720 r.p.m.; exhaust fan, 6x2 in.; weight, complete, 575 lb.

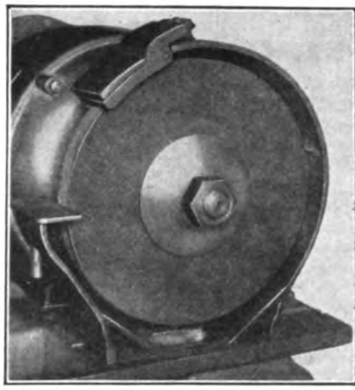


FIG. 3. HOOD WITH NEW WHEEL IN PLACE

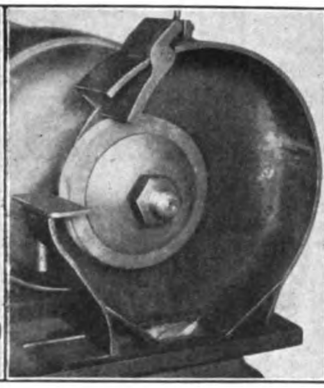


FIG. 4. POSITION OF HOOD PARTS AS WHEEL WEARS

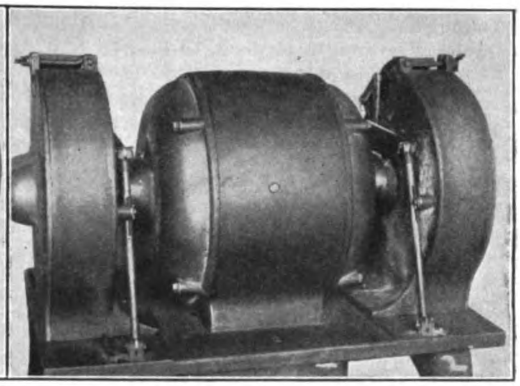


FIG. 5. ARRANGEMENT OF LEVERS FOR BREAKER OPERATION

Indianapolis, Ind. With the exception of being fitted for the use of different current, they closely resemble each other.

One of the principal features is that the machines are running only while in actual use. As the operator goes to the machine to grind, he steps on a foot treadle, the wheels instantly commence to move and quickly get up to full speed. As he leaves, the release of the treadle opens the switch and stops the machine.

Arrangements are provided so that a sudden forcing of the work on a wheel will not cause a burn-out. All of the electrical apparatus is combined in the machine itself, with suitable fuse blocks on the back of the column, where they are easily accessible. In setting up a machine only two wires need to be connected for the direct and three for the alternating type. Both the motor spindle and the exhaust fan are equipped with a double row of ball bearings. The electric starting action is purely mechanical. The exhaust fan is belted direct to the spindle and starts with it.

Attention is called to the wheel hoods. The work rests are quickly adjusted to the wheel as it wears, by loosening a hand bolt and sliding the hood along. The same operation automatically adjusts the spark and dust breaker guard at the top. As a rule, this has to be adjusted separately by the operator and in consequence is seldom moved at all, leaving a large open space above the wheel.

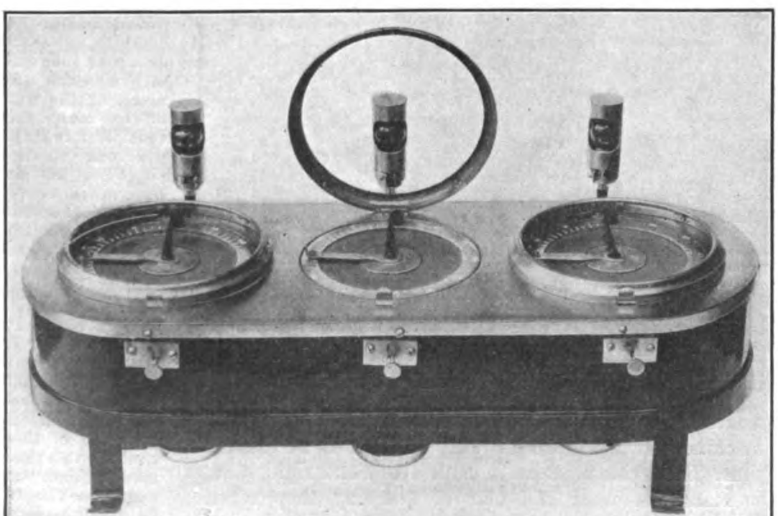
The action of this breaker is plainly illustrated in Figs. 3, 4 and 5. In Fig. 3 the hood is shown with a new wheel on the spindle. As this wheel is worn down, the work rest is pushed along, so as to be close to the cutting part of the wheel, and the breaker assumes the position shown. The position of the breaker makes it necessary for it to travel in faster the more the wheel wears, while the work guard is moved in exact proportion to the wear. This action of the breaker is accomplished by means of a series of levers, arranged as shown in Fig. 5. All parts of the hoods proper are easily removed by the loosening of convenient wing nuts.

Automatic Timing Reminders

The type of instrument described herewith was designed for use where a predetermined time is required, as notably in the case of heat treating steel. The instrument is made in a number of styles, singly or in groups, as shown.

In operation it is simply necessary to set a lever at the number of seconds or minutes it is desired to have work treated, and at the expiration of the predetermined period a bell will ring or a light flash, or the instruments can be arranged to serve both signals. An automatic check is thus kept on the time required for certain processes or operations. The attendant is relieved of the necessity of paying any attention to the time and is enabled to devote attention to other duties.

The hand that normally stands at zero is placed in motion by raising a small lever on the side of the case. The hand travels around the dial until it comes in contact with a lever that has been previously set at the time the operator wishes to be signaled. When the signal is given, the hand releases itself and returns to zero automatically. It will be apparent that the little attention required permits the operation of many instruments by one attendant.



AUTOMATIC TIME REMINDERS

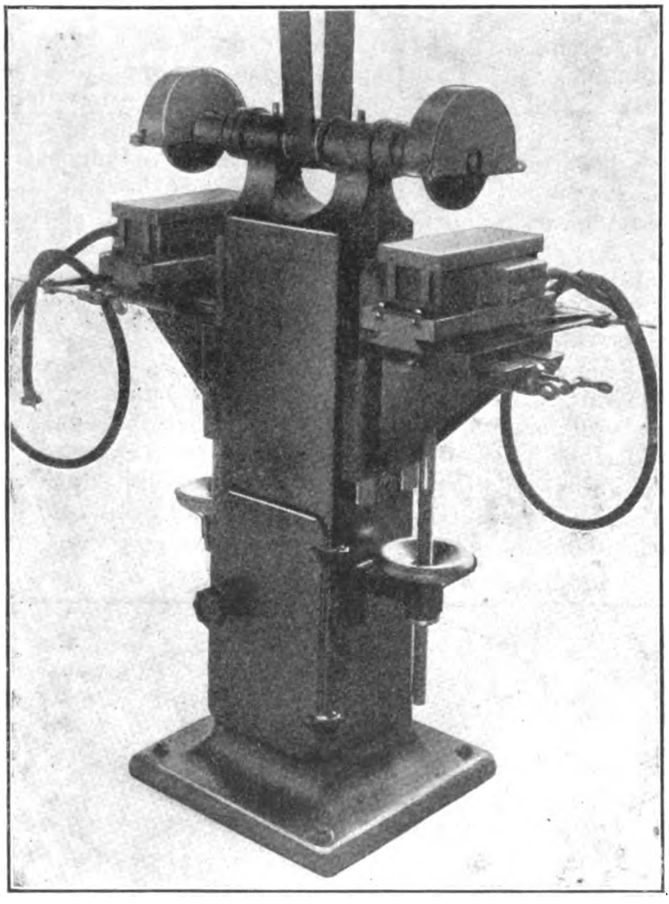
A single instrument is about 9 in. in diameter and 6 in. high. The weight is about 15 lb.

While this class of instrument was designed primarily for application in hardening rooms, there are other classes of work in which they can no doubt serve a useful purpose, such as dipping, electroplating and other electrolytic and chemical processes. The triple type of instrument shown is especially well adapted for a process applied to a certain product in which different times are used for certain elements, as in the case of preheating, soaking and quenching.

These instruments are made in a variety of styles for any special purposes by C. H. Brown, 47 Butternut St., Detroit, Mich.

Double-End Surface Grinder

The grinder shown is intended for the lighter forms of plain surface grinding frequently encountered in manufacturing. Both the table feed and the crossfeed are hand operated, and the screw dials are graduated to read in thousandths. The table traverse movement is by hand lever only. The general construction of the machine



DOUBLE-END PLAIN SURFACE GRINDER
Table, 5¼ in. wide by 12 in. long; extreme stroke, 5½ in.; crossways, 10¾ in. long by 6 in. wide; table movement, 4¼ in. without overhang; vertical ways, 6 in. wide by 16 in. long; knee, 8 in. long on the ways; spindle, 1⅜ in. in diameter by 24 in. end to end; base, 19x19 in.; column, 9x10 in. at base and 7x10 in. at top; overall height, 48 in.; weight, 675 lb.

makes it take up but little more floor space than a single machine, yet two operators can work on it at the same time. The whole machine is made heavy and rigid enough to stand the wear and tear of everyday shop service. It may be had with plain table or fitted with magnetic chuck or vise, as ordered.

It is made by the Stenotype Co., Indianapolis, Ind.

NEW PUBLICATIONS

AUTOMOBILE REPAIRING MADE EASY—By Victor W. Page. One thousand and sixty pages, 5¼x8 in.; 479 illustrations. Published by the Norman W. Henley Publishing Co., New York City.

This is a new, 1916 edition of a book that should help almost anyone to become familiar with many details of automobile construction and repair. It is profusely illustrated to show many of the different motors, clutches and other parts and has numerous double-page inserts. It also contains much that seems very elementary in the way of showing pliers, vises and similar tools, and many of the illustrations have a familiar look. But the average garage repairman should be able to find much of value about cars with which he may not be familiar, while owners can get many suggestions that should help keep their cars out of the repair shop. The book includes ignition, starting and lighting systems and tire repair.

THE WELDING ENGINEER. L. A. MacKenzie, editor. The Welding Engineer Publishing Co., Chicago, Ill. Domestic subscription, $2 per year.

The issue before the reviewer is No. 1, Vol. 1, of a technical journal founded to meet the needs of those who are interested in the art of welding. The editorial announcement states:

> In the past the problems of the welder have been treated by many of the leading trade journals of this country with beneficial results. The time has arrived, however, when the industry has reached a point where no one of the existing trade papers can devote sufficient space to welding topics to keep the interested reader fully advised on welding subjects. In other words, the welding industry has become a specialized field, and a specialized trade paper is needed.

The standard journal size of 9x12 in. has been adopted, and the make-up and illustrations in this first number are above the average of new trade publications. The 16 pages of editorial matter cover a wide range of welding practice, in which the leading article treats of welding high-speed steel bits to carbon-steel shanks. The usual features of an alphabetical index to advertisements and a buyers index are included.

ENGINEERING AS A CAREER—Edited by F. H. Newell and C. E. Drayer. Two hundred and fourteen 5x7½-in. pages; cloth bound. D. Van Nostrand Co., New York City. Price, $1.

Reviewed by DEXTER S. KIMBALL*

This interesting book is an effort to present to young men and their advisers some facts and advice concerning engineering as a life work. It consists of 22 short essays on as many phases of industrial life, closely connected with some form of engineering. Nearly all these papers have been written by eminent practicing engineers, the remainder being the work of educators. Each article discusses some field of engineering, with the view of showing what this field is like, what the chances of success are and what characteristics a boy must have, to do well in this line. Most of the articles were first published in the "Cleveland Plain Dealer" and in the "Scientific American" in response to questions asked from time to time about the opportunities and requisites for success in the engineering professions.

It is axiomatic that a collection of articles from such a group of men contains much of interest and profit for young men who are thinking of engineering as a profession. While much of the advice offered is of a standard type, there are offered many facts and illustrations of a practical character that illuminate the several fields of engineering as they appear only to those who have had actual experience in them. Of course, as one of these writers points out, it is doubtful of how much value advice of this kind is to young men, and it may be doubtful how much they will profit by it. But the fact remains that the engineering field becomes more complex daily, and it is only by means of this kind that it is possible to give young men some idea of what their opportunities may be.

It is interesting to notice that, while these papers were written by men in widely different fields and while, as might be expected, their conclusions are not always the same, there are some points on which practically all agree. A great many of them, for instance, state specifically that a college training, if not absolutely essential, is highly desirable and is in any case a great asset. There is, in fact, an undercurrent of approval of the technical school and its methods that is extremely interesting in view of the opposite opinions that are held by many manufacturers and industrial leaders. The articles on Vocational Guidance, by James F. Barker, and that on Incomes of Technically Trained Men, by David E. Rice,

*Professor of Machine Design and Construction, Sibley College, Cornell University.

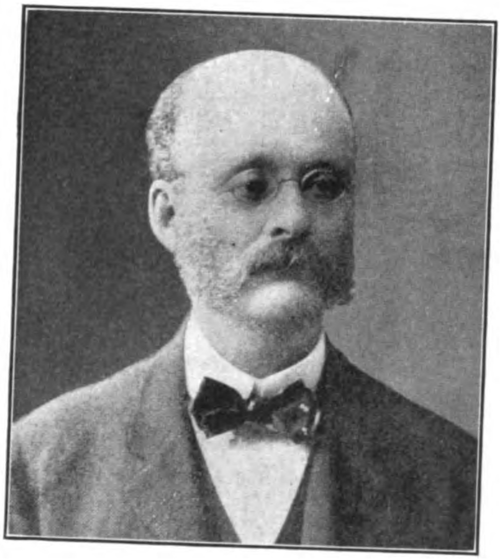
are of particular interest in this respect, as they give some statistics and mathematical examples on the advantages of technical training. We are in need of more data of this kind.

The book will be valuable to young men generally, to parents, to teachers in high schools who are concerned with vocational guidance and to teachers in higher technical schools. All the articles are well written and may be read with pleasure and profit by many other people who wish to know something about the most interesting occupations of modern life.

Melville H. Barker

Melville Hazen Barker, general manager of the American Tool and Machine Co. and one of the most familiar figures in the machine-tool building industry, died at his home in Dorchester, Mass., on Mar. 9, after a brief illness.

Mr. Barker's career in the machinery-building field made him one of its most respected members. For more than 20 years he acted as general manager of the American Tool and Machine Co. In addition to his long business career Mr. Barker's activity in the affairs of the National Metal Trades Association, of which he was a charter member, brought him much prominence. He had been continuously a member of the administrative council of this association since its organization in 1897 and served a term as its president in 1907.



MELVILLE H. BARKER

Mr. Barker was born in Bridgton, Me., 70 years ago.

PERSONALS

John S. Atkinson, for three years with the Cleveland Twist Drill Co., has taken the position of general tool foreman with the Stenotype Co., Indianapolis, Ind.

Forrest E. Cardullo, formerly designer with the Curtiss Motor Co. has accepted the position of chief draftsman of the Pierce?Arrow Motor Car Co., Buffalo, N. Y.

Clement F. Street has been awarded the John Scott Legacy Medal and Premium by the Franklin Institute for his development of the Street locomotive stoker.

R. T. Pollock, until recently assistant general manager of the New England Westinghouse Co., Springfield, Mass., has become vice-president and works manager of the Stenotype Co., Indianapolis, Ind.

B. G. Welchans who has been connected with the Canadian-Westinghouse Comuany, and previously with the engineering divisions of the Bethlehem Steel and American Locomotive Companies, has been appointed general superintendent of the Stanley G. Flagg & Co. plant at Pottstown, Penn.

Arthur C. Wright, recently manager of the Commonwealth Small Arms Factory, Lithgow, N. S. W., Australia, and previous to that foreign connection superintendent of the old Hopkins & Allen plant in Norwich, Conn., is now works manager of the New England Westinghouse Co., E. Springfield, Mass.

H. L. Harrison, formerly connected with the Barber-Colman Co., Rockford, Ill., and more recently superintendent of the munition department of the American Car and Foundry Company's plant at Berwick, Penn., has become production engineer of the Hazelton (Penn) plant of the International Steam Pump Co.

Arthur Churchill, for the past few years at the head of the small tool department of Charles Churchill & Co., Ltd., London, has been elected managing director, succeeding his brother the late Charles Henry Churchill. Willis Churchill who has been associated with the firm for over thirty years has been elected a member of the board of directors. Messrs. Walter Chamberlain and J. W. W. Gabriel remain as active members of the board.

TRADE CATALOGS

B. C. Ames Co., Waltham, Mass. Folder. Bench lathe and fixtures. Illustrated.

W. & B. Douglas, Middletown, Conn. Circular. "Connecticut" high duty lathe. Illustrated.

The Titanium Alloy Mfg. Co., Niagara Falls, N. Y. Catalog. Titanium aluminum and bronze castings. Illustrated, 48 pp., 3½x8½ in.

International Oxygen Co., 115 Broadway, New York. Catalog. I. O. C. bipolar oxygen and hydrogen generators. Illustrated, 24 pp., 8½x11 in.

FORTHCOMING MEETINGS

A course of free lectures on military engineering will be given under the auspices of a committee representative of the four national engineering societies, by Captains Robins, Coiner and Ardery, Corps of Engineers, U. S. A. This course will be under the direction of Major-Gen. Leonard Wood and is designed to assist those who desire to enter the engineering battalion which will be formed at Plattsburg next summer. All engineers interested in preparedness will be welcome, but attendance at these lectures does not imply obligation to subsequent camp duty. Through the cordial attitude and coöperation of the United Engineering Society, the auditorium of the Engineering Societies Building has been placed at the disposal of the army officers. These lectures will be given weekly, having begun on Feb. 14, under the following divisions:

March 27, 1916—The construction, operation and maintenance of railways under military control and the construction and operation of armored trains.

American Society of Mechanical Engineers. Spring meeting, April 11-14, New Orleans, La., Calvin W. Rice, secretary, 29 West 39th St., New York, N. Y.

National Metal Trades Association. Annual meeting, Apr. 27-28, New York, N. Y., Hotel Astor. H. D. Sayre, secretary, Peoples Gas Building, Chicago, Ill.

American Society for Testing Materials. Annual meeting June 27 to July 1, 1916, Hotel Traymore, Atlantic City, N. J. Edgar Warburg, secretary, University of Pennsylvania, Philadelphia, Penn.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Wednesday each month. J. A. Brooks, secretary, Brown University, Providence, R. I.

New England Foundrymen's Association. Regular meeting second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. Secretary, R. H. Barnes, Taylor Instrument Companies, Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. J. H. Warder, secretary, 1785 Monadnock Block, Chicago, Ill.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Technical League of America. Regular meeting second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York, N. Y.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points indicated:

	Mar. 17, 1916	One Month Ago	One Year Ago
No. 2 Southern foundry, Birmingham	$15.00	$15.00	$9.50
No. 2 X Northern foundry, New York	20.75	19.75	14.25
No. 2 Northern foundry, Chicago	18.50	18.50	13.00
Bessemer, Pittsburgh	21.95	21.45	14.55
Basic, Pittsburgh	19.20	18.70	13.45
No. 2 X, Philadelphia	20.00	20.00	14.25
No. 2 Valley	18.50	18.25	13.00
No. 2, Southern Cincinnati	17.90	17.90	12.15
Basic, Eastern Pennsylvania	19.50	19.50	13.50
Gray forge, Pittsburgh	18.45	18.45	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger from jobbers' warehouse at the places named:

	New York				
	Mar. 17, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Steel angles, base	2.95	2.70	1.85	3.25	3.10
Steel T's, base	3.00	2.75	1.90	3.25	3.10
Machinery steel (bessemer)	2.95	2.70	1.80	3.25	3.10

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse at the places named:

	New York				
	Mar. 17, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
No. 28 black	3.50	3.50	2.60	2.95	3.10
No. 26 black	3.40	3.40	2.50	2.85	3.00
Nos. 22 and 24 black	3.35	3.35	2.45	2.80	2.95
Nos. 18 and 20 black	3.30	3.30	2.40	2.75	2.90
No. 16 blue annealed	4.30	2.45	2.35	3.00	3.30
No. 14 blue annealed	4.20	3.35	2.25	3.60	3.20
No. 12 blue annealed	4.15	3.30	2.20	3.55	3.15
No. 28 galvanized	5.65	5.65	4.00	5.25	5.25
No. 26 galvanized	5.35	5.35	3.75	4.95	4.95
No. 24 galvanized	5.20	5.20	3.55	4.80	4.80

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot:

	Black		Galvanized	
	Mar. 17, 1916	One Yr. Ago	Mar. 17, 1916	One Yr. Ago
¾- to 2-in. steel butt welded	73%	80%	55½%	69½%
2½- to 6-in. steel lap welded	72%	79%	54½%	68½%
Diameter, In.				
¾	3.11	2.30	5.12	3.51
1	4.59	3.40	7.57	5.19
1¼	6.21	4.60	10.24	7.02
1½	7.43	5.50	12.24	8.39
2	9.99	7.40	16.47	11.29
2½	16.38	12.29	26.62	18.43
3	21.42	16.07	34.81	24.10
4	30.52	22.89	49.60	34.34
5	41.44	31.08	67.34	46.62
6	53.76	40.32	87.36	60.48

Bar Iron—Prices are as follows in cents per pound at the places named:

	Mar. 17, 1916	One Month Ago
Pittsburgh, mill	2.40	2.20@2.30
New York	2.60	2.40@2.45
Warehouse, New York	2.90	2.70
Warehouse, Cleveland	2.95	...
Warehouse, Chicago	2.90	...

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-sized orders the following quotations hold:

New York..5% above List Price   Cleveland...... List Price   Chicago............List Price

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York.... $4.50   Cleveland.... $5.05   Chicago.... $3.60

In coils an advance of 50c. is usually charged.

METALS

Antimony—Chinese and Japanese brands are quoted as follows in cents per pound for spot delivery, duty paid:

New York.... 45.00   Cleveland.... 50.00   Chicago.... 45.00

Copper Bars from warehouse sell as follows per pound:

New York.... 39.50   Cleveland.... 39.00   Chicago.... 37.00

Miscellaneous Metals—The present quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	New York		
	Mar. 17, 1916	One Month Ago	One Year Ago
Copper, electrolytic (carload lots)	27.25	27.25	14.00
Tin	52.00	42.00	....
Lead	8.00	6.30	4.10
Spelter	18.25	20.50	10.50
ST. LOUIS			
Lead	7.80	6.15	...
Spelter	18.00	6.20	...

At the places named, the following prices in cents per pound prevail:

	New York				
	Mar. 17, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Copper sheets, base	35.00	35.00	19.75	34.00	34.00
Copper wire (carload lots)	35.00	35.00	16.50	34.50	36.00
Brass rods, base	37.50	37.00	16.25	36.00	35.00
Brass pipe, base	41.50	40.00	19.00	43.00	41.50
Brass sheets	37.50	37.00	16.25	36.00	35.50
Solder ½ and ½ (case lots)	31.75	26.50	34.00	35.00	29.00

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York		
	Mar. 17, 1916	One Year Ago	Cleveland
Copper, heavy and crucible	23.00	12.50	24.00
Copper, heavy and wire	22.00	....	23.00
Copper, light and bottoms	19.00	10.75	20.00
Lead, heavy	5.25	3.50	7.00
Lead, tea	4.75	3.25	5.25
Brass, heavy	14.00	8.50	19.00
Brass, light	17.00	6.75	12.00
No. 1 yellow rod brass turnings	14.00	....	14.50
Zinc	14.00	5.25	15.00

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	31.50	32.00	32.50	33.00	36.00
¼ to 5/16	31.25	31.75	32.25	32.75	35.75
⅜ to 1⅛	31.00	31.50	32.00	32.50	35.50
1 3/16 to 2⅞	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3 7/16	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3½ to 3 15/16	32.25	32.75	33.25	35.75	36.75
Squares					
3 1/16 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4 15/16	33.00	33.50	36.00	36.50	37.50
5 to 6 15/16	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places indicated:

	New York	Cleveland	Chicago
Best grade	55@60	63.00	55@60
Commercial	25@30	23.50	25@30

SHOP ACCESSORIES

Nuts—From warehouses at the places named, the following amount is deducted from list price:

	New York	Cleveland	Chicago
Hot pressed square	$3.00	$3.70	$3.70
Hot pressed hexagon	3.20	3.80	3.80
Cold punched square	3.00	3.50	3.75
Cold punched hexagon	3.75	4.25	4.50

Semifinished nuts sell at the following discount from list:

New York..70%   Cleveland..70 and 10%   Chicago..70 and 10%

Wrought Washers—From warehouses at the places named the following amount is deducted from list price:

New York.... $4.50 Cleveland.... $6.50 Chicago.... $6.30

At this rate the net prices follow:

Diameter, In.	New York	Cleveland	Chicago
5/16	$9.50	$7.50	$7.70
¾	7.70	5.70	5.90
⅞	6.90	4.90	5.10
1	6.00	4.00	4.20
1⅛	5.20	3.40	3.50
1⅜	4.70	2.95	3.10
1½	4.60	2.80	3.00
1¾	4.50	2.70	2.90
2, 2¼, 2½, 2¾	4.30	2.60	2.80
3, 3¼	4.50	2.70	2.70
3½	4.70	3.00	2.90
4, 4¼, 4½	5.00	3.00	3.20

For cast-iron washers the base price per 100 lb. is as follows:

New York.... $2.50 Cleveland.... $2.00 Chicago.... $1.90

Carriage Bolts—From warehouses at the places named the following discounts from list price are in effect:

	New York	Cleveland	Chicago
⅜ by 6 in. and smaller.....	60%	65%	50 and 15%
Larger and longer..........	50%	60%	65%

Length, In.	New York ¼	New York ½	New York ¾	Cleveland ¼	Cleveland ½	Cleveland ¾	Chicago ¼	Chicago ½	Chicago ¾
1½	$0.40	...	...	$0.35	...	...	$0.43	...	...
2	.44	...	...	.38	...	...	.47	...	...
2½	.48	$1.63	$4.25	.42	$1.30	$3.40	.52	$1.14	$2.98
3	.52	1.77	4.50	.45	1.41	3.60	.57	1.24	3.15
3½	.56	1.91	4.75	.49	1.52	3.80	.62	1.34	3.32

Tap Bolts—The discount from list at warehouses is as follows:

New York .... 20% Cleveland 30%

Bolt Ends—Fair-sized orders of bolt ends with hot-pressed nuts sell at the following discounts from list:

New York	50%
Cleveland	60%
Chicago	50 and 20%

Turnbuckles—From warehouses at the places named the following prices prevail:

New York—Smaller than 1¼ in. diam., 40%; 1¼ up to 2 in., 30%.

Cleveland—Smaller than 1¼ in. diam., 60%; 1¼ up to 2 in., 35%.

Chicago—Up to 1 in., 50%; up to 1½ in., 45%; over 1½ in., 33⅓%.

Size	New York	Cleveland	Chicago
½	$0.27	$0.18	$0.28
¾	.38	.25	.32
1	.53	.35	.44
1½	1.05	.97	.44
2	1.86	1.06	1.75

These buckles have right and left stub ends with turnings between the heads measuring 5½ in.

Rivets—The following are the base quotations from warehouse for fair quantities:

	New York	Cleveland	Chicago
Steel 7/16 and smaller..........	65%	60, 10 and 10%	60—10%
Tinned	65%	60, 10 and 10%	60—10%*

*An addition of 3.5c. per lb. is usually charged.

For button heads ¾, ⅞, 1 in. diam. by 2 in. to 5 in. sell as follows per 100 lb.:

New York.... $4.50 Cleveland.... $3.25 Chicago.... $3.25

Cone heads, same sizes:

New York.... $4.60 Cleveland.... $3.35 Chicago.... $3.35

	Extra per 100 Lb.
1⅛ to 1⅞ in. long, all diameters..................	$0.25
⅝ in. diameter	0.15
½ in. diameter	0.50
1 in. long and shorter..............	0.50
Longer than 5 in..............	0.25
Less than kegs..............	0.50
Countersunk heads	0.50

Coach or Lag Screws—For fair-sized orders from warehouses at the places named the following discounts hold:

New York.. 65% Cleveland.. 70% Chicago..65, 10 and 5%

Machine Bolts—For fair-sized orders from warehouses at the places named the following discounts hold:

	New York	Cleveland	Chicago
⅜ by 4 in. and smaller......	60%	65 and 10%	50 and 20%
Larger and longer up to 1 in. by 30 in..................	50%	60%	65 and 5%

Length, In.	New York ¼	New York ½	New York 1	Cleveland ¼	Cleveland ½	Cleveland 1	Chicago ¼	Chicago ⅝	Chicago 1
2	$0.71	$1.93	$8.00	$0.56	$1.44	$6.04	$0.71	$1.28	$5.32
2½	.74	2.06	8.45	.58	1.54	6.40	.74	1.37	5.61
3	.78	2.19	8.90	.61	1.64	6.76	.78	1.45	5.90
3½	.81	2.32	9.35	.64	1.75	7.12	.81	1.53	6.19

Copper Rivets from warehouse sell at the following rate:

New York..............25% Cleveland.......10% from list
Chicago............10% from list

Nails—Wire nails f.o.b. Pittsburgh sell at $2.40; galvanized, 1 in. and longer, $4.40, and shorter, $4.90. These prices are to regular customers and delivery is made at the mill's convenience. From warehouse wire and cut nails sell as follows:

New York.... $2.90 Cleveland.... $2.90 Chicago.... $2.70

MISCELLANEOUS

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire

⅜, 11/32, 5/16, ¼, 7/32, 3/16....	8.50
No. 8, 5/32 and No. 10....	9.25
⅛	10.00
No. 12	11.00
3/32, No. 14 and 1/16......	12.00
No. 18	14.00
No. 20	16.00

Special Welding Steel

⅛	33.00
5/32	30.00
3/16	28.00

Cast-Iron Welding Rods

¼ by 19 in. long.......	22.00
3/16 by 12 in. long.......	26.00
⅜ by 19 in. long.......	20.00
½ by 21 in. long.......	20.00

Vanadium Wire in Coils or Sticks

1/16	15.50
3/32	15.00
⅛	14.00
5/32	12.00
3/16 and larger..........	11.00

Seamless Drawn Tubing—The base price in cents per pound from warehouse is as follows:

	New York	Cleveland	Chicago
Brass	41.50	44.00	39.00
Copper	42.50	45.00	39.00

For immediate stock shipment the following quotations are in effect:

Diameter, In.	Copper New York Mar. 17, 1916	Copper New York One Year Ago	Copper Cleveland	Brass New York Mar. 17, 1916	Brass New York One Year Ago	Brass Cleveland
¾ to 2½.....	45.50	22.00	45.00	43.50	19.00	44.00
3	45.50	22.00	45.00	43.50	19.00	44.00
3½	46.50	22.00	45.00	45.00	19.50	44.00
4	47.50	23.50	46.00	46.00	20.00	45.00
4½	49.50	24.50	48.00	48.00	21.00	47.00
5	51.50	25.50	50.00	50.00	22.00	49.00
6	52.50	28.50	52.00	51.00	25.00	51.00
7	54.50	30.50	52.00	53.00	27.00	51.00
8	56.50	32.50	56.00	55.10	29.00	55.00

Tin Plates—The following prices are in effect from warehouses at the places named:

			New York	Cleveland	Chicago
Coke tin plate, 14x20:					
100 lb.		....	$5.00	$4.87½	$4.75
I. C. 107 lb.		....	5.15	5.05	4.90
Terne plate, 20x28:					
Base Weight	Net Weight	Coating			
100 lb.	200	8.........	$9.00	$8.60	$8.50
I. C.	214	8.........	9.30	8.90	8.90
I. X.	270	8.........	11.30	11.10	12.75
I. C.	218	12.........	12.00	10.10	10.80
I. C.	221	15.........	13.00	10.90	11.25
I. C.	226	20.........	13.50	12.20	12.20
I. C.	231	25.........	14.25	13.40	15.35
I. C.	236	30.........	15.50	12.40	15.60
I. C.	241	35.........	17.00	15.60	16.20
I. C.	246	40.........	19.00	16.60	16.80

Zinc Sheets—The following prices in cents per pound prevail:

Carload lots, f.o.b. mill.............................. 25.00

	New York	Cleveland	Chicago
In casks	26.00	26.25@26.50	27.00
Broken lots	26.50	26.50@26.75	28.00

Cotton Waste—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	11.00@13.00	9.50@13.50	11.00@12.00
Colored mixed	8.00@10.00	7.00@ 9.00	9.00@10.50

Sal Soda sells as follows per 100 lb.:

New York .... $1.25 Cleveland $1.62½
Chicago $1.85

Roll Sulphur in 360-lb. bbl. sells as follows per 100 lb.:

New York.... $2.25 Cleveland.... $2.60 Chicago.... $2.85

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Feb. 26	Mar. 4	Mar. 11	Mar. 18
Prompt furnace	$3.00@3.50	$3.50@3.75	$3.50@3.75	$3.50@3.75
Prompt foundry	3.75@4.25	3.75@4.25	3.75@4.00	3.75@4.00

Linseed Oil—These prices are per gallon:

	New York	Cleveland	Chicago
Raw in barrels..............	$0.81	$0.84	$0.81
5-gal. cans	.91	.94	.86

Boiled, it is 1c. per gal. higher.

White Lead, dry and in oil, in cents per pound sells as follows:

100-lb. keg	10.50
25- and 50-lb. kegs..................	10.75
12½-lb. keg	11.00
1- to 5-lb. cans..................	12.50

Red Lead, dry, in cents per pound sells as follows:

100-lb. keg	10.50
25- and 50-lb. kegs..................	10.75
12½-lb. keg	11.00

In oil, the price in cents per pound is as follows:

100-lb. keg	11.00
25- and 50-lb. kegs..................	11.25
12½-lb. keg	11.50

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

Beaupre Bros. plans to enlarge its foundry on Webster St., Franklin, N. H.

W. J. Murphy Co., Amesbury, Mass., will build a 3-story bronze factory at Amesbury. E. R. Simpson, 176 Federal Bldg., Boston, Mass., Engr.

Plans have been prepared for the construction of a foundry for the Stafford Co., Hyde Park Ave., Boston, Mass.

Plans are being prepared for the construction of a 1-story, 80x150-ft. garage at Brockton, Mass., for E. L. Bonney. Estimated cost, $20,000.

The W. A. Snow Iron Works is constructing a 2-story, 50x 82-ft. addition to its plant at 187 3rd St., Chelsea, Mass.

The Davis Foundry Co., Island St., Lawrence, Mass., plans to construct a plant at Market and Parker St., Lawrence.

Plans are being prepared by W. H. Hunt & Son, Federal Bldg., Salem, Mass., for the construction of a 1-story, 55x140-ft. garage at Winchendon, Mass. Estimated cost, $12,000.

E. M. Clark has awarded the contract for the construction of a 1-story, 45x90-ft. garage at Worcester, Mass. Estimated cost, $15,000. Noted Jan. 20.

Plans are being prepared by George H. Clemence, Arch., Walker Bldg., Worcester, Mass., for the construction of a garage at Worcester for the city.

The Reed-Prentice Co., manufacturer of machines and tools, is constructing an addition to its plant at Worcester, Mass.

The contract has been awarded for the construction of a 1-story, 60x62-ft. garage at Worcester, Mass., for J. Francis Southgate, 5 Crown St., Worcester. Estimated cost, $60,000. Noted Dec. 23.

The Standard Nut and Bolt Co. plans to construct a 2-story, 70x80-ft. addition to its plant at Valley Falls, R. I.

The Pratt & Whitney Co., manufacturer of machinists tools, has awarded the contract for the construction of a 4-story addition to its plant at Hartford, Conn. Estimated cost, $75,000. Noted Mar. 16.

The Underwood Typewriter Co. has awarded the contract for the construction of additions to its plant on Woodbine St., Hartford, Conn.

The Eagle Lock Co. has awarded the contract for the construction of a 1-story addition to its factory at Terryville, Conn. Noted Mar. 2.

The Mattatuck Manufacturing Co., manufacturer of brass goods, has been granted a permit for the construction of a 3-story addition to its plant at Waterbury, Conn.

MIDDLE ATLANTIC STATES

The Sizer Forge Co., 238 Larkin St., Buffalo, N. Y., has awarded the contract for a forging plant.

The Chile Exploration Co., 120 Broadway, New York, N. Y., is in the market for locomotive cranes to be shipped to Chile.

The contract has been awarded for the construction of a 2-story, 74x200-ft. garage on 152d St. west of Broadway, New York, N. Y. (Borough of Manhattan), for D. I. Dean. Estimated cost, $75,000. Noted Mar. 2.

R. Fabien & Co., 35 South William St., New York, N. Y., is in the market for 2 second-hand foundry cranes for export.

The Titanium Alloys Co., Niagara Falls, N. Y., plans to construct an addition to its plant at the north end of the city. Estimated cost, $200,000. W. F. Meredith, 61 East 65th St., New York, N. Y., is Pres.

We have been informed that the Hexamer Auto Co., 217-19 Hudson St., Hoboken, N. J., will soon be in the market for an elevator and complete machine shop equipment for the 4-story, 62x150-ft. garage which it plans to construct. Estimated cost, $60,00. E. L. Reynolds, Asst. Mgr. Noted Mar. 9.

The Keyport Engineering Co., Irvington, N. J., will build a machine tool shop on Chancellor Ave.

The W. F. Taubel Co. plans to construct a hosiery finishing plant at Millville, N. J. Estimated cost, $150,000.

The contract has been awarded for the construction of an addition to the plant of the Art Metal Works, Newark, N. J., manufacturer of metal novelties. L. V. Aronson is Pres. Noted Mar. 2.

The Fairbanks Co., 416 Broome St., New York, N. Y., manufacturer of scales, will establish a plant on Academy St., Newark, N. J.

The Newark Spring Mattress Co., Newark, N. J., has awarded the contract for the construction of a foundry. Noted Mar. 2.

The Splitdorf Electrical Co., Newark, N. J., has awarded the contract for a 6-story addition to its plant. Noted Dec. 30.

William R. Thropp Sons Co., Trenton, N. J., manufacturer of machinery, plans to enlarge its plant in the future.

The contract has been awarded for a 2-story garage for Fred Diehl, 16th and Hudson Ave., West New York, N. J. Noted Dec. 30.

The Donora Sink Co., Donora, Penn., is building a plant for the manufacture of muriatic acid to be used for galvanizing iron. Estimated cost, $1,000,000.

The American Fork and Hose Co., Girard, Penn., plans to remodel its plant. Estimated cost, $15,000.

The Benjamin & Butler Steel Works plans to build an addition to its plant at Hazleton, Penn.

The contract has been awarded for the construction of a 2-story, 50x129-ft. factory for the Earle Gear and Machine Works, Philadelphia, Penn. Estimated cost, $20,000.

The contract has been awarded for a 1-story garage for Louis Felber, 4546 Wayne Ave., Philadelphia, Penn.

Kahn & Greenburg, Philadelphia, Penn., has awarded the contract for a 6-story auto service building. M. H. Dickinson, 2330 Market St., Philadelphia, Arch.

Plans are being prepared for a garage for Robert E. Lamb, Philadelphia, Penn. Estimated cost, $10,500 Harrison, Rea Co., 1027 Wood St., is interested.

The Pennsylvania Taximeter Cab Co., Philadelphia, Penn., has awarded the contract for a 10-story concrete garage on South Broad St., Philadelphia. Estimated cost, $300,000. Carl P. Berger, Arch. Noted Jan. 20.

The Thomas Iron Co., Stephen Girard Bldg., Philadelphia, Penn., plans to construct additions to its plant. Estimated cost, $400,000.

Hubbard & Co., manufacturer of shovels, etc., has awarded the contract for the construction of a factory at Pittsburgh, Penn. Noted Mar. 16.

Plans are being prepared for the construction of a 2-story foundry for the Grander Stove Co., Royersford, Penn. J. V. Poley, Arch.

The Valley Iron Works, Williamsport, Penn., has awarded the contract for an addition to its foundry. Estimated cost, $5,000.

The Bethlehem Steel Corporation Bethlehem, Penn., has acquired the plants of the Maryland Steel Co., Sparrows Point, Md., and the Pennsylvania Steel Co., Steelton and Lebanon, Penn., and will improve same.

SOUTHERN STATES

J. W. Hoopes, Denbigh, Va., contemplates equipping a general repair shop.

The Quantico Co., Quantico, Va., recently organized, plans to construct a steel plant of 7 units. Eldredge E. Jordan, Real Estate Trust Co., Washington, D. C., is Pres.

The Southern Structural Steel Corporation, Burlington, N. C., recently incorporated with $50,000 capital stock, will construct a plant at Burlington.

The Chattanooga Steel Co., Chattanooga, Tenn., plans to construct a plant.

MIDDLE WEST

The Save-a-Life Fender Co. will build a 50x100-ft. factory at Belpre, Ohio.

Bids will soon be received for the construction of a 5-story, 50x80-ft. factory for the American Diamalt Co. at Cincinnati, Ohio. Estimated cost, $25,000.

Work will soon be started on the construction of a 1-story, 130x140-ft. addition to the plant of the Ajax Manufacturing Co., manufacturer of nut and bolt machinery, at Cleveland, Ohio. Noted Mar. 9.

The Cleveland Lathe and Machinery Co., Rockefeller Bldg., Cleveland, Ohio, is in the market for an 18-in. engine lathe and a 10-in. sensitive drill press.

The Cleveland Wire Spring Co., 3864 Hamilton Ave., Cleveland, Ohio, plans to enlarge its plant at Cleveland.

The contract has been awarded for the construction of a 1-story, 28x126-ft. addition to the plant of the Foster Bolt and Nut Manufacturing Co., 3550 East 72nd St., Cleveland, Ohio.

Plans have been prepared for the construction of an addition to the plant of the Lake Erie Iron Co. at Cleveland, Ohio.

The S. & M. Welding Co., recently organized, will build a plant on East 55th St., Cleveland, Ohio.

Plans have been prepared for the construction of a 40x 100-ft. factory at Columbus, Ohio, for the Lamneck Co., manufacturer of heating equipment. A. P. Lamneck is Pres. Noted Feb. 3.

The Reliance Textile Co., 2d and Russell St., Covington, Ohio, will build a 1-story, 90x150-ft. addition to its plant at Covington.

The Stevens Manufacturing Co., manufacturer of tools, dies and fixtures, 3d and Canal St., Dayton, Ohio, plans to con-

struct a plant at Dayton. Estimated cost, $150,000. Fred Stevens is Pres.

The Thomas Manufacturing Co. will construct an addition to its plant at Dayton, Ohio, for the manufacture of automobile accessories.

The Crescent Metal and Manufacturing Co. plans to construct a plant at Fremont, Ohio.

The American Steel Grave Valut Co. has awarded the contract for the construction of an addition to its plant at Church and Bloomer St., Galion, Ohio. Noted Feb. 24.

The Wogaman Bros Co., manufacturer of gasoline engines, contemplates constructing additions to its plant at Greenville, Ohio.

The Ohio Tractor Co. will build a plant at Marion, Ohio.

The Meteor Motor Car Co. plans to equip a section of its plant at Piqua, Ohio, for the manufacturer of automobile bodies.

L. A. Woodard, Vice-Pres. of the William Tod Co., Youngstown, Ohio, has purchased the plant of the Canton-Hughes Pump Co., Wooster, Ohio, and contemplates enlarging the plant.

The Youngstown Sheet and Tube Co. has awarded the contract for the construction of a factory at Youngstown, Ohio.

The Hayes Wheel Co. will build an addition to its plant at Anderson, Ind. Estimated cost, $20,000.

The Remy Electric Co. contemplates constructing an addition to its plant at Anderson, Ind. Estimated cost, $50,000.

The Standard Plating and Brass Foundry Co. contemplates constructing a factory at Anderson, Ind.

The National Car Coupler Co. plans to construct an addition to its plant at Attica, Ind. Estimated cost, $75,000. J. W. Harrison is Gen. Mgr.

The Foster Machine Co. plans to build an addition to its plant at Elkhart, Ind.

The Majestic Furnace and Foundry Co. will build a 1-story, 50x75-ft. addition to its plant on Erie St., Huntington, Ind.

The Indianapolis Cordage and Implement Co. contemplates constructing an addition to its plant at Indianapolis, Ind. Estimated cost, $500,000.

The Huron Implement Co., manufacturer of farm tools, will build a 50x150-ft. foundry and a manufacturing building at Bad Axe, Mich.

The United States Register Co. plans to build a 3-story factory at Battle Creek, Mich. L. Mobile, 3300 Humboldt Ave., S., Minneapolis, Minn., is Vice-Pres.

E. M. Clark & Son, Detroit, Mich., plans to construct a factory on South Main St., Clarkston, Mich., for the manufacture of brass fixtures and ornamental fencing.

The Detroit Shipbuilding Co. contemplates constructing an addition to its machine shop at Detroit, Mich.

The Detroit Steel Products Co. is constructing shops Nos. 4, 5 and 6 at Detroit, Mich. Estimated cost, $60,000. Noted Feb. 24.

The Detroit Vapor Stove Co., 407 Franklin St., Detroit, Mich., will build a plant at Kercheval Ave. and Waterloo St., Detroit.

The Scripps-Booth Co., manufacturer of automobiles, Detroit, Mich., has been reorganized with a capital of $1,000,000. Plans are being prepared for the construction of an addition to its plant at Detroit. Noted Sept. 23.

We have been advised that the Charles A. Strelinger Co., Detroit, Mich., is constructing a 6-story warehouse, general office, salesrooms and machine tool demonstrating plant at Larned, Randolph and Bates St., Detroit.

The contract has been awarded for the construction of a 100x105-ft. factory at 8th and Fairbanks Ave., Holland, Mich., for the Michigan Foundry Co. John Glupker is Mgr. Noted Mar. 9.

The Sparks-Withington Co., manufacturer of roller bearings and pressed metal products, will build an addition to its plant at Jackson, Mich.

The Lane Motor Truck Co. plans to build a factory at Kalamazoo, Mich. M. H. Lane is interested.

The J. A. Richards Co. is constructing a factory on Pitcher St., Kalamazoo, Mich., for the manufacture of steel cut dies and jig-saws. J. A. Burke is Pres.

The Continental Motor Co. is constructing a machine shop at Muskegon, Mich.

The Detroit Valve and Fittings Co. will build a 50x72-ft. addition to its annealing room at Wyandotte, Mich.

The Malleable Iron Co., 1801 Direres Parkway, Chicago, Ill., will construct an addition to its plant at Chicago. Estimated cost, $4,000.

The Tri-City Railway Co. plans to construct car shops at Rock Island, Ill.

Work will soon be started on the construction of a factory at Springfield, Ill., for the Sangamo Electric Co., manufacturer of electric meters.

The Kohler Co., manufacturer of enameled plumbing ware, plans to construct a 1-story, 75x200-ft. addition to its factory at Kohler, Wis.

The Liebel & Tetzlaff Manufacturing Co. plans to construct a 30x30-ft. addition to its machine shop at Luxembourg, Wis.

Bids will soon be received for the construction of a 1-story foundry and machine shop on Kefe Ave., Milwaukee, Wis., for the Claus Automatic Gas Cock Co., 2601 Vliet St., Milwaukee. Estimated cost, $20,000. Noted Mar. 16.

The Crary Tool Co. will establish a factory at Milwaukee, Wis.

The Pawling & Harnischfeger Co., manufacturer of cranes and hoists, will build a 2-story addition to its pattern shop at Milwaukee, Wis.

The Ewald Works plans to construct a garage and machine shop addition to its plant at Oakfield, Wis.

The Thom Auto Co. plans to construct a garage at Merritt St. and Jefferson Ave., Oshkosh, Wis.

James Morgan, proprietor of the Morgan's Garage, contemplates constructing a 2-story, 60x140-ft. garage and machine shop at Rhinelander, Wis.

Carpenter & Freyer plans to construct a garage and machine shop on Main St., Waukesha, Wis.

WEST OF THE MISSISSIPPI

The Martin Manufacturing Co., Mason City, Iowa, contemplates building a factory at St. Paul, Minn., for the manufacture of tinware. Estimated cost, $150,000.

Bids will be received about Apr. 1 for constructing a 1-story garage for T. J. O'Connell, Waterloo, Iowa. Estimated cost, $35,000.

The Pioneer Auto Co. plans to build a garage at 326 East Superior Ave., Duluth, Minn.

The Minneapolis General Electric Co., 15 South 5th St., Minneapolis, Minn., will build a 5-story addition to its plant on 5th St. Robert F. Park is Gen. Mgr.

The Packett Motor Car Manufacturing Co., recently incorporated, plans to build a factory at St. Paul, Minn. Henry Orne, 880 Grand St., is Pres.

The Twin City Frog and Switch Co., St. Paul, Minn., is building a factory for the manufacture of railway truck appliances.

Press reports state that the Hudson Motor Car Co. will lease garage and business building to be built at Sherman and Walnut St., Hutchinson, Kan.

The Lord Auto Co., 17th and O St., Lincoln, Neb., has awarded the contract for an addition to its garage. Estimated cost, $20,000.

Ira L. Bendon, Sidney, Mont., agent for the Ford, Dodge and Overland cars, will build a commercial garage and machine shop at Sidney.

The contract has been awarded for a 2-story garage for Edward Isben, Jefferson City, Mo. Estimated cost, $15,000.

Laciny Bros., 2524 North 25th St., St. Louis, Mo., will construct coppersmith, machinist, brass finisher and sheet iron departments. The company is in the market for lathes, drill presses, vises, taps, dies, sheet metal cutters, small tools, measuring instruments, etc.

Fred Medart Manufacturing Co., St. Louis, Mo., has awarded the contract for a 2-story factory for the manufacture of steel ladders. Estimated cost, $40,000. Noted Mar. 9.

F. C. Fahrendorf, Cameron, Tex., will build a machine shop and garage.

Bids will soon be received for 1-story garage for Jeffs Machine and Auto Co., Inc., Cushing, Okla. Estimated cost, $15,000.

WESTERN STATES

Albert Schubach is at the head of a new corporation which has leased the Lindstrom Shipbuilding Yards at Aberdeen, Wash. The new corporation plans an expenditure of $15,000 to improve and enlarge the plant.

The Ferris Motor and Machine Co., 815 East Pike St., Seattle, Wash., is in the market for milling and power hack saw machinery and annealing furnace. Noted Mar. 2.

Barbare Bros. plans to construct an addition to its shipbuilding plant at Tacoma, Wash. Estimated cost, $20,000.

The Blewitt Harvester Co. plans to construct a factory at Pendleton, Ore., for the manufacture of harvesters. Estimated cost, $100,000.

Plans being prepared by E. Kroner, Arch., Worcester Bldg., Portland, Ore., for the construction of a garage and machine shop at 29th and Thurman St., Portland, for A. L. Carson.

The Oakland Launch and Tugboat Co. plans to construct a machine shop at East Oakland, Calif. (Oakland post office).

We have been advised that work will be started about May 15 on the construction of a plant at Los Angeles, Calif., for the Homer Laughlin Engineering Corporation, for the manufacture of drop forgings. Estimated cost, $200,000. The company will be in the market for equipment for the manufacture of automobiles and drop forging machinery. Noted Feb. 17.

The Keystone Iron Works will construct a foundry at 114 College St., Los Angeles, Calif.

Plans are being prepared by Thomas Preston, Arch., Investment Bldg., Los Angeles, Calif., for the construction of a 50x130-ft. garage and machine shop at Main and 28th St., Los Angeles, for Robert G. Schroeter, 735 Security Bldg., Los Angeles.

Lisle Esler, San Bernardino, Calif., plans to construct a garage and machine shop at 2nd and F St., San Bernardino.

Plans are being prepared for the construction of a garage and machine shop for the California Baking Co., Ellis and Pierce St., San Francisco, Calif. Estimated cost, $16,000.

The contract has been awarded for the construction of a 1-story machine shop on Fremont St., San Francisco, Calif., for E. M. Otto. Estimated cost, $12,000.

CANADA

The Canada Iron Corporation plans to construct an addition to its plant at Three Rivers, Que.

The Pollard Manufacturing Co., manufacturer of machinery, plans to construct an addition to its plant at Niagara Falls, Ont.

GENERAL MANUFACTURING

NEW ENGLAND STATES

Bids will soon be received for the construction of a factory on Islington St., Portsmouth, N. H., for the Morley Button Co. Noted Feb. 17.

The contract has been awarded for the construction of a 2-story, 92x500-ft. factory at Lawrence, Mass., for the Menomac Spinning Co. Estimated cost, $400,000. Noted Nov. 25.

The Appleton Manufacturing Co., manufacturer of cotton goods, has awarded the contract for the construction of a 5-story, 75x191-ft. plant at Lowell, Mass. Estimated cost, $100,000.

The contract has been awarded for the construction of an addition to the plant of the American Tire Fabric Co. at Newburyport, Mass.

Contract will soon be awarded for the construction of a weave shed at Hope, R. I., for the Hope Mill Co., manufacturer of shirting. Noted Mar. 16.

The Cowan Truck Co. plans to build a 1-story, 100x200-ft. factory on Appleton St., Providence, R. I.

Bids have been received for the construction of a 2-story, 77x120-ft. mill at Woonsocket, R. I., for the Sidney Worsted Co.

Bids will soon be received for the construction of a 3-story, 84x220-ft. addition to the plant at Baltic, Conn., of the Baltic Mills Co., manufacturer of cotton goods. Noted Jan. 13.

The American Velvet Co. plans to construct a factory at Stonington, Conn.

SOUTHERN STATES

The Lynchburg Hosiery Mills, Lynchburg, Va., plans to install new machinery.

The Corrugated Box Co., Parkersburg, W. Va., plans to construct a 1-story factory. Estimated cost, $10,000. E. Waldschmidt, Mgr.

The Acme Hosiery Mills, Ashboro, N. C., will install new machinery in its plant during 1916. Noted Feb. 24.

The Star Hosiery Mills, Spartanburg, S. C., recently incorporated with $100,000 capital stock, will construct a 2-story mill.

The Berryton Mills, Berryton, Ga., manufacturer of hosiery, plans to construct a 2-story addition to its factory. Estimated cost, $20,000.

J. A. Kendrick, Greenville, Ala., and associates plan to build a cotton mill at Greenville.

Loudon Hosiery Mills, Loudon, Tenn., contemplates building a 5,000-spindle mill.

MIDDLE ATLANTIC STATES

Plans have been prepared for a 1-story factory on the Buffalo River at Katherine St. and the Erie R.R., Buffalo, N. Y., for the Buffalo Potash and Cement Corporation, 51 Hamburg St., Buffalo. Estimated cost, $25,000.

The Niagara Oxygen Co., Inc., 570 Carroll St., Buffalo, N. Y., will construct a plant at Philadelphia, Penn.

The Niagara Searchlight Co., Niagara Falls, N. Y., contemplates building an addition to its factory. Estimated cost, $8,000.

The Mutual Chemical Co. of America contemplates building a chemical factory at Jersey City, N. J. E. H. Simpson is Mgr.

The S & K Co., Chicago, Ill., manufacturer of leather, has acquired a site on 3rd St., Newark, N. J., on which it will construct a branch manufacturing plant.

The plant of the Ryan Leather Co., Newark, N. J., recently destroyed by fire will be rebuilt. Estimated cost, $35,000. Thomas Ryan is Pres.

The Consolidated Lamp and Glass Co., Corapolis, Penn., will build a 2-story factory. Estimated cost, $15,000. Edward Cornelius, Pittsburgh, is Arch.

The Security Silk Co., Morris Run, Penn., will construct a silk mill.

Bids will soon be received by Day & Zimmerman, Arch., 611 Chestnut St., Philadelphia, Penn., for a 3-story factory at Emerald St. and Allegheny Ave. for the Cleveland Worsted Mills, 8932 Broadway, S. E. George Hodgson, is Gen. Mgr.

Dill & Collins, 6th and Cherry St., Philadelphia, Penn., manufacturer of paper, has awarded the contract for constructing a factory. Estimated cost, $30,00. William Steel & Sons Co., is Arch.

Bids will soon be received for a 1-story factory for the Baltimore Engine Oil Co., Baltimore, Md. Estimated cost, $50,000. Walter M. Gieske is Arch.

MIDDLE WEST

The Portage Rubber Co., Akron, Ohio, has awarded the contract for the construction of a 3-story factory at Barberton, Ohio.

Bids will soon be received for a factory for the Cleveland Worsted Co., Cleveland, Ohio, for the manufacture of worsted. Day & Zimmerman is Arch.

The Linde Air Products Co., East 12th St., Cleveland, Ohio, will construct an addition to its plant at Cleveland.

The Ocoee Woolen Mill plans to build a factory at Cleveland, Ohio. W. H. Durkee, Supt. of Cleveland Woolen Mills, is Mgr.

The H. C. Godman Co. has taken over the plant of the Columbus Clock Co. on Thurman St., Columbus, Ohio, and will install machinery for the manufacture of shoes.

Plans are being prepared for the construction of a 2-story, 60x135-ft. factory on East 5th St., Dayton, Ohio, for the Monarch Tag Co. Estimated cost, $35,000. Fred Kohnle is Pres. and Gen. Mgr.

The Valentine Packing Co. contemplates construction a packing plant on Mulberry St., Terre Haute, Ind. Estimated cost, $100,000.

The Michigan Limestone and Chemical Co., Alpena, Mich., plans to improve its plant at Calcite, Mich.

The Detroit Sulphite Pulp and Paper Co., 2607 Jefferson St., Detroit, Mich., plans to construct a 1-story factory on Jefferson St., Detroit. Estimated cost, $30,000.

The Western Thread Co. plans to construct an addition to its plant at Elgin, Ill. W. R. Swartwout is Mgr.

John A. Heller, R. J. Connery and associates contemplate constructing a packing plant at Quincy, Ill. Estimated cost, $50,000.

Plans are being prepared by W. E. Bennett, Arch., for the construction of a 2-story, 50x100-ft. factory at 6th and State St., La Crosse, Wis., for the Fisk Rubber Co., Chicopee Falls, Mass.

Bids will soon be received for the construction of a 4-story, 90x225-ft. packing and cold-storage plant at Madison, Wis., for the Farmers' Coöperative Packing Co. Estimated cost, $375,000. Noted Nov. 4.

The Jung Shoe Co., 302 North 8th St., Sheboygan, Wis., plans to construct a 3-story, 30x135-ft. addition to its plant at 8th and Virginia St., Sheboygan. Henry Jung is Pres.

The West Bend Woolen Mills plans to construct additions to its factory at West Bend, Wis.

WEST OF THE MISSISSIPPI

The Ft. Madison Produce and Storage Co. Ft. Madison, Iowa, will build a plant at Ft. Madison. Estimated cost, $40,000.

The Wichita Carriage Works, Wichita, Kan., has awarded the contract for a factory. Estimated cost, $10,000.

The Gas Engine Efficiency Co., Kingshighway and Manchester St., St. Louis, Mo., contemplates building an oil refinery at St. Louis.

John T. Milliken & Co., 316 Clark Ave., St. Louis, Mo., will build a 4-story factory at 3rd and Cedar Ave., St. Louis, for the manufacture of chemicals. Estimated cost, $100,000.

The Corsicana Cotton Mills, Corsicana, Tex., will build a 2-story addition to its plant. Estimated cost, $100,000.

Fire recently destroyed the cotton plant of Arthur, Storrs, Granger, Tex. Loss, $25,000.

Fire recently destroyed the plant of the Stock Cotton Gin Co., Hamlin, Tex. Loss $10,000. W. H. Birdwell, Mgr.

The Oriental Textile Mills, Houston Heights, Tex., plans to build additions to its plant. Estimated cost, $6,000.

W. S. Noble, Rockdale, Tex., will build a canning factory at Milano.

Posttex Cotton Mill Co. Post, Tex., has awarded the contract for a 1-story addition to its bleachery. Estimated cost, $4,250.

Fire recently destroyed the plant of the Western Cotton Gin Co., Seymour, Tex.

WESTERN STATES

The Seattle Box Co. plans to construct a factory at 401 Spokane St., Seattle, Wash.

The contract has been awarded for the construction of a plant at Grants Pass, Ore., for the Oregon-Utah Sugar Co. Estimated cost, $600,000. Noted Jan. 13.

CANADA

Frank D. Law is interested in a company which contemplates constructing a factory at Brampton, Ont., for the manufacture of rubber, tires, etc.

Fire recently destroyed the packing plant of the Gordon Ironsides at Moose Jaw, Sask. Loss, $50,000.

Classified Advertising

The Classified Advertising section appears on pages 151, 152, 154, *of this issue and will in future appear in the same relative position in the paper.*

Happy

American Machinist

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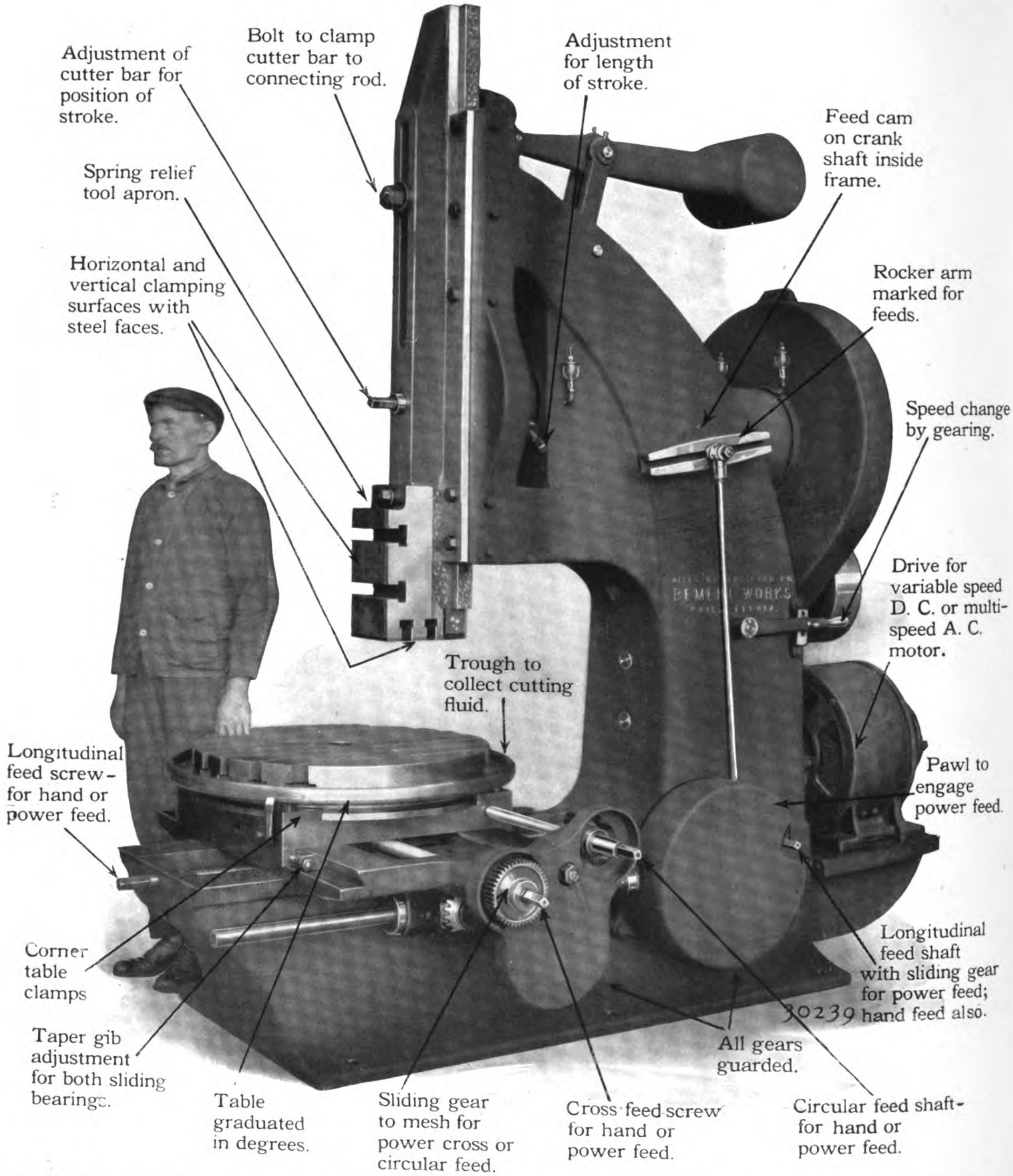
Bement Slotters



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CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormay processes, protected by United States patent issued June 22, 1915, and another pending

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Talks With Our Readers

By the Publisher

"THE OUTSIDE point of view" is a healthy one for each and all of us to get once in a while.

Just because we are in the machinery business is no reason why we shouldn't be interested in a whole lot outside of it.

In "Advertising and Selling" HERBERT N. CASSON writes, along this line:

"It is physically impossible for a man to see more than two sides of a square house at one time. It is necessary to project oneself mentally to imagine the other sides. But to have it under really close observation, you must have someone else help you, from a different vantage point than your own.

The same thing is true of business. No organization can hope to see all its sides unaided. It must have outside point of view, or work on a distorted basis.

This is the rock on which thousands of stubborn business men split. And this is the magnificent opportunity which scores of brainy men have seized to wrest leadership from those too dull to see their own benefit.

It is a matter of history that general improvements come from outside and that detail improvements come from inside.

For instance—

Field was a merchant, yet he laid the first ocean cable.

Bell was a professor of elocution, yet he invented the telephone.

Carnegie was a railroad official, yet he became the richest steel maker in the world.

Judge Gary is a lawyer, yet he is at the head of the Steel Corporation.

Allis was an auditor, yet he created the Allis-Chalmers Works at Milwaukee.

Ingersoll, who gave the world good cheap watches, was not a watchmaker.

Selden, who secured the first automobile patent, was a lawyer.

Eastman, creator of the Kodak, was a bank clerk.

Harriman, the greatest of American railway organizers, was a stock broker.

Even in the larger affairs of national history we find this extraordinary law. Cromwell, for instance, was an outsider; he was not born of royal blood; and Napoleon, who put kings up and pulled kings down until they sent him to St. Helena, was an outsider.

The most desirable thing in the world is *balance*. Balance means sanity, it also means success. It is the balanced man and the balanced business that win—aided by the outside point of view to achieve such balance."

Manufacture of Punchings

By C. W. Starker*

SYNOPSIS—A careful explanation of the features in the design of punchings for electric motors, generators and transformers that affect manufacture. Different kinds of dies and methods of production of such punchings are described and their uses and limitations pointed out. The matter of economical scrap is also considered.

In the manufacture of electrical apparatus the principal active parts of motors, generators, transformers, magnets and other electric devices are usually built in laminated form—from thin sheet-steel punchings, insulated from one another—instead of as a solid body of iron or steel. The object of this laminated construction is to reduce by such subdivision the losses from eddy currents.[1] Typical examples of laminated stator and rotor cores are shown in Fig. 1.

The work of the punch shop becomes therefore of particular importance to the designer and others interested in the manufacture of electrical apparatus. Viewed from the standpoint of cost, it may be stated that between 13 and 25 per cent. of the factory cost of the average alternating-current motor is in the punchings.

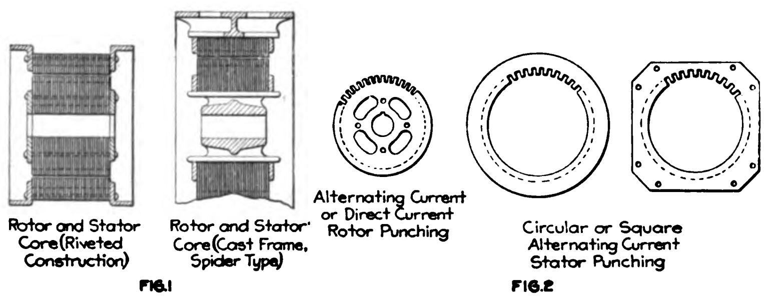
While all the problems arising from the various branches of punch-shop work are interesting, they are so varied that only those features of design and manufacture necessary to a full understanding of the class of punchings used in the stator and rotor cores of alternating-current motors or generators and of direct-current armatures will be considered in this article. Typical cases of such punchings are shown in Fig. 2.

The raw material for the punchings is received from the mill or storeroom in sheet form and is then slit into strips of a width corresponding to the size of the punching to be made, plus a certain margin. This work is done on a machine such as illustrated in Fig. 3. Further operations in producing punchings depend entirely on the kind of tool available. It will be well, therefore, first to consider the various types of dies generally used. There are three distinct types—1, simple; 2, combination; 3, compound.

1. By the simple type is understood a standard round-hole die used in connection with a slot die. Their construction will be described later, but Fig. 4 is shown to illustrate the successive steps in making a punching with round-hole dies. These steps are, for rotor punchings: Split or shear, center-hole, keyway, trim, slot; and for stator punchings: Split or shear, center-hole, trim, outside keyway, punch out center, slot. The center hole and keyway are sometimes punched in the same operation.

2. There are two different forms of the combination dies. The most commonly used form blanks the punchings completely at one blow; that is, inside and outside diameter, including rivet—or vent holes, if any—but not including the slots, which are punched out in a separate operation. This will be made plain by referring to Fig. 5. In the other form of combination dies the punchings are blanked complete, including slots, but the center is not punched out in this operation. A round-hole die completes the punching. There are therefore two operations required in both cases. The two steps are indicated in Fig. 6. The center is usually punched out before slotting, except that with smaller punchings and thin tooth tips it may to advantage be punched out after slotting.

3. Compound dies make a complete punching in one operation, provided the tooth tip is $\frac{1}{16}$ in. wide or more, Fig. 7. In cases where the tooth tip is less than this the



FIGS. 1 AND 2. TYPICAL EXAMPLES OF CORES AND PUNCHINGS

die is made with at least a $\frac{1}{16}$-in. tip, to give it sufficient strength at that point. The teeth must then be trimmed off in a separate operation, to obtain the required tooth tip and punching diameter. This question of tooth tips will later be referred to more in detail.

The selection of one or the other of these dies depends on a number of considerations. The principal questions are tool cost and quantities required. However, the size of die and punching, limitations of manufacturing equipment, thickness and hardness of the sheet steel must also be considered.

The advantage of simple dies is the low cost of tools. Round-hole dies of suitable diameter being usually available in a large punch shop, the only new tool required is, as a rule, a slot die, the cost of which is small. Simple dies are used where the activity is small or for very large punchings where compound dies would be too large for the presses; that is, the power required in punching would exceed the permissible load on the presses. This limitation generally applies to punchings approximately above 35 in. in diameter. The disadvantages of this type are principally the many operations, therefore the high cost of the punching and the consequent delay to production.

The so-called "set-up" cost—the expense for installing and lining up the dies in the press for each operation,

*Engineer, Westinghouse Electric and Manufacturing Co.

[1]Eddy currents are local currents in the iron or parts of the circuit interlinked with an alternating or pulsating flux. They cause heating and are sources of loss as well as possible danger to windings. As an analogy may be cited a whirlpool in which a stream of water retards its flow. The eddying may be prevented by providing a series of comparatively narrow channels.

including the time lost to production in making these preparations—is of course greatest for simple dies. The expense must be distributed over the number of punchings made in one set-up. This is one reason why quantity production is essential in all punch-shop work. Orders for five or ten punchings, as in the case of certain special parts such as finger plates, blowers and the like, result therefore in enormously high punch-shop costs. The remedy is either larger quantities by grouping orders together and stocking the parts separately or by standardizing a design so that the same detail may be used interchangeably and therefore in larger quantities. Where this is not possible, a construction different from punching should be used.

Combination dies are, as a rule, well adapted to standard apparatus that have large activities, particularly the type of combination die first mentioned, which blanks out the center. A semifinished punching of this sort can have any number of slots punched into it, thereby permitting the use of a common blanking die in connection with various dies for punching different numbers of slots. The tool cost, while considerably higher than for the simple die, is comparatively low with this form of combination die.

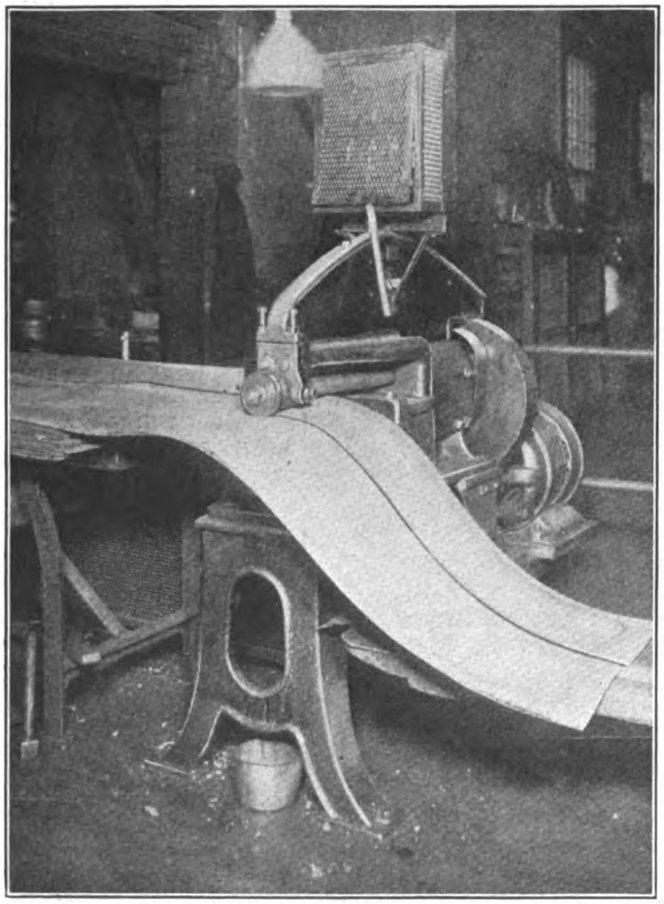


FIG. 8. ADJUSTABLE SLITTING MACHINE FOR SHEET MATERIAL

Combination dies that punch out slots are well suited to punchings having less than $\frac{1}{16}$-in. tooth tip. The small tooth tip does not affect the strength of the die, as the center is punched out in a separate operation. The activity should be large when such a die is used, as one that punches out the slots at the same time with the blanking is of course more expensive and good only for a given number of slots. This type is, from some points of view, preferable even to a compound die, as it leaves a plain circle coming out of the center, while a compound die leaves centers with teeth sticking out along the periphery. Such a center is illustrated in Fig. 8. These teeth are the material punched out as slots. Centers from large punchings are used wherever possible in making smaller punchings, and obviously a center with such teeth along the periphery, known as "toothpick scrap," is more difficult to handle and therefore requires a higher rate to be paid for labor in using it up.

Compound dies give the cheapest method of making punchings when the tooth tip is $\frac{1}{16}$ in. or more, as only one operation is required. A disadvantage is the fact that it leaves "toothpick scrap," as stated. The cost of a compound die is high, and the activity therefore must be large to warrant the tool cost. The relation in tool cost for the three different types of dies and also the relative cost of punchings produced with each type are more conveniently and clearly shown by a curve, such as Figs. 9 and 10. Identical conditions, as material, labor, rates, shape of punchings, etc., must of course exist, and curves are prepared for a given set of facts. The figure is intended merely to illustrate the relation without giving actual costs, which depend on the various factors mentioned.

It is interesting to observe that, contrary to general assumption, the compound die is less expensive than the combination die of the type that punches out the slots. In manufacture, however, the more expensive combination die has the advantage, not only of leaving plain center scrap—no toothpicks—but it is found to have a considerably longer life, particularly where the narrower tooth tip is wanted, for the reason that this tip is not cut in the same operation with the center.

The cost of the punchings made by the different dies is graphically shown in Fig. 10. For a given type of punching we may take from the curve for a certain outside diameter the cost of the raw material less scrap allowance, shown in the curve next to the horizontal line, expressed in dollars per hundred pieces. The vertical distance between this curve and the adjacent one represents the labor plus overhead expense for the punching, if it is stamped out complete in one operation by a compound die. The distance between the material curve and curve No. 2 represents the cost of labor plus indirect factory expense, if the sheet is punched out complete with the compound die: but an additional trimming operation is required on account of the narrower tooth tip, as already explained. In the same way curve No. 3 shows the cost for the type of combination die that punches out the center, curve No. 4 for the combination die that punches out the slots and curve No. 5 for simple dies.

In drawing conclusions from these curves it is to be understood that, while the labor rates are fairly well fixed, the value of material varies for different designs of punchings, and other conditions may enter to alter the costs; but for a given case such curves give as definite data as practicable on the cost relation of a punching made with different types of dies.

It will be noticed that all the labor-cost curves given show a kink at a certain diameter. The reason for this is that above this diameter a helper is usually employed, which of course increases the cost. On the other hand,

at about the same diameter the slitting operation is no longer required, as the full width of the sheet may be used. These two features may offset one another or even cause the cost figure to drop.

In connection with the dies used on punchings for rotors and stators mention may also be made of the so-called radius cutter. This is an attachment to a slot die, whereby centers may be cut out when slotting teeth, in cases where there is no round-hole die of the proper diameter available.

Circular punchings are used on electrical machines up to a certain size. On larger machines they are uneconomical and are therefore divided into segments. Fig. 11 illustrates typical cases of segmental punchings for stators and rotors.

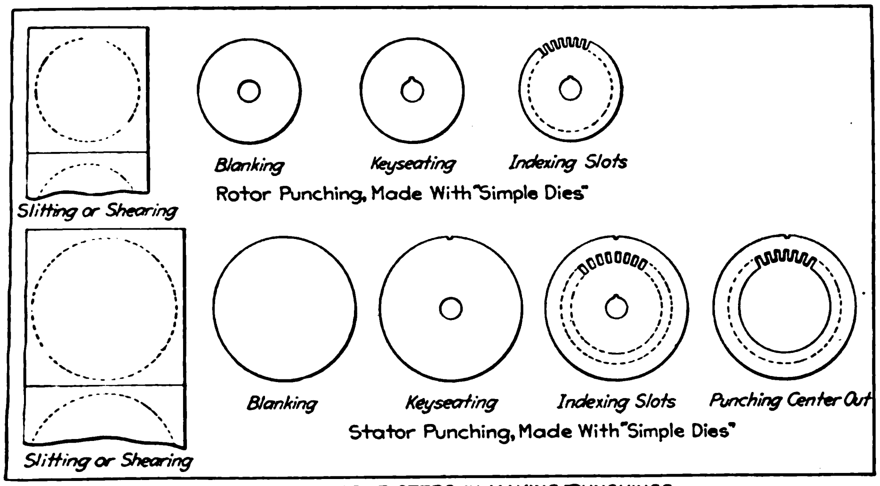


FIG. 4 SUCCESSIVE STEPS IN MAKING PUNCHINGS

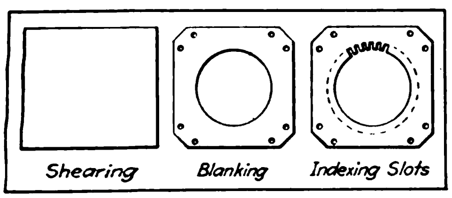


FIG. 5 STATOR PUNCHING, MADE WITH "COMBINATION DIE, PUNCHING CENTER OUT"

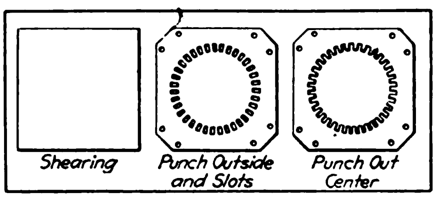


FIG. 6 SAME PUNCHING, MADE WITH "COMBINATION DIE, PUNCHING SLOTS OUT"

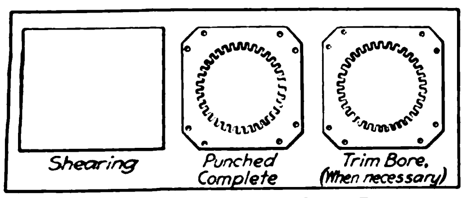


FIG. 7 SAME PUNCHING, MADE WITH "COMPOUND DIE"

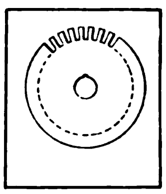


FIG. 8 "TOOTH-PICK SCRAP CENTER"

FIGS. 4 TO 8. DETAILS OF VARIOUS FORMS OF PUNCHINGS

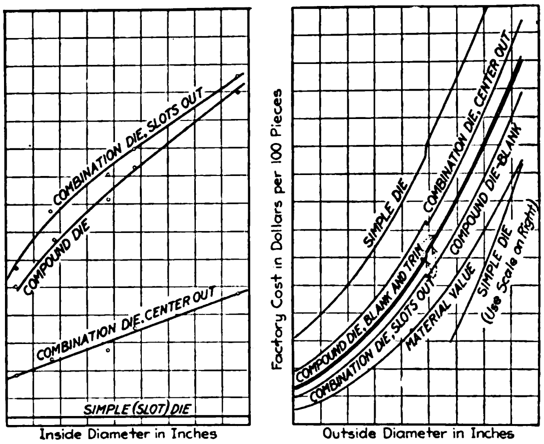
The dividing line between the two is determined largely by the relative cost and by manufacturing conditions. There may be considerations of design that make the full-circle punching desirable even on larger machines, but as a rule, the stated conditions are the determining factors. The cost is dependent on several items—the material in the punching and the labor in making it, to which should also be added the labor in building up the core, either in full circles or from segments, and finally the labor and material for dovetails in the frame, or spider, that becomes necessary with segmental punchings. The same considerations apply to the question of how many segments per circle should be used. The choice between four and six or more segments per circle is determined largely by the cost and manufacturing conditions, although design conditions, such as the number of segments, should also be taken into account.

Considering the punching alone and the labor and material involved in producing it, a curve can be prepared by calculating on a number of examples the cost of a bundle of punchings, say 1 in. thick, for various inside and outside diameters, first as full circles, then with 4, 6, 8 segments, etc. The intersection of these lines, then, would give the economical dividing line between full circles and segments and for various numbers of segments per circle. Such a curve is shown in Fig. 12.

All the cost figures are to be based on the same material value, labor rates, types of dies, etc.; and as it is merely the relative cost we are interested in, it is not necessary to consider the actual cost in dollars. As the inside diameter of the punching is a factor in the cost, the curves are prepared for different widths of rim. A 2-in. rim, for example, means an inside diameter 4 in. less than the outside diameter.

These curves show that there is quite a consistent change in the point of intersection; that is, of equal cost for circular punchings and segments or for various numbers of segments per circle. If we connect these intersections by separate curves, we come to the simple lines in Fig. 13. The principal break in the curve—the jump in the cost—occurs where the size of punching becomes such that, according to punch-shop practice, a helper is required in addition to the man operating the punch press. These curves can be used by the designer to determine roughly for any diameter, within the range of ordinary practice, which form of punching will be cheapest. Assuming, for instance, a certain outside diameter and 3-in. width of rim, a vertical line at that outside diameter and a horizontal line at 3-in. rim give a point of intersection. If this point lies to the left of the line *AB*, a circle will be cheapest; if between *AB* and *CD*, 4 segments; between *CD* and *EF*, 6 segments; and to the right of *EF*, 8 segments will be cheapest.

In using this curve a considerable margin should be allowed at one side or the other of the curve, as in these curves only the punchings are considered and additional cost for dovetails, etc., as previously stated, would have to be considered separately for closer calculation. However, for ordinary purposes they form a sufficiently accurate basis and guide for the designer. Further, such standardized cost data have the advantage of leading to uniform and consistent cost calculations and save the time of repeatedly going over the same ground. The curves are made up for compound dies. Similar curves can be prepared for various combinations; for example, using combination dies on the circular punchings as compared with compound dies on the segments—a case which



FIGS. 9 AND 10. APPROXIMATE COSTS OF DIFFERENT TYPES OF DIES AND STATOR PUNCHINGS USED

may quite frequently occur in practice on account of the relative tool cost, which will be referred to later.

Aside from these cost considerations there are, as already stated, manufacturing limitations to be taken into account in deciding between circular punchings and segments or between various numbers of segments per circle. These limitations are: First, the size of sheet available—that is, carried in stock—which usually has a maximum width of 39 in. Circular punchings are therefore limited to about 38 in. in diameter, allowing ½ in. on a side for margin. Segmental punchings usually do not come up to this width. The general rule followed in practice is to keep the long chord within 30 in. as maximum and 20 in. as minimum. In the second place, punchings from circles are limited by the throat space of the press. Presses available even in large manufacturing plants usually do not permit more than 30-in. diameter of punchings. Third, the upkeep of the dies must be considered and the tendency of large dies to alter their shape, both in getting out of round and in a certain amount of warping. The limitation in this respect is also usually placed around 30-in. diameter.

In deciding between full circles and segments a further and most important factor is the relative cost of dies.

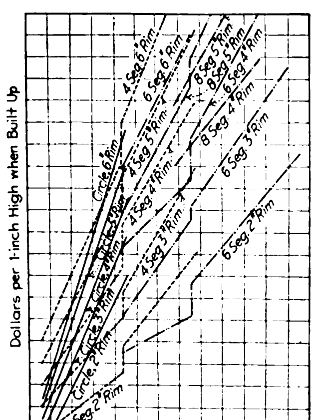


FIG. 12. FACTOR COST OF CIRCULAR VERSUS SEGMENTAL PUNCHINGS

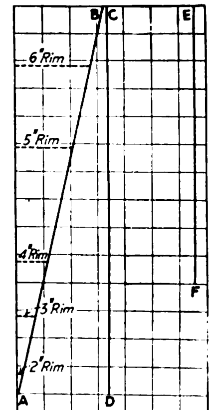


FIG. 13. CIRCULAR VS. SEGMENTAL PUNCHINGS

In the larger sizes the cost of a compound, or even combination, die may be very high, as compared with the cost of a segmental die. Then, too, the activity on these larger machines is comparatively small, so that investment in tools must be kept low. With segmental punchings the activity and number of pieces are greater than with circles, according to the number of segments per circle. For segmental punchings compound or combination dies may be used, the latter blanking the segment with dovetails and vent holes, if any, in the first operation, the slots being indexed in a second operation.

In referring to dimensions of tips and slots the work of tooth tip was mentioned. The shapes of slots most commonly used in alternating- and direct-current motors and generators are shown in Fig. 14. From the standpoint of electrical performance it is desirable to limit the width of the tooth tip to a minimum; that is, a narrow strip of iron between the surface of the core or punching and the top of the slot wedge used for holding the winding in place is desired. This tip under conditions affects the performance, as it may increase the magnetic leakage and thereby reduce the torque of the motor. The reason for this is—to give a popular explanation—that the lines of force tend to follow the path of least resistance and therefore pass from tip to tip instead of passing

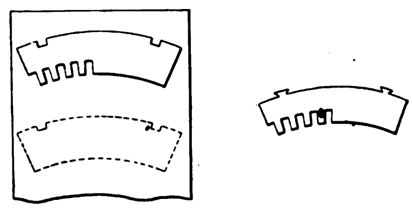


FIG. 11. SEGMENTAL PUNCHINGS, 4 AND 6 PER CIRCLE

through the air gap between stator and rotor, as intended, in order to produce relative motion between stator and rotor—that is, torque.

On the other hand, from a manufacturing standpoint a $\frac{1}{32}$-in. tooth tip (in fact, anything less than $\frac{1}{16}$ in.) is a most undesirable proposition, as obviously such thin projections on the punch will not stand up very long in manufacture, thereby necessitating frequent expensive renewals, which unduly burden the overhead expense of the punch shop. In present shop practice this difficulty is being avoided by punching the tooth tip wider at first and then trimming it in a separate operation. This practice of course means another die and additional cost for every punching.

Here is therefore a case where designer and punch shop must compromise, resorting to this narrower tip only where the additional cost of the punching is offset by an equal gain in copper or iron in the machine which otherwise would be required in order to obtain the desired performance with the wide tooth tip. A decision along this line is also influenced by the number of poles of the motor and by the construction of steel wedges, if such are used.

While speaking of designing slots with a view to economical manufacture, two more particulars may be mentioned briefly. The narrowest point of the tooth at the end between the slot grooves should not be less than $\frac{1}{16}$ in. for material 0.0172 in. or 0.0281 in. thick and not less than ⅛ in. for heavier material, as 0.0375 in. and 0.0625 in. At the root of the tooth its width should not be less

than $\frac{1}{16}$ in. for 0.0172-in. and 0.0281-in material for punchings below 6 in. in diameter and $\frac{3}{32}$ in. as the minimum for punchings above 6 in. in diameter. For heavier material, 0.0375 in. and 0.0625 in., this dimension should not be less than $\frac{1}{8}$ in.

The other point is the radius in the corner of the slot. Such radii are often specified on drawings as small as 0.016 in. and 0.031 in., although the slot cell, wires or bars usually have well-rounded corners and there is no necessity for the small radius. If the die is built up in such a way that two pieces of steel are joined at the root of the tooth, it would be easiest and cheapest to leave the corner entirely square, and it is difficult to make a radius in this case. However, it is impossible to give any general rule along this line, as the construction chosen for a given die by the tool designer depends on many factors, principally on the relative proportions of the design of punchings (small teeth, obstructing keyways, vent holes, etc.) and on accessibility for machining. This latter item involves in turn the tool equipment available (size of head on the boring mill or shaper) and questions of production. It is therefore necessary to allow the tool designer to use his judgment or to confer with the engineer on the individual case. Drawings generally specify $\frac{1}{32}$-in. radius. From the standpoint of the punch shop some radius is usually necessary to prevent the material from dragging in the die.

Frequently, it is desirable to make the rotor punchings from the sheet used in making the stator punchings. This method results not only in a saving of material, but also

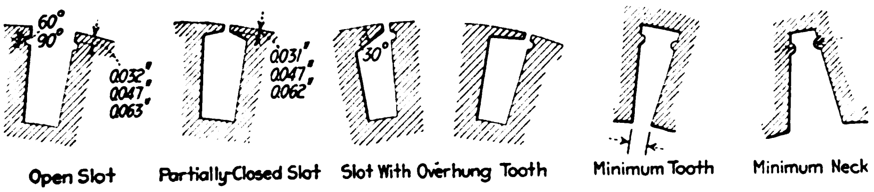


FIG. 14. SHAPES OF SLOTS COMMONLY USED IN MOTORS AND GENERATORS

in labor, as one operation—that of center holing and keyseating for the rotor—is avoided, this latter operation being part of the operation for the stator punchings. This method means that rotor and stator must be made of the same thickness and grade of material and required in similar quantities. Quite often rotor punchings could be made of slightly heavier material, 0.0281-in., instead of 0.0172-in. thickness usually employed in the stator. This is principally on account of the lower frequency occurring in the rotor with correspondingly less serious iron losses.

A core built up of the heavier material is cheaper than the light iron. The price per pound of the two materials varies in a ratio of about 0.0185 to 0.0286 by the sheet; or if the ratio of good punching material to scrap in a punching is considered, it averages about 0.064 for the heavier material and 0.088 for the lighter material. The labor per punching is about 50 per cent. greater for the heavier iron, but there are fewer punchings required per inch width of core. For 0.0172-in. iron it is customary to figure on 56 punchings per inch, taking the film of insulating enamel on the punchings into consideration, while 0.0281-in. iron requires only about 32 punchings per inch.

The difference in cost is considerable. For an average diameter of rotor approximating 12 in. it amounts to 25 to 30c. per inch-width of core, which may be equivalent to approximately one-fourth of 1 per cent. of the factory cost of the machine. However, as it is necessary to dispose of the light-iron centers from the stators which accumulate in actual manufacture, rotors are in practice made very largely of the light iron; and then it becomes very desirable to make the stator and rotor from the same sheet. This method has several limitations. In general it can be followed:

1. When both rotor and stator are made by simple dies—round-hole dies and slot dies—and the air gap is $\frac{1}{32}$ in. or more on one side. This applies to punchings having a tooth tip of $\frac{1}{16}$ in. as well as to those having the thinner tip. With round-hole and slot dies this point has no influence.

2. When the rotor is made with compound die and the air gap is $\frac{1}{16}$ in. or more on a side and there is no trimming operation. The reason for this is that a compound die leaves "toothpick scrap," and at least $\frac{1}{16}$ in. must be allowed on the outside to hold toothpicks and center together. This rule applies only to tooth tips of $\frac{1}{16}$ in. or more. With less than $\frac{1}{16}$-in. tip, the center cannot be used for the corresponding rotor, but must be used up on the next smaller diameter.

3. When the stator punching is made with a combination die of the type in which, as described before, the center is punched out in a separate operation, leaving plain circle scrap, and when simple dies are used on the rotor, the air gap to be $\frac{1}{32}$ in. or more on one side. In other words, this air gap can be made the limit and the center for the rotor still used, even though the stator tip is less than $\frac{1}{16}$ in., since the dies used on the stator as well as on the rotor do not require resorting to the heavier tip, with the additional trimming operation. This rule therefore applies to both the $\frac{1}{16}$-in. tip and the smaller tip. Whenever compound dies are used on the stator and rotor, an additional trimming operation on account of the tooth tip is necessary. Sufficient material—$\frac{1}{16}$ in. on a side—must be left for the trimming operation on the stator, plus $\frac{1}{16}$ in. on a side for the toothpick center, making a total of at least $\frac{1}{8}$ in. on a side. In other words, this method of using the center from the stator for making the rotor punchings would in this case be feasible only if the air gap is $\frac{1}{8}$ in. or more on a side, which as a rule is not the case on present-day alternating-current machines.

When this method of making rotor punchings from the centers of the stators is used, it is necessary to arrange a system whereby orders for stator and rotor punchings are placed with the punch shop at the same time. The saving that may be accomplished by the method described varies of course with the size of machine and other conditions.

⁂

Development of Welding Process—In summarizing the development of the welding process, H. R. Smartley, Jr., in a paper read before the International Engineering Congress, states that it was early found that welds having a breaking strength equivalent to that of the metal itself could be produced, but the sacrifice of elongation and reduction of area materially lessened the apparent value of such welds. Present practice is directed toward securing a weld of good tensile strength, as compared with the strength of the plate, with high ductility, since thereby the service conditions are better fulfilled.

Punches and Dies for Making Talking-Machine Details

By Robert Mawson

SYNOPSIS—In this article are shown some punches and dies of modern construction. They are made separate from the main body of the tool and attached with dowels and screws, so that any necessary repairs can be made quickly and cheaply. The tools are all of the compound type, first piercing and then blanking out the part.

On page 450 are shown some of the jigs used by the Rex Talking Machine Corporation, Wilmington, Del., in manufacturing its machines. In this article are shown punches and dies used in producing other parts. Like those shown in the previous articles, they are good examples of high-grade small-tool design and manufacture.

In manufacturing details for talking machines it is necessary that the parts be produced cheaply. Wherever it is possible and the pieces are of a suitable nature, punches and dies are used. If these tools are properly designed and made, the parts will be manufactured at a minimum cost and will be interchangeable.

On some details the tool can be designed of the compound type. This style of punch and die enables the perforating or piercing of one part and the finish-blanking of another element in one stroke of the press.

In manufacturing the punch and die it is advisable to make the various elements separate. For example, if the shank of the punch is made as a separate element, it may be of a cheaper material. The tool-steel punches should then be attached securely by means of screws and dowels. The base of the die is often made of cast iron, and the stripper plate and die are fastened to it.

The stripper may be made of machinery steel, using screws and dowels to hold it down in position on the die bed. The tool-steel die element is inserted in the cast-iron die bed and is kept in position by means of setscrews or keys. By manufacturing the tools in this manner, if any of the parts break, it is easier to repair them than if they are of unit construction.

This method of making punches and dies also lends itself very well to a small strap, where the tools are only occasionally used. Under such conditions the shank of the punch and the bed of the die may serve for many operations. It is only necessary to make separate punch stripper plates and die elements, which are accurately located by similar dowel holes and attached by setscrews or other means. In the illustration are good examples of such punch and die design.

The punch and die shown in Fig. 2 is interesting, as it illustrates the best method of blanking out a long piece with the smallest amount of waste. The punch and die shown in Fig. 4 illustrates the manufacturing of a gear with the holes and teeth cut completely. When such parts are made in this manner, the subsequent operation of cutting the teeth is obviated. As this is often a rather lengthy operation, requiring another machine, with its operator, on thin stock, the method illustrated is worth studying.

The gears produced with the tools shown work sufficiently well for the purpose for which they are used. This is done by placing the punch at an angle, as shown.

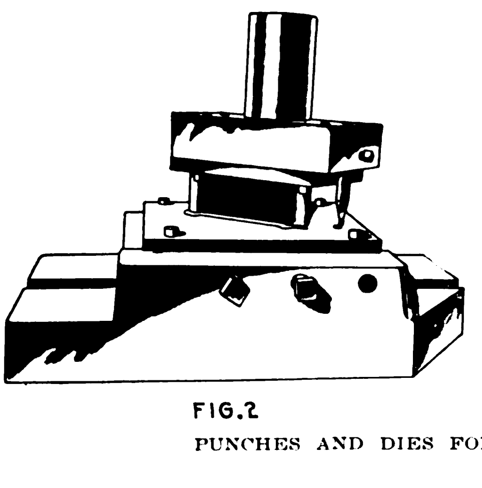


FIG. 2

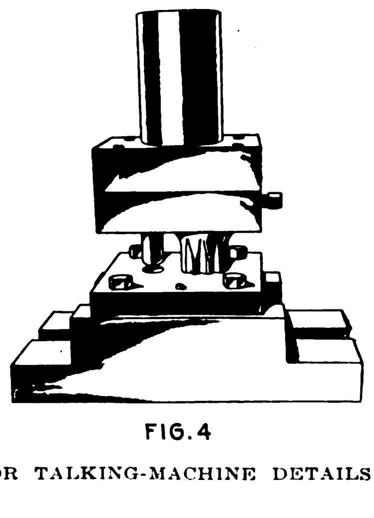


FIG. 4

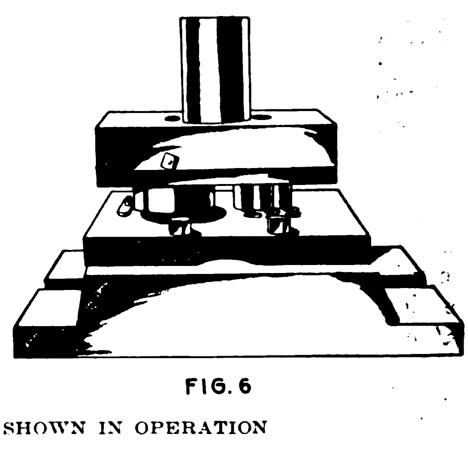


FIG. 6

PUNCHES AND DIES FOR TALKING-MACHINE DETAILS SHOWN IN OPERATION

FIGS. 2 AND 2-A

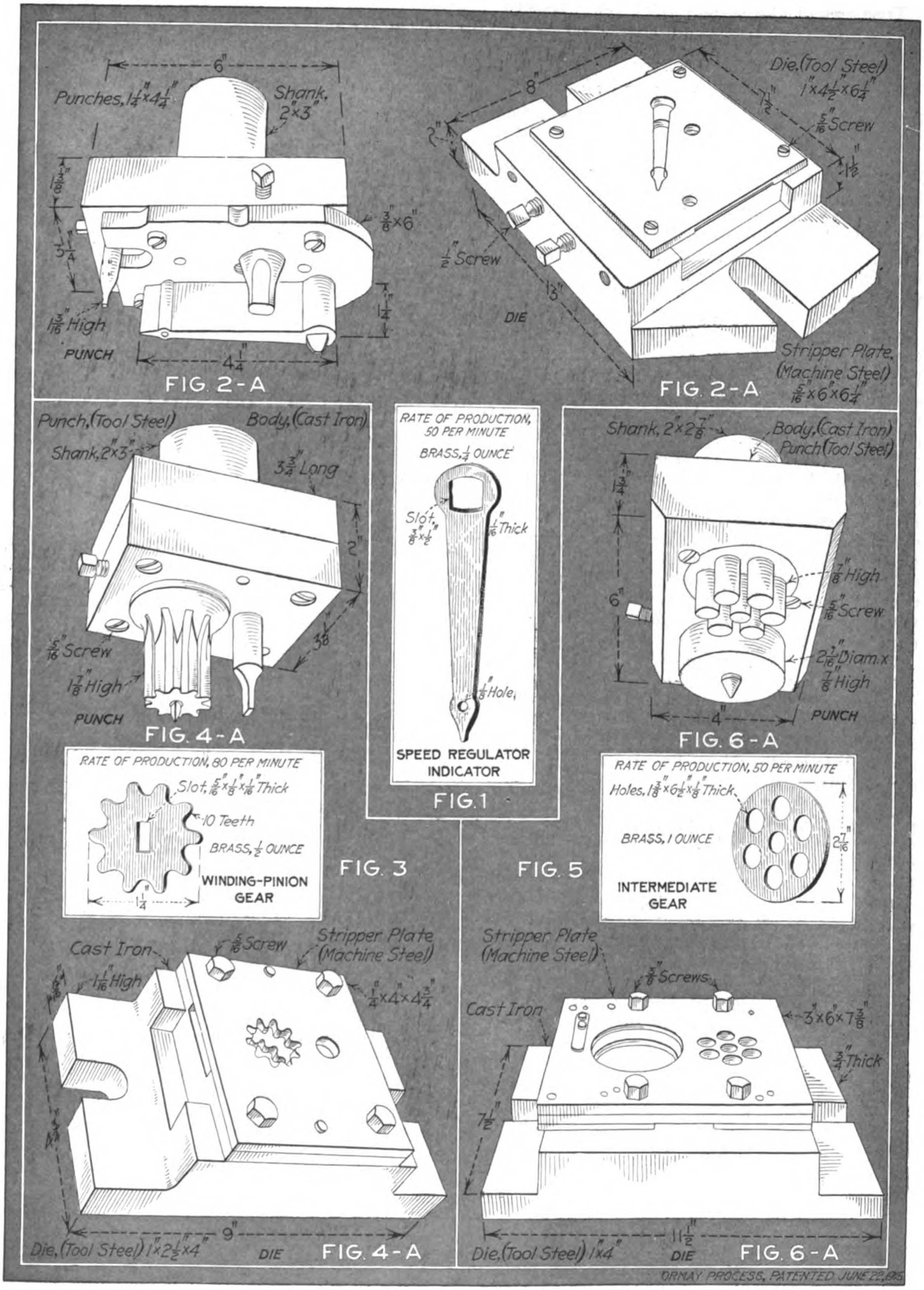
Operation—Slotting, piercing and blanking speed-regulator indicator, Fig. 1. The stock is fed into the die under the stripper, and the tool is made of the compound type. The slotting and piercing tools are set in advance of the blanking punch. The stock is thus slotted and pierced; and when it is fed forward to the second position, the punch is made to descend and the piece is blanked out to the desired shape.

FIGS. 4 AND 4-A

Operation—Slotting and blanking winding-pinion gear, Fig. 3. The stock, which has been cut to the correct width, is fed in from the end. The compound punch pierces the slot of the first blank. The stock is then fed along and the punch blanks out the gear. One strike of the press thus pierces out one blank and punches out a finished gear.

FIGS. 6 AND 6-A

Operation—Piercing and blanking intermediate gear, Fig. 5. The stock, which has been previously cut to the correct width, is fed into the end of the die from the right, under the stripper. The first punch pierces the seven holes. When the stock has been fed forward against a stop pin, the second punch blanks out the gear. Teeth are cut on the periphery of the gear blank in a later operation. The gear is completed in two operations.



DETAILS OF PUNCHES AND DIES USED IN TALKING-MACHINE WORK

Determining Working Limits for Interchangeable Parts

By J. C. P. Bode

When determining working limits for interchangeable parts there are several important questions to be considered, and on the answers depends success or failure.

The first question is, How large can the limits be? Because from a manufacturing standpoint we know that the larger the limits the more economically we can produce. Large limits allow tools to be used longer, and unskilled labor can be employed to greater advantage than when a higher degree of accuracy is required. Cutters, drills, reamers, etc., can be ground down further when the limits are large, and money will be saved in making the jigs, fixtures, dies and gages.

In fixing limits we must consider the purpose the piece is to serve in the finished machine, and whether it need be a close fit in order to work to best advantage. Many a piece has been given a certain dimension just because it has to be made some reasonable width or length within a sixteenth of an inch. In making an interchangeable part we should always, if at all possible, locate from the same point. The nature of the part may make it necessary to locate from an unimportant point. Still we must keep our limits low, because we use this side, hole or slot for locating purposes. We must determine what the errors and differences would be and what they would amount to if carried all through the subsequent operations. We must make sure that even the extreme case would be acceptable with reference to every step in manufacturing.

While it is not common practice, it would be well to give limits for the toolmaker's use. Many a man has spent extra hours to make a fixture dead right when he might have made it in far less time had he possessed an idea of the degree of importance of that fixture. Give him limits in questionable points. It often saves a great deal of time, worry and money.

Much depends on the system or rule followed in expressing limits. Shall it be plus limits, minus limits, or both for the same figure? My experience has been that, with a few exceptions, the only safe way is to give a limit in only one direction.

If we have a hole to drill or bore into which another piece must fit, we should give a plus limit only, and there will never be a question about fit. The piece fitting in this hole, however, should have a minus limit. This is a simple example; and while it would not require extra time to fix a plus and minus limit in this case, there would be a much greater chance for mistakes. If, for example, our diameter is 4 in., we allow 0.002 in. limit; if we give a plus limit for the hole and a minus limit for the plug, we would have 4 in. plus 0.002 in. for the hole, and for the plug we would have 4 in. minus 0.002 in. It will be seen at once that the basic diameter, 4 in.—which is the ideal diameter—appears in both cases, whereas this true diameter will not appear both times, if a "plus or minus" limit were given. We would then have for the hole 4 in. plus or minus 0.002 in. and for the plug 3.988 in. plus or minus 0.002 in. The plus and minus plan leads to no end of mixups when it comes to a combination of dimensions.

Still there are cases where plus or minus limit is the only right thing to give—as, for instance, distances between holes. If the toolmaker bores his jig and the correct figure between holes is 6 in., allow a difference of 0.002 in. not only because that gives you a tolerance of 0.004 in., but also because the toolmaker does not know just which way he is going to be out a little. If you give this 6 in. plus 0.002 in. he will probably aim at 6 in. plus 0.001 in. which will permit him to be out 0.001 in. in either direction.

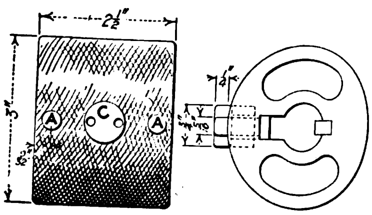
The ideal time to determine limits is after all operations have been laid out; but this is often impractical. So the man who puts on the limits should have a good knowledge of manufacturing methods, and even he may often have to change his limits for manufacturing reasons which were not evident at first. Close coöperation between the tool designer and the man designing the actual components of a machine is very much to be desired, and in following the rules laid down here one will be pretty sure to get things right.

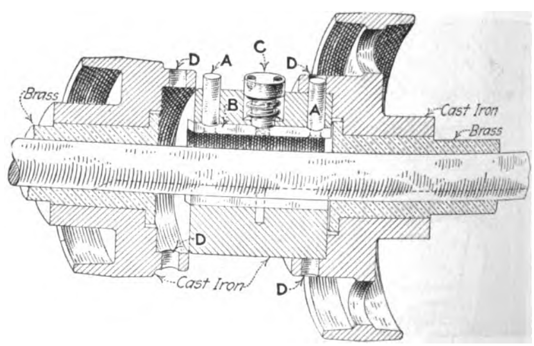
A Simple Positive Clutch

By G. B. Olson

The illustration shows a clutch used on the spindle and on the countershaft of a high-speed drilling machine. The original design called for cone type friction clutches, but on account of the small diameter they were not satisfactory. I also tried several types of expanding band clutches without success.

The clutch shown was then designed and has proved a complete success. It is made of a 3-in. diameter by 2½-in. cast-iron body, cored to make it lighter and also





A POSITIVE TWO-SPEED DRIVING CLUTCH

to assist in balancing. The driving pins *A* are of $\frac{5}{16}$-in. drill rod, hardened at the upper end, while the lower end is riveted into a piece *B* of $\frac{3}{16}$x$\frac{7}{16}$x3-in. cold-rolled steel *B*.

To change from one speed to another the center button *C* is pressed down and the whole center piece moved sidewise to clutch into either pulley. The driving pin then enters one of eight holes *D* in the pulley and the spring holds it in position.

Manufacturing 12-In. Shrapnel--I*

By Robert Mawson

SYNOPSIS—In these, the first authentic, articles describing the operations followed in manufacturing 12-in. shrapnel are shown not only photographic illustrations, but detailed drawings of the attachments to machines, jigs, fixtures, gages and other necessary equipment. In the manufacture of this shell, owing to its size and the fact that it is made from a solid bar, it was found that ordinary machine tools were not strong enough to take the cuts desired. Therefore, it was necessary either to add cutting-bar supports or to design special machine tools. This set of articles forms a comprehensive treatise on the making of this shell.

The manufacture of the 12-in. shrapnel shell calls for many interesting methods, owing to its size and the accuracy of finish demanded. These conditions ordinarily would warrant the highest degree of mechanical thought and experience. When the problem must be tackled by either changing over present shop equipment or designing special machine tools without any precedent for guidance, the task becomes much more difficult.

Owing to the fact that time was at a premium, tools already in service that could be used to perform any machining operation were utilized. On some operations, however, the strains set up were so enormous that one-purpose machines were designed, built and are being used.

In Fig. 2 are shown samples of each stage of manufacture from the blank cut to length to the finish-machined shell ready for filling and charging with the bullets, rosin and powder. A detailed illustration of the shell is shown in Fig. 1. The sequence of operations is as follows:

1. Lay off ends of billet for center and center punch.
2. Square center and countersink.
3. Rough-turn and cut blanks to length.
4. Rough-bore.
5. Second bore.
6. Bore powder chamber and bore for diaphragm.

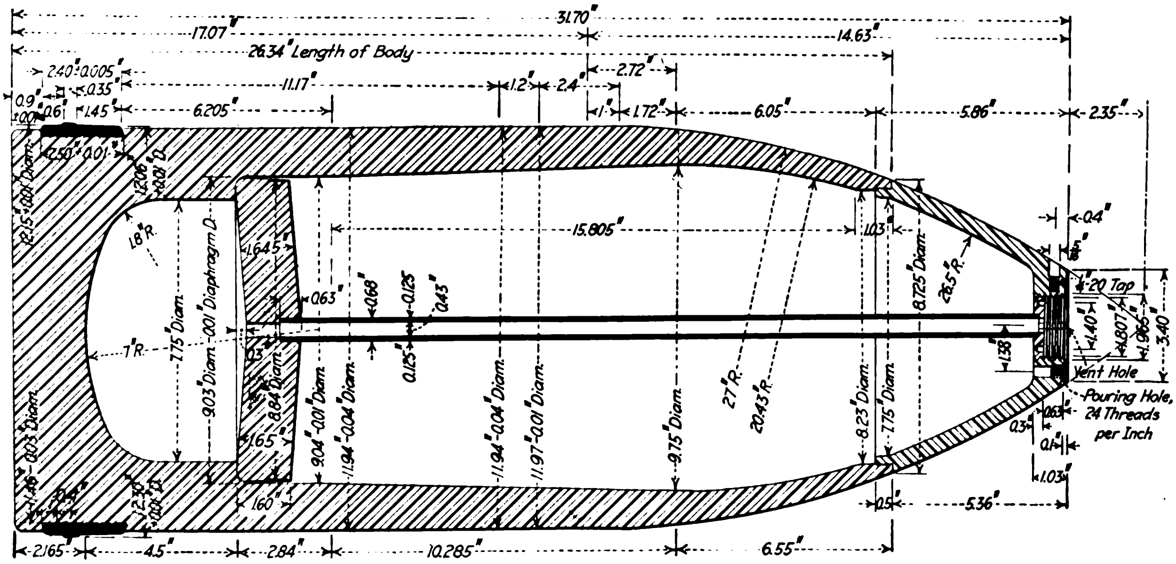


FIG. 1. DETAILED ILLUSTRATION OF 12-IN. SHRAPNEL SHELL

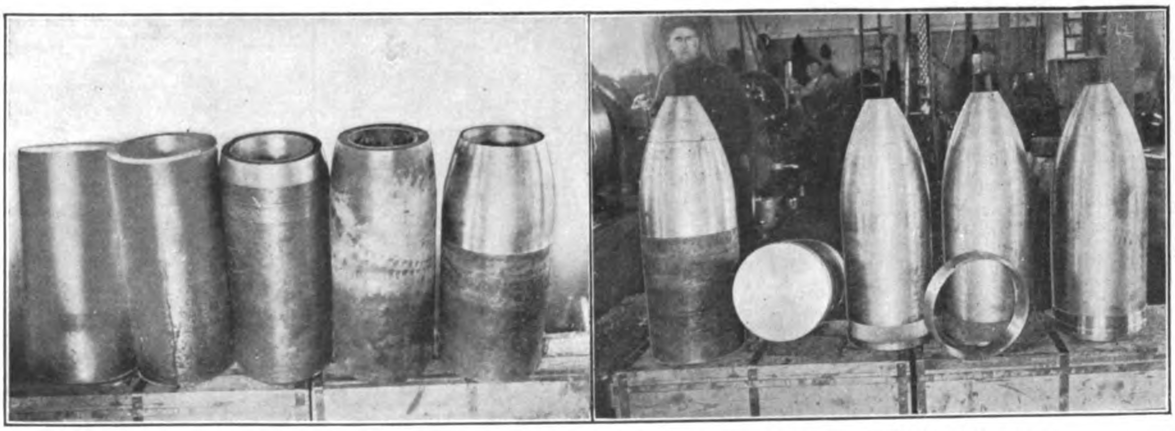


FIG. 2. VARIOUS STAGES OF 12-IN SHRAPNEL FROM ROUGH TO FINISHED SHELL

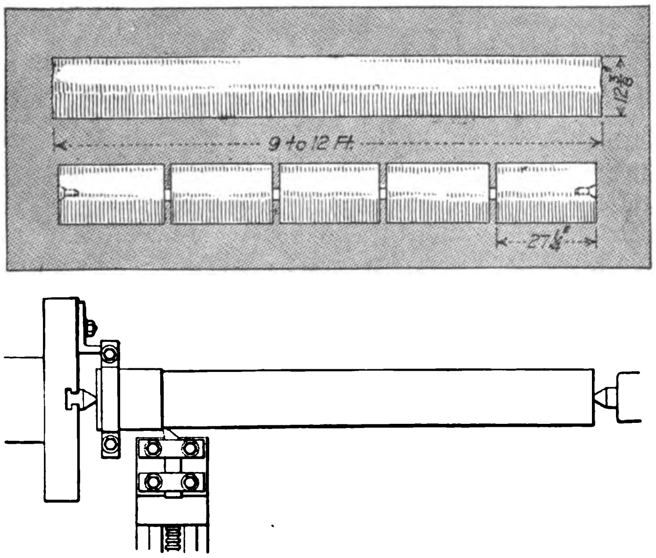


FIG. 3. OPERATION 3. ROUGH-TURNING AND CUTTING THE BLANKS

Machine Used—Bement-Miles lathe. using ½-in. width cutting-off tool.
Special Fixtures and Tools—None.
Gages—None.
Production—4 in 12 hours.
Lubricant—Turn dry and use 50 per cent. lard oil and 50 per cent. kerosene oil when cutting off.
Note—Between Grinding of Tool—Two.
Lathe operates at 6 r.p.m. with a feed of 0.125 in. per rev.
References—Fig. 3.

7. Fit in diaphragm.
8. Nosing.
9. Turn inside form.
10. Open end faced and thread cut to suit adapter.
11. Fit in adapter and turn part of outside and machine contour.
12. Face back end and turn rest of body on outside.
13. Turn channel and knurl.
14. Force on copper band.
15. Turn copper band to shape
16. Final inspection.
17. Remove plug, adapter bottom and adapter.
18. Fit in spider to hold powder tube central.
19. Fill in bullets and rosin.
20. Remove spider, place on adapter, fill with bullets to required weight.
21. Insert adapter bottom.
22. Fill with powder through powder tube.
23. Fill powder tube with pellets.
24. Final weighing.
25. Screw in plug and grease ready for packing.

The steel from which the blanks are made comes to the works in billets averaging from 9 to 12 ft. in length and approximately $12\frac{3}{8}$ in. in diameter. Its chemical analysis is: Carbon, 0.47 per cent.; manganese, 0.68 per cent.; phosphorus, 0.022 per cent.; sulphur, 0.035 per cent. The physical analysis is: Tensile strength, 90,000 to 110,000 lb. per sq.in.; elastic limit, 50,000; elongation, not less than 8 per cent.; reduction of area, not less than 21 per cent. For the operation of rough-turning the outside of the billet and cutting the blanks to length, which follows the centering operations, the billet is held on the centers of a lathe and driven with a dog attached to the faceplate. A diagrammatical illustration of this operation is shown in Fig. 3. The bar is rough-turned to $12\frac{1}{16}$ in. and cut into lengths of about $27\frac{1}{4}$ in., no gage being used.

The blank is then held in the special chuck, Fig. 4, for the next operation, which is rough-boring to $5\frac{1}{2}$ in. in diameter. The boring bar, head and cutter for this operation are shown in Fig. 5. The depth gage, which is of the pin type may be seen in Fig. 6. The bar is supported and

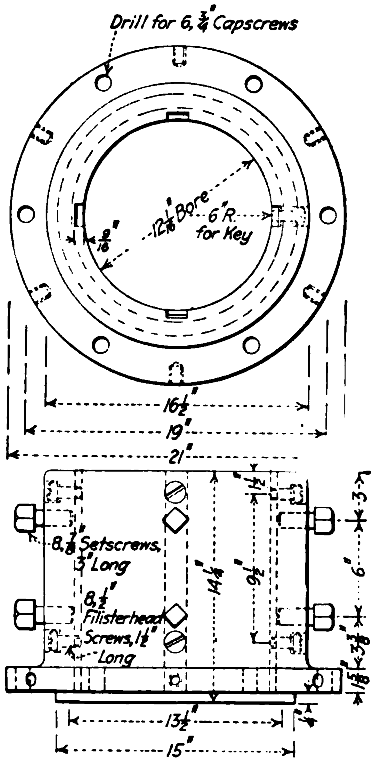


FIG. 4. HOLDING CHUCK FOR LATHE

guided through special clamps fitted on the lathe carriage. A detail of this attachment is given in Fig. 7.

It will be observed that the guide clamp is fitted with a $\frac{7}{8}$-in. key that is set into a keyway machined in the boring bar, thus holding the bar from rotating. The outer end of the shell is supported by a steadyrest, a detail of which appears in Fig. 8. Fig. 9 shows the lathe set up for performing this rough-boring operation. A diagrammatical view of the surface machined and manner in which the shell is held is given in Fig. 10.

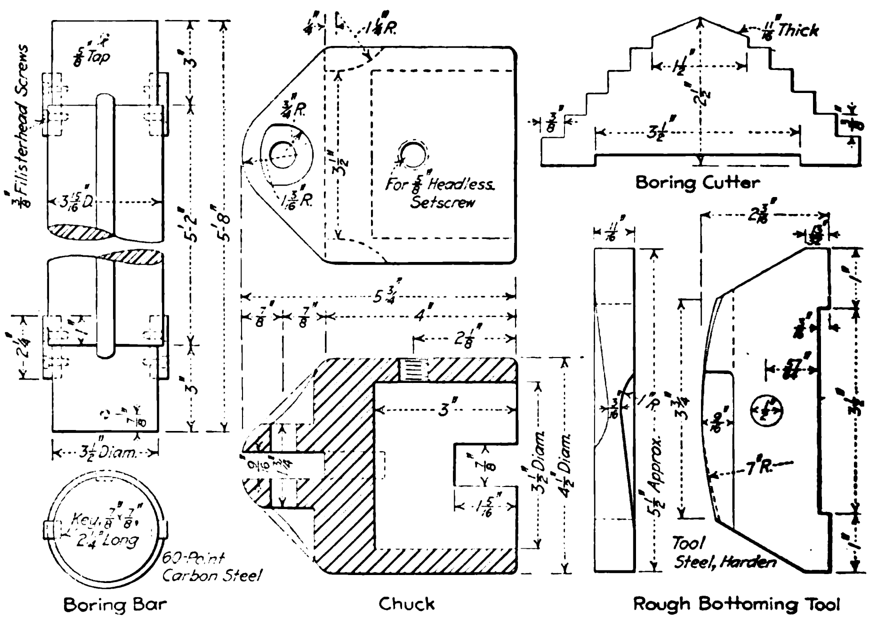


FIG. 5. DETAIL OF BORING BAR, HEAD AND CUTTER

For the next operation the blank is held in a chuck similar to that in Fig. 4. This operation is opening out the bored hole to 7.6875 in., using a boring bar like that in Fig. 5 and the head and cutter of Fig. 11. This tool is fed into the shell to the same depth as the roughing cutter—24½ in. The cutter is then removed and the 9.07-in. tool, Fig. 12, inserted in the same head. This cutter is then fed into the shell for approximately 16 in., measuring from the open end.

The next operation—the sixth—is performed with the shell in the same setting on the lathe. The powder cham-

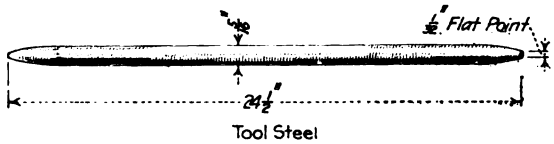


FIG. 6. DEPTH GAGE FOR ROUGH BORE

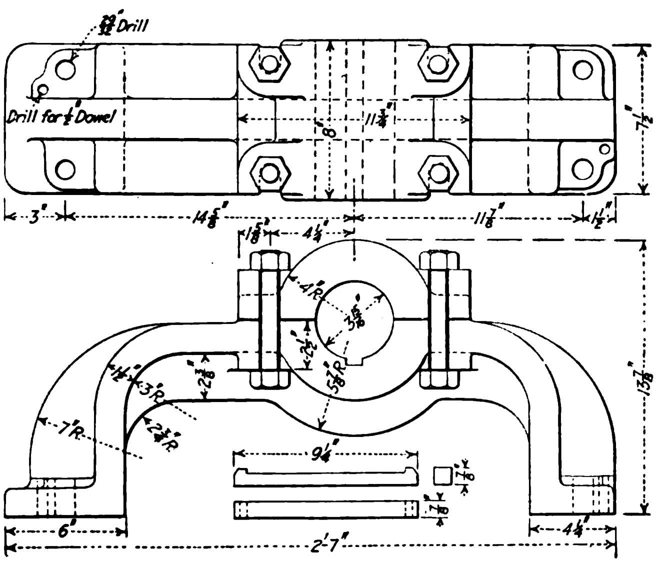


FIG. 7. CLAMP FOR LATHE

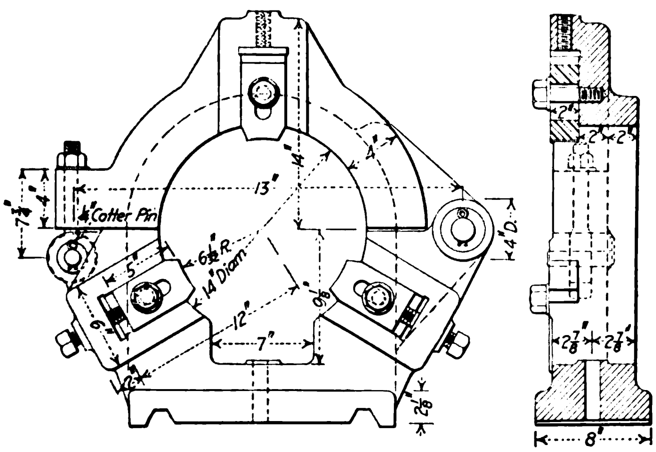


FIG. 8. STEADY REST FOR BORING

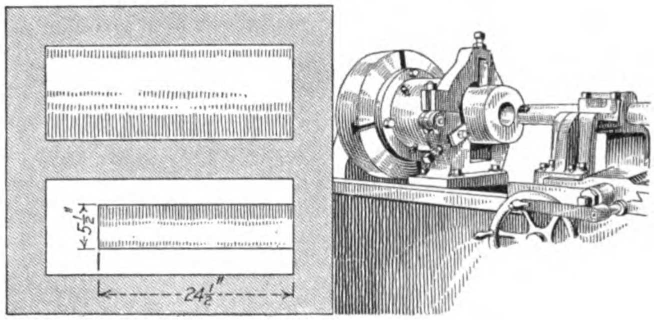


FIG. 10. OPERATION 4: ROUGH BORING

Machine Used—Bement-Miles lathe.
Special Fixtures—Steady rest, supports for boring bar, boring bar, head and cutter.
Gages—None.
Production—One in 8 hours.
Lubricant—"Exanol."
Note—Between Grinding of Tool—Average two shells.
Note—Lathe operates at 30 r.p.m. and feed of 0.014 in. per revolution.
References—Figs. 4, 5, 6, 7, 8 and 9.

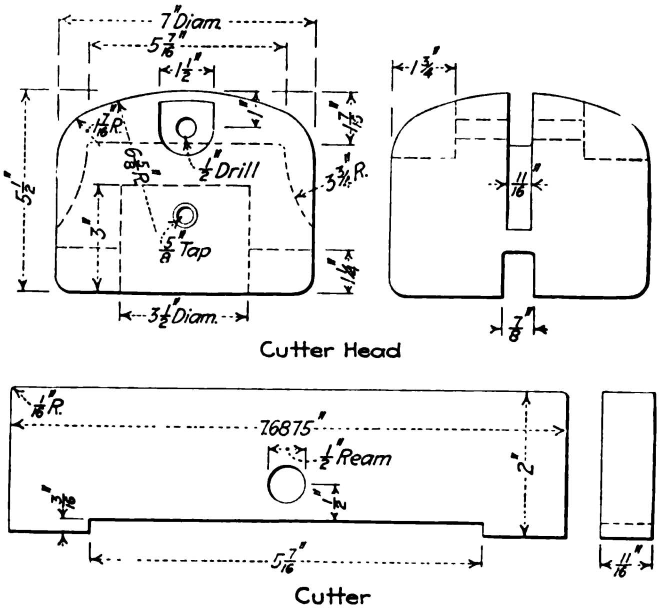


FIG. 11. BORING CUTTER AND HEAD

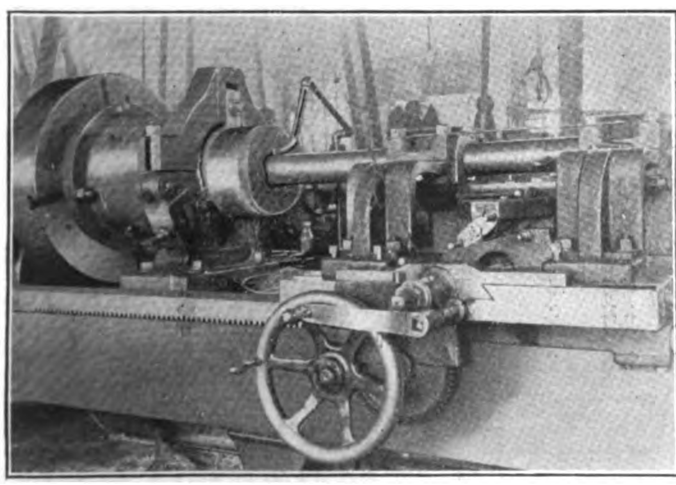


FIG. 9. ROUGH-BORING THE SHELL

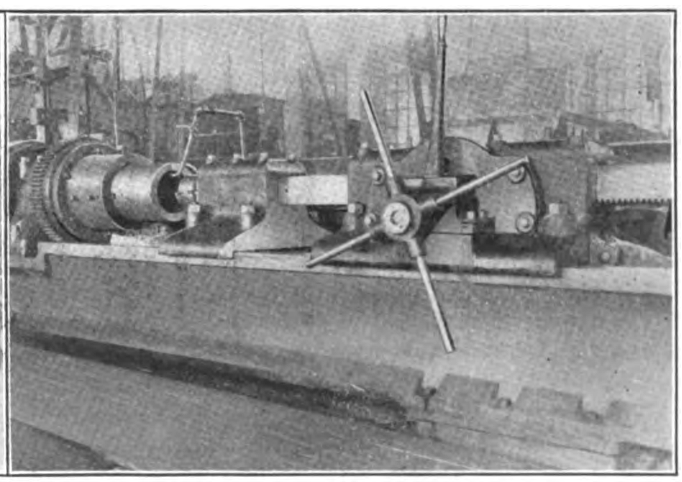


FIG. 17. SECOND BORING OPERATION

ber is rough- and finish-bored with a bar similar to that in Fig. 5 holding the head and cutters, Fig. 13. The gage, Fig. 6, is for testing the depth of the bored hole. The machined contour of the powder chamber is measured by the gage shown in Fig. 14.

The next suboperation is machining the surface to suit the diaphragm. A boring bar similar to the one in Fig. 5 is used, holding a head like that illustrated in Fig. 11. The boring cutter appears in Fig. 15. The gage for testing this bored hole, so that the correct depth of powder chamber will be obtained, is illustrated in Fig. 16.

The lathe employed in boring the powder chamber and machining for the diaphragm is shown in Fig. 17 and a diagrammatical view of the work in Fig. 18. Before the shell is removed from the chuck, the front end is chamfered down for about 3 in., thereby facilitating the nosing-in operation, which follows. The shell at this stage is detailed in Fig. 19. For the nosing operation, for which it is transferred to the blacksmith shop, the shell is heated in a special crude-oil furnace, Fig. 20. It will be observed that the furnace is designed to heat four shells at once, and the approximate temperature is 1,600 deg. F. The average consumption of crude oil is 10 gal. per hr.

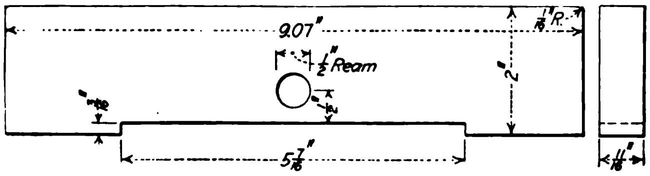


FIG. 12. DETAIL OF BORING CUTTER

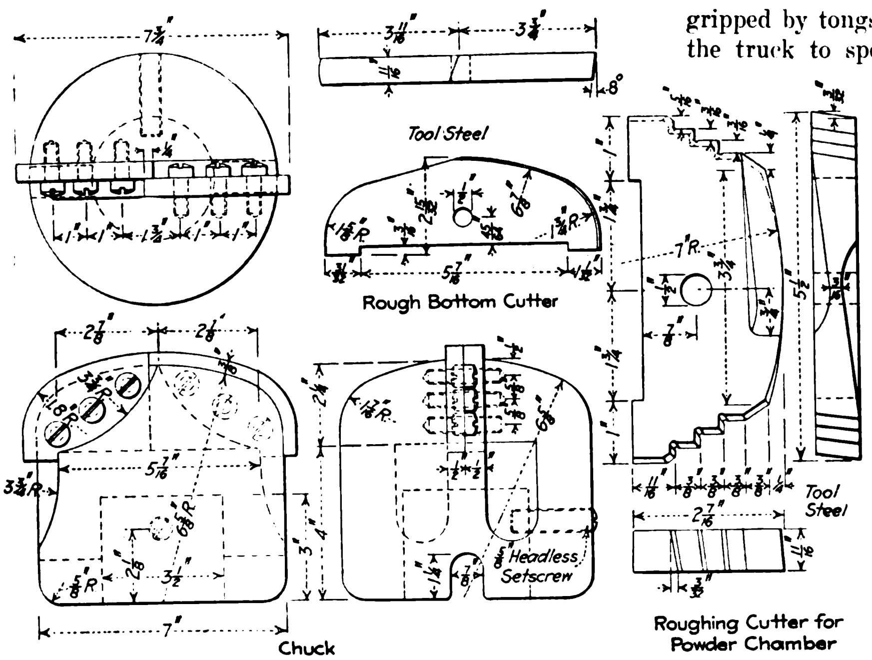


FIG. 13. CUTTER AND CHUCK FOR POWDER CHAMBER

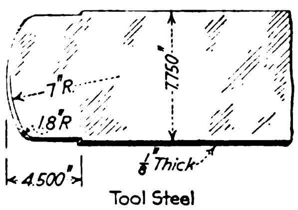


FIG. 14. GAGE FOR POWDER CHAMBER

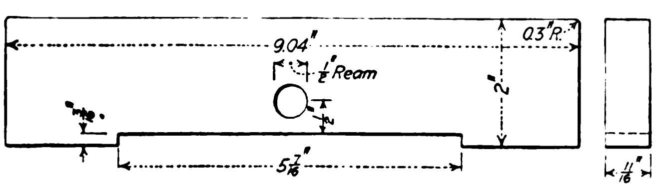


FIG. 15. BORING CUTTER FOR DIAPHRAGM SURFACE

The operation of inserting the diaphragm and nosing is given in diagrammatical form in Fig. 21. After a shell has been heated to the desired temperature, it is gripped by tongs, as shown, and transferred by means of the truck to special dies attached to a steam hammer. The diaphragm, the manufacturing of which will be described in another article, is then slid inside the shell. A rod placed in the hole bored to receive the powder tube holds the shell squarely.

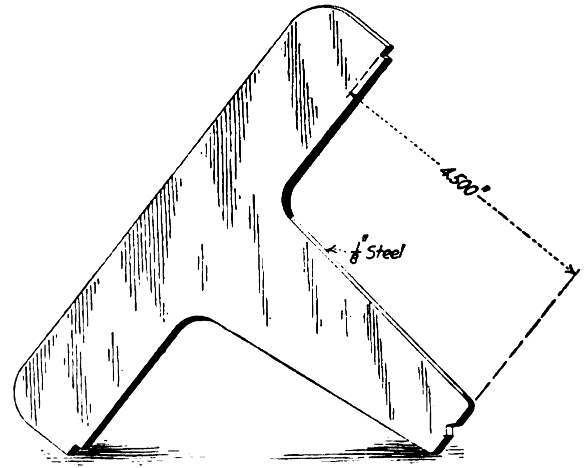


FIG. 16. GAGE FOR DEPTH OF POWDER CHAMBER

In Fig. 22 is one of the shells held between a diaphragm in position and the dies. The shell is then placed in the furnace and heated a second time. When the correct temperature is reached, the shell is placed between the dies of the steam hammer in a manner similar to that described. The tup of the hammer carrying the upper die is forced down on the end of the shell until the correct nosing is obtained.

Fig. 23 presents a view of the steam hammer with a shell in position for being nosed and also illustrates the dies

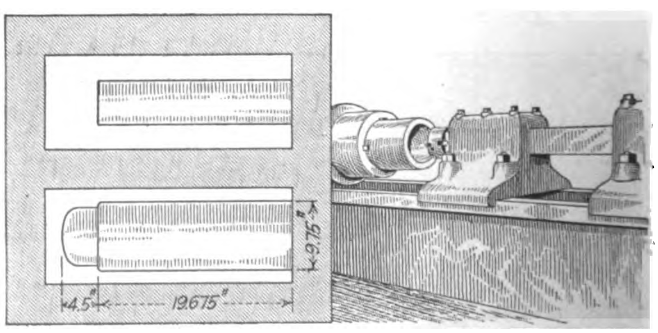


FIG. 18. OPERATIONS 5 AND 6. SECOND BORING; POWDER CHAMBER AND SEAT FOR DIAPHRAGM

Machine Used—Specially designed lathe.
Special Fixtures—Holding chuck for shell.
Gages—Depth and contour.
Production—One in 7 hours.
Lubricant—"Exanol."
Note—Average number of shells between grinding of tools—one.
Lathe operates at 30 r.p.m. with a feed of 0.014 in. per revolution.
References—Figs. 4, 5, 6, 11, 12, 13, 14, 15, 16 and 17.

and the method used to attach them to the steam hammer. The dies, Fig. 24, are fed down on the heated shell until their horizontal edges meet, no gage being used for testing the diameter, and the contour of the dies produces the desired shape.

The nosing gang consists of four men, one of whom is the hammer man. One man handles the tongs for placing the shell in the furnace and also guides the blank between the dies under the hammer. After the correct contour has been secured, the shell is allowed to cool in

TABLE OF WEIGHTS FOR 12-IN. SHELLS

Item	Weight, Lb.
Adapter with screw	18.316
Adapter bottom	0.218
Powder tube	1.420
Diaphragm	29.020
Body	356.40
Bullets	291.696
Rosin	15.911
Powder and powder pellets	6.711
Copper band	10.080
Time fuse	1.620
Total	731.392
Specified	729.000
Excess	2.392

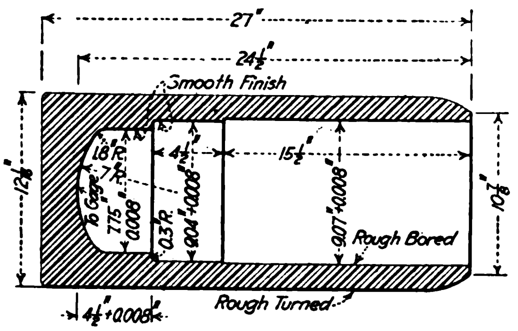


FIG. 19. DETAIL OF ROUGH-TURNED SHELL

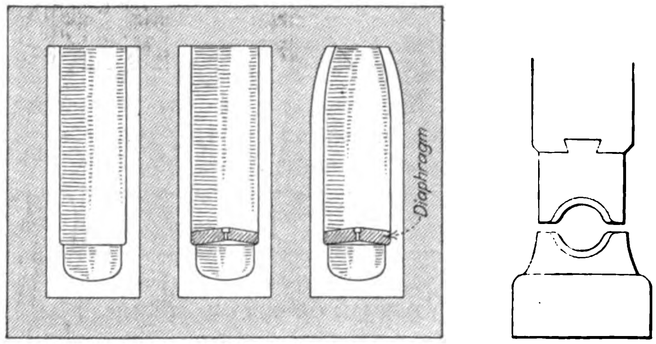


FIG. 21. THE NOSING OPERATION

Machine Used—Niles-Bement-Pond 2,500 lb. steam hammer.
Special Fixtures Used—Crude-oil furnace heating four at once, special tongs for handling work, truck to convey shells to hammer, special top and bottom dies and trucks to machining department.
Gages—Contour.
Production—Steam hammer and four men, four shells per hour.
References—Figs. 21, 22 and 23.

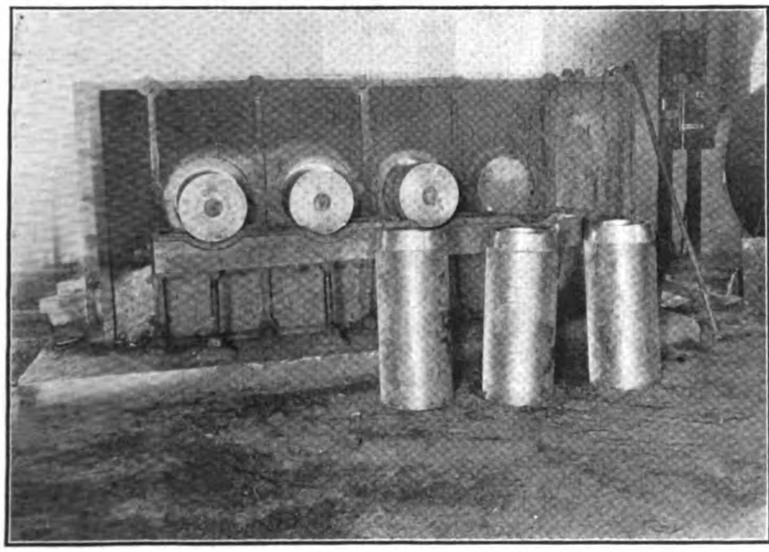


FIG. 20. VIEW OF NOSING FURNACE

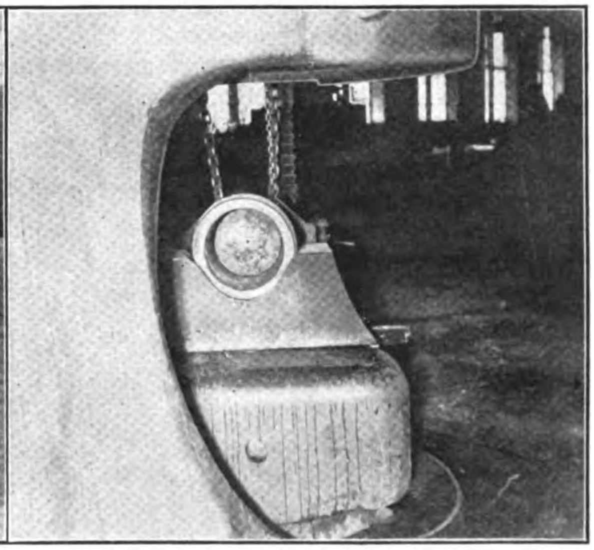


FIG. 22. FITTING IN DIAPHRAGM

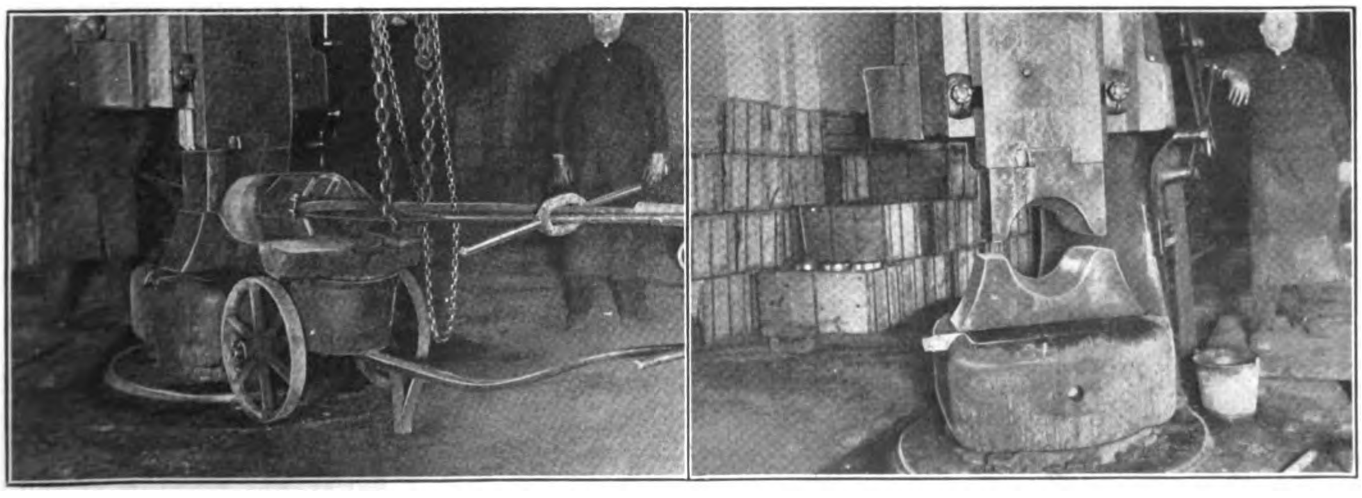


FIG. 23. DIES ON STEAM HAMMER FOR NOSING SHELL AND METHOD OF ATTACHING DIES

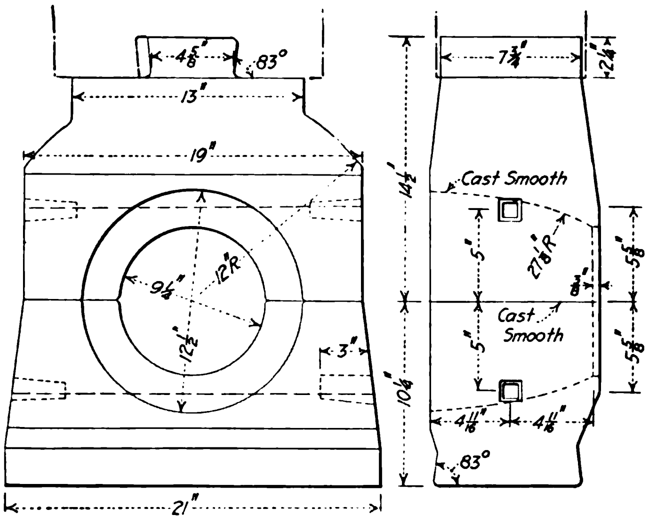


FIG. 24. DETAIL OF NOSING DIES

the air; then it is returned to the machine shop for the subsequent operations.

A vertical hydraulic press was modified and forming dies fitted for the nosing operation; but the steam hammer has been giving such good results that the press is not used. However, the press might be found to be the better method on smaller shells.

Fixtures for Sword Bayonets

By C. D. Corwin

During the past summer the writer was called upon to design for rapidly milling sword bayonets several fixtures suitable for use on the Briggs high-duty miller.

The bayonet is made from $\frac{5}{16}$x1⅛-in. specially rolled steel stock, complying with specifications. The first operation after cutting to proper length is to clamp several pieces side by side and gang mill the tang and 1½ in. of blade edge, to give the shape shown at *A*, Fig. 2.

Four of these pieces are then clamped side by side in the fixture shown in Fig. 3, and the shape of the cutting edge is milled. It will be noticed that, as the work proceeds against the cutter, the profile pieces marked *R* slide over the rollers *H*, lifting the table *P* the proper amount to enable the cutter to give the correct shape to the bayonet. As soon as the point of the bayonet has passed the cutter a sufficient distance, a positive stop on the knee of the machine throws out the feed.

The four blades are then removed by loosening the three nuts *T*, and four new ones are put in and locked. The lever *L* is then thrown over to the right, permitting the left end of the fixture table to swing downward sufficiently to give the cutter clearance above the blanks. A quick-return mechanism tripped by the operator causes the miller table to run to the left until automatically stopped at the correct position under the cutter. The lever *L* is then thrown to the left, which raises the fixture table to the cutting position, whereupon the feed mechanism is engaged and the cut starts. The blanks after this cut appear as at *B*, Fig. 2.

Two of the blades are then placed on the table of the fixture shown in Fig. 4, at the left or No. 1 position, and a cut is taken on one side, changing the shape from a rectangle to that at *C*, Fig. 2. These two pieces are then shifted to position No. 2, Fig. 4, wh[illegible] their shape is changed from that at *C* to that at *D*, Fig. 2. All four cuts are carried on at the same time. The pieces then go from this fixture to a similar one with slightly different table, where they are given the slope shown at *E*. Fig. 2. At the same time two other blades are milled from the section *E* to *F*, Fig. 2.

The bayonet now has the sections shown at *G*, Fig. 2, with the blade tapering toward the point. Next, the bayonets are fitted for the hilt attachments and afterward hardened and ground to a cutting edge.

A description of the two types of fixtures may be of interest. In Fig. 3 at *A* is the knee of the Briggs miller, upon which the table *B* rides, being driven by a nut and feed screw, not shown. Fastened rigidly to the knee are two brackets *C* and *D*. These support the shaft *E*, upon which are pinned two roll carriers *F*.

Passing through the upper end of the roll carriers is a shaft *G*, with a head turned on one end. This shaft serves as the journal for the two rollers marked *H*, while its head forms the pin to which one end of the link *I* is attached. The link *I* is operated by the crank *J* keyed to the shaft *K*, which carries at its outer end the shifting handle *L*. A spring *M* serves to hold the handle *L* securely in the running position and also prevents any small vibration.

Two pins *N* serve as stops for the handle. When this is to the left, the link and centers are so arranged as

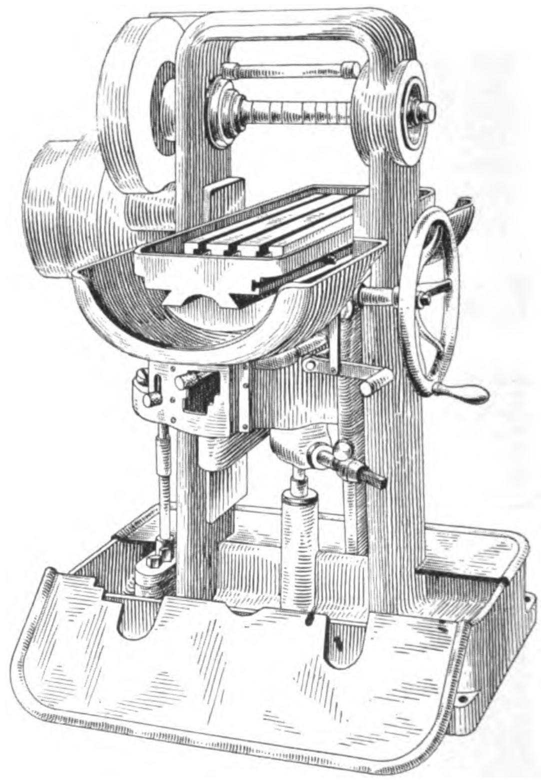


FIG. 1. MILLER ON WHICH THE SWORD BAYONET MILLING WAS PERFORMED

to lock the mechanism. A raised boss on the bracket *C*, met by a boss on crank *J*, forms a rigid stop for the link while the cut is being taken.

Mounted on the table at the right is shown a bracket *O*, definitely located in the center of the table and positioned longitudinally by means of two tongues at right angles to each other and fitting into the grooves of the table. Through the bracket *O* passes the shaft *Q*, upon which the fixture table *P* can swing. At *R* are the two

profile plates of steel, which slide over the rollers H and are so shaped as to give the proper lift to the fixture table. At S is a bracket accurately positioned. It serves to take any side thrust, as well as to act as a guide for the fixture table. There are three bolts T, threaded on one end to

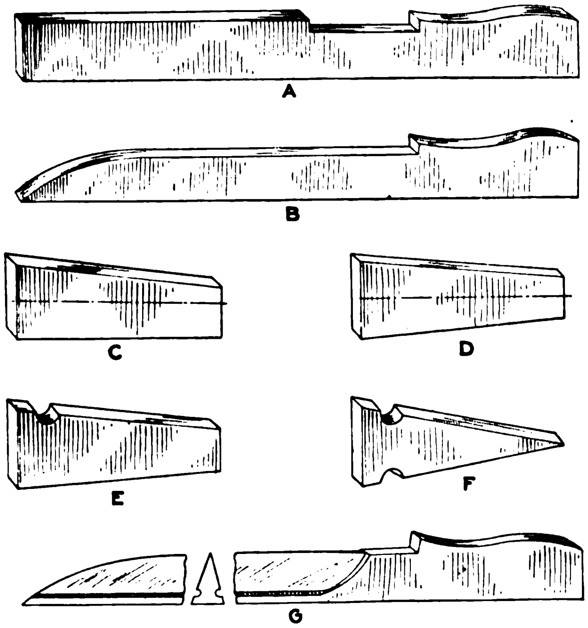


FIG. 2. CHANGES IN THE SHAPE AND SECTION OF SWORD BAYONETS

receive hexagon nuts and hold the blanks fast in position.

In designing the fixture it was necessary to make three tables, each with its own profile plates, because the bayonets taper from near the hilt along the back edge toward the point, as shown at G, Fig. 2.

In the fixture of type 1 the bayonets are held from the sides at three points and positioned from the tang end,

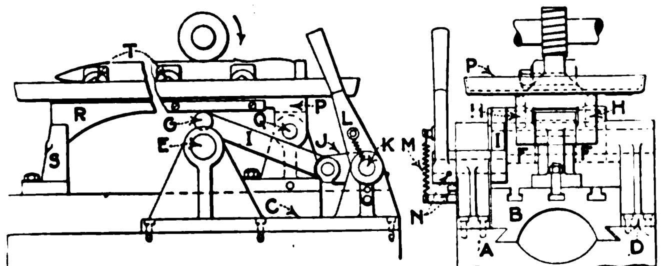


FIG.3

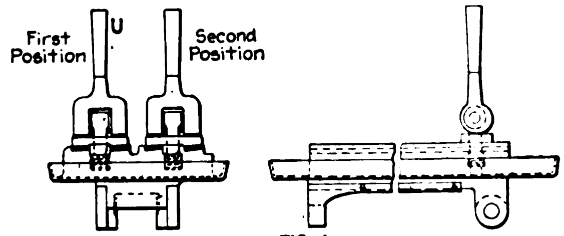


FIG.4

FIGS. 3 AND 4. DETAILS OF MILLING FIXTURES FOR SWORD BAYONETS

Fig. 3—Edge milling fixture fitted with Type I table. Fig. 4—Fixture for the flat sides

while on tables of types 2 and 3 they are held down at the tang by means of two cam clamping handles, shown in Fig. 4. Each handle holds two bayonets, and the positioning is done by means of a pin fitting against the tang projection. The clamping handles are made up as shown in Fig. 4, in which U is the handle proper, with its lower end forming a cam.

All tables have ample troughs around them and two outlets with flexible hose connection to the tank at the base of the machine. This tank forms the reservoir for the cooling fluid, which is pumped to the cutters by means of a small twin-gear rotary pump driven from the feed shaft of the machine.

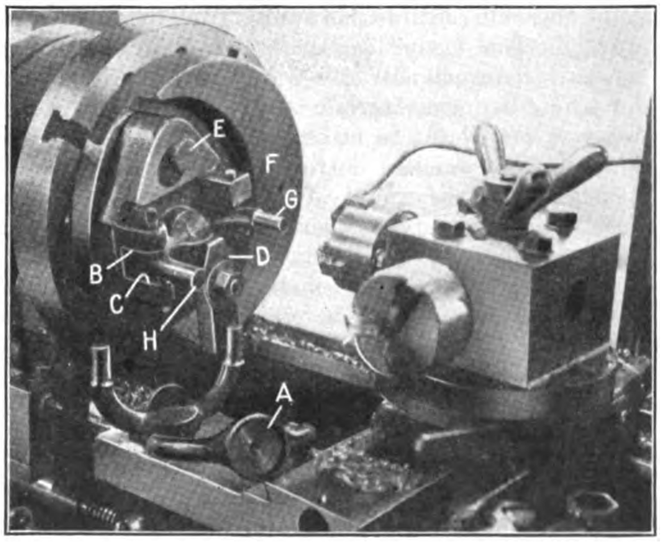
The fixtures were so designed that one set of patterns answered for all castings except the two extra types of tables; and this pattern was made up of three pieces, so that with slight alterations it served for all fixtures. The profile plates, rollers and pins upon which any appreciable wear might occur were made of steel, hardened and ground.

The successive cuts, changing the bayonet from a rectangular shape to a sharp triangle, necessitated a little different rest for each position of the blank and a slightly different profile plate. Otherwise, tables of types 2 and 3 are identical.

Machining Forged Fork Ends

By E. V. Thomas

The ends of the drop-forged forks on Henderson motorcycles are machined in the indexing lathe fixture shown. The crown of the fork is first machined out, as at A, in another machine. This hollowed-out crown is then used to locate by in the indexing fixture, where it is placed



MACHINING FORGED FORKED ENDS

over a locating plug. The sides of the fork rest between guides B and C and are centered by setscrews in the guiding jaws. The entire forging is clamped in with the strap clamp D.

The indexing part of the fixture is offset enough to bring each fork end in turn central with the lathe spindle. The lockpin for the indexing part may be seen at E. As the weight of the forging and carrier is considerably to one side of the center of rotation, the counterweight F is used to balance it. Two three-jawed hollow mills are employed in the turret to machine the ends. One roughs the end, and the other gives a finishing cut. With one end finished as at G, the carrier is indexed and the end H brought in line with the hollow mills.

Casehardening Small-Shop Steels--II

By John H. Van Deventer

SYNOPSIS—This article deals with the subject of quenching case-carbonized articles and with the heat treatment of such pieces to secure maximum toughness. Pack-hardening is discussed and also the casehardening of alloy steels and cast iron. A combination quenching tank for hardening and coloring is illustrated.

All blacksmiths are by nature and training more or less experimenters, and very few have not some "secret" formula for accomplishing wonderful results in hardening. Cast-iron hardening has received a good part of their attention in this respect with varying degrees of success. While it has been an easy matter to make cast iron extremely hard on the surface—in fact, as hard as the hardest tool steel—no one has as yet found a way to add the element of strength to this hardness without which its use is limited to gages, templets and other things that do not require much strength.

Some amusing results often accompany such experiments. One blacksmith of my acquaintance, who had obtained very fair results with cast-iron hardening, was always searching for some chemical or compound to add to the quenching bath to make this "grip" the metal more forcibly. This "grip" is a noticeable thing in hardening cast iron; not only can you feel it on the end of the tongs, but when certain solutions are used, it becomes so forcible as to make itself heard—making one think that a miniature torpedo was exploding beneath the surface of the water. I was passing through his blacksmith shop one day when a new mixture was being tried out. As soon as the blacksmith plunged the red-hot casting into the barrel containing this mixture, there was a violent explosion in which blacksmith, barrel, quenching mixture and casting were indiscriminately mixed. The experimenter picked himself up, felt of the various parts of his anatomy to see what was missing and, finding himself intact, exclaimed regretfully: "Say, what a fine mixture that would be if you could only get a barrel strong enough to hold it!" I do not know what caused this explosion, but having seen it, can be sure that it happened and also that it put an end to the experimenting of this particular blacksmith, who afterward stuck to the tried and tested formulas. Probably the heat of the casting was all that was needed to set up some powerful chemical reaction between the elements in the bath.

An old formula that has done good service in the matter of surface-hardening cast iron is as follows: To 20 gal. of water add 1 pint of oil of vitrol, 2 pecks of salt, 4 lb. of alum, ½ lb. yellow prussiate of potash, ½ lb. cyanide of potash and 1 lb. saltpeter. This bath can be kept in a covered wooden barrel. The casting is heated cherry-red and then plunged into this bath, which hardens its surface. Sometimes it is necessary to repeat this performance two or three times to get the surface sufficiently hard.

The quenching tank is an important feature of apparatus in casehardening—possibly more so than in ordinary tempering. One reason for this is because of the large quantities of pieces usually dumped into the tank at a time. One cannot take time to separate the articles themselves from the casehardening mixture, and the whole content of the box is dropped into the bath in short order, as exposure to air of the heated work is fatal to results. Unless it is split up, it is likely to go to the bottom as a solid mass, in which case very few of the pieces are properly hardened. A combination cooling tank is shown in Fig. 1. Water inlet and outlet pipes are shown and also a drain plug that enables the

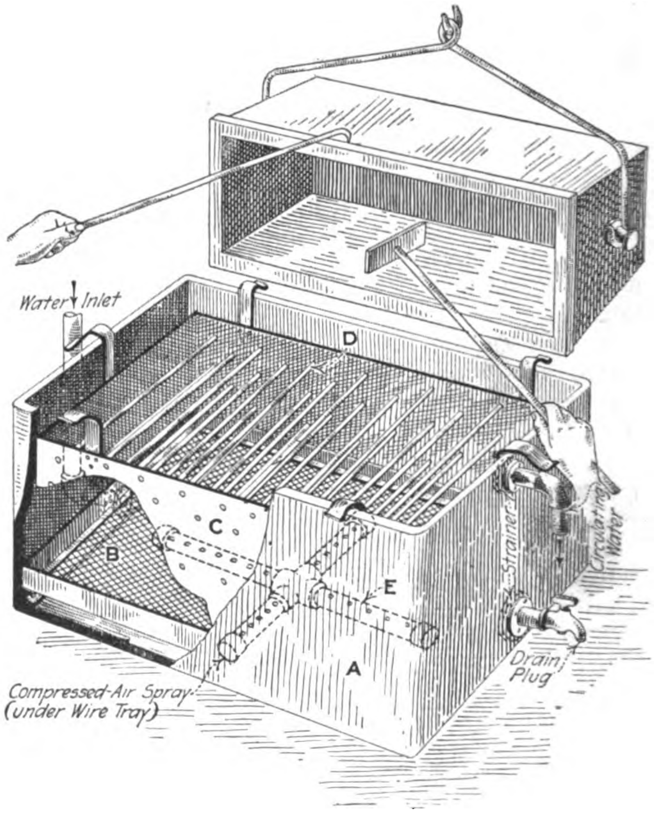


FIG. 1. COMBINATION COOLING TANK FOR CASEHARDENING

tank to be emptied when it is desired to clean out the spent carbonizing material from the bottom. A wire-bottomed tray, framed with angle iron, is arranged to slide into this tank from the top and rests upon angle irons screwed to the tank sides. Its function is to catch the pieces and prevent them from settling to the tank bottom, and it also makes it easy to remove a batch of work. A bottomless box of sheet steel is shown at *C*. This fits into the wire-bottomed tray and has a number of rods or wires running across it, their purpose being to break up the mass of material as it comes from the carbonizing box.

Below the wire-bottomed tray is a perforated cross-pipe that is connected with a compressed-air line. This is used when casehardening for colors. The shop that

has no air compressor may rig up a satisfactory equivalent in the shape of a low-pressure hand-operated air pump and a receiver tank, for it is not necessary to use high-pressure air for this purpose. When colors are desired on casehardened work, the treatment in quenching is exactly the same as that previously described except that air is pumped through this pipe and keeps the water agitated. The addition of a slight amount of powdered cyanide of potassium to the packing material used for carbonizing will produce stronger colors, and where this is the sole object, it is best to maintain the box at a dull-red heat.

The old way of casehardening was in nine shops out of ten to dump the contents of the box at the end of the carbonizing heat; in fact, this plan still exists in many shops that should know better. Later study in the structure of steel thus treated has caused a change in this procedure, the use of automobiles and alloy steels probably hastening this result. The diagrams reproduced in Fig. 2 show why the heat treatment of casehardened work is necessary. Starting at *A* with a close-grained and tough stock, such as ordinary machinery steel containing from 15 to 20 points of carbon, if such work is quenched on a carbonizing heat, the result will be as shown at *B*. Here we have a core that is coarse-grained and brittle and an outer case that is fine-grained and hard, but is likely to flake off, owing to the great difference in structure between it and the core. Reheating this work beyond the critical temperature of the core refines this core, closes the grain and makes it tough, but leaves the case very brittle; in fact, more so than it was before. This is remedied by reheating the piece to a temperature slightly above the critical temperature of the case, this temperature corresponding ordinarily to that of steel having a carbon content of 85 points. When this is again quenched, the temperature, which has not been high enough to disturb the refined core, will have closed the grain of the case and toughened it. Thus, instead of but one heat and one quenching for this class of work, we have three of each, although it is quite possible and often profitable to omit the quenching after carbonizing and allow the piece or pieces and the case-carbonizing box to cool together, as in annealing. Sometimes another heat-treatment is added to the foregoing, for the purpose of letting down the hardness of the case and giving it additional toughness by heating to a temperature between 300 and 500 deg. Usually this is done in an oil bath. After this the piece is allowed to cool.

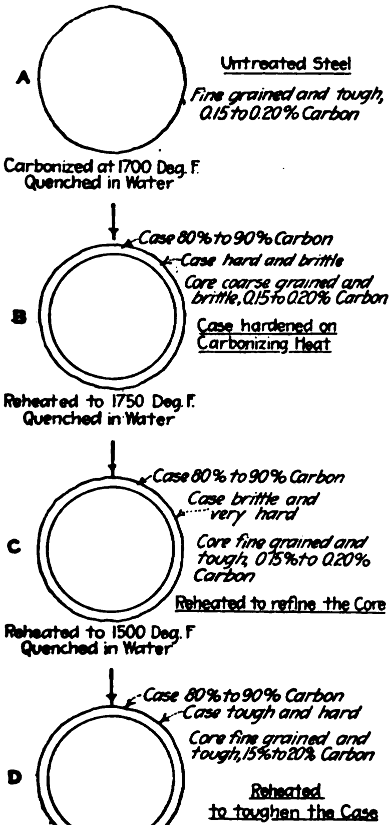


FIG. 2. WHY HEAT TREATMENT OF CASEHARDENED WORK IS NECESSARY

It is possible to harden the surface of tool steel extremely hard and yet leave its inner core soft and tough for strength, by a process similar to casehardening and known as "pack-hardening." It consists in using tool steel of carbon contents ranging from 60 to 80 points, packing this in a box with charred leather mixed with wood charcoal and heating at a low-red heat for 2 or 3 hr., thus raising the carbon content of the exterior of the piece. The article when quenched in an oil bath will have an extremely hard exterior and tough core. It is a good scheme for tools that must be hard and yet strong enough to stand abuse. Raw bone is never used as a packing for this class of work, as it makes the cutting edges brittle.

Casehardening Treatments for Various Steels

Plain water, salt water and linseed oil are the three most common quenching materials for casehardening. Water is used for ordinary work, salt water for work which must be extremely hard on the surface, and oil for work in which toughness is the main consideration. The higher the carbon of the case, the less sudden need the quenching action take hold of the piece; in fact, experience in casehardening work gives a great many combinations of quenching baths of these three materials, depending on their temperatures. Thin work, highly carbonized, which would fly to pieces under the slightest blow if quenched in water or brine, is made strong and tough by properly quenching in slightly heated oil. It is impossible to give any rules for the temperature of this work, so much depending on the size and design of the piece; but it is not a difficult matter to try three or four pieces by different methods and determine what is needed for best results.

The alloy steels are all susceptible of casehardening treatment; in fact, this is one of the most important heat treatments for such steels in the automobile industry. Nickel steel carbonizes more slowly than common steel, the nickel seeming to have the effect of slowing down the rate of penetration. There is no cloud without its silver lining, however, and to offset this retardation, a single treatment is often sufficient for nickel steel; for the core is not coarsened as much as low-carbon machinery steel and thus ordinary work may be quenched on the carbonizing heat. Steel containing from 3 to 3½ per cent. of nickel is carbonized between 1,300 and 1,400 deg. F. Nickel steel containing less than 25 points of carbon, with this same percentage of nickel, may be casehardened by cooling in air instead of quenching.

Chrome-nickel steel may be casehardened similarly to the method just described for nickel steel, but double treatment gives better results and is used for high-grade work. The carbonizing temperature is the same, between 1,300 and 1,400 deg. F., the second treatment consisting of reheating to 1,400 deg. and then quenching in boiling salt water, which gives a hard surface and at the same time prevents distortion of the piece. The core of chrome-nickel casehardened steel, like that of nickel steel, is not coarsened excessively by the first heat-treatment, and therefore a single heating and quenching will suffice for ordinary work.

Device for Filling Wristpins for Casehardening

By E. V. Allen

The wristpins in the pistons of the motors on Henderson motorcycles are approximately ½ in. in diameter and 2½ in. long, with a hole through them lengthwise. They are made of mild steel and pack-hardened. To prevent

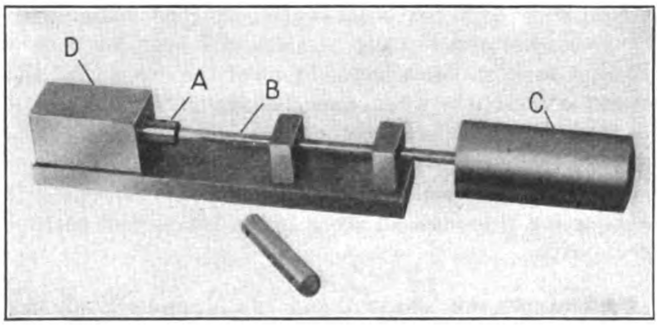


FIG. 1. DEVICE FOR REMOVING CLAY

the hardening of the inside of the pins, the holes are filled with a clay mixture. As the inserting of this clay by hand took considerable time, a filling device was made, which is shown in Fig 2.

The clay mixture is placed in the pointed holder *A* and is squeezed out through the nozzle by screwing down on the handwheel *B*. The pin to be filled is placed at *C* and brought up snugly to the nozzle by the screw *D*. To facilitate the insertion and removal of the pins in the locating V-block, finger spaces are cut in the block at *E* and *F* on each side of the pin.

One filling of this device will suffice for a large number of pins, and no trouble is experienced in having air spaces left inside the pin or in having the clay fall out,

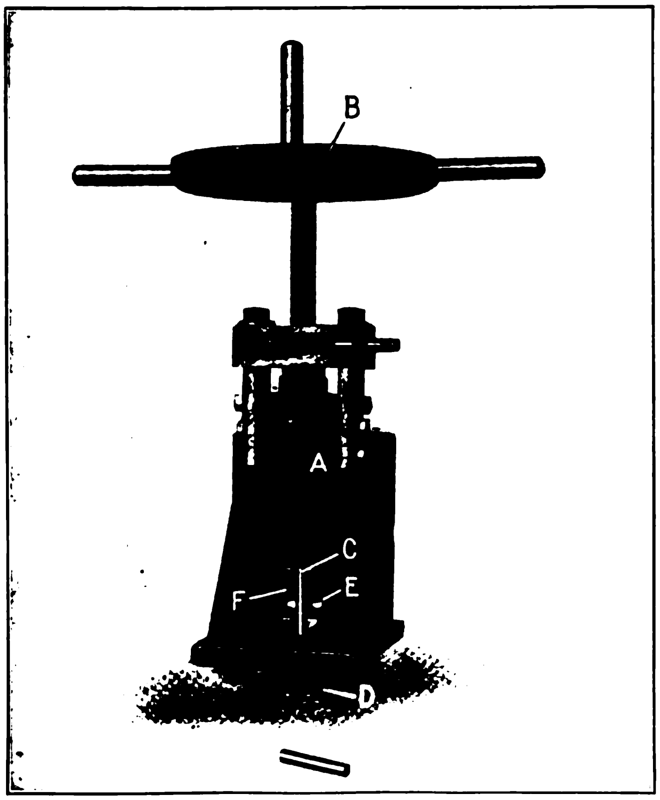


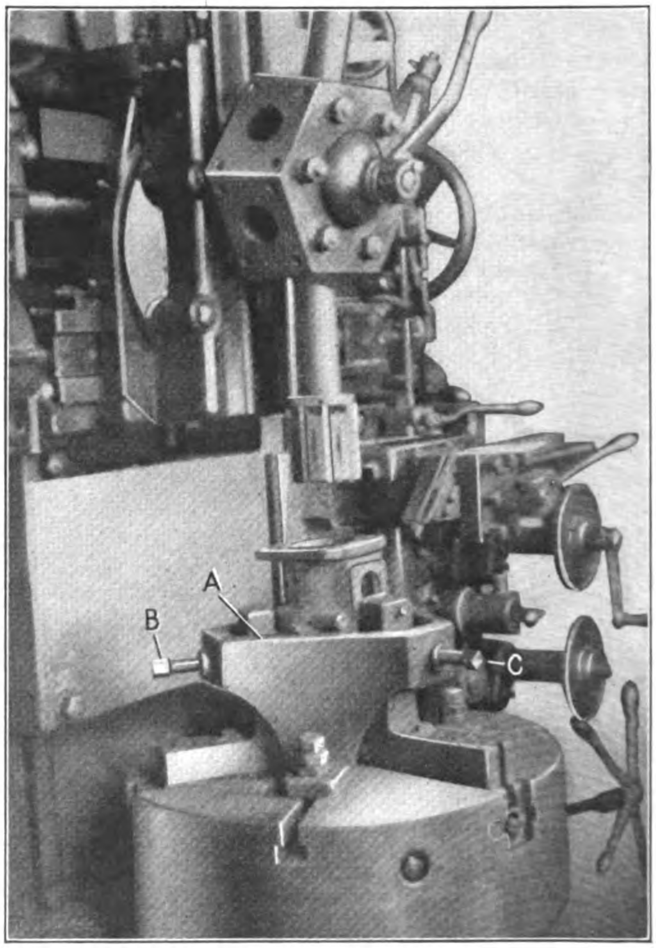
FIG. 2. WRISTPIN FILLING DEVICE

as is frequently the case with that put in by hand. A latch device makes it possible quickly to remove the plunger for refilling.

After the pins have been hardened, the clay is punched out with the contrivance shown in Fig. 1. The pin is placed at *A*, and the plunger *B* is rammed into the hole by the weight *C*, the clay being forced out through a hole in the outer end of the block *D*.

Special Chuck-Jaw Supports

In chucking motor-cylinder castings on a Bullard machine the Caille Perfection Motor Co., Detroit, Mich., uses special extension chuck jaws. These, as shown, extend up so high that, unsupported, they would spring.



SPECIAL CHUCK-JAW SUPPORTS

This difficulty is remedied by using a cast-iron supporting bracket *A*. After the chuck jaws have been run in to the work, the screws *B* and *C* are screwed in to back up the end of the chuck jaws, thus avoiding chatter.

Employment Managers' Problems—The selecting, hiring, training and promotion of workers as a phase of industrial management was considered by an "employment managers' conference," called as a preliminary to the ninth annual convention of the National Society for the Promotion of Industrial Education. In the official announcement of the conference the following significant comment was made: It has been found that only a few employers have "blue-printed" the jobs which were being filled in such a way as to bring about a fair selection of competent workers. More friction, waste, disaffection and ill will are probably bred in the failure to give this subject the thought that it requires than come from almost any other source. The conference emphasized that the "overturn" in working forces of industrial plants each year constitutes a positive waste.

Inclined Plane in Tool Design

By Walter G. Groocock

SYNOPSIS—These interesting applications of the wedge, or inclined-plane, principle to the design of tools for cutting metal show what a useful method this is of securing short movements with considerable power. The wedge, or incline, is in fact one of the fundamental principles of mechanics, and it is difficult to find a tool or machine that does not utilize it in some way.

The use of the inclined plane as a means for moving a cutting tool is not a new idea. The principle is used quite frequently in machine-tool design, as for instance in the ordinary taper-turning attachments for both center and turret lathes. Then there are such special cases as the tangent bar used on ordnance work for rifling and also for making slight changes in the lead of screws, as in the case of the Holroyd screw-milling machine. Another variation of the tangent bar is found on the Loewe relieving lathe for correcting minute differences in the gear ratio of the relieving train of gears.

But while all these particular cases are interesting, this article refers to those adaptations of the principle that apply directly to boring, threading and recessing bars and to such taper-turning tools as are self-contained. I have had, both as tool maker and designer, many such tools pass through my hands, and a few of them may demonstrate the possibilities of various types.

The bar shown in Fig. 1 was designed for use on a boring machine. It is particularly useful either for recessing or threading holes and is shown adapted to both these classes of work. As drawn, it was intended for use as a "stump bar"—that is, a bar with its outer end unsupported. In Fig. 1, *B* is the bar proper, which is threaded at *A* to fit into an adapter on the nose of the boring-machine spindle.

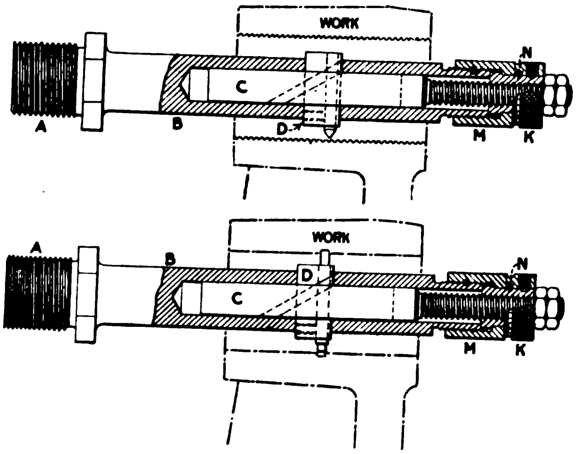


FIG. 1. BORING BAR FOR USE ON BORING MACHINE

It may of course be made with a cone instead of a screw. But as a stump bar, if fitted with a cone instead of a screw and particularly when used for screw cutting, it must be secured to the machine spindle either by means of a key or a draw-bolt.

The outer bar *B* is drilled to take the rod *C*, which actuates the tool box *D*. The actuating rod *C* is slotted (see details in Fig. 2) in such a manner that the inclined projections *T* fit into grooves *G* of tool box *D* and force it up or down the rectangular slot of the main bar when the actuating bar *C* is moved.

The end of the main bar, opposite the chuck of the boring machine, is threaded to fit the retaining collar *M*, this collar being fastened in position by a pin. The rod *C* is threaded at the end to fit the nut *N*, which is retained in position by the collar *M*. The nut is moved by means of the knurled collar *K*, and graduations on this collar in conjunction with a zero line on the face of the collar

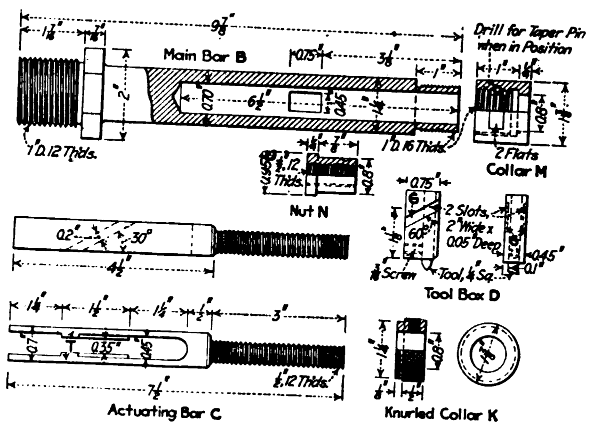


FIG. 2. DETAILS OF BORING DETAILS

M form a ready means by which the cut can be accurately gaged. In other words, the adjustment of the cut is micrometric.

For repetition work, such as threading or recessing to a given depth, a stop can be arranged by putting two locknuts on the threaded end of the actuating rod *C*. These will limit the travel of the rod inward to a definite point, and as a result, the depth of the cut will be fixed. When locknuts are used as stops, the tool should be in the opposite side of the tool box from that shown in Fig. 1. Dimensioned details of this bar are given in Fig. 2, each detail bearing the same letter as in the description.

A bar designed for recessing under the drilling machine and used through a bushing in a drilling jig is shown in Fig. 3. Obviously it would be equally useful in a boring machine where an outer support was necessary, if it was made longer. In use, this bar came into operation for putting in a recess after a hole was drilled, and it was followed by a reamer that completed the job.

While this bar is in principle similar to that shown in Fig. 1, it differs from it, inasmuch as the cut is put on from the opposite end. Here *A* is the main bar and *B* is the actuating bar that moves the tool box. The bar *B* is moved by means of the nut *N*, which is knurled on its outer diameter. This nut engages with a left-hand thread on the outside of the main bar *A*, and by means of a groove *G* it moves the pin *P* along a slot in the main bar. As the pin *P* is driven into the actuating

bar, it follows that when the nut N moves, the tool moves also. It will be readily seen that when the bar revolves in the drilling machine, if the nut N is held by the operator and prevented from turning, then the screw, being left-handed, will carry the actuating bar downward, thus putting on a regular feed to the recessing tool as long as the nut is prevented from turning. By fastening

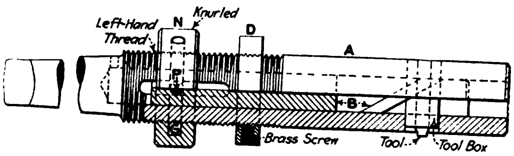


FIG. 3. RECESSING BAR FOR DRILLING MACHINE

the collar D at some definite point it follows that the recess can be gaged as to depth to close limits, if desired, because the nut, striking the locking collar D, will slip through the operator's fingers, thus stopping the feed. By reversing the drilling machine and again gripping the nut the tool is withdrawn from the recess.

A bar designed for threading work on a boring machine that was not fitted with a lead screw is shown in Fig. 4. Here the principle used for moving the chaser is similar to that of previous examples. The main bar A was threaded on one end to act as a guide screw when running in a thread bush. The inclined plane for moving the chaser was cut on one side of bar B and acted directly on the chaser.

This bar B is moved by means of the sleeve C, which is free to rotate between the two collars D and E. The inside of sleeve C is threaded and engages with nut N, the inner bore of which is a sliding fit on the main bar A.

The nut N is connected to the actuating bar B by means of the pin P. This pin works along a slot in the main bar and thus prevents nut N from turning.

Consequently, when the sleeve C is turned, the nut N and the bar B are moved longitudinally according to the direction in which the sleeve C is turned. The collar D being graduated and the sleeve C having a zero line, it follows that any desired cut can be had with exactness. When this bar is used on a boring machine, the machine is disconnected from the feed gear, thus leaving the longitudinal control of the bar to the guide screw.

In the illustration this bar is shown as it was designed, with the guide screw integral with the bar, suitable for

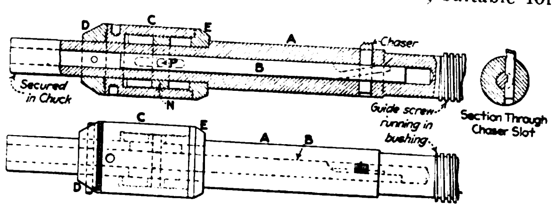


FIG. 4. THREADING BAR FOR BORING MACHINE

chasing a double thread in brass. For general purposes the guide screw would be made as a sleeve, in which case the bar would be adaptable for any pitch of screw.

When cutting an internal thread up to a shoulder, it is imperative that either the bar shall stop revolving at a given position or that the tool shall be rapidly withdrawn. Stopping a boring machine almost instantaneously, at a given position, is not easy. Accordingly, if the tool can be quickly withdrawn, it is undoubtedly the safer method. Apart from this, the quick withdrawal of the tool saves time.

A bar that will give this quick withdrawal is shown in Fig. 5. The main portion of the bar A fits into the spindle of the boring machine or is attached to the lathe spindle. It is bored to take the actuating bar B and is also counterbored and threaded at C to take a supplementary bar. These supplementary bars can be made either as shown in Fig. 6 for small work, in which case the actuating bar B engages directly with the tool, or as shown in Fig. 4, where the actuating bar is divided so that two inclined planes P engage with the tool box T. With regard to the type shown in Fig. 6 the writer has made such a bar to work in a 1-in. hole. It is this adaptability in conjunction with the quick withdrawal that makes this type of bar, Fig. 5, so useful.

Referring again to Fig. 5, D is a sleeve that fits on the main bar A, being free to move longitudinally between the solid collar E and the adjusting nut F. This sleeve D is coupled to the actuating bar B by means of the

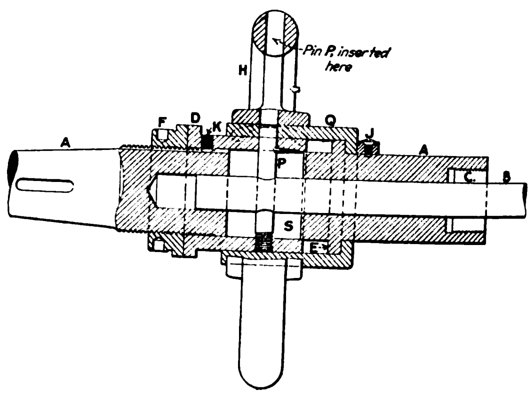


FIG. 5. QUICK-REVERSAL BAR

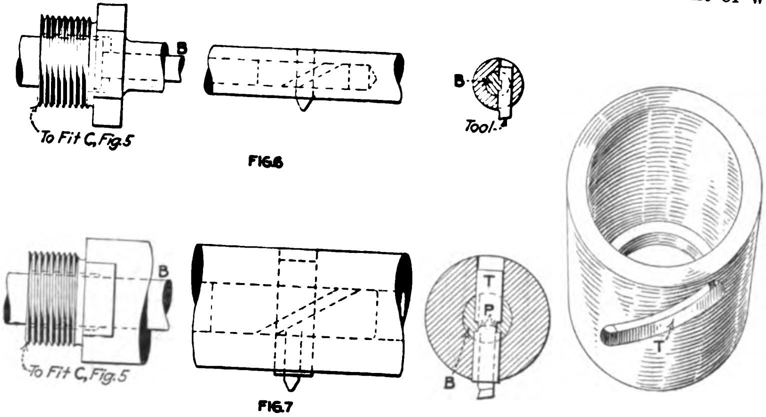
pin P. This pin is allowed longitudinal movement within the limits of the slot S in the bar A. The pin P is screwed into one side of the sleeve D and projects on the other side so as to engage in a spiral slot formed in the quick-return sleeve Q. Keyed to the outside of sleeve Q is the small handwheel H, and both are prevented by collars E and J from moving in a longitudinal direction.

The sleeve Q is shown again for clearness in Fig. 8, and T is the spiral slot into which pin P of Fig. 5 projects. The smaller the angle this spiral slot makes with the axis of the bar the more rapid the withdrawal of the tool, but for easy action it should be about 45 deg.

It will be clear that if the handwheel is prevented from rotating while the bar still revolves, then the tool actuating the bar B will be forced forward—by the pin P working in the spiral slot of the bushing Q—and the threading tool will thus be rapidly withdrawn. The boring machine is reversed and the bar run back to the starting point. The machine is then stopped and another cut is put on as follows:

The handwheel is turned in the direction of the machine rotation until the sleeve D strikes the adjusting collar F. This collar is screwed on to bar A and is graduated on the periphery. The sleeve D has a zero line to coincide with these graduations, and consequently we can

advance the tool by any desired amount. The inclined plane on the actuating bar is 1 in 4, and the adjusting collar *F* is threaded 5 threads per inch and divided on the outside into 50 graduations. Moving the collar through one of these graduations will advance the tool 0.001 in., equal to 0.002 in. in diameter of work. After the collar *F* is moved—toward the boring-machine spindle



FIGS. 6 TO 8. DETAILS OF SUPPLEMENTARY BARS

to advance the cut—the sleeve *D* should be moved up to it by the handwheel and the machine started to take another cut.

Although it takes some time to describe the operation of putting on a cut, it is in reality particularly rapid. As designed, there is no fear of accident, for should the handwheel be accidentally touched while the bar is revolving, it will only withdraw the cut. To prevent a too easy withdrawal—such as might be due, for instance, to the inertia of the handwheel in starting up the bar—a brass screw *K*, working in a flat-bottom groove, gives a ready and adjustable means of applying a retarding force.

I have no knowledge as to who originated the idea of a quick withdrawal, as described, but I am prepared to

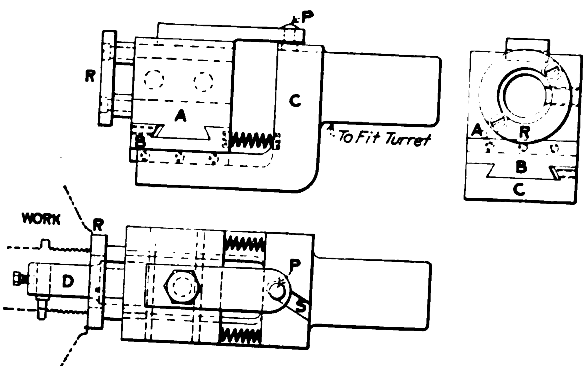


FIG. 9. RECESSING TOOL FOR AUTOMATICS

give the credit to one of the late foremen at the Woolwich arsenal, where a number of variations from the one described have been in use for probably more than 20 years. It is a good idea, whoever originated it, and capable of many adaptations. It is particularly useful on ordnance work, where cheap production is so seldom studied.

An interesting variation will be found in the next example—a recessing tool used on the automatics for fuse parts—shown in Fig. 9. This consists of a small compound slide *A* and *B* mounted on the stem *C*, which is turned to fit the turret of the machine.

The tool bar *D* is secured into the cross-slide *A*, on the front of which is fastened a hardened rubbing ring. Mounted on top of slide *A* is a bar carrying the stud *P*. This stud engages with an inclined slot *S* cut into the stem *C*. The action of this recessing tool is as follows:

When the turret moves forward, the ring *R* comes into contact with the face of the work, thus preventing the slides from moving forward; the relative movement between the slide *B* and the stem *C* is such that the slide *A* and the tool are forced toward the work by means of the pin *P* working in the slot *S*. When the recess is complete, the backward motion of the turret allows the springs to return the slides to their starting point, thus withdrawing the tool. The tool, although faulty in design, did well on small work. Proportionality in design may be all right in some cases, but it failed here when we attempted to make a similar tool for a larger job. The trouble was that the slides jammed. Undoubtedly, this was due to the fact that the inclined plane was too far away from the slide carrying the tool. With a light cut—that is, for a narrow recess—this never gave trouble; but with a wider recessing tool, things happened. However, we got over this trouble as follows:

The bar carrying the stud *P* (a roller in the larger tool) was fastened to the top of the stem *C*, and the inclined slot (into which *P* engaged) was cut into the top of the cross-slide *A*. By this means heavy cuts were taken without any tendency of the slides to bind.

For heavy recessing work, the type of bar shown in Fig. 10 has much to recommend it for all cases to which it can be applied. Here the bar *A* is slotted at the end, and the inclined plane *P* is formed on one side of the slot. This plane engages directly with the recessing tool that is carried in the supporting bushing *B*. The distance from the tool to the flange on bushing *B* governs the position of the recess in the work. To take the pressure of the cut, a driving key *K* is let in and secured to the bushing *B*, passing through a slot in the bar *A*. At the end of this bar a collar *C* ties the open ends together and incidentally acts as a stop against which the spiral spring pushes the bushing *B* when the tool is withdrawn by the turret.

In action the turret moves forward, taking the hardened bushing *B* into the already bored hole until the flange of the bushing *B* meets the work. As the turret still goes forward, the tool is forced into the work and the recess is formed. The strip *S* on the bushing *B* may be at any convenient position and acts as a pilot while the tool is cutting. When the turret recedes, the spring keeps the bushing *B* pressed against the work until the tool is withdrawn. For the sake of clearness, bar *A* and key *K* are shown again in Fig. 11. We have used this type on several occasions and have always found it both

cheap and efficient. The illustration shows it in the turret of a Potter & Johnston automatic.

There is one other example that should be shown, both because it is interesting and also because the type possesses infinite possibilities. It is particularly applicable to tools for turning or boring tapers from the turret of the larger type of automatic lathe. The one shown in Fig. 12 is one of several I have made for this class of work. As shown, it is adapted to the 7-A Potter & Johnston lathe for turning the clutch portion of a petrol-motor flywheel.

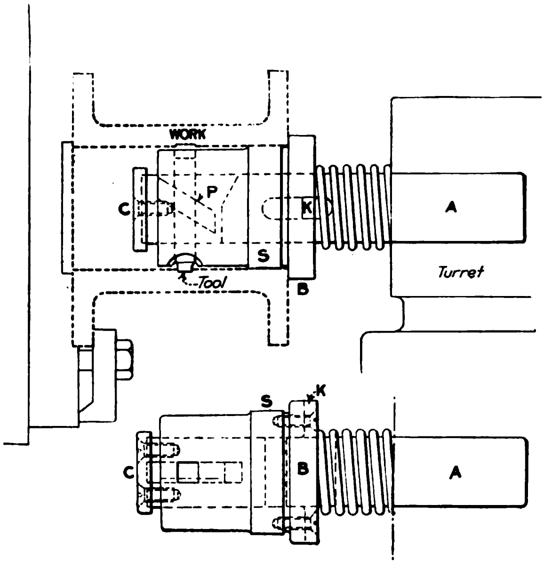


FIG. 10. BAR FOR HEAVY RECESSING WORK

It consists, in the main, of a steel casting *A* that is turned at one end to fit into one of the turret tool blocks of the machine. The other end of the casting *A* forms a pair of guides on which the sliding tool holder *B* works. The sliding tool holder is controlled by means of a hardened roller *R* working along the slot *S* of the rectangular control bar *D*. This control bar works along a groove machined in the main casting *A*, being retained in position by the rod *E* and the plate *P*. Attached to the end of the control bar *D* is the hardened pusher ring *H*, which is bored out to slide freely on the pilot bar *G*.

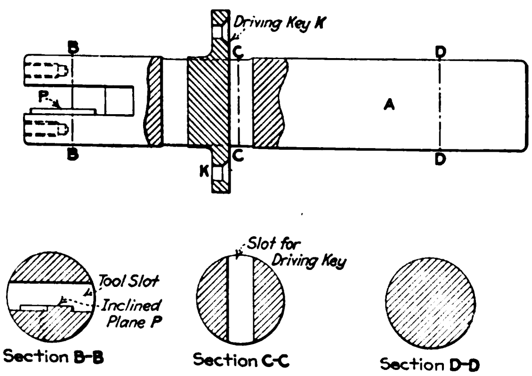


FIG. 11. DETAILS OF HEAVY RECESSING TOOL

A spiral spring on the pilot bar exerts a pressure between the turret and the pusher ring *H*. In the illustration the tool is shown just about to start cutting, and it will be obvious that as the turret moves forward, carrying the tool, the pusher ring *H*, being in contact with the pilot bushing of the machine, cannot move. Consequently, the control bar *D* also remains stationary; and as the tool is fed forward by the turret, it is also pulled downward by means of the roller *R* and the slot *S*.

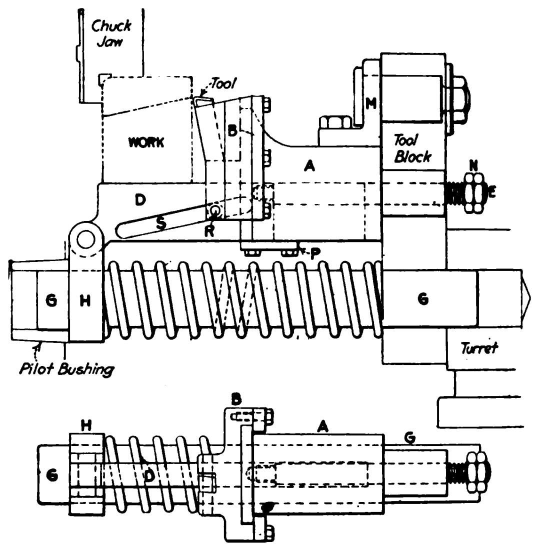


FIG. 12. BAR FOR BORING TAPER PLUGS

When the turret recedes, the spring keeps the ring *R* in contact with the pilot bushing until the locknuts *N* come into contact with the stem of the bar. This limits the outward stroke of the control bar. The bracket *M* was bolted to the main bar *A* and also to the turret tool block, thus materially helping to stiffen the bar in action. This bracket could of course be made integral with bar *A*, but in this case it was made separate, for simplicity.

College Military Training

Identical bills have been introduced into the United States Senate and House of Representatives providing for the extension of the military training now given in land-grant colleges and some other civil educational institutions and for the establishment of military instruction in such additional institutions as elect to come under the provisions of the bills. The prime object of the proposed legislation is that of building up a reserve of trained officers available for officering volunteer forces in case of war. The plan of the proposed legislation will accomplish this object at a minimum cost to the nation and will, at the same time, provide an element of discipline and training of great value in civil life.

The members of the committees of the five engineering societies who have prepared these bills earnestly request that the members of the various national engineering societies send personal letters or telegrams to their individual senators and representatives worded somewhat as follows: "I urgently request you to support and vote for the plan covered by Bill S-3946, introduced by Senator Pomerene, and H. R. 10845, introduced by Representative Gard, providing for the extension of military training in civil educational institutions."

Increases and Decreases of Machine Tool Exports

BY LUDWIG W. SCHMIDT

SYNOPSIS—A study of the percentage increases and decreases of machine-tool exports from the United States, Germany and England for the normal years 1910 to 1913. The American showing is quite satisfactory, giving many striking increases and only a few decreases.

Generally speaking, the machine-tool builder rather follows than leads the industrial development of his market. Machine tools are constructed according to the needs of the user, and constructive energy finds its greatest incentive from the progress made in other industries dependent upon the use of metal-working machines. This at least is the case in countries where competition exists and where, consequently, industrial production is forced to keep going ahead or perish. It is therefore no surprise that the American machine-tool industry has made rapid progress, having as its immediate customers industries well known for their progressiveness.

It is a generally recognized fact that American machine-tool makers have been able to build certain classes of machine tools superior to those of the same class made in Europe. This superiority is shown mainly in machines built for turning out large quantities of a certain article with a minimum of manual labor. It is further claimed for the American machine that it will do more exact work than the competing European machine and that it will be as a rule of greater durability. It is not my intention to inquire into the rights or wrongs of such contentions, which are of a purely technical character, but rather to study their economic effects.

Quantity Production Dominant

Quantity production is now recognized practically everywhere. Germany has made enormous progress. It has been taken up in England and France, and only the less industrial districts in Europe are still confining themselves to the older methods. It has been reserved to thé American constructor to build many of the leading machine tools necessary for such a development; and it is an astonishing fact that, notwithstanding the great progress machine-tool construction has made elsewhere, this country has still kept abreast in many ways.

One reason for this may be found in the general national American trend toward the new, which during some period of the American economic life suddenly evidenced itself strongly among machinery users. The rapidly changing demand, the lack and expensiveness of labor and the general high pressure under which American industries are carried on may have added as well to this development, which has ultimately brought American machine-tool builders to the top of their profession.

Foreign visitors, well connected with the machine-building industry in the old world, have frequently pointed out the general uniformity of equipment in the modern American machine shops. There is a tendency to use only the most recent machine tools. Even in small repairing plants one notices an abundance of modern machines, which astonishes the foreign visitor who knows how primitively similar places are furnished in other countries. This desire of the American machine user to have always the most modern and, as he hopes, also the most efficient machines of course brings the American machine-tool builder a very large number of customers. Consequently, he builds his machines in correspondingly large quantities.

We have therefore in the United States a highly developed machine industry, worked on a very efficient basis by the latest machinery, supported by a machine-tool industry that will readily take up every hint coming from the market. This condition, while tuning up the machine-tool industry to a high pitch of efficiency and constructive ability, has also limited it to a certain grade of machines—a limitation that, however, has produced many of the best and most suitable machine tools. The same system has slowly crowded out minor grades of machine tools, for which little or no demand has been left. The building of such machines, therefore, has in general become unprofitable as far as the American market is concerned.

Designing for Special Markets

While machinery construction in this country has been developed according to the conditions in the home market, in other countries, especially England and Germany, a new competition has grown up. European machine-tool constructors began to strike out in a different direction. Machine tools are constructed in large numbers to meet a demand for a machine of lesser efficiency than that required by the American user, but also cheaper in price. Those machines are selling well in their own markets and have found an active support in others. American constructors will do well to watch this movement, so as not to be overtaken by it if it should become predominant. The fact is that, while American machine-tool constructors have limited their designs to certain well-defined fields, the European industries are frquently building machines that are more suitable for foreign trade than are the American.

It must not be forgotten, however, that the market has changed as well during the last few years. The American machine-tool industry may not have reached all the markets possible, but the progress made during recent years in all the countries which are able to buy in large quantities is quite satisfactory.

Comparative Statistics of American Trade

After we have heard a good deal in the press and elsewhere about the inefficiency of American export methods, as well as about the unsuitability of the goods exported by this country (wherefore, as a rule, the example of England or Germany is held up before our eyes), the result of the following inquiry may be something like a shock to many. To prevent any possibility of using periods of unusual economic activity in this case, the figures of 1914 and later are excluded from the statistics and only

those relating to 1910 to 1913 are taken. They show that in 16 of the leading markets the American machine-tool imports have increased more rapidly than those of England or Germany. To take at first the European field, figures are given for Belgium, France, Germany, Great Britain and Russia.

TABLE 1. EXPORTS OF MACHINE TOOLS FROM THE UNITED STATES, GERMANY AND ENGLAND

	United States	Germany	England
To Belgium			
Exported during 1910	$162,529	$898,000	$112,945
Exported during 1913	$786,679	$1,650,000	$160,640
Total, 1910–13	$1,992,906	$4,450,750	$570,475
Difference, 1910 and 1913	+$624,150	+$742,000	+$47,695
Percentage of difference	+384.02	+82.83	+42.21
Sold during 1914	$552,531	....	$86,865
To France			
Exported during 1910	$691,480	$1,452,000	$363,030
Exported during 1913	$1,936,908	$3,131,500	$710,635
Total, 1910–13	$4,859,109	$8,814,500	$1,778,895
Difference, 1910 and 1913	$1,245,428	+$1,679,500	$+347,605
Percentage of difference	+180.11	+115.66	+95.75
Sold during 1914	$1,771,525	....	$464,855
To Germany			
Exported during 1910	$1,804,682	....	$117,355
Exported during 1913	$3,175,188	....	$229,990
Total, 1910–13	$10,456,966	....	$718,780
Difference, 1910 and 1913	+$1,370,506	....	+$112,635
Percentage of difference	+75.95	....	+95.97
Sold during 1914	$2,167,240	....	$91,450
To Great Britain			
Exported during 1910	$1,362,965	$623,250	
Exported during 1913	$3,417,655	$1,450,000	
Total, 1910–13	$9,766,417	$3,597,000	
Difference, 1910 and 1913	+$2,054,690	+$826,750	
Percentage of difference	+150.75	+132.65	
Sold during 1914	$3,178,630	....	
To Russia			
Exported 1910	$234,776	$1,687,000	$135,380
Exported during 1913	$1,088,751	$3,874,000	$425,105
Total, 1910–13	$2,260,609	$9,717,750	$1,128,510
Difference, 1910 and 1913	+$853,975	+$2,187,000	+$289,825
Percentage of difference	+363.73	+120.64	+214.82
Sold during 1914	$1,333,644	....	$1,364,085

The American figures for 1914 relate to the 12 mos. from July 1, 1913, to June 30, 1914; those for England and Germany relate always to the calendar year.

These figures, Table 1, show, as might well be expected, an enormous superiority in the total imports of German machine tools in three of the markets, while in the case of England the American machine-tool industry has the advantage. Except in these three instances, it appears that the American machine-tool industry has every reason to be satisfied with the progress made. To take the case of Belgium, the actual difference in the imports of the years 1910 and 1913 shows that the imports from the United States increased by $624,150. During the same years import from Germany increased by $742,000, while England was very much left behind, with an increase of only $47,695. Looking at the percentage increase, it appears that America takes first place with 384 per cent., followed by Germany with 82 per cent. and by England with an increase of 42 per cent. Taking France, Germany leads in the increase of value, but again it will be noticed that the American exports increased 180 per cent. against the 115 per cent. of the German and the 95.75 per cent. of the English.

In Germany, England has made a more rapid percentage progress. Both the total value of the import and the figures of the actual increase during the years in question compare, however, very badly with the American sales. Germany sells considerably less metal-working machinery to England than does the United States. The small difference in the percentage increase shows that that country was a very active competitor before the war. It would be impossible to predict how the conditions will be after the conclusion of peace.

An interesting problem is offered by Russia. Russia is generally considered one of the less developed industrial markets, consequently having only a medium demand for American machine tools. This was certainly the case until about 1912, from which time a rapid increase in the demand set in. Germany still dominated the Russian market at the end of 1913. The percentage increases against the year 1910, however, are in favor, not only of the United States, but of England as well. The figures are an increase of 363 per cent. in American, 129 per cent. in German and 214 per cent. in English machine-tool sales.

As in former studies of the same character the statistical facts are not taken from the import figures of the countries in question, but from the export statistics prepared by the Governments of the United States, Germany and England, representing probably the most reliable facts in each case.

Exports to Continental North America

Turning to our neighboring markets, the figures for which are given in Table 2, we find that the American machine-tool industry is supreme, holding by far the biggest part of the business. This is especially the case in Canada, where American machine tools show an increase of 593 per cent. against the 120 per cent. of the German imports and 49 per cent. of the English imports. The full significance of those figures becomes only apparent if one sees that during the four years in question the United States exported $4,790,895 worth of metal-working machines, while the English exports, the nearest, were only $415,585. In Cuba the situation is much in favor of this country, while in Mexico, Germany, as well as the United States, has to resign itself to an unavoidable loss that may hold on until political unrest ceases in that unfortunate country.

The markets across the Pacific may become some of the best buyers for the American-made machines in the near future, and they certainly deserve close attention. We have in Australia and Tasmania good and progressive buyers of such machinery, who until recently have favored very much the English style of machine. For some time, however, a decided leaning toward American-made machine tools has taken place, and the increase in favor of this country has been 193 per cent. against 77 per cent. in the English and only 59 per cent. in the German imports. The first two figures are especially interesting, as they indicate an energetic progress that is shown later in 1914 by the fact that American machine-tool sales in Australia nearly trebled the sales of English machine tools, which were formerly larger than those of American origin. In New Zealand a progress of 262 per cent. in favor of American machines was made, while

TABLE 2. EXPORTS OF MACHINE TOOLS FROM THE UNITED STATES, GERMANY AND ENGLAND

	United States	Germany	England
To Canada			
Exported during 1910	$336,172	$10,750	$82,820
Exported during 1913	$2,326,270	$23,750	$124,020
Total, 1910–13	$4,790,895	$73,750	$415,585
Difference, 1910 and 1913	$1,990,098	$13,000	+$41,200
Percentage of difference	+593.17	+120.93	+49.73
Sold during 1914	$1,199,356	....	$177,305
To Cuba			
Exported during 1910	$42,072	$4,500	....
Exported during 1913	$124,669	$5,250	....
Total, 1910–13	$323,111	$14,250	....
Difference, 1910 and 1913	+$82,697	+$750	....
Percentage of difference	+196.56	+16.66	....
Sold during 1914	$146,569	....	....
To Mexico			
Exported during 1910	$84,892	$22,750	....
Exported during 1913	$83,259	$21,000	....
Total, 1910–13	$375,755	$70,700	....
Difference, 1910 and 1913	$1,633	$1,750	....
Percentage of difference	1.91	7.69	....
Sold during 1914	$74,706	....	....

the English machines are showing a clean loss of 29 per cent.

In China, on the other hand, this country seems to be on the losing side, as it has lost 49 per cent. of its machine-tool trade since 1910 while, of course, an increase has taken place during 1914 and 1915, which is far surpassing that loss. The enormous activities of the English special agents in India have brought about a correspondingly large increase in the English exports of metal-working machines to that country. In fact, England showed an increase of 109 per cent. against a loss of 55 per cent. on the German and 4 per cent. on the American side. In the Japanese machine business Germany has been favored, increasing her sales at the rate of 316 per cent. against the 37 per cent. of the American sales and 54 per cent. of the English imports of machine tools.

TABLE 3. EXPORTS OF MACHINE TOOLS FROM THE UNITED STATES, GERMANY AND ENGLAND

	United States	Germany	England
To New Zealand			
Exported during 1910.....	$15,114	$2,250	$96,670
Exported during 1913.....	$54,732	$4,500	$68,630
Total, 1910–13...........	$155,935	$17,000	$331,250
Difference, 1910 and 1913.	+$39,618	+$2,256	—$28,040
Percentage of difference....	+262.12	+100.00	—29.00
Sold during 1914.........	$36,260	....	$80,390
To China			
Exported during 1910.....	$6,339	$58,500	....
Exported during 1913.....	$3,192	$60,000	....
Total, 1910–13...........	$42,741	$249,250	....
Difference, 1910 and 1913.	—$3,147	+$1,500	....
Percentage of difference...	—49.62	+2.58	....
Sold during 1914.........	$17,668	....	....
To British India			
Exported during 1910.....	$45,765	$76,250	$212,980
Exported during 1913.....	$43,717	$34,000	$446,195
Total, 1910–13...........	$137,925	$158,000	$1,373,365
Difference, 1910 and 1913.	—$2,048	—$42,250	+$233,215
Percentage of difference...	—4.47	—55.40	+109.50
Sold during 1914.........	$17,953	....	$494,035
To Japan			
Exported during 1910.....	$87,160	$66,250	$381,420
Exported during 1913.....	$119,558	$276,250	$590,300
Total, 1910–13...........	$576,997	$708,400	$2,119,615
Difference, 1910 and 1913.	+$32,498	+$210,000	$+208,880
Percentage of difference...	+37.25	+316.98	+54.76
Sold during 1914.........	$120,166	....	$187,545
To Australia and Tasmania			
Exported during 1910.....	$138,392	$40,500	$325,715
Exported during 1913.....	$406,093	$61,000	$579,210
Total, 1910–13...........	$1,176,102	$233,750	$1,943,925
Difference, 1910 and 1913.	+$267,701	+$20,500	+$253,495
Percentage of difference...	+193.43	+50.61	+77.83
Sold during 1914.........	$1,316,952	....	$137,065

It remains to review the position in the South American market as represented by the three A-B-C republics (see Table 4). In Argentina the machine-tool business of all three countries—United States, England and Germany—has declined. In Brazil the United States has shown the large increase of 1,615 per cent., while Germany shows an increase of 111 per cent. and England of 72 per cent. The American exports to Chile increased 49 per cent., the German 91 per cent. and the English 99 per cent. In Argentina and Brazil, Germany was the biggest seller, while England takes that place in Chile. This country, however, is pressing very hard now for second, or even first, place.

The most easy way of explaining the small sales of American metal-working machines in those countries where progress was slow or where a reduction took place is that of blaming the sales methods of the American manufacturer. The real reason, however, is that of respective industrial development. It is quite obvious that an industrial community like England or Germany will offer a better demand for high-grade machines than countries with a less developed industry. While in most of the leading European countries all signs are pointing in the direction of quantity manufacture, organized on the lines of the United States, there are still many countries relying on Europe or the United States for all those goods which have to be turned out by highly organized industrial effort and making at home only such goods as can be easily produced with the sort of labor obtainable. It seems to be waste of time and money for those countries to buy machines preëminently made for quantity production—a case of firing a 42-cm. gun at a sparrow, the object being not worth the charge, however efficient this method of destroying the bird might be.

Most of the repair shops in those markets are small, they have to do cheap work where labor does not count, and their overhead expenses naturally must be kept low. Also, they must not use complicated machines that cannot be repaired on the spot. So they buy from those markets still able to supply such machines or specializing for the needs of that class of buyers. England, Germany and Belgium found it a very profitable business to cater to such markets, while the American business in that direction is less successful, as shown by the figures given. Today the war has brought about an entirely new situation. For a time at least, German, English, Belgian and French machine-tool competition has gone out of the market and this country has become the largest machine-tool supplier of the world. It is well worth while to view the future possibilities of the American machine-tool industry in this new light.

Leaving the fighting nations out of consideration, it appears that many of the neutral countries in Europe—as Holland, Sweden, Norway and, of late Switzerland—have become considerable buyers of American-made metal-working machines. They all bought formerly from their European neighbors. They will now become more intimately acquainted with American machines than they were before, and the question arises, Will they in the future prefer the American machines or will they return to those supplied by European makers?

Undoubtedly, the European influence will again be larger than the American when peace is restored. But something of the experience of the present year will remain, and the American machines sold in so large numbers will act as powerful advertisers in every direction. So there will be a larger demand for American machines, and European manufacturers will be compelled to follow that demand by increasing their own output in modern machines. Lack of labor and more expensive labor in Europe undoubtedly will add as well to that development. We shall find after some years about the same conditions in the European machine-tool industry that are governing the industry in this country.

TABLE 4. EXPORTS OF MACHINE TOOLS FROM THE UNITED STATES, GERMANY AND ENGLAND

	United States	Germany	England
To Argentina			
Exported during 1910.....	$237,123	$494,750	$198,610
Exported during 1913.....	$112,747	$418,000	$152,870
Total, 1910–13...........	$555,086	$1,804,750	$742,190
Difference, 1910 and 1913.	—$124,376	—$76,750	—$45,840
Percentage of difference...	—52.45	—15.51	—23.08
Sold during 1914.........	$109,836	....	$108,070
To Brazil			
Exported during 1910.....	$19,657	$203,750	$167,050
Exported during 1913.....	$346,187	$429,750	$288,670
Total, 1910–13...........	$525,720	$1,155,000	$1,030,430
Difference, 1910 and 1913.	+$327,530	+$226,000	+$121,620
Percentage of difference...	+1,615.35	+111.41	+72.80
Sold during 1914.........	$115,974	....	$142,235
To Chile			
Exported during 1910.....	$29,302	$43,000	$42,935
Exported during 1913.....	$13,930	$82,250	$85,505
Total, 1910–13...........	$158,543	$252,250	$269,225
Difference, 1910 and 1913.	$14,628	$39,250	+$12,570
Percentage of difference...	+49.92	+91.28	+99.14
Sold during 1914.........	$85,168	....	$38,170

European construction methods will be more like the American. European machines will be more expensive, and it will be less profitable to build the cheaper and simple types, owing to a decrease in the purely European demand. The ultimate outcome of this condition will be a general raising of the standard of machine-tool construction and demand all over the world. In the end,

TABLE 5. PERCENTAGE INCREASE IN THE SALE OF MACHINE TOOLS DURING THE PERIOD 1910-13

Percentage of Increase More Than	United States to	Per Cent.	Germany to	Per Cent.	England To	Per Cent.
500	Brazil	1,615.35	....	......	....	......
	Canada	593.17	....	......	....	......
350	Belgium	384.02	....	......	....	......
	Russia	363.73	....	......	....	......
300	......	....	Japan	316.98	....	......
250	New Zealand	262.12	....	......	....	......
200	Cuba	196.56	....	......	....	......
	Australia	193.43	....	......	Russia	214.82
150	France	180.11	....	......	....	......
	England	150.75	....	......	British India	109.50
	......	....	England	132.65	....	......
	......	....	Russia	129.64	....	......
100	......	....	Canada	120.93	....	......
	......	....	France	115.66	....	......
	......	....	Brazil	111.41	....	......
	......	....	New Zealand	100.00	....	......
	Germany	75.95	Chile	91.28	Germany	95.97
	......	....	Belgium	82.83	France	95.75
50	......	....	Australia	50.61	Australia	77.83
	......	....	....	......	Brazil	72.80
	......	....	....	......	Japan	54.76
0	Chile	49.92	Cuba	16.66	Canada	49.73
	Japan	37.25	China	2.58	Belgium	42.21
	Mexico*	1.91	Mexico*	7.69	Argentina*	23.08
	British India*	4.47	Argentina*	15.51	New Zealand*	29.00
...	China*	49.62	British India*	55.40	....	......
	Argentina*	52.45	....	......	....	......

* Decrease.

it must make the American machine-tool manufacturer more of a competitor in those markets where he has been more or less excluded until now, owing to the rather low standard of the demand.

The following statistics, given to round up the scope of the present inquiry, show that in eight of the analyzed countries the imports of American machine tools have progressed over 150 per cent. and that the total percentage

TABLE 6. TOTAL SALES OF MACHINE TOOLS DURING 1910-13

More Than	From United States to		From Germany to		From England to	
$10,000,000	Germany	$10,456,966	......	....	......	....
9,000,000	England	9,766,417	Russia	$9,717,750	......	....
8,000,000	......	....	France	8,814,500	......	....
7,000,000	......	....	......	....	......	....
6,000,000	......	....	......	....	......	....
5,000,000	......	....	......	....	......	....
4,000,000	France	4,859,109	......	....	......	....
	Canada	4,790,895	Belgium	4,450,750	......	....
3,000,000	......	....	England	3,597,000	......	....
2,000,000	Russia	2,260,609	......	....	Japan	$2,119,615
	Belgium	1,992,906	Argentina	1,804,750	Australia	1,943,925
	Australia	1,176,102	Brazil	1,155,000	France	1,778,895
1,000,000	......	....	......	....	British India	1,373,365
	......	....	......	....	Russia	1,128,510
	......	....	......	....	Brazil	1,030,430
	Brazil	825,720	Japan	708,400	Argentina	742,190
500,000	Japan	576,997	......	....	Germany	718,780
	Argentina	555,086	......	....	Belgium	570,475
400,000	......	....	......	....	Canada	415,585
300,000	Mexico	375,755	......	....	New Zealand	331,250
	Cuba	321,111	......	....	......	....
	......	....	Chile	252,250	Chile	269,225
200,000	......	....	China	249,250	......	....
	......	....	Australia	233,750	......	....
	Chile	158,543	British India	158,000	......	....
100,000	New Zealand	156,935	......	....	......	....
	British India	137,925	......	....	......	....
	China	42,741	Canada	73,750	......	....
10,000	......	....	Mexico	70,700	......	....
	......	....	New Zealand	17,000	......	....
	......	....	Cuba	14,250	......	....
Total exports to previously named markets during 1910-13.......		$40,452,817		$31,287,000		$12,422,245

increase in those markets has been the largest of all the three countries whose export was investigated. Germany's increase is strongest between the figures from 50 to 150 per cent., while England shows an increase above 100 per cent. in two cases only. An average increase of 243.36 per cent. against 79.50 per cent. of the German increase and 69.20 per cent. of the English is a figure to be satisfied with (see Table 5).

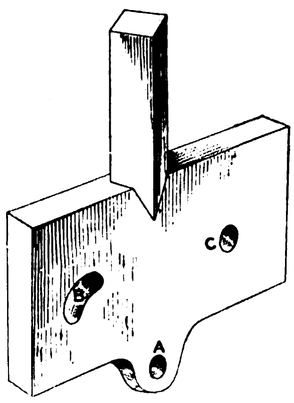
However, it must not be forgotten that, while the progress certainly has been very good, Germany has remained a competitor of very great importance and will surely show her strength again after the war.

The figures given in Table 6 relate preëminently to countries in which American machine-tool makers have shown special interest. It is therefore not surprising that the position of the American machine-tool sales should be so exceptionally good. The total exports of the United States, England and Germany to these countries during the years 1910 to 1913 were valued at $84,162,062. The United States supplied 48.06, Germany 37.17 and England 14.77 per cent. It will be interesting to see what the position of each of those countries is at the end of 1917.

Improved Type of Flask Pin

By A. E. Holaday.

Flask makers have been using an ear with three common countersink holes for wood screws. I noticed that a large amount of time was lost trying to get the pin to line up. To overcome this trouble, the pin is made as follows:



IMPROVED TYPE OF FLASK PIN

A common stove bolt is placed in the lower hole *A*. The long hole *B* is an arc, and the second stove bolt is placed in the center of this hole, to line up the pin. Then the last bolt is placed in the hole *C*, with the result that a perfectly lined-up pin is produced with little lost labor in assembling.

The job when completed is as good in every respect as that which is fastened with wood screws and the chances for readjustment when necessary are 100 per cent. better.

Taper-Shank Drills

By Robert J. Spence

Take a glance over the drill rack in any shop and notice the number of $\frac{9}{16}$- and $\frac{7}{8}$-in. drills with broken tangs. The reason for this lies in the fact that the shank sizes of drills do not change from one number to the next larger number of taper shank soon enough.

Take the Morse standard, for instance. The No. 1 taper on the shank does not change over to No. 2 until $^{37}/_{64}$ in. is reached. This leaves too weak a tang for the $\frac{9}{16}$-in. drill. The change of taper should take place at $\frac{1}{2}$ in. A greater weakness yet occurs in the $\frac{7}{8}$-in. and $\frac{15}{16}$-in. drills. Here, the tang is much too weak. The change from the No. 2 taper to the No. 3 taper should take place at $\frac{3}{4}$ in. diameter. The No. 4 taper should start at 1 in. instead of at $1^{17}/_{64}$.

A tang $\frac{1}{4}$ in. thick on a No. 2 taper for a $\frac{15}{16}$-in. drill is out of all proportion to the stresses to which such a drill is ordinarily subjected. It takes but a glance at a drill rack to prove that this assertion is correct. Any tool, such as a drill, should have a large margin of safety

with the ordinary machine-shop usage in view. The laboratory test should have second consideration.

Of course, it would add to the cost of the drill, especially at the present high price of tool and high-speed steels, by reason of the larger diameter of stock required for the shank; but the loss in cost would be greatly offset in the smaller number of mutilated drills.

Yet I presume it would be just as difficult to have manufacturers of drills adopt these changes as it would be to have them all adopt a single standard taper on all tapered machine parts. Both the tang and the taper are established things that will always remain with us against all argument, no matter how sound, like the French heel and the buttons on the sleeves of men's coats.

Argentine Manufacturing Shop

SPECIAL CORRESPONDENCE

For the accompanying illustrations and for the information in regard to the shop shown, thanks are due R. S. Rushton, manager of the Sociedad Anonima Fundicion y Talleres "La Union," Buenos Aires, Argentina. This is a good-sized shop, totaling about 31,000 sq.ft. and manufacturing a large line of both brass and iron goods, such as pumps, pipe fittings, hose couplings, bells, boat trimmings and such plumbers' supplies as valves, compression cocks and flush-tank fittings. This large variety of work in different lines demands a varied equipment as well as adaptability in both men and management.

FIG. 1. THE IRON FOUNDRY WITH ITS 8,500 SQ.FT. OF FLOOR SPACE

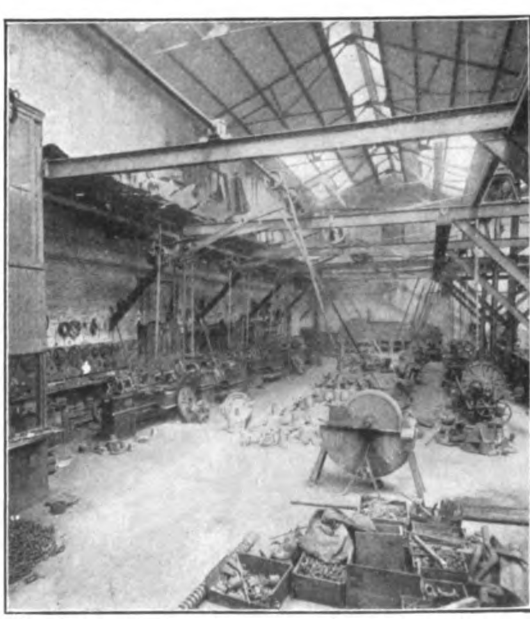


FIG. 2. THE IRON TURNING SHOP

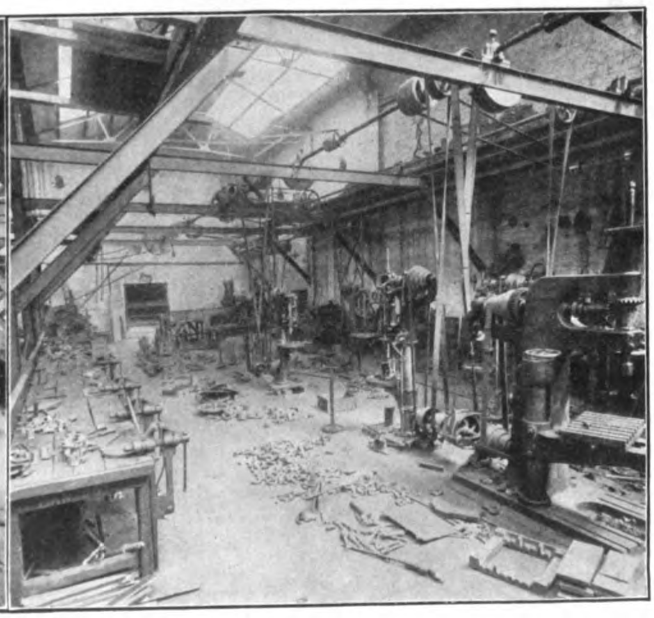


FIG. 3. IRON FITTING AND ERECTING

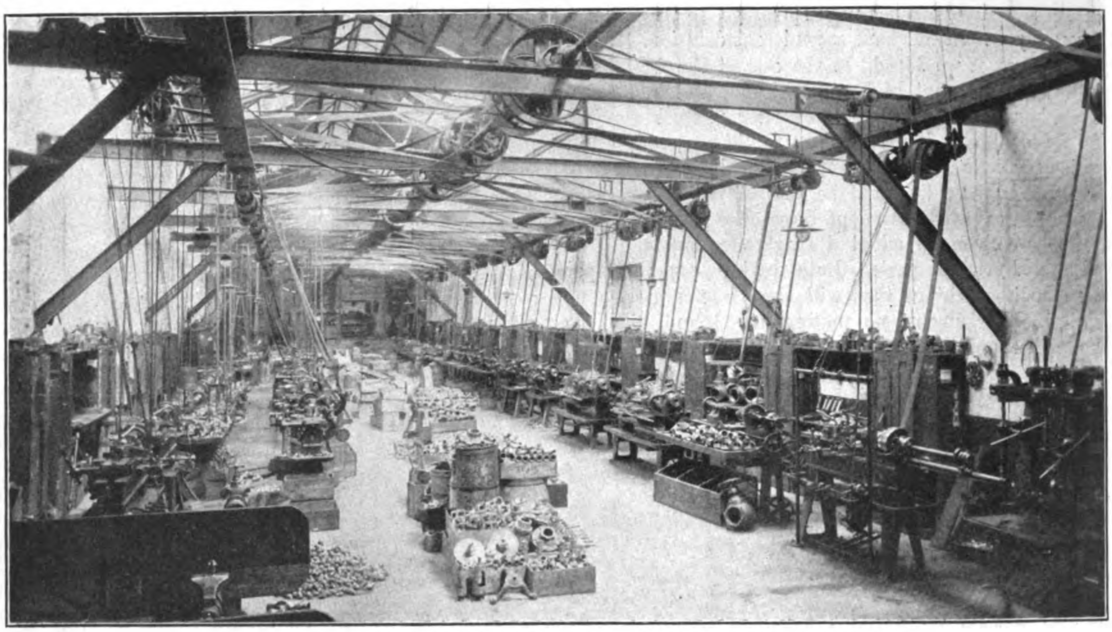


FIG. 4. THE BRASS TURNING SHOP; ITS EQUIPMENT AND PRODUCT

The iron foundry, shown in Fig. 1, contains about 8,500 sq.ft. The illustration gives a good idea of the building construction and shows the crane equipment and the businesslike lining-up of snap flasks on the floor.

There are two brass foundries, with a total of 9,400 sq.ft., equipped with crude-oil furnaces. From 4 to 5 tons of brass per day is cast.

The iron turning and fitting shops are shown in Figs. 2 and 3. They also total 9,000 sq.ft. These views show the monitor roof and the construction of the countershaft supports and also give an idea as to the variety of work turned out. Wooden and sheet-steel pulleys are used.

The brass shop, used for the manufacture of the firm's standard line, is shown in Fig. 4. It contains 4,000 sq.ft. The standard brass-shop equipment of turret lathes seems to have been followed. The parts shown, among them being the large globe valve at the right, give a good idea of the variety of work done.

Some conception of the toolroom can be gained from Fig. 5, the conditions making it necessary for the company to make practically all its own tools. As will be seen, the tool equipment is good; and a little study shows some of the dies, reamers and special tools made for the particular class of work on which this shop specializes.

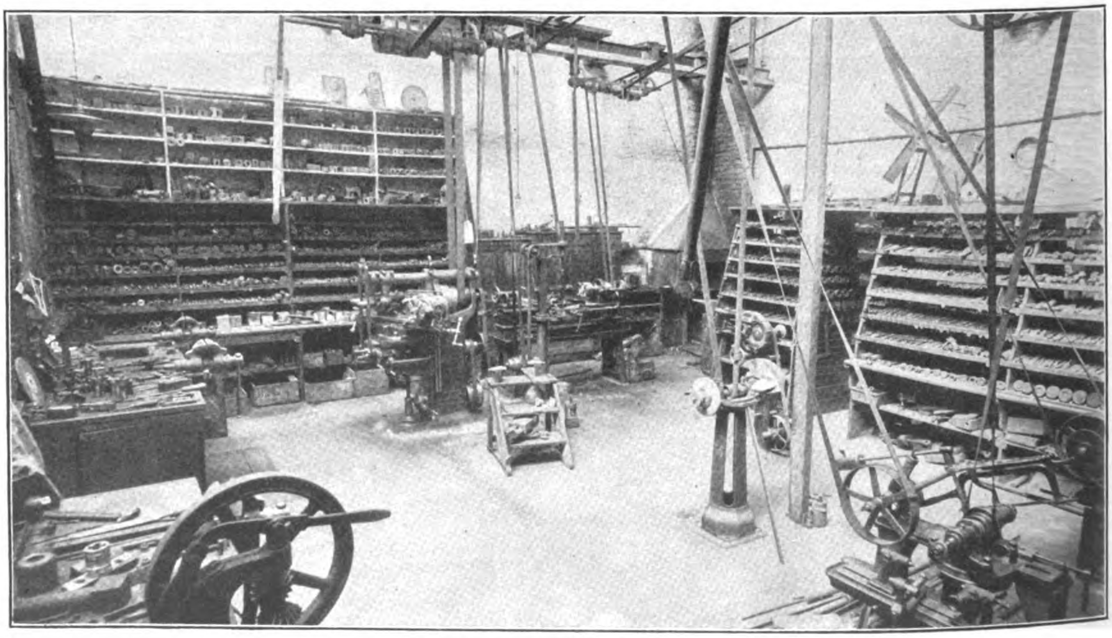
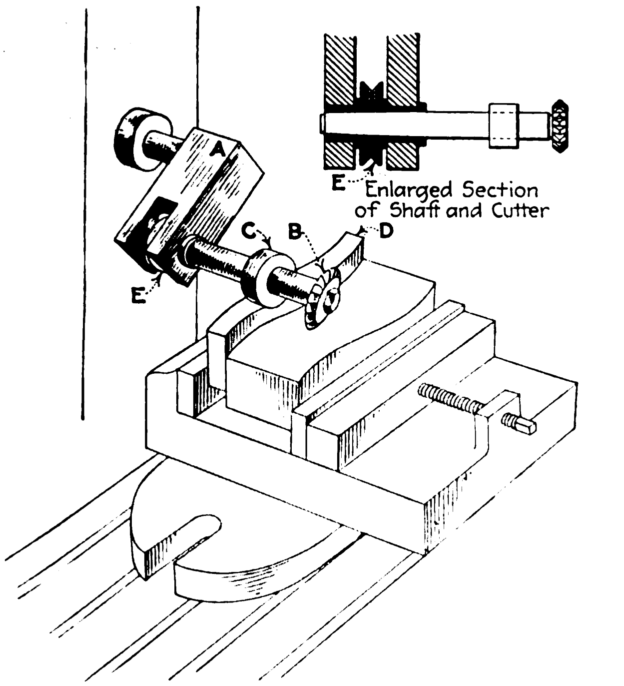


FIG. 5. TOOL-MAKING AND TOOL STORAGE ROOM

Letters from Practical Men

Neat Milling Attachment

The attachment shown in the illustration was used by a model maker in order to knurl the curved surface of a block. The device consists of a block *A*, having one hole to fit loosely on the mandrel of a miller and another hole to take a bushing with the cutter *B*. On the straight part of the cutter shank is a roll or bushing *C*, having a sliding fit. This roll rests on top of the



NEAT MILLING ATTACHMENT

guide cam *D*, which has the exact form of the work. By lowering the cam the depth of the cut is altered.

To drive the cutter, a dental electric motor was used, the belt running over the small pulley *E*; the table was fed by hand. WILLIAM SCHULTHEIS.

New Haven, Conn.

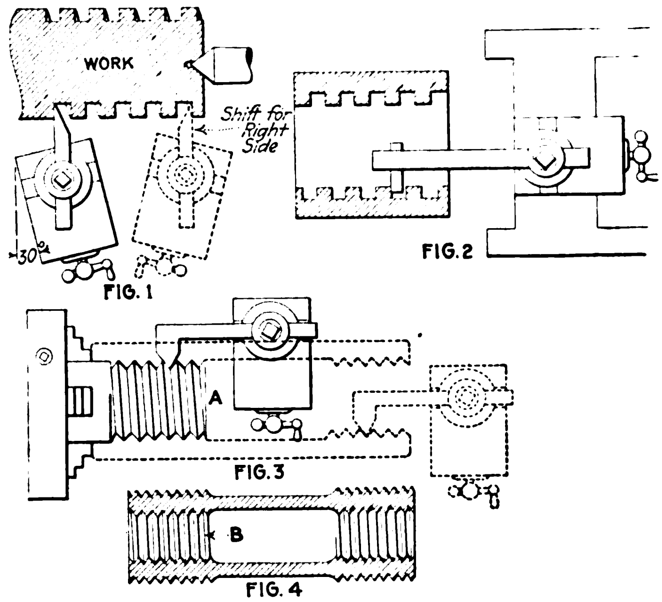
Cutting Square Threads

Cutting square threads on an engine lathe is sometimes very annoying, especially when it comes to the finishing cuts. This work is even more vexing on square-threaded taps, if the steel is hard from any cause. The following methods have been used in our shop and leave nothing to be desired for both external and internal single and multiple threads.

The thread is rough-turned to 0.010 in. of finish width with a square-nosed tool. The compound rest is then set at an angle of 30 deg. for external threading and at 90 deg. for internal threading. To finish-turn, two side tools are required, set at 90 deg. with the axis of the work. The kind of material governs the grinding of these tools.

Figs. 1 and 2 show the finishing of external and internal threads. The internal threading tool is held in an Armstrong boring bar. It will be seen that the width of the thread does not depend on an accurate width of the finishing tool.

Sometimes threads must be of continuous lead, both externally and internally, which is accomplished as fol-



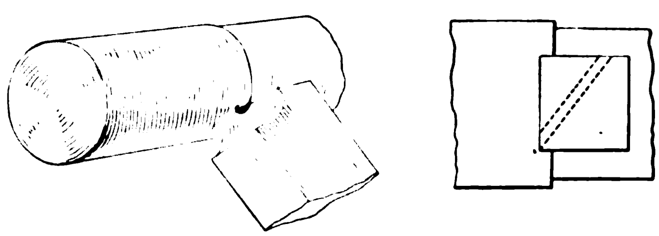
CUTTING SQUARE THREADS

lows: A piece is chucked and threaded, as at *A*, Fig. 3. The piece to be threaded has previously been bored to size and one end threaded, as at *B*, Fig. 4. It is then screwed on the chucking piece. The method of setting the tool correctly to obtain a continuous lead is shown by Fig. 3. Fig. 4 shows a sleeve made in this way for an inventor. It had four sleeves telescoping each other.

Titusville, Penn. G. STROM.

Finish-Turning Tool for Steel

The lathe tool shown in the illustration operates satisfactorily for finish-turning steel, especially if the piece is long and comparatively slender or if it is of unusually hard material. It is almost impossible for this tool to



A FINISH-TURNING TOOL FOR STEEL

chatter, providing too heavy a cut is not taken. With a fine feed, the finish can scarcely be distinguished from a ground surface; and as the thrust of the cut is almost negligible, the diameter varies but slightly from end to center on a long shaft.

The tool resembles closely a finished-planing tool, except that the chip is curled ahead of the tool. For this reason it is not advisable to work close to a shoulder, unless the tool is set well above center, as shown. Where the shoulder is filleted, as on crankshafts and similar work, this feature is not objectionable.

The angle of the cutting edge varies from 28 to 40 deg. from the perpendicular, depending on the material—the harder the material the smaller the angle. The rake should be about 15 deg. and the clearance about 2 deg. each way, giving a slight drag for polishing, if desired.

Charles City, Iowa. H. E. McCray.

Clamping Devices for Jigs

Clamping devices that have been used successfully in connection with drill jigs are here shown.

Fig. 1 illustrates a form of jig that allows the drilling to be done from the bottom side. In this figure, *A* is the jig base and *B* the leaf. The work is placed on a plate *C* and is located between two buttons *D* on each side of the work and against the button *E*. On the block *B* is mounted a stud *F*, in which swings a lever *G* hinged on

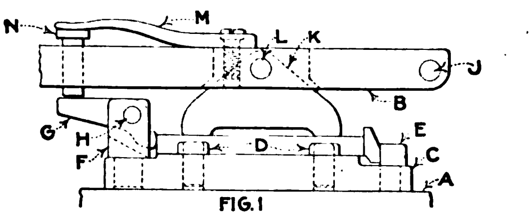


FIG. 1

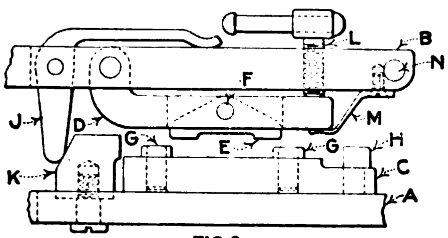


FIG. 2

CLAMPING DEVICES FOR JIGS

a pin *H*. The leaf is hinged on the pin *J* through the base casting and carries a swivel clamp *K* swinging on the pin *L*. A spring *M*, pressure from which is brought to bear upon a pin *N*, is attached to the leaf by two screws. As the leaf is brought down over the work, the pin strikes on the lever *G*, which in turn forces the work against the button *E*. By further pressure the swivel clamp *K* is brought up to the work and holds it securely by means of a cam handle.

This clamping device is of no use when it is desired to drill from both sides or perhaps to drill from one side and ream from the other. The reason is that the thickness of the work must have some limits. If the jig is made up to drill holes square with the work for maximum thickness, it will not drill a hole square if the piece is of minimum thickness. Therefore, all drilling must be done from the bottom or through the base.

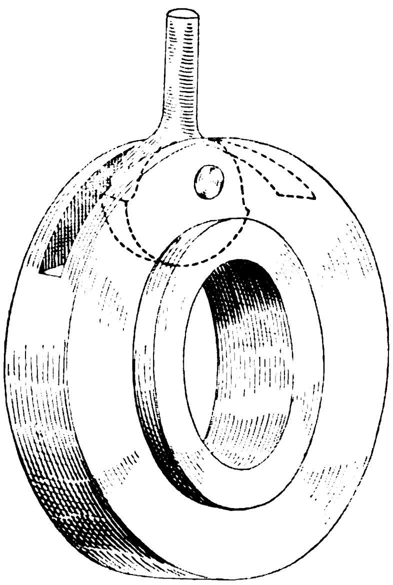
When it is desirable to drill and ream from different sides, the device shown in Fig. 2 should be used. The base is *A* and the leaf *B*; the locating block is *C*. In the leaf is hung a clamping arm *D*, in which is swung a swivel clamp *E* on the pin *F*. T[illegible]ork is located between the studs *G* and against t[illegible] before. The pressure of the work against the end locator *H* in this case comes from a spring finger *J* pushing against a sliding block *K*. In the base is milled a slot, into which fits a tongue on the bottom of *K*. As this slot is about $\frac{3}{16}$ in. narrower than the wide part of *K*, the tongue prevents the block from turning, and the screw prevents it from coming out.

The leaf is set parallel to the base, and the work is clamped by the screw *L*. In order that the clamping arm may not swing out into the operator's way when he is putting the work into, or taking it out of, the jig, a spring *M* is provided, which holds the arm against the screw. This spring should be very light, offering practically no resistance to the binding screw *L*.

Providence, R. I. M. W. Wright.

Quick-Acting Grinding Dog

Herewith is shown a very practical dog which may be used either for grinding or turning, but more particularly for grinding. The locking cam may be of any de-


A QUICK-ACTING GRINDING DOG

sired rise; but about 0.08 in. constant rise per revolution is satisfactory for ordinary use.

The dog is slipped on the work hub first and when the driver engages the stem of the cam the cam tightens. The heavier the cut the tighter it grips. One cam may be interchanged with several different sizes of collars. For rapid production where a dog is to be used this is a winner.

Harold E. Greene.

Ilion, N. Y.

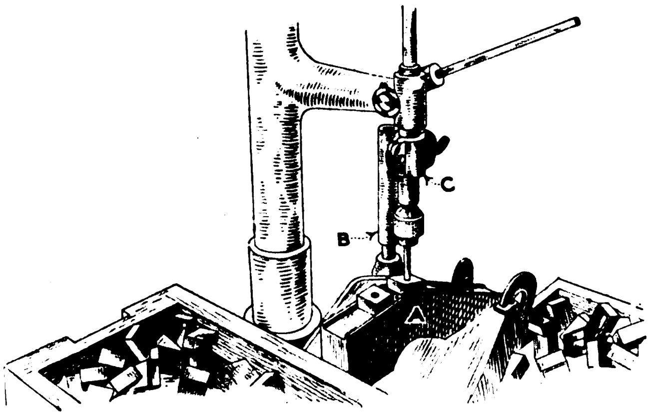
Simplifying Drilling Operations

A large quantity of cast-iron blocks were to have a $\frac{3}{16}$-in. hole drilled in their centers. These blocks were $1\frac{1}{4}$ in. square and were made hollow; that is, they had four sides and one end, all of about $\frac{5}{32}$ in. thickness. It will be gathered from this that the operation time must be principally consumed in clamping, centering, loading and unloading.

A fixture to simplify the operation and reduce the time to nearly all drilling was designed as shown at *A*. A base was made with raised sides, in which to lay the

blocks and by means of which to slide them under the drill. The sides kept the block from turning, and sloped down on one end so that the drilled block when pushed by the block entering would slide down and fall into boxes. Fully half of the handling and the necessity for holding the blocks while drilling were thus taken care of.

An arrangement *B* clamped to the spindle sleeve served to center the blocks under the drill. Inside a piece of steel



SIMPLIFYING A DRILL OPERATION

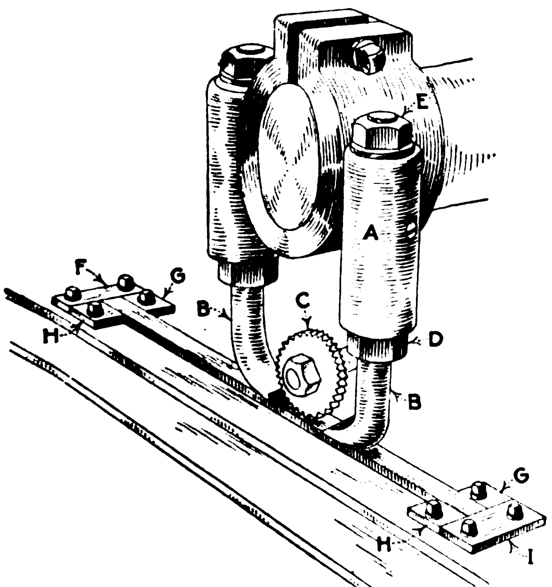
tubing a rod is fitted to travel up and down, but is prevented from turning by keys and is normally held down by a spring, also in the tube. The tube is held in a split casting socket *C* that is clamped to the sleeve. The rod carries the casting that centers the block. This casting is hollow and has four hardened ribs on the inside, the ribs tapering at an angle of 45 deg., so that a block is pushed to their center as the foot is brought down. This foot can go no farther, but holds the block while the drill is fed through.

The outfit was cheap to make and the results could hardly be bettered by an automatic device.

Middletown, N. Y. DONALD A. HAMPSON.

Attachment for Milling Flat Stock Without Clamping

A somewhat difficult thing to do on a miller is to grip thin, flat stock securely and quickly for surface milling. If gripped in a vise, the chances are it will



MILLING FLAT STOCK WITHOUT CLAMPING

buckle; if held by wedges, considerable time is lost in setting up. The illustration shows a simple attachment that fits on the supporting arm of the miller and holds the work down, at the same time supporting it close up to the cut.

This device consists of a bracket *A*, which fits the supporting arm, two rods *B* curved at the lower end to go under the cutter *C*, and the nuts *D* and *E* for adjusting the rods for various thicknesses of stock or different diameters of cutter.

The work is set on the machine table, located against the stop *F* between the blocks *G*, *H* and *I* for location and to take the thrust of the cut. The table containing the work is fed under the cutter in the usual manner. As it passes under the curved rods, they are adjusted to hold the work down in place, while allowing the work to slide under them.

With this arrangement it is unnecessary to clamp the work down, as one rod bears on the size before milling and the other on the thickness as milled, the stock machined being cold-rolled, running close to standard dimensions.

It is advisable on this class of work to keep the cutter flooded with oil or soda water. It washes the chips away, and there is no tendency for them to catch under the curved rods. M. HENDRICK.

Pawtucket, R. I.

Trying Out Inventions and a Bit of History

In conversation with an inventor the question of getting original ideas tried out was raised. The inventor said that when the proprietor of a plant is an inventor

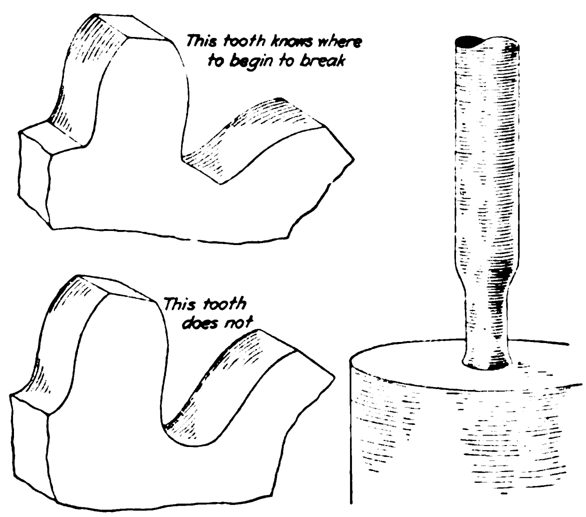


Fig. 1 Fig. 2

POINTS ON WEAR OF STEEL

he can do all the experimenting he wants to. This remark called to mind my brother, William A. Sweet, who did enough original work to have made him a big man. only the people in the steel business would not allow themselves to profit by his discoveries.

He told the mining engineers at their meeting in Pittsburgh, in the seventies, that steel rolled at a low heat during the last passes was very much tougher than if finished hot. Twenty-five years later an engineer claimed he had made this discovery and advocated that railroad rails be so finished.

My brother found that the teeth of his roll pinions were breaking beyond endurance, and he overcame this by cutting out the stock at the roots of the teeth, as shown at *A*, Fig. 1. He did practically the same thing with the piston rods of his steam hammers, which were all made as they are now—just a straight rod put in the hammer head by a taper fit. What he did was the sensible thing to do. He turned the rods down, as shown by Fig. 2, and that ended the trouble. He was the first to make a successful semiautomatic stoker by forcing the coal into the fire by a plunger above the bottom and below the top of the fire. Furnaces of this kind have been in use for years. The plungers are worked by hand, and the men do not like them.

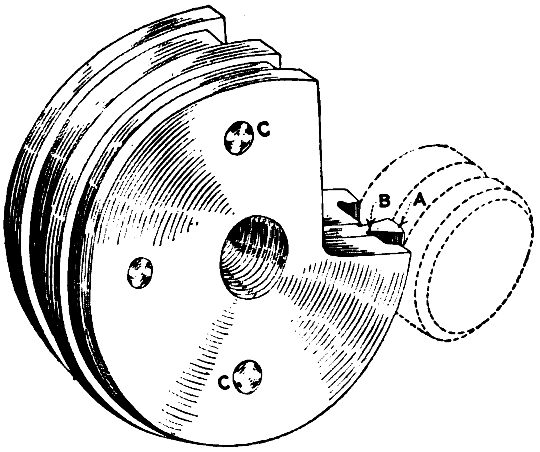
The change in the gear teeth was a wonderful improvement; but no one will accept it, and probably no one could sell a machine with gears so cut. Besides, it would call for several series of extensive tests to determine the strength of the new gear teeth. Yet one can only wonder how such tests can amount to anything when the strength of the standard test bars varies from perhaps 2,000 to 5,400 Johnson iron.

In the case of the piston rod the cause of the breaking is simple enough: The strain is centered on a line at the top of the hammer head and is excessive where the hammer does not hit exactly central. This repeating the strain centered on a single line breaks the rod in detail. It may be that the French scientist would explain it as the fatigue of the metal, while my brother would put it in plain English and say that it gets tired and lets go, which means exactly the same thing. If the engineer proposes to turn down the piston rods to save the breaking, the boss won't let him; and this comes back to the original claim that if the proprietor is the inventor he can get his ideas tried.

Syracuse, N. Y. JOHN E. SWEET.

Built-Up Circular Forming Tool

When making a forming tool, it is sometimes hard to grind the sides of the step *A*. This is especially difficult if it is necessary to provide a clearance angle, as at *B*. Since this step acts as a parting tool, it takes the brunt



A BUILT-UP CIRCULAR FORMING TOOL

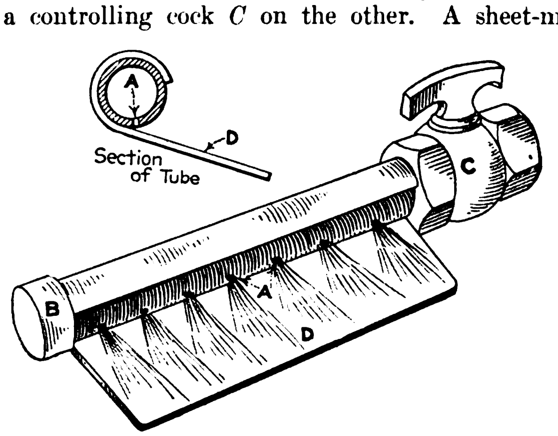
of the work and will wear much faster than the other steps. Furthermore, being very narrow, it is subject to breakage.

The forming tool shown is built up of three pieces, each hardened and ground, and the whole assembled together with rivets *C*. By grinding each part separately considerable accuracy can be obtained. If the step is a separate piece, it can be seen that trouble will be met in making the threads match after hardening; but if the rivet holes are drilled first and well doweled before tapping, everything will work all right. The threads should be cut a little full, so as to lap out after hardening. Of course, this tool has the drawback that it cannot be reground so many times as a solid tool, because of the rivets. WILLIAM BURR BENNETT.

Bridgeport, Conn.

Hacksaw Lubricator

The illustration shows a device for feeding lubricant to a hacksaw. It consists of a pipe, with several small holes *A* drilled in a line. There is a cap *B* on one end and a controlling cock *C* on the other. A sheet-metal



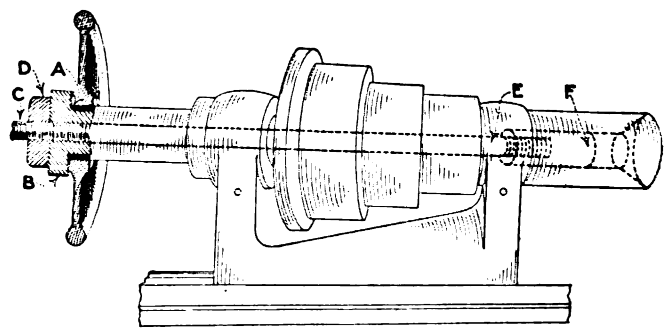
A HACKSAW LUBRICATOR

lip *D* is attached as shown and should be arranged so that the coolant flows off its edge in a thin flat stream and onto the saw blade. A little care by the operator in the adjustment of this lip will keep the blade well cooled.

Bridgeport, Conn. B. W. BURR.

Stop for Bench Lathe

The stop illustrated is convenient for use on bench lathes with the draw-in collet. It was designed to hold pieces which were drilled from each end. A thread was chased in the end of the tube at *A* and a plug *B* was tapped with a $\frac{5}{16}$x24 thread. On the stop a thread was cut on at *C*, which screws into the plug *B*. The thread



STOP FOR BENCH LATHE

is cut long to allow for adjustment, and is held in position with the nut *D*. The end *E* is tapped so that sockets of various diameters can be screwed on as shown at *F*.

By butting the end of the piece to be machined against the end of the stop at *F* and using the stop on the tailstock, accurate work is obtained, as the stop will keep the work from being drawn in. THOMAS B. BRACEY.

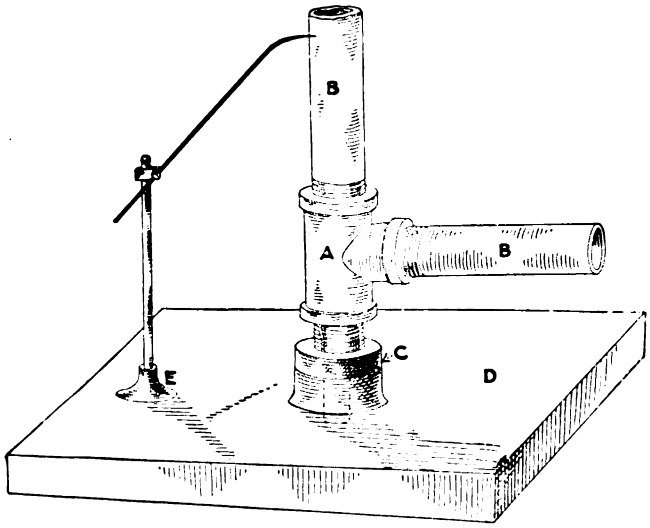
Wilmington, Del.

Discussion of Previous Question

Device for Testing Fittings

The device shown on page 164 brings to mind another that I have seen used for the same purpose. The illustration is almost self-explanatory. *A* is the fitting to be tested, *B* a standard test piece and *C* a special plug having a hub fitting into the base plate *D*, as shown, while *E* represents a surface gage.

In use, plug *C* is revolved 180 deg. The surface gage will show at once if the fitting is not tapped straight.



DEVICE FOR TESTING FITTINGS

To test for horizontal tapping, do not revolve, but use the gage near the fitting and at the end of the test piece. The different test pieces should have the threads marked for depth and act as thread gages.

Odd-angle or 45-deg. fittings cannot be gaged with this device, but screwed flanges can be tested to see that tapping is perpendicular to the flange. It was for this purpose that I first saw this contrivance in use.

Milwaukee, Wis. JOHN BAILEY.

The Suggestion System

At different times articles on the suggestion system have appeared in the *American Machinist*. Generally, the articles do not speak well of the plan. In the first year there is a large flow of ideas, gradually decreasing until only 20 or 30 per year are received.

Of course, a system of this description would not be thought of in connection with such big plants as Ford's and Studebaker's. These are up-to-the-minute shops; but what about the shop with a hundred men, which is being run in a go-as-you-please way? Just the same thing would happen here. The first year would bring in a hundred or more ideas, and then there would be a decrease. But I think this is just the reason why each shop should adopt the system. The operators are the men right in touch with the details of the work. If the manager and foremen would pull themselves together and decide to row in the same boat as the men in the shop, matters would be successful.

Now take the suggestion system when it gets to where only 20 or 30 ideas come in a year. The majority of these might come from one man. He loves his work, but likes it better if some of his suggestions are paid for. His ideas are carefully thought out. Is he not worth watching? He is not always going to be an operator. It would pay to run a suggestion scheme if the only result was the finding of such men. J. H. DAVIS.

Wembley, England.

Effect of Oil in Cutting Off

The article by W. G. Groocock on page 295 is in line with the experience of many who have had to do with broaching. Some time back, a broach that had been tested at the factory, giving satisfactory results, was complained of by the user. It acted as described by Mr. Groocock. A man from the broach makers found oil being used as a coolant. Upon his recommendation a change was made to "economy compound" in the proportions of five parts of water to one of compound and excellent results were obtained.

On another occasion a lot of tough low-carbon steel had to be threaded 8 threads per inch. The cut was very rough, the tool gouging in. Three men tried the job before it was turned over to the toolroom foreman, who experimented with all the lubricants that had been used in the lathe department, with no better result. Finally, he tried turpentine and white lead, which proved all that was needed. I. K. MACKENZIE.

South Acton, Mass.

Lack of Attention to Want Ads

The editorial on page 346, discussing certain phases of advertising for employees, deserves to be carefully pondered by every small-shop owner who, like myself, cannot afford a regular employment clerk and is therefore in the habit of leaving the job of finding new employees to someone in "the office" who has probably neither the training nor the patience to fit him for this task.

No matter how large the town, there is only a certain definite number of men available for work in a given shop, and no manufacturer can afford lightly to antagonize or discourage a single one of these prospective employees, lest he be the very man best fitted to fill some future vacancy.

When advertising for help, a manufacturer should bear in mind that he is really endeavoring to sell an opportunity to the man who best deserves it and should make his advertisement appeal to that man in terms that will make him covet the opportunity and set about securing it. "Men Wanted" will attract only the out-of-works, but "Opportunity for an ambitious man to work into a position of responsibility" will bring answers from the

best class of workmen—those who are always alert to better themselves and willing to give the best that is in them in the process. It need hardly be added that it is futile to "color" the position misleadingly; that will mean merely a disgruntled employee who will leave on the first payday. But write up honestly and convincingly the attractions of the place you have to offer, even if it takes a little time and thought to get the proper wording.

Having secured and read your answers, the usual process is to write to the two or three most promising applicants and throw the remaining letters in the waste-basket. "No time" or "Costs too much" to answer them all, you say. But the time and the money thus spent will yield big returns when help is scarce and you have to come out in the open and fight for the men you need. In such an event a reputation for decent and considerate treatment of help will be as bread cast upon the waters. An easy and inexpensive way of dealing with answers to ads is to have a number of stamped post cards printed with the following form:

Dear Sir—We have received and considered your reply to our recent "Help Wanted" ad and do not believe that your qualifications will enable you to fill this vacancy satisfactorily.

We have, however, filed your letter and will write you further when a suitable vacancy occurs.

Kindly call about o'clock next for an interview.

Thanking you for bringing your services to our attention, we are, very truly yours,

THE BLANK MANUFACTURING CO.

By crossing out the irrelevant lines this makes a suitable reply to the three classes of applicants—promising, unpromising and hold-overs—and requires in addition merely the writing of the name and address on the face side. In this way, at an expense of about $2 per hundred, many friends and advocates of the establishment are secured, and as many men are relieved of the uncertainty and suspense that always follow the sending of a letter seeking employment.

"Courtesy pays" is a slogan that applies as aptly to the relations between employer and employee as to those between dealer and customer.

New York City. W. J. SPIRO.

Miller Designer and Shop Superintendent

On page 10 E. P. Armstrong writes, "The scarcest men in the country today are men who are capable of satisfactorily filling the superintendent's position . . . because it is not altogether a question of skill in cutting iron and machinery, but of broad-sightedness, diplomacy and tact coupled with well-developed executive ability.

In a discussion of this subject recently with some friends it was pointed out that the foregoing is doubtless very true to some people's minds, but let us review the prospects facing aspirants for such positions—men who are fully qualified, possessing both mechanical skill and knowledge, with executive ability and tact acquired in positions that call for and train the holders in the broadest manner.

The most likely means of finding better opportunities are the advertisement columns of the *American Machinist*. Many hours are spent composing letters, setting forth, as if writing for the mechanical "Who's Who," all one's life history in answer to such inquiries as seem to offer steps in advancement. The result in far too many instances is not even an acknowledgment.

At times I have found it necessary to advertise for skilled help. I considered it a question of honor, if nothing more, to answer even the postal card of some poor fellow who had no more ability, or knew no better, than to state his experience in such a condensed form.

The alternative method for "upward and onward" candidates is to wait until chance positions come in their way through the tips or recommendations of friends. This procedure does not always result in the right man being fitted into exactly the right place.

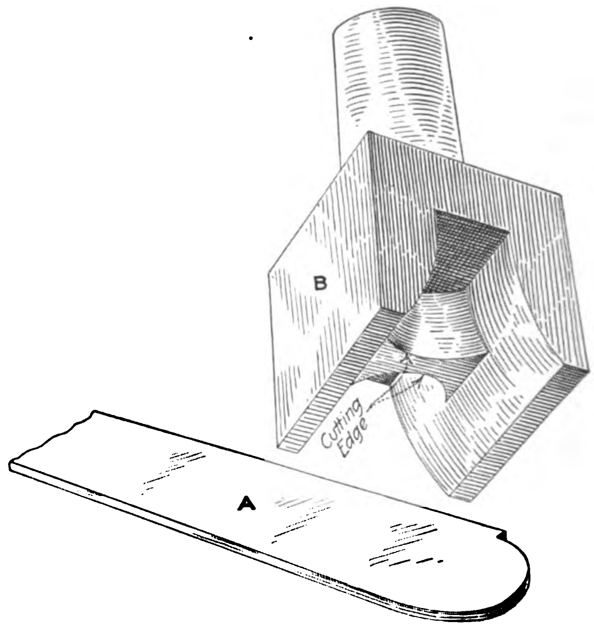
Is there not a need for a clearing house or exchange for men who have sufficient confidence in themselves to be willing to demonstrate their ability to fill better positions.

Middletown, Conn. J. A. ERITH.

Saving Costs in Shearing and Punching Flat Bars

The method of cutting off flat bars described by A. Patterson, in the *American Machinist*, Vol. 44, page 372, is very old. The trouble with the tools as he shows them is that all commercial flat-bar stock varies so much in width that it is impossible to center the stock properly and get a good-looking job. Anybody who tries this kind of tool will find that a big percentage of the work will look as illustrated at *A*.

To overcome this objection, I have used a punch, as shown, with very good results. The two tapered sides



STOCK-ALIGNING DIES

on this punch act as a guide for the stock and will naturally bring it central over the die every time, provided the distance between the prongs is made right. The two projections on the punch are backed up by the die and act as guides between the punch and the die, at the same time guiding the stock.

In making this punch, care must be taken in hardening, as it has a tendency to break at the sharp corner where the prongs leave the punch proper. If the prongs are made thick enough and ordinary care is taken in quenching, no difficulties will be experienced.

New York City. B. NAUCKHOFF.

Editorials

Take Warning!

The most dangerous and insidious of all attempts to foist the metric system on this country is now underway. Dr. Stratton, Director of the National Bureau of Standards, has prepared a "Report to the International High Commission Relative to the Use of the Metric System in Export Trade." This report has been prepared at the request of Secretary McAdoo for the International High Commission which convenes in Buenos Aires, Apr. 3, next, for which Secretary McAdoo is at this writing en route; and all signs point toward its use before the commission in order to commit our Government to the adoption of the system.

In this devious and roundabout way it is sought to undo the great work accomplished by manufacturing interests a dozen years ago in defeating the bill for the compulsory adoption of the metric system then before the House Committee on Coinage, Weights and Measures. It must be remembered that that work is now ancient history and practically forgotten in Washington. The personnel of Congress has largely changed, the administration has changed more than once, and meanwhile Dr. Stratton has been constantly on the ground and ceaselessly active in poisoning our public officials with his specious assumptions.

Let no one be deceived by the reference to export trade in the title, for most of the report is an argument for the general use of the system, and all know Dr. Stratton's aim to be the bringing about of such use. In the concluding paragraph we find, "A common system of weights and measures will also aid in realizing one of the aims of the High Commission in securing the unification of law and practice." The body is a commission on uniform law and the report can have no other use at Buenos Aires than to commit our Government to the adoption of the system.

The second paragraph opens as follows: "The following examples are given as a few typical of the large number of manufacturers who are already using the metric system, in some cases in both domestic and foreign trade." In this enumeration we find the following from our list of advertisers (we give the names as they appear in the report): Brown & Sharpe, Pratt & Whitney, the Standard Tool Co., Morse Twist Drill Co., L. S. Starrett Co. Some (we think all) of these companies will be recognized as unalterably opposed to the system; and they will certainly enjoy seeing their names thus lugged in to support the metric cause, as they will enjoy this piece of wisdom: "Some well-meaning men have urged that English measures are working well enough and a change would be all but impossible. Yet the very firms concerned are using the metric system for their own profit. No more could be asked."

The report is expressly announced as intended for wide circulation. It is a Senate document, which means that, to the resources of the Bureau of Standards, Dr. Stratton has now annexed the facilities of the Government Printing Office and, through the franking privilege, the use of the postal service in spreading his metric propaganda—and all without cost. It is the object of Dr. Stratton's life to force the metric system upon this country; and much as we condemn, we cannot but admire, his ingenuity in enlisting the Government departments in his service. It is plain that since the victory of a dozen years ago manufacturing interests have been asleep, and on them Dr. Stratton has stolen a march. Much as we deplore the re-introduction of a subject of which all—and none more than we—are heartily tired, it is plain that another and united effort must be made to nullify the activities of the most dangerous enemy of our industries which our country harbors.

The pamphlet is Senate Document No. 241 of the Sixty-fourth Congress, First Session. Every reader should write to the Government Printing Office at Washington for a copy. While of school-boy grade and unworthy of serious discussion, the pamphlet cannot fail to have large influence with the unthinking and uninformed, for whom, indeed, it is obviously intended. It is inconceivable that Dr. Stratton regards his arguments as of serious value.

Commercial Credits in South America

With the exception of Colombia and Venezuela, the common method of doing business in South American countries is on a credit basis. The two countries named have always been on a cash basis, for reasons that are perhaps not entirely complimentary. At the present time the length of credit is running from 60 to 120 days, although in the past much longer terms have often been extended.

The position of Ecuador is strong financially, and the best houses expect terms of from 60 to 90 days from the date of receipt of goods there. In Peru, Chile and Bolivia the conditions are very much the same. At one time German exporters used to give credit in these countries for long periods up to two years, and it is stated that there were heavy losses from this custom.

Up to the opening of the European War the business of Argentina had been very largely handled through Europe; thus commercial houses in that country were not well known in North America, and the little business that was conducted was very largely on a basis of cash against documents in Buenos Aires or New York. But this situation has now changed, and the average length of credit extended to Argentine buyers is from 90 to 120 days. The long-established well-known houses get this extension from the arrival of the goods in their home port.

The situation in Brazil is very similar to that now prevailing in Argentina, although before the opening of the war there had been a much greater flow of commodities from Brazil to North America and from the United States back than had prevailed with Argentina.

The South American inclination to be easy-going exhibits itself in the payment of these obligations, as in many other business relations. It is not at all unusual for customers to allow a draft to run over a few days, say three or four or five, before taking it up. But in the end they pay, which is the important consideration. Thus it is always wise for a North American exporter to allow a draft or note to run on a few days beyond the date of payment without entering a protest. As a simple rule, say, let such documents run for at least ten days before taking steps to collect. This is a wise policy, which in the long run works no serious hardship to the exporter. On the other hand, it is a course that tends to build up the all-important asset of good feeling.

There has been an erroneous opinion in the United States that South American accounts are apt to be bad. Southern credit has often been looked upon with suspicion. In the main this viewpoint is all wrong. There are as strong, well-established, reputable business houses in South America as can be found anywhere in the world.

In this connection the experience of a United States manufacturer during the year 1915 is of particular interest. During the year 1914 this firm exported about $8,000 worth of goods to Brazil. Owing to the cutting off of European supplies, this account jumped to $500,000 for the year 1915. (As a matter of interest, this concern is now doing about 65 per cent. of the business in its line in all Brazil.) During the year 1915, when this half-million dollars' worth of business was done, there was only one bad account—amounting to $146. And in that case the goods were not claimed at the custom house; thus the property was not lost. Where is there a half-million dollars' worth of business in the United States, divided up into a large number of small accounts, that can equal this record?

Still another Brazilian incident is instructive in this consideration of the reliability of South American business houses. Some six months ago the Brazilian congress passed a law requiring the execution of a written document with revenue stamps attached as an acceptance in the case of all credit sales. One house in Rio de Janeiro, doing business with 1,800 customers scattered throughout the length and breadth of Brazil, wrote to each one, pointing out this law and asking that it be conformed to in connection with its business. With hardly an exception the customers wrote back saying that they would not execute such documents and rather than do so would not accept any more goods. As a result the merchants got together and appealed to the Brazilian congress, which at first prorogued the law and finally annulled it.

The viewpoint of the customers was that this law was a reflection upon their honesty and business integrity. They thought that the merchants had inspired it and were prepared to fight.

At the present time the efforts of the banks are being directed toward cutting down long credits. A number of evils flow from them. They tend to foster spasmodic buying and even speculative buying. These facts are being pointed out to South American customers, with the hope of influencing them toward short credits or cash business. The practical advantages of short credits to the seller are easily pointed out. Frequent orders mean a steady flow of product. This tends to stabilize the working conditions in machinery-building shops.

Navy-Yard Preparedness

We are in the midst of a campaign for military preparedness—that is, an agitation looking toward the appropriation of large sums of money for the provision of ships, armies, artillery and munitions. Also there is likely to be a campaign for industrial preparedness. The *American Machinist* has already signified its approval of this project.

There is a little combination of these two ideas that could be put into operation right away. It would conduce to military preparedness and be an example of industrial preparedness; moreover, it would require no appropriations.

Under the Navy Department there are several industrial plants—the navy yards, including the gun factory at Washington; the powder factory, the torpedo factory and a number of magazines, or arsenals, at which powder and shell are stored and packed. A navy yard is not a park, where ships may tie while the officers and crews go ashore on liberty. It is a good-sized industrial plant, employing from 1,000 to 5,000 hands; and four or five of the navy yards are equipped for shipbuilding.

The *American Machinist* has taken occasion previously to dwell on the necessity of doing something toward the development and organization of these properties. They are not run economically, nor modern in equipment and methods. They should be models for the rest of us.

Not only should the economic wastes be eliminated; the military value of the properties should be recognized and developed. As at present organized, all the magazines, the torpedo factory, the powder factory and the gun factory are officered by line officers doing shore duty. Each navy yard is divided into two industrial divisions, and the line officers run one of these in each yard. This condition is subject to criticism, not alone because line officers—conscientious and hard working though they may be—are not experienced in this work, but principally because on the outbreak of hostilities it would be necessary to withdraw them from shore duty to officer naval vessels—necessary because the ships would require them. Incidentally, the navy is shorthanded as to officers even for a peace footing.

Upon removal of the line officers who chance to be in these industrial plants at the outbreak of hostilities it appears to be the plan to replace them with retired officers not suitable for sea service. This would be a military mistake, if not a calamity.

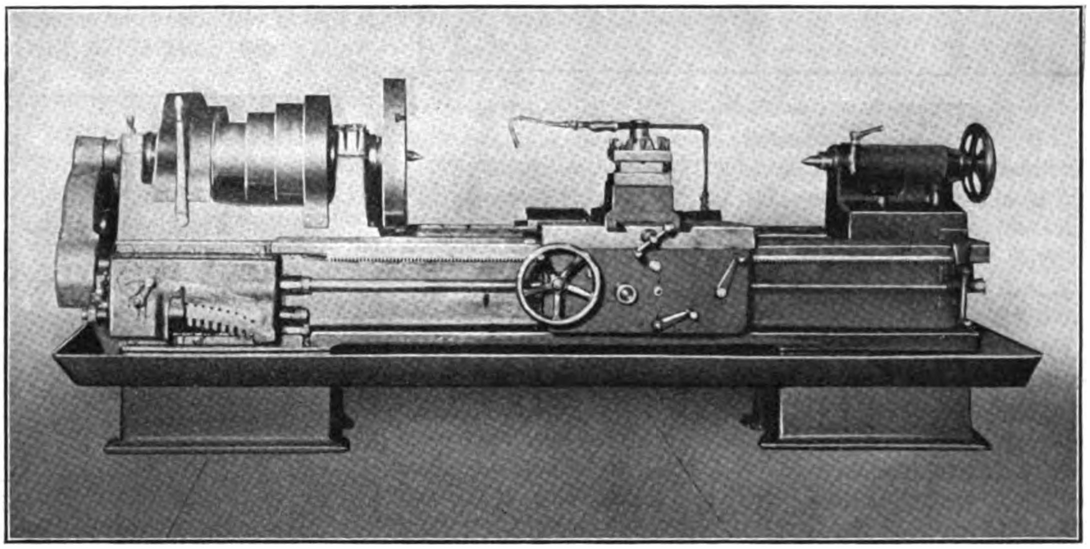
These Government plants are wanted for war-time purposes principally. At the outbreak of war they would go as quickly as possible on a 24-hr. basis. The navy yards in converting merchantmen and refitting men of war would have to do in a week what they now take six weeks or more to do. In order that these plants may fulfill their mission, in order that their military value may be maximum at the time of greatest need, they must at that time have well-oiled, smooth-running organizations in the hands of officers trained to run them and stay with them during the war. The present is the time to start to develop these organizations; and the work of development can be done without the appropriation of large sums of Government money.

The authority to issue an order involves the responsibility to see that it is properly executed.—H. L. Gantt.

Shop Equipment News

Quick-Change Double Back-Geared 24-In. Lathe

The Weir Frog Co., Cincinnati, Ohio, has taken over the drawings, patterns, templets and jigs for the Series D 24- and 26-in. lathes made by the Rahn-Larmon Co. Under this arrangement the latter company, no longer manufactures these sizes. The 24-in. size is here shown. A lathe built along similar lines has been previously described in these columns, but the present machine is equipped with quick-change gear box, oil pan, oil pump and cross-slide turret, which were not on the former machine of this size.



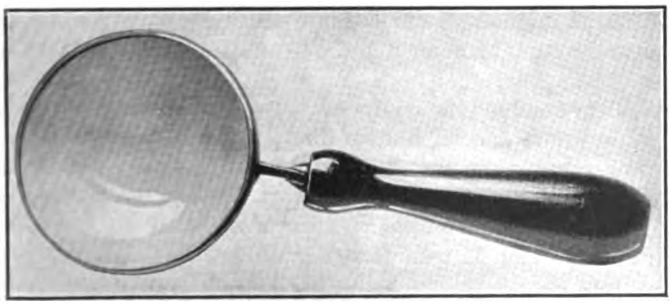
QUICK-CHANGE DOUBLE BACK-GEARED 24-IN. LATHE

Swing over V's, 25 in.; swing over carriage, $17\frac{1}{4}$ in.; front bearing, $4\frac{5}{8}$ in. in diameter by $7\frac{1}{4}$ in. long; back bearing, $3\frac{1}{8}$x5 in.; hole through spindle, $2\frac{1}{8}$ in.; tail-spindle diameter, $2\frac{7}{8}$ in.; traverse of tail spindle, $9\frac{3}{4}$ in.; cone diameters, 10, 13 and 16 in.; width of belt, 4 in.; ratio of first back gear, 4.75 to 1; ratio of second back gear, 12 to 1; cuts threads, 2 to 20 per in.; threads on lead screw, 4 per in.; range of feed, 0.01 to 0.27 in.; length of bed, 10 ft. 6 in. and longer; extreme length between centers, 5 ft.; weight, with 10-ft. bed, 5,600 lb.

The wings of the saddle are provided with the usual T-slots, their top surfaces being above the top of the cross-slide. By removing the turret tool post and cross-slide, work can be bolted direct to the top of the carriage, for boring, etc. All gears are protected by gear guards, which are readily removable. The lathe is furnished with taper attachment if desired.

Handy Magnifying Mirror

The form of magnifying mirror shown was designed primarily for tool makers' and machinists' use. In addition to its handiness for the close examination of various classes of machinists' work and toolroom operations it is calculated to afford relief from eye strain in connection with fine work. The mirror is of course adjustable.



HANDY MAGNIFYING GLASS
Diameter of mirror, $2\frac{3}{16}$ in.

Many applications for such a mirror will come to mind, as, for example, observing the points of cutting tools while in the machine, examining internal threaded and other work, setting dividers to scale lines, etc.

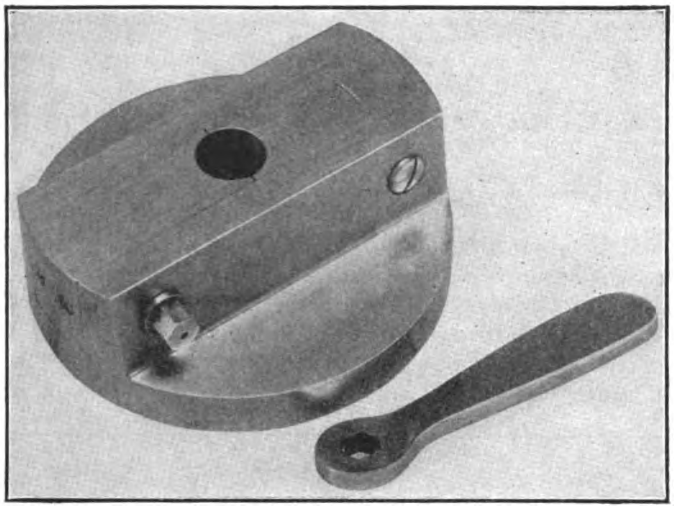
The convex mirror is of high magnifying power and is mounted in a white-metal die casting. Either metal or wooden handles may be obtained. The device is a recent product of the Pajaro Manufacturing Co., 1251 Brown's Ave., Erie, Penn.

Self-Centering Bushing Chuck

To provide adequate means of holding thin bushings for boring or internal grinding, the Rivett Lathe and Grinder Co., Brighton, Boston, Mass., has recently developed a self-centering chuck, one size of which is shown.

The chuck is designed to take a bushing of a given size and hold it on the outside in such a manner as to prevent distortion. The chuck has two jaws, the total travel of which is not over $\frac{1}{16}$ in. It is universal in action, both jaws moving simultaneously. The body of the chuck is made of cast iron. The two chuck jaws are of ample depth to afford sufficient bearing on the bushing to be held. The jaws slide in a slot cut through the body of the chuck. At right angles to the travel of the jaws are two spindles through which the movement of the jaws is secured. The spindles are connected by means of suitable links, and the jaws are operated through the eccentricity of the spindles.

It will be observed that all the moving parts are entirely inclosed and that the design has been made especially compact. The chuck may be used in any lathe or



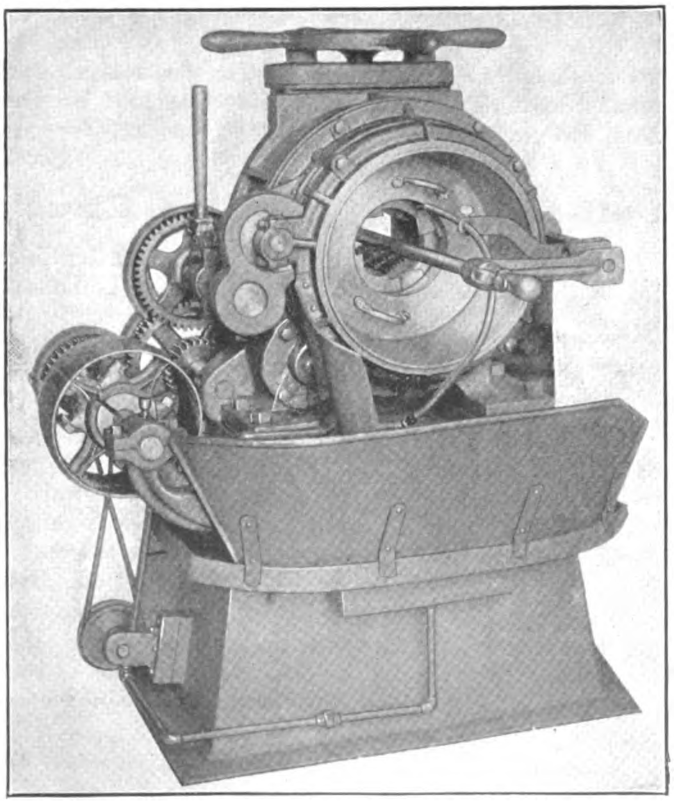
SELF-CENTERING BUSHING CHUCK

grinder and is mounted on a faceplate in the regular way. It is made in two sizes—for holding bushings up to $\frac{7}{8}$ in. and $2\frac{9}{16}$ in. in diameter.

Shell Cutting-Off Machine

The illustration shows an automatic cutting-off machine for cutting off the ragged ends of shrapnel and high-explosive shells. In this machine the Curtis & Curtis Co., 66 Garden St., Bridgeport, Conn., has adapted the principle followed in its line of pipe and threading machines—namely, turning the dies around the work instead of turning the work in the dies.

Four cutting-off tools are used, all cutting simultaneously under automatic control, and there is provided quick return for the cutting-off tools.



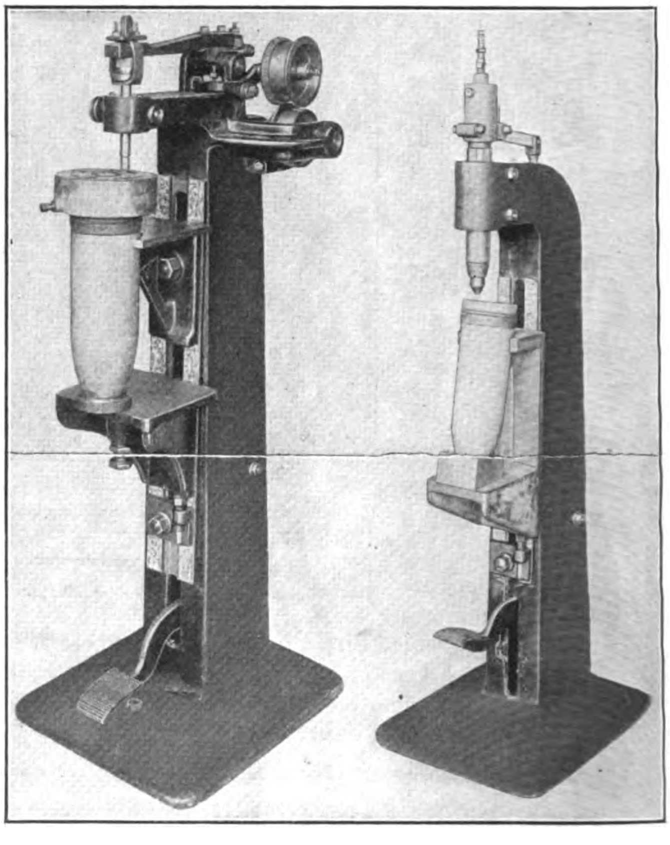
AUTOMATIC CUTTING-OFF MACHINE

The general construction of the machine is made apparent by the illustration. Aside from the insertion and removal of the work, the machine is entirely automatic. It may be arranged for direct-connected motor drive by installing a motor in the base and interposing a train of compound gears.

The machine is made in a number of sizes for shells ranging from 3 to 6 in. and with varying thicknesses of walls.

High-Speed Shell-Riveting and Marking Machines

The two machines shown were adapted by the Grant Manufacturing and Machine Co., Bridgeport, Conn., from its line of riveters, to be especially suitable for high-speed riveting and marking of high-explosive type of shells.



HIGH-SPEED SHELL-RIVETING AND MARKING MACHINES FOR HIGH-EXPLOSIVE SHELLS

Diameter of piston of riveting machine, $1\frac{1}{16}$ in.; length of stroke, 4 in.; speed, 1,000 blows per minute; air pressure per square inch, 80 to 100 lb.; weight, 300 lb.; speed of marking machine, 2,000 blows per minute; marking can be arranged for 18-lb., 4.5-in. and 60-lb. shells

The riveting machine, shown to the right, is of the pneumatic stationary type, designed for heading the base plugs in high-explosive shells fitted with plugs having an annular rim turned on the end of the shell for riveting over the plug.

The machine is equipped with a special supporting table, and a special fixture that fits the nose of the shell, thus supporting the shell in proper position under the riveting hammer to close the joint. Inasmuch as the riveter is of the stationary type and fitted with a foot treadle, which is used to bring the riveting hammer into action, the operator's hands are free to handle the shells.

After the shell is in position, the treadle is depressed, thus starting the machine; the shell is then rotated one

complete revolution by hand, and with the riveting hammer striking about 1,000 blows per minute the plug can be riveted perfectly tight into the shell in about 20 sec. This machine can be equipped for riveting various sizes of shells.

The machine shown to the left is an adaptation of the rotary vibrating shell-riveting machine made by the same company and especially fitted up for rapidly marking the bases of high-explosive shells.

The arrangement is such that the blow is brought to bear on each individual letter and figure successively and with uniform pressure. Adjustment is provided so that a shallow or deep impression can be obtained. In operation a marking chuck is fastened on the end of the shell by means of a thumb-screw. The shell is then placed on the ball-bearing revolving fixture, which fits the nose of the shell. The base of the shell is supported in a position that brings the vibrating hammer to the proper location to do the marking. The machine is then started and the shell rotated one complete revolution by hand. With the machine striking 2,000 blows per minute, the official marking is done in about 15 sec. The machine can be equipped for various-sized shells.

Worm Thread Miller

The latest model of worm thread miller built by the Newton Machine Tool Works, Philadelphia, Penn., is shown in the illustrations.

In operating, the turned worm blanks are forced on a mandrel inserted in a taper draw chuck in the hollow spindle, controlled by a lever. After this first clamping, the mandrel is not released until the worm is entirely completed, as the adjustment to, and division for, the successive leads is controlled by a tooth clutch connected to the indexing worm and wormwheel.

The gear box contains the required gear combinations through sliding sleeves controlled by latch levers. Six leads are covered without removal of gears, whether threads are right or left hand. The various pitches are obtained through change gears.

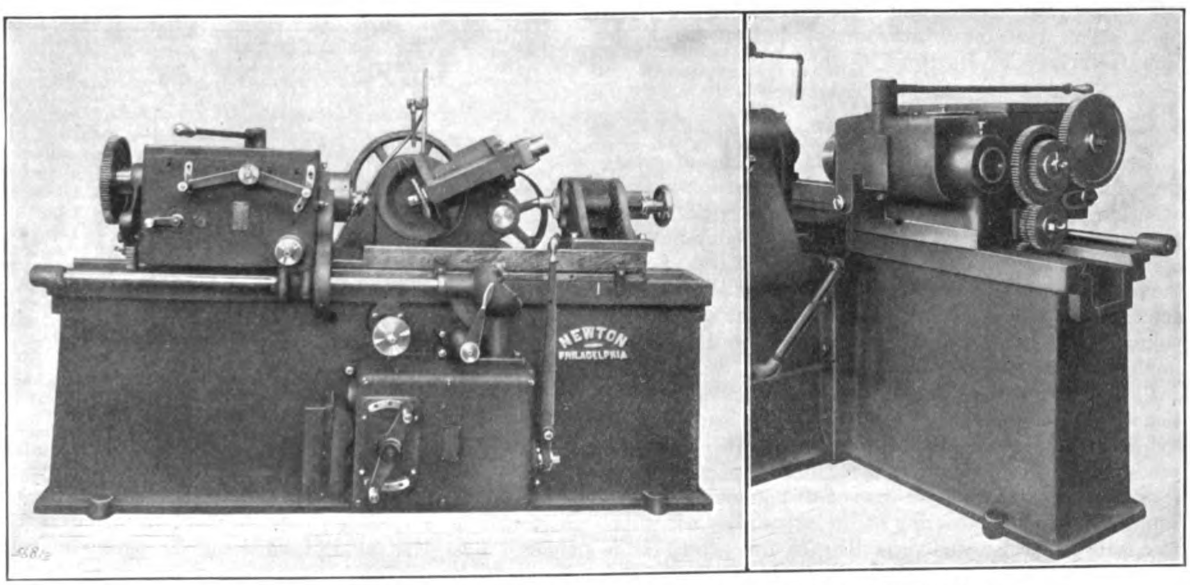
Motion is transmitted to the index box from a feed box, in which sufficient gears, mounted on sliding sleeves, controlled by levers, are included to give nine changes of feed without removal of the gears.

The feed is also carried through a box for connection with the rotating mechanism and then to gears for connection with the table feed screw. A lever controls the engagement of the feed clutch and another lever the reversing fast-power table clutch.

An eccentric clamp is controlled by a lever to lock the head securely in place after the cutter has been adjusted to the required depth through a screw equipped with a micrometer measuring collar.

All features are controlled from the front, with the one exception of the spindle-head rotating worm-shaft, which is fitted with an adjustable circular gage to give fractional degrees of angularity to the cutter spindle, within a maximum range of 40 deg. each side of the horizontal. Cutters are located with the axis by the use of spacing collars. A latch pin lever controls the clutch that gives suitable feeds and rotation for the left- and right-hand worms.

The drive is from a pulley through reduction gear, a spur gear through bevel gears and finally through hardened pinion and gear to the hardened helical gear made integral with the spindle, which has a taper bearing on each end. The thrust of the spindle is taken by an oil-immersed bearing of ample proportions for the purpose.



IMPROVED DESIGN OF WORM THREAD MILLER WITH CENTRALIZED CONTROL

Diameter of bore in spindle chuck, 3 in.; maximum distance between end of spindle and center, 24 in.; center of spindle to table, 8¼ in.; width of table, 14½ in.; base, over all, 8 ft. 3 in. by 4 ft. 6 in.

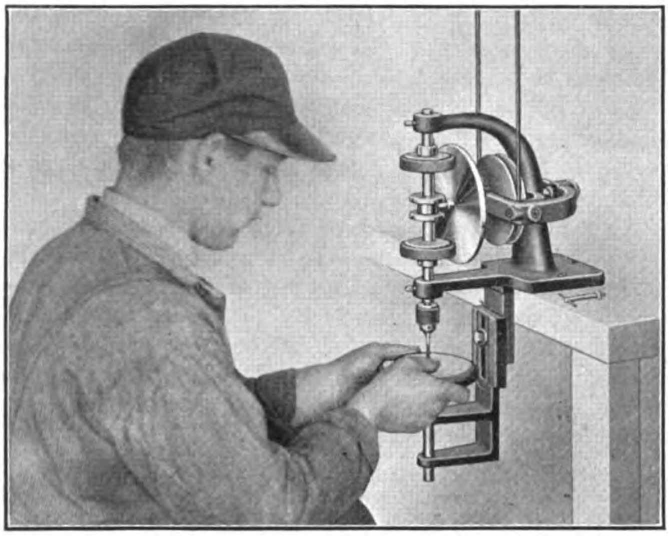
The base serves as a reservoir for the lubricant, which is delivered at the point of cutting by a pump and conductors.

It will be noted that control of all of the machine's motions is effected from the front with the exception of the spindle head rotating wormshaft. It will be understood that the work to be finished on this machine is in the form of hollow cylinders previously turned.

Sensitive Tapping Machine

The special feature of the tapping machine shown is the friction drive for both forward and reverse, making it sensitive to the touch of the operator and reducing the possibility of tap breakage.

The friction rolls are adjustable, simplifying the speed changes and at the same time permitting reversal at a higher speed than when driving forward. The friction-roll adjustment secures any speed from 225 to 600 r.p.m. This machine is a recent product of the Fenn Manufacturing Co., Hartford, Conn.



SENSITIVE TAPPING MACHINE

Capacity, $\frac{3}{16}$ in.; maximum distance from chuck to table, $3\frac{3}{8}$ in.; distance from upright to center of spindle, 3 in.; weight, with countershaft, 62 lb.

Coating for Blueprint Paper

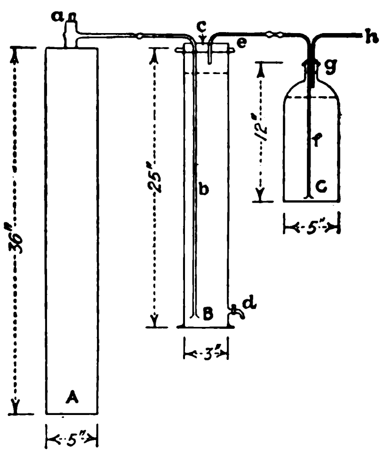
As a result of the great increase in the price of potassium ferricyanide, or red prussiate of potash, which is extensively used as a coating material for blueprint paper, an economical method of preparing the substance has been devised by the Department of Agriculture. Before the beginning of the war potassium ferricyanide could be obtained for 55c. a pound. It now sells for about $6 a pound, and moreover, it is exceedingly difficult to obtain in this country even at that price.

Potassium ferricyanide is produced by oxidizing a solution of potassium ferrocyanide with chlorine gas. At the same time a small amount of potassium chloride is produced. Investigations by the Bureau of Chemistry show, however, that the presence of this amount of potassium chloride in the coating of the paper does not interfere with the color and durability of the print. It is unnecessary, therefore, to separate the potassium chloride by crystallizing the potassium ferricyanide, provided that the latter is to be used on the spot and soon after it is prepared.

The apparatus devised by the Bureau of Chemistry for preparing in this way potassium ferricyanide solution is simple. The chief precaution to be taken in its operation is to see that the finished solution does not contain an excess of chlorine. At the prevailing prices of the materials potassium ferricyanide solution can be made by this process at the cost of approximately $2.80 per pound, calculated on the dry-salt basis. At the prices which prevailed before the war and which may be regarded as normal the cost would be approximately 35c. per pound.

Allowing for possible loss, 100 lb. of potassium ferrocyanide should yield about 75 lb. of potassium ferricyanide.

In the illustration is shown apparatus designed to produce 1 lb. of potassium ferricyanide from 1.33 lb. of potassium ferrocyanide. *A* is a cylinder containing chlorine; *B* is a glass cylinder 3 in. in diameter and 25 in. in height, capacity approximately ¾ gal., in which the solution of potassium ferrocyanide is placed. *C* is an ordinary acid bottle containing a solution of sodium hydroxide for absorbing any excess of chlorine that may be unabsorbed by the solution of potassium ferrocyanide. The glass cylinder *B* is fitted with a glass pet-cock *d* near the base for withdrawing a portion of the solution for testing completion of oxidation. At the top it is fitted with a 3-in. cork *c* sealed with paraffin and having two holes to accommodate the glass tubes *b* and *e*. One of these tubes *b* extends to the bottom of the cylinder and is blown at the end to distribute the gas. It is connected by a short piece of rubber tubing to the pipe attached to the chlorine cylinder. The other tube *e*, which does not touch the surface of the solution in cylinder *B*, is connected by a rubber tube to a glass tube *f* running to the bottom of the acid bottle and blown to distribute any gas that may not be absorbed in *B*. Bottle *C* is fitted at the top with a cork *g* sealed with paraffin and having two holes through which pass tubes. One of these tubes *f* runs to the bottom of the bottle; the other *h*, starting from above the liquid, is so connected as to carry unabsorbed chlorine out of doors. The chlorine gas is regulated by a valve *a* in the head of the chlorine cylinder. The glass tubing used should be ⅛ in. in inside diameter.



APPARATUS FOR THE PREPARATION OF POTASSIUM FERRICYANIDE

In operation it is only necessary to dissolve 1.33 lb. of potassium ferrocyanide in about 2½ qt. of distilled water and pour into cylinder *B*. Nearly fill bottle *C* with a 10 per cent. solution of causic soda. Connect the chlorine cylinder with tube *b* by means of a short piece of rubber tubing, tube *e* with tube *f*, and finally run a tube *h* from bottle *C* out of doors. Turn on the chlorine gas and allow it slowly to bubble through the solution of potassium ferrocyanide. Shut off the chlorine at intervals of a half-hour or so; and to aid the absorption of the gas, shake or agitate the container. Do not allow

the caustic soda solution to suck back when the gas is shut off. This can be prevented by breaking the connection between *B* and *C* immediately after shutting off the chlorine. Continue passing the chlorine into the potassium ferrocyanide solution for some time after the color has darkened considerably. After this, frequent tests are necessary to determine when the oxidation has been completed. To test for complete conversion to the ferricyanide, draw off a little of the solution through the pet-cock *d*, dilute with distilled water and test with a solution of ferric chloride. If a blue precipitate is formed, potassium ferrocyanide is still present and the process must be continued. If a brownish or amber-colored solution results, the oxidation is complete. After tests show the oxidation to be complete, turn off the chlorine gas, disconnect the chlorine cylinder and connect *b* with an air-pressure line. Bubble air through the solution until no odor of chlorine is noticeable. In case air pressure is not available and suction can be obtained, break the rubber connection between tubes *e* and *f* and connect *e* with the suction and draw air through the solution until it is free of chlorine.

Great care must be exercised that no chlorine escapes into the room and comes in contact with the flesh, as it is a powerful irritant and serious injury may result to the throat, nose, eyes and hands from exposure to the fumes or from contact with the liquid.

NEW PUBLICATIONS

AMERICAN MACHINIST GEAR BOOK—By Charles H. Logue. Revised edition, Reginald Trautschold, editor. Three hundred and forty 6x9-in. pages; 300 illustrations; indexed; cloth bound. Published by "American Machinist," McGraw-Hill Book Co., sole selling agents. Subscription price with the "American Machinist," $4.75; sale price, $2.50.

The first edition of this book was published some five years ago and met with a most gratifying success. It provided reliable, useful information on the subject of gearing. However, the last few years have added much to our knowledge of certain types of gears, making it advisable to revise a part of the original matter and to add some that is new. In doing this the original plan of the work has been followed, and much of the text remains intact. However, four sections have been entirely rewritten. These cover bevel, worm, helical and skew-bevel gears. In addition, the former section on gear-pattern work and molding has been omitted, and its place has been taken by a new section devoted to the costs of standard gears.

STEAM POWER—By W. E. Dalby. Seven hundred and sixty 6x9-in. pages; 258 illustrations; 35 tables; indexed; cloth bound. Longmans, Green & Co., New York City. Price, $6.

English technical books, particularly those relating to thermodynamics, have certain disadvantages when used by American readers. The most apparent is the system of units. Professor Dalby's massive volume, for instance, makes use of the pound-calorie rather than of the British thermal unit and consequently of the Centigrade rather than of the more familiar Fahrenheit temperature scale.

The book opens with an outline of the practical working of a steam plant, then goes on to explain how the power developed can be measured, and afterward considers practical and theoretical thermodynamics and dynamics of the plant.

The author has chosen to divide the heat-carrying media into three interacting circuits—the heating circuit, dealing with the transformation of the fuel into gas and the work done by the latter; the motive-power circuit, in which the steam gives up its energy; and finally the so-called cooling circuit, where the water is circulated through the condensing system. The first five chapters are devoted to the consideration of these three circuits.

Chapter I gives a general description of the duties of the boiler, reciprocating engine, condenser and auxiliary apparatus forming the power plant. It also explains the meaning of such terms as indicated and brake horsepower, as well as the principle and construction of apparatus used in their measurement. The reader is next given an elementary conception of the method of calculating thermal efficiency and is shown by carefully prepared flow diagrams the heat-energy conditions in various steam plants.

The second chapter deals with the steam boiler. The principal elements of the construction of several English boilers are described, as also are safety valves, gages and other very English mountings. Particularly clear and useful are the sections relating to fuels and to the theory of combustion.

The third chapter is a 75-page review of the laws of thermodynamics.

Chapter IV applies the theory to the performance of compound engines for both stationary and locomotive work, paying considerable attention to losses and to the means of reducing them. Concluding the part of the book concerned with heating, motive power and cooling circuits is a chapter on condensing apparatus, which seems all too short in view of the importance of the condenser and auxiliary apparatus in the operation of the modern power plant.

Chapters VI, VIII and IX relate chiefly to locomotive design and operation considered from a technical point of view.

Chapters VII and X deal with engine mechanism, the first explaining the method of calculating and graphically determining turning couples and giving the theory of flywheels and governors. The tenth chapter relates to steam distribution and therefore to valves and valve mechanisms. The rectangular-valve diagram is used to illustrate a number of practical problems. The Reuleaux, Bilgram and Zeuner diagrams are explained, as are also typical locomotive valves, link and reversing motions.

The last hundred pages (Chapters XI and XII) are devoted to the steam turbine. After starting with the theory of steam flow and of nozzles and applying the theory to the steam jet in the vacuum-brake ejector and the boiler injector, the reader is introduced gradually to the principles underlying impulse and reaction turbines and to the general design of such apparatus. The construction of the Zoelly, Sturtevant, De Laval, A. E. G. Parsons and Curtis turbines is described somewhat briefly, mainly as used for ship propulsion.

Professor Dalby's treatise should prove exceedingly valuable to students, to engineers and, in fact, to anyone desiring a thorough and authoritative exposition of the principles, both thermodynamic and dynamic, on which the design and operation of steam-power apparatus depend. Original authorities, such as Newton, Carnot, Clausius and Lord Kelvin, have been consulted, and even the most advanced theory presented is at all times closely linked with fundamental principles. The author has not been niggardly in giving his authorities. In fact, he goes farther, so that the references to articles dealing with particular phases of the subject are in themselves a useful part of the book. Another pleasing feature is that the illustrations, instead of being photographic reproductions, are nearly all line drawings carefully prepared to explain and to amplify the text.

PLANE GEOMETRY—By Claude Irwin Palmer and Daniel Pomeroy Taylor. Two hundred and seventy-seven 5x7½-in. pages; illustrated; indexed; cloth bound. Scott, Foresman & Co., New York City. Price, $1.

Reviewed by Walter B. Carver*

He who undertakes the thankless task of writing a textbook on geometry at this time finds himself between the devil and the deep sea. On the one hand are the centuries of Euclidean tradition, demanding an ostensibly logical deductive system. This tradition is given immediate and vital significance by the fact that the examinations which the student will be expected to pass are based upon it. On the other hand, there is the growing conviction that the student would acquire a better working knowledge of the truths of geometry and greater facility in the application of them if it were not necessary for him to devote so much of his time and energy to the proving of these truths. Moreover, it is generally conceded that many of the socalled proofs are so lacking in rigor as to be of very questionable value as a training in logic. Following the traditions, an author may produce a book that is distinguishable from its predecessors by means of the color of its binding. It will be made up largely of proofs of formal propositions, and many of these proofs will be unworthy of the name. If, on the other hand, the author be so courageous as to disregard the prescribed canons, he is quite likely to produce a book not usable as a text under present conditions.

The authors of the work under review have been notably successful in steering a careful course between these two disasters. The book impresses the reviewer as a conservative step in the right direction. In the editor's preface he suggests that the book should be gaged by "pedagogical rather than logical standards" and admits that at certain points "logic has been intentionally sacrificed to insight." It is then somewhat surprising to find the book distinctly su-

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perior to the average plane geometry in the rigor of its reasoning. The sacrifice of logic seems to consist largely of the omission of formal proofs in certain difficult cases. For instance, at the beginning of the chapter on areas there is an informal discussion, in which even the treatment of the incommensurable case is clearly suggested by a numerical illustration. Then we read, "From the foregoing considerations the truth of the following statement may be accepted: The area of a rectangle is equal to the product of its base and altitude." Perhaps this may be called a sacrifice of logic. But it is not faulty logic. There is no pretense that the theorem has been proved. Is this not the simple pedagogical and logical solution of our difficulty in elementary geometry?

The first obvious truths of the subject are presented in an informal way, appeal being made to the student's intuitions rather than to his reasoning powers. There are at the beginning no formal definitions or axioms; no pretense at proving anything. The first (very simple) proof occurs on page 39. The more important statements made in these earlier pages are proved later in the text. This method of procedure, admirable from a pedagogical point of view, is dangerous logically. It is easy to show, by a circular route of faultless reasoning, that if a statement is true it follows that it is true. One comes out by the same door where one went in. The two series of paragraphs—30, 32, 96, 97, 132, 133, 143 and 122, 123, 132, 133, 135—seem to furnish two examples of this kind of reasoning. It is only fair to add that the book is comparatively free from such defects.

The very difficult matter of measurement is well handled. The necessary assumptions are made explicitly, but in a natural form that makes them intuitively acceptable. There may be objections to defining the numerical measure of a quantity as "the number of times the quantity contains the unit of measure" and then following this by the assumption that "the numerical measure may be an integer, a fraction or an irrational number." Nevertheless, this treatment obviates many difficulties that are often less happily disposed of. It is to be regretted that the paragraphs on measurement in general (332-336) were not inserted before the paragraphs on angle measurement (304-305). The definite statements of paragraph 333 are tacitly assumed in paragraph 304.

The arrangement of the book is excellent. The subject is divided into five "chapters" (instead of "books"), and the usual order of the chapters on areas of polygons and similarity has been reversed. The material presented is more than sufficient to meet college-entrance requirements, and the arrangement is such that certain parts may be omitted when a short course is desired.

A review of the text would be incomplete without some mention of the exercises. They are numerous and varied and are well selected both for emphasizing and making clear the abstract truths of geometry and for connecting these truths with everyday experience. One is pleased to find a large number that involve the use of algebraic methods and numerical computations. There are a collection of formulas for reference and a good index.

The typographical work on the book is good; the figures are clean cut and accurate, and the general appearance is attractive.

INDUSTRIAL LEADERSHIP—By H. L. Gantt. One hundred and twenty-eight 5x7⅜-in. pages; 9 charts; cloth bound. Yale University Press, New Haven, Conn. Price, $1.

The five chapters of this book constitute the Page lectures for 1915, delivered before the senior class of the Sheffield Scientific School, Yale University. Presented now in permanent form, this book is one of the most important of recent works dealing with any phase of industrial management. In some quarters there is a feeling of uneasiness and dread of the coming period of industrial competition that must follow the great European War. In some minds there is a belief that the forces that can knit peoples together for physical warfare can also produce a superior industrial competition that will be very difficult to meet.

Mr. Gantt in his foreword admits that autocracy in the past has been able to organize a nation for both industrial and military efficiency in a manner superior to anything that has been accomplished by democracy. He then goes on to say: "If democracy is to compete successfully with autocracy in the long run, it must develop organizing and executive methods which shall be at least equal to those of the autocracy."

He believes that this can be done, however, and states the purpose of this series of lectures as follows: "In this course of lectures I have tried to set forth the principles on which I believe an industrial democracy can be based which will be even more effective than any system of industrialism which can be developed under autocracy." This conviction, expressed after mature reflection, should serve to encourage every weak-kneed American industrialist.

The titles of the five lectures, or chapters, are these: Industrial Leadership; Training Workmen; Principles of Task Work; Results of Task Work; Production and Sales.

The first naturally receives the most attention by the reviewer, for Mr. Gantt's method of training workmen and developing task work is well known and its results generally recognized. At the outset we are invited to ponder on the fact that our industrialism is so modern that its greatest problems have hardly been clearly grasped, even by those who have given them most study. Then a brief sketch of the usual conditions that have prevailed in industrial plants leads us to accept as truth: "Both employer and employee thus put a premium on inefficiency."

But the experience of the last ten years has tended to change this, and it is now becoming recognized among the most progressive manufacturers of the day that "the ratio between the wages paid and the work done is more important than the absolute amount of wages paid, and that the absolute amount of work done is more important than either." And the most important principle that is today working for the success of industrial organization is, "The authority to issue an order involves the responsibility to see that it is properly executed."

From this brief outline of industry as it was and as it is trending, Mr. Gantt invites us to consider the importance of leadership in war as the starting point of emphasizing the importance of leadership in industry. He quotes this well-known passage from Napoleon: "In war, men are nothing; it is the man who is everything. The general is the head, the whole of any army. It was not the Roman army that conquered Gaul, but Cæsar; it was not the Carthaginian army that made Rome tremble at her gates, but Hannibal; it was not the Macedonian army that reached the Indus, but Alexander; it was not the French army that carried the war to the Weser and the Inn, but Turenne; it was not the Prussian army which for seven years defended Prussia against the three greatest powers of Europe, but Frederick the Great."

The historian who gives the above quotation stated that Napoleon merely reiterated a truth confirmed by the spirit of successive ages—that a wise direction is of more avail than overwhelming numbers, sound strategy than the most perfect armament. Mr. Gantt paraphrases this conclusion for industrial conditions as follows: "A wise policy is of more avail than a large plant; good management, than perfect equipment."

The remaining pages of the first chapter amplify and expand this idea, carrying the conviction that industrial leadership is not a haphazard growth, not the chance positioning of some man or small group of men. On the contrary, it is an avocation for which men should be especially selected and trained to make them industrial leaders of the quality that the future will need, if American industries are to hold their present position in world-wide affairs.

The second chapter of the book outlines Mr. Gantt's principles and methods for training workmen, which have been associated with his name for a number of years. The third chapter outlines the principles of task work, and the fourth gives the result of this work in several industries. The examples are striking and are presented by means of the colored graphical charts that Mr. Gantt has used in his previous writings.

The fifth chapter, devoted to production and sales, follows very closely the argument of a professional paper contributed by Mr. Gantt at the Buffalo meeting of the American Society of Mechanical Engineers in May of last year. Early in the chapter he invites us to consider this fact: "If we produce an article for which there is a large demand, and sell it for a price that most people can afford to pay, the cost of selling that article in large quantities will be extremely small." Then after holding up the production and sale of the Ford automobile as an example, he writes: "This seem to dispute the theory held by so many business men, that a high selling price is necessary to large profits."

The final pages of the book are devoted to a brief discussion of the problem of expense apportionment and of the newer theory advanced by Mr. Gantt himself: "The output of the factory should not bear the total expense of the factory, but only that portion of the expense needed to produce it."

Every man who wishes to keep in touch with the newer theories and developments of the best thought on industrial management will be compelled to read this book.

Cutting Downward in the Lathe—The captions for the two illustrations accompanying the discussion of downward cutting in the lathe, which appeared on page 518, were erroneously transposed. The upward and downward cutting actions were made clear by the illustrations, and therefore the transposition of the captions was no doubt obvious.

Metal Trades Branches

At the annual meeting of the Cincinnati branch of the National Metal Trades Association, held on Mar. 2, the following officers were elected for the ensuing year: August H. Tuechter, president; J. B. Doan, vice-president; John A. Le Blond, secretary; J. W. Manley, business secretary; William Emmes, treasurer. Murray Shipley, E. A. Muller and C. H. Fox constitute the executive committee.

The Cleveland branch, the annual meeting of which convened on the same date, elected the following officers: Christian Girl, president; Franklin Schneider, vice-president; J. D. Cox, Jr., treasurer. A. W. Foote, N. S. Calhoun, J. H. Francis and Henry Souther were elected the Board of Directors.

OBITUARY

Eugene E. Garvin, vice-president of the Garvin Machine Co., New York City, which was founded by his father, the late Hugh R. Garvin, died at his home in Englewood, N. J., Mar. 20. Mr. Garvin was born in Hartford, Conn., 58 years ago, and had been connected with the above concern during his entire business career, for the past twelve years as vice-president.

John Watson, proprietor of the plant of John Watson & Sons Co., Trenton, N. J., and a veteran machinist, died at his home in that city on March 15. Mr. Watson was 80 years old and had the distinction of building the first automobile in his section of the country. He was a prolific inventor, particularly in the field of pottery machinery. During the Civil War Mr. Watson was superintendent of the old Trenton Arms and Ordnance Works at which plant many guns were manufactured for the Union Army.

William H. Dayton, master mechanic of the Excelsior Needle Co., Torrington, Conn., died suddenly of heart failure on Mar. 6. Mr. Dayton was born in Torrington, then known as Wolcottville, Oct. 28, 1840, the son of Arvid Dayton, a builder of melodeons and organs, from whom no doubt he inherited his mechanical genius. He was first employed in his father's shop, but joined the newly organized Excelsior Needle Co. in 1866, remaining in its employ until his death. His many inventions concerned the machinery used in the product of the Excelsior Needle Co.—sewing-machine and knitting-machine needles, bicycle spokes, nipples and pedals. Mr. Dayton was also the inventor of the swaging machine which bears his name. Mr. Dayton is survived by a son, James M. Dayton, and three grandchildren.

PERSONALS

Clarence G. Arvidson has been promoted to the position of foreman of the experimental department of the Stenotype Co., Indianapolis, Ind.

Fred C. Meyer is now assistant superintendent of the Stenotype Co., Indianapolis, Ind., having recently been promoted to the position.

A. R. Murray has resigned from the designing department of the Cincinnati Shaper Co. to become general manager of R. A. Jones & Co., Covington, Ky.

Clifford N. Lockwood has become treasurer and general manager of the Vulcan Process Co., Minneapolis, Minn., succeeding L. E. Jordan, who has disposed of his interests in the firm.

Dewitt Tappan, for eleven years with the Watervliet Arsenal, has resigned from the position of planning-room foreman to enter the employ of the Veeder Manufacturing Co., Hartford, Conn., as assistant superintendent.

F. D. Walden, formerly of the Heald Machine Co., Worcester, Mass., has taken a position with the Davis Machine Tool Co., Rochester, N. Y., as manager in charge of operation. Peter Plantinga has been placed in charge of the mechanical engineering department.

George M. Basford, for several years assistant to the president of the American Locomotive Co., and more recently chief engineer of the railroad department of Joseph T. Ryerson & Son, has been elected president of the recently organized Locomotive Feed Water Heater Co., 30 Church St., New York City.

INQUIRY FOR MACHINERY

Machine wanted for branching artificial flowers used for decorative purposes. Address, Information Department, "American Machinist."

TRADE CATALOGS

Cowan Truck Co., Holyoke, Mass. Catalog. Transveyors. Illustrated, 8x10½ in.

C. F. Roper & Co., Hopedale, Mass. Circular. Gear circulating pumps. Illustrated.

Charles Eisler, 43 Dodd St., Bloomfield, N. J., Circular A. Turret heads for bench and engine lathes. Illustrated.

The C. J. Root Co., 100 Stone St., Bristol, Conn. Catalog No. 17. Revolution counters. Illustrated, 36 pp., 5½x8 in.

Spray Engineering Co., 93 Federal St., Boston, Mass. Bulletin No. 210. Coating Explosive Shells. Illustrated, 12 pp., 6x9 in.

The Greaves-Klusman Tool Co., Cincinnati, Ohio. Pamphlet. "G-K Betterments." Engine lathes. Illustrated, 20 pp., 8½x11 in.

Bay State Saw and Tool Mfg. Co., 30 Whittier St., Boston, Mass. Catalog. "Tiger" hack saw blades. Illustrated, 8 pp., 3½x6 in.

The Chisholm-Moore Mfg. Co., Cleveland, Ohio. Catalog No. 24. Third Edition. Cyclone chain hoists. Illustrated, 96 pp., 6x9 in.

Rome Brass and Copper Co., Rome, N. Y. Loose Leaf Catalog. Brass and copper sheet, rods, tubes, wire, etc. Illustrated, 5x7 in.

The Curtis & Curtis Co., 66 Garden St., Bridgeport, Conn. Catalog No. 14. Pipe cutting and threading machinery. Illustrated, 32 pp., 7½x10 in. Circular. Automatic cutting-off machine for pipe, shrapnel, etc. Illustrated.

U. T. Hungerford Brass and Copper Co., Hungerford Building, New York. Catalog. Brass, copper, bronze, yellow metal, in sheets, tubes, wire rods, rolls, etc., extruded metals, brass fittings, hardware, roofing materials, etc. Illustrated, 404 pp., 6x9 in.

FORTHCOMING MEETINGS

American Society of Mechanical Engineers. Spring meeting, April 11-14, New Orleans, La., Calvin W. Rice, secretary, 29 West 39th St., New York, N. Y.

National Metal Trades Association. Annual meeting, Apr. 27-28, New York, N. Y., Hotel Astor. H. D. Sayre, secretary, Peoples Gas Building, Chicago, Ill.

American Society for Testing Materials. Annual meeting June 27 to July 1, 1916, Hotel Traymore, Atlantic City, N. J. Edgar Warburg, secretary, University of Pennsylvania, Philadelphia, Penn.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Wednesday each month. J. A. Brooks, secretary, Brown University, Providence, R. I.

New England Foundrymen's Association. Regular meeting second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. J. H. Warder, secretary, 1735 Monadnock Block, Chicago, Ill.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Technical League of America. Regular meeting second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York, N. Y.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points indicated:

	Mar. 24, 1916	One Month Ago	One Year Ago
No. 2 Southern foundry, Birmingham	$15.00	$15.00	$9.25
No. 2 X Northern foundry, New York	20.50	19.75	14.25
No. 2 Northern foundry, Chicago	19.00	18.50	13.00
Bessemer, Pittsburgh	21.95	20.70	14.55
Basic, Pittsburgh	19.20	18.70	13.45
No. 2 X, Philadelphia	20.00	20.00	14.25
No. 2 Valley	18.50	18.25	13.00
No. 2, Southern Cincinnati	17.90	17.90	12.15
Basic, Eastern Pennsylvania	19.50	19.50	13.00
Gray forge, Pittsburgh	18.45	18.45	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger from jobbers' warehouse at the places named:

	New York Mar. 24, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Steel angles, base	3.10	2.95	1.85	3.25	3.10
Steel T's, base	3.15	3.00	1.90	3.25	3.10
Machinery steel (bessemer)	3.10	2.95	1.80	3.25	3.10

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse at the places named:

	New York Mar. 24, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
No. 28 black	3.50	3.50	2.60	2.95	3.20
No. 26 black	3.40	3.40	2.50	2.85	3.10
Nos. 22 and 24 black	3.35	3.35	2.45	2.80	3.05
Nos. 18 and 20 black	3.30	3.30	2.40	2.75	3.00
No. 16 blue annealed	4.30	3.75	2.35	3.00	3.45
No. 14 blue annealed	4.20	3.70	2.25	3.60	3.35
No. 12 blue annealed	4.15	3.65	2.20	3.55	3.30
No. 28 galvanized	5.65	5.65	4.00	5.25	5.50
No. 26 galvanized	5.35	5.35	3.75	4.95	5.20
No. 24 galvanized	5.20	5.20	3.55	4.80	5.05

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot:

	Black Mar. 24, 1916	Black One Yr. Ago	Galvanized Mar. 24, 1916	Galvanized One Yr. Ago
¾- to 2-in. steel butt welded	73%	80%	55½%	69½%
2½- to 6-in. steel lap welded.	72%	79%	54½%	68½%
Diameter, In.				
¾	3.11	2.30	5.12	3.51
1	4.59	3.40	7.57	5.19
1¼	6.21	4.60	10.24	7.02
1½	7.43	5.50	12.24	8.39
2	9.99	7.40	16.47	11.29
2½	16.38	12.29	26.62	18.43
3	21.42	16.07	34.81	24.10
4	30.52	22.89	49.60	34.34
5	41.44	31.08	67.34	46.62
6	53.76	40.32	87.36	60.48

Bar Iron—Prices are as follows in cents per pound at the places named:

	Mar. 24, 1916	One Month Ago
Pittsburgh, mill	2.45	2.20@2.30
New York	2.70	2.45
Warehouse, New York	3.10	2.60
Warehouse, Cleveland	3.25	2.60
Warehouse, Chicago	3.10	....

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-sized orders the following quotations hold:

New York	10% above list price
Cleveland	20% above list price
Chicago	List price

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York.... $4.75 Cleveland.... $5.05 Chicago.... $3.60

In coils an advance of 50c. is charged.

METALS

Aluminum—Quotations in cents per pound are as follows for ton lots:

No. 1 virgin 98-99%	59.00@61.00
Pure 98-99% remelt	58.00@60.00
No. 12 alloy remelt	48.00@50.00

Jobbers usually charge 2c. per pound over these figures.

Copper Bars from warehouse sell as follows per pound:

New York.... 40.00 Cleveland.... 39.00 Chicago.... 38.00

Antimony—Chinese and Japanese brands are quoted as follows in cents per pound for spot delivery, duty paid:

New York.... 45.00 Cleveland.... 50.00 Chicago.... 44.75

Miscellaneous Metals—The present quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	New York Mar. 24, 1916	One Month Ago	One Year Ago
Copper, electrolytic (carload lots)	27.00	27.25	15.50
Tin	49.50	44.00	49.00
Lead	8.50	6.30	4.15
Spelter	18.00	21.65	9.00
ST. LOUIS			
Lead	8.40	6.20	...
Spelter	17.87½	21.50	...

At the places named, the following prices in cents per pound prevail:

	New York Mar. 24, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Copper sheets, base	35.50	35.00	19.75	34.00	34.50
Copper wire (carload lots)	35.50	35.00	16.50	34.50	35.00
Brass rods, base	37.50	37.00	16.25	36.00	35.00
Brass pipe, base	41.50	41.00	19.50	43.00	42.00
Brass sheets	37.50	37.00	16.25	36.00	35.00
Solder ½ and ½ (case lots)	30.50	27.00	32.00	35.50	31.35

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York Mar. 24, 1916	One Year Ago	Cleveland
Copper, heavy and crucible	23.00	12.50	25.00
Copper, heavy and wire	22.00	....	24.00
Copper, light and bottoms	19.00	11.00	21.00
Lead, heavy	6.00	2.63½	7.50
Lead, tea	5.50	3.37½	6.00
Brass, heavy	14.00	8.50	19.50
Brass, light	12.00	6.75	13.00
No. 1 yellow rod brass turnings	14.00	....	15.00
Zinc	13.00	6.00	16.00

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	31.50	32.00	32.50	33.00	36.00
¼ to 5/16	31.25	31.75	32.25	32.75	35.75
⅜ to 1⅞	31.00	31.50	32.00	32.50	35.50
1 15/16 to 2⅞	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3 7/16	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3½ to 3 15/16	32.25	32.75	33.25	35.75	36.75
Squares					
3 1/16 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4 15/16	33.00	33.50	36.00	36.50	37.50
5 to 6 15/16	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places indicated:

	New York	Cleveland	Chicago
Best grade	55.00@60.00	59.00	60.00
Commercial	25.00@30.00	22.50	30.00

SHOP SUPPLIES

Bolt Ends—Fair-sized orders of bolt ends with hot-pressed nuts sell at the following discounts from list:

New York	50%
Cleveland	50, 10 and 5%
Chicago	50 and 20%

Nuts—From warehouses at the places named, the following amount is deducted from list price:

	New York	Cleveland	Chicago
Hot pressed square	$3.00	$3.75	$3.70
Hot pressed hexagon	3.20	3.75	3.80
Cold punched square	3.00	3.00	3.50
Cold punched hexagon	3.75	3.75	4.25

Semifinished nuts sell at the following discount from list:
New York...70% Cleveland..70 and 10% Chicago....75%

Wrought Washers—From warehouses at the places named the following amount is deducted from list price:
New York.... $4.50 Cleveland.... $6.20 Chicago.... $6.30

At this rate the net prices per 100 lb. follow:

Diameter, In.	New York	Cleveland	Chicago
9/16	$9.50	$7.20	$7.70
3/4	7.70	5.40	5.90
7/8	6.90	4.60	5.10
1	6.00	3.70	4.20
1 1/4	5.20	3.10	3.50
1 3/8	4.70	2.65	3.10
1 1/2	4.60	2.50	3.00
1 3/4	4.50	2.40	2.90
2, 2 1/4, 2 1/2, 2 3/4	4.30	2.30	2.80
3, 3 1/4	4.50	2.40	2.70
3 1/2	4.70	2.70	2.90
4, 4 1/4, 4 1/2	5.00	2.70	3.20

For cast-iron washers the base price per 100 lb. is as follows:
New York.... $2.50 Cleveland.... $1.75 Chicago.... $1.90

Carriage Bolts—From warehouses at the places named the following discounts from list price are in effect:

	New York	Cleveland*	Chicago
3/8 by 6 in. and smaller	60%	65%	65%
Larger and longer	50%	50 and 5%	50 and 15%

At this rate the net prices are as follows:

Length,	New York			Cleveland			Chicago		
In.	1/4	1/2	3/4	1/4	1/2	3/4	1/4	1/2	3/4
1 1/2	$0.40	...	...	$0.35	...	...	$0.43	...	...
2	.44	...	...	.38	...	...	.47	...	...
2 1/2	.48	$1.63	$4.25	.42	$1.55	$4.04	.52	$1.14	$2.98
3	.52	1.77	4.50	.45	1.68	4.27	.57	1.24	3.15
3 1/2	.56	1.91	4.75	.49	1.81	4.51	.62	1.34	3.32

*The discounts and net prices under this heading are for rolled thread bolts 3/8 by 6 in. and smaller and on the larger sizes are for cut thread.

Tap Bolts—The discount from list at warehouses is as follows:
New York .... 20% Cleveland 25%

Turnbuckles—From warehouses at the places named the following prices prevail:
New York—Smaller than 1 1/4 in. diam., 40%; 1 1/4 up to 2 in., 30%.
Cleveland—Smaller than 1 1/4 in. diam., 60%; 1 1/4 up to 2 in., 35%.
Chicago—Up to 1 in., 50%; up to 1 1/2 in., 45%; over 1 1/2 in., 33 1/3%.

Size	New York	Cleveland	Chicago
1/2	$0.27	$0.18	$0.28
3/4	.38	.25	.32
1	.53	.35	.44
1 1/2	1.05	.97	.83
2	1.86	1.06	1.75

These buckles have right and left stub ends with turnings between the heads measuring 5 1/2 in.

Rivets—The following are the base quotations from warehouse for fair quantities:

	New York	Cleveland	Chicago
Steel 7/16 and smaller	65%	60, 10 and 10%	60—10%
Tinned	65%	60, 10 and 10%	60—10%*

*An addition of 3.5c. per lb. is usually charged.

For button heads 3/4, 7/8, 1 in. diam. by 2 in. to 5 in. sell as follows per 100 lb.:
New York.... $4.50 Cleveland.... $3.25 Chicago.... $3.50

Cone heads, same sizes:
New York.... $4.60 Cleveland.... $3.35 Chicago.... $3.6

	Extra per 100 Lb.
1 1/8 to 1 7/8 in. long, all diameters	$0.25
5/8 in. diameter	0.15
1/2 in. diameter	0.50
1 in. long and shorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

Coach or Lag Screws—For fair-sized orders from warehouses at the places named the following discounts hold:
New York.............. 65% Cleveland........ 65 and 10%
Chicago..........65, 10 and 5%

Machine Bolts—For fair-sized orders from warehouses at the places named the following discounts hold:

	New York	Cleveland	Chicago
3/8 by 4 in. and smaller	60%	65 and 10%	65 and 5%
Larger and longer up to 1 in. by 30 in.	50%	50 and 15%	50 and 20%

Nails—Wire nails f.o.b. Pittsburgh sell at $2.40; galvanized, 1 in. and longer, $4.40, and shorter, $4.90. These prices are to regular customers and delivery is made at the mill's convenience. From warehouse wire and cut nails sell as follows:

	New York	Cleveland	Chicago
Wire	2.90	2.95	2.70
Cut	2.90	2.85	2.70

Copper Rivets and Burs sell at the following rate:

	Rivets	Burs
Cleveland	List price	List price
Chicago	List price	List price

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire

3/8, 11/32, 5/16, 1/4, 7/32, 3/16	8.50
No. 8, 5/32 and No. 10	9.25
1/8	10.00
No. 12	11.00
3/32, No. 14 and 1/16	12.00
No. 18	14.00
No. 20	16.00

Special Welding Steel

1/8	33.00
5/32	30.00
3/16	28.00

Cast-Iron Welding Rods

1/4 by 19 in. long	22.00
3/16 by 12 in. long	26.00
3/8 by 19 in. long	20.00
1/2 by 21 in. long	20.00

Vanadium Wire in Coils or Sticks

1/16	15.50
3/32	15.00
1/8	14.00
5/32	12.00
3/16 and larger	11.00

Seamless Drawn Tubing—The base price in cents per pound from warehouse is as follows:

	New York	Cleveland	Chicago
Brass	41.50	44.50	39.00
Copper	42.50	45.50	42.00

For immediate stock shipment the following prices hold:

	Copper			Brass		
	New York			New York		
Diameter, In.	Mar. 24, 1916	One Year Ago	Cleveland	Mar. 24, 1916	One Year Ago	Cleveland
3/4 to 2 1/2	45.50	22.50	45.50	43.50	19.50	44.50
3	45.50	22.50	45.50	43.50	19.50	44.50
3 1/2	46.50	23.50	45.50	45.00	20.50	44.50
4	47.50	24.50	46.50	46.00	21.50	45.50
4 1/2	49.50	26.50	48.50	48.00	23.50	47.50
5	51.50	28.50	50.50	50.00	25.50	49.50
6	52.50	29.50	52.50	51.00	26.50	51.50
7	54.50	31.50	52.50	53.00	28.50	51.50
8	56.50	33.50	56.50	55.10	30.50	55.50

Tin Plates—The following prices are in effect from warehouses at the places named:

			New York	Cleveland	Chicago
Coke tin plate, 14x20:					
100 lb.			$5.00	$4.87 1/2	$4.75
I. C. 107 lb.			5.15	5.05	4.90
Terne plate, 20x28:					
Base Weight	Net Weight	Coating			
100 lb.	200	8	$9.00	$8.60	$8.30
I. C.	214	8	9.30	8.90	8.80
I. X.	270	8	11.30	11.10	10.55
I. C.	218	12	12.00	10.10	10.30
I. C.	221	15	13.00	10.90	11.25
I. C.	226	20	13.50	12.20	12.05
I. C.	231	25	14.25	13.40	13.30
I. C.	236	30	15.50	12.40	14.30
I. C.	241	35	17.00	15.60	15.25
I. C.	246	40	19.00	16.60	16.55

Zinc Sheets—The following prices in cents per pound prevail:
Carload lots, f.o.b. mill 25.00

	New York	Cleveland	Chicago
In casks	26.00	26.25@26.50	28.50
Broken lots	26.50	26.50@26.75	29.00

Cotton Waste—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	11.00@13.00	9.50@13.00	11.00@12.00
Colored mixed	8.00@10.00	7.50@10.00	9.50@10.50

Sal Soda sells as follows per 100 lb.:
New York .... $1.25 Cleveland $2.00
Chicago $1.85

Roll Sulphur in 360-lb. bbl. sells as follows per 100 lb.:
New York.... $2.25 Cleveland.... $2.60 Chicago.... $2.85

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Mar. 4	Mar. 11	Mar. 18	Mar. 25
Prompt furnace	$3.50@3.75	$3.50@3.75	$3.50@3.75	$3.50@3.75
Prompt foundry	3.75@4.25	3.75@4.00	3.75@4.00	3.75@4.00

Linseed Oil—These prices are per gallon:

	New York	Cleveland	Chicago
Raw in barrels	$0.81	$0.84	$0.83
5-gal. cans	.91	.94	.88

Boiled, it is 1c. per gal. higher.

White Lead, dry and in oil, in cents per pound sells as follows:

100-lb. keg	10.50
25- and 50-lb. kegs	10.75
12 1/2-lb. keg	11.00
1- to 5-lb. cans	12.50

Red Lead, dry, in cents per pound sells as follows:

	Dry	In Oil
100-lb. keg	10.50	11.00
25- and 50-lb. kegs	10.75	11.25
12 1/2-lb. keg	11.00	11.50

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

The Cowan Truck Co. has awarded the contract for the construction of a 2-story, 100x200-ft. factory at Holyoke, Mass. Noted Feb. 24.

The contract has been awarded for the construction of a 1-story, 60x120-ft. garage on Mass Ave., Lexington, Mass., for Frank W. Hodgdon. Estimated cost, $20,000. Noted Feb. 24.

The American Steel and Wire Co. will build an addition to its plant on Prescott St., Worcester, Mass.

The Beaman & Smith Co. has awarded the contract for the construction of a 4-story, 40x160-ft. reinforced-concrete machine shop at Providence, R. I.

The Standard Nut and Bolt Co. has awarded the contract for the construction of a 2-story, 70x80-ft. addition to its plant at Valley Falls, R. I. Noted Mar. 23.

Plans are being prepared for the construction of a 3-story, 50x157-ft. garage at Hartford, Conn., for Gordon Bros.

The Russell Manufacturing Co. will build a 2-story machine shop at Middletown, Conn.

The Stanley Works, manufacturer of hardware, plans to construct a factory at New Britain, Conn.

Cowles Tolman has awarded the contract for the construction of a 3-story, 89x90-ft. garage at New Haven, Conn. Estimated cost, $20,000. Noted Dec. 9.

The Norfolk Manufacturing Co., manufacturer of steel clamps, hand screws and vises, plans to build a 2-story, 50x 100-ft. factory at Norfolk, Conn.

Plans are being prepared for the construction of a factory at Waterbury, Conn., for the Connecticut Brass Co., Inc., West Cheshire, Mass.

MIDDLE ATLANTIC STATES

The Buffalo Union Furnace Co., foot of Hamburg St., Buffalo, N. Y., plans to construct 1-story steel casting shop at plant on Buffalo River. Estimated cost, $18,000.

We have been informed that the W. Robertson Machine and Foundry Co., 32 Greenwood Pl., Buffalo, N. Y., has purchased the property of the Buffalo Pen Co., Rano St., and will construct an addition of 4,500 sq.ft. for a machine shop. W. Robertson is Pres.

The Champion Hardware Co., Geneva, N. Y., will construct an addition to its plant.

Bids will soon be received for a 1-story garage on Park Pl., New York, N. Y. (Borough of Brooklyn), for James McDonald, Bedford and Myrtle Ave. Estimated cost, $15,000. John J. Carroll, Rockaway Park, Arch.

F. W. Wurster & Co., 375 Kent Ave., New York, N. Y. (Borough of Brooklyn), rooling mill and axle works, plans to construct a plant at Kent Ave. and South 6th St. Estimated cost, $60,000.

The Philpott & Leuppie Co., Niagara Falls, N. Y., manufacturer of machinery, has awarded the contract for new factory buildings. Estimated cost, $12,000.

W. A. Rogers, Ltd., Niagara Falls, N. Y., manufacturer of cutlery, etc., has awarded the contract for the construction of a 3-story factory.

Plans are being prepared for a fabricating shop for the Syracuse Architectural Iron Works, Syracuse, N. Y.

Plans have been prepared for the construction of a 3-story reinforced-concrete addition to the plant of the Crocker-Wheeler Co., manufacturer of electrical machinery, Springdale Ave., Ampere, N. J. Estimated cost, $60,000.

The contract has been awarded for the construction of a factory at Bloomfield Ave. and Grove St., Bloomfield, N. J., for the Eastern Tool Co. Estimated cost, $80,000. Noted Oct. 28 and Mar. 16.

The Lindholm Metal Stamping Co., Camden, N. J., has awarded the contract for an addition to its plant at Erie and Front St.

The Ashton Manufacturing Co., Newark, N. Y., manufacturer of gasoline torches, fire pots and mechanical specialties, has acquired a site on Emmett St., Newark, and will establish a new factory.

The Thomas Iron Works, Allentown, Penn., will improve its plant at Alburtis, Penn.

The Alston Say and Steel Co., Bristol, Penn., recently organized, plans to construct a plant on Dorrance St. O. W. Laston is interested.

The Thomas Iron Works, Allentown, Penn., plans to improve its plant at Hellertown, Penn.

The Thomas Iron Works, Allentown, Penn., plans to improve its plant at Hokendauqua, Penn.

The Cambria Steel Co., Johnstown, Penn., plans to improve its plant. Estimated cost, $2,000,000. A. C. Dinkey is Pres.

The plant of the Mauch Chunk Foundry and Iron Works, Mauch Chunk, Penn., recently destroyed by fire with a loss of $50,000, will be rebuilt. Noted Feb. 3.

The Central Machine Co., 708 Cherry St., Philadelphia, Penn., has awarded the contract for the construction of a 4-story factory. Estimated cost, $35,000. Noted Feb. 24.

The contract has been awarded for the construction of a garage at 23d and Chestnut St., Philadelphia, Penn., for Edward N. Harris, 22nd and Market St., Philadelphia. Estimated cost, $35,000.

Bids will soon be received for a 4-story factory at 147 North 3rd St., Philadelphia, Penn., for the Mershon Patent Shaking Grate Works, 1203 Filbert St., Philadelphia. F. T. Uezzell, 1203 Filbert St., Philadelphia, is Arch.

The Pedrick Tool and Machine Co., Philadelphia, Penn., has awarded the contract for a 2-story addition to its plant.

The contract has been awarded for the construction of a 4-story, 68x110-ft. garage for T. A. Scott, 232 Juniper St., Philadelphia, Penn. Estimated cost, $45,000.

The Splitdorf Electrical Co., Philadelphia, Penn., has awarded the contract for the construction of a 5-story reinforced-concrete manufacturing building. Estimated cost, $200,000. Noted Mar. 16.

Plans are being prepared for a 1- and 4-story garage and service building at 23rd, 24th, Walnut and Locust St., Philadelphia, Penn., for John Wanamaker, 13th and Market St., Philadelphia.

The Carbon Steel Co., Pittsburgh, Penn., will construct additions to its plant at 31st St. and Allegheny River.

The Pittsburgh Knife and Forge Co., Farmers Bank Bldg., Pittsburgh, Penn., will construct addition to its plant.

The Scranton Steel and Iron Co., Scranton, Penn., plans to improve its plant on Capouse Ave. Estimated cost, $100,000.

V. A. Somrell, 529 Linden St., Scranton, Penn., has awarded the contract for the construction of a 1-story garage. Estimated cost, $18,000.

The city of Baltimore has awarded the contract for the construction of a garage at 27 South Charles St. Estimated cost, $100,000. Noted Feb. 17.

Bids will soon be received by Sparklin & Childs, Arch., Law Bldg., Baltimore, Md., for 2-story garage on Belvidere Pl., for W. W. Kemp, 401 East Oliver St. Estimated cost, $10,000.

Bids are being received by J. Wilson Leakin, 813 Fidelity Bldg., Baltimore, Md., for the construction of a 4-story garage at 1307-09 Cathedral St.

Plans are being prepared by Mack & Kountz, Arch., Hagerstown, Md., for 1-story garage for M. O. Muller, North Prospect St., Hagerstown. Estimated cost, $15,000.

The Mt. Pleasant Garage Co., 2412 18th St., Washington, D. C., has awarded the contract for the construction of a 3-story reinforced-concrete garage.

SOUTHERN STATES

The Maiwurm Aluminum Corporation, Pittsburgh, Penn., plans to construct a plant at Sisterville, W. Va.

The Atlanta Steel Co., Atlanta, Ga., plans to construct additions to its plant. Estimated cost, $100,000.

E. Van Winkle, Atlanta, Ga., plans to construct a motor truck assembling plant at Altonpark, Tenn.

MIDDLE WEST

Work will soon be started on the construction of a 30x50-ft. addition to the foundry of the C. L. Dorer & Co. at Bellaire, Ohio. Noted Jan. 6.

The Canton Motor Car Co. has been granted a permit for the construction of a garage at Cleveland Ave. and 5th St., N. W., Canton, Ohio. Estimated cost, $90,000.

The United Furnace Co. plans to build a plant at Canton, Ohio.

The R. K. Le Blond Machine Tool Co. is constructing a 1- and 2-story factory at Cincinnati, Ohio. Estimated cost, $250,000. E. M. Chase, Mercantile Library Bldg., Cincinnati, Consult. Engr. Noted Mar. 16.

The American Steel and Wire Co. plans to build a machine shop at Cleveland, Ohio. Estimated cost, $9,100.

The R. F. Carpenter Manufacturing Co., manufacturer of metal products, 1519 East 32d St., Cleveland, Ohio, has purchased a plant at Cleveland and plans to improve and equip same.

A permit has been granted to the Crescent Brass Manufacturing Co. for the construction of a 1-story, 50x138-ft. addition to its plant at 1364 West 110th St., Cleveland, Ohio. Estimtaed cost, $15,000. Noted Mar. 2.

R. J. Cunningham will establish a 2-story factory on West 77th St., Cleveland, Ohio, for the manufacture of automobile bodies, etc.

The contract has been awarded for the construction of a 1-story factory at 2698 East 79th St., Cleveland, Ohio, for the Electric Controller and Manufacturing Co. Estimated cost, $30,000.

The Ford-Clark Co. has purchased the plant of the Aetna Rubber Co. at 3125 Perkins Ave., Cleveland, Ohio, and will enlarge and equip it for the manufacture of automobile accessories.

The contract has been awarded for the construction of a 1-story, 80x116-ft. addition to the plant of the J. Roamer Heating Co., 735 St. Clair Ave., Cleveland, Ohio.

John Kellar, care of the Chamber of Commerce, Columbus, Ohio, plans to construct a plant for the manufacture of mechanical tools.

The City Machine and Tool Works has purchased a site at East 3d and June St., Dayton ,Ohio, and plans to build a factory. Estimated cost, $30,000.

The Marting Iron and Steel Co. has purchased a site on South 3d St., Ironton, Ohio, and plans to build a factory.

Plans are being prepared by William Loomis, Arch., 501 Canal St., Logan, Ohio, for the construction of a 2-story garage at Logan for the Main Motor Car Co. Estimated cost, $10,000.

Bids will soon be received for the construction of a garage at Miamisburg, Ohio, for D. A. Stump. Estimated cost, $15,000.

The W. H. Huber Co. plans to build a 40x80-ft. aluminum foundry at New Berlin, Ohio.

The Binnell Automobile Co. has taken over the plant of the Binnel Buggy Co. at Sidney, Ohio, and will improve it for the manufacture of automobiles.

Bids will soon be received for the construction of a garage on Market St., Warren, Ohio, for James A. Gargill, 7 Electric Bldg., Warren. Estimated cost, $10,000.

The contract has been awarded for the construction of an addition to the plant of the National Malleable Casting Co., 546 Holmes Ave., Indianapolis, Ind. Estimated cost, $20,000. Noted Mar. 16.

Plans are being prepared by George W. Graves, Arch., for the construction of a 2-story,60x300-ft. factory on Kercheval Ave., Detroit, Mich., for the Bour-Davis Motor Car Co. Estimated cost, $150,000. C. J. Bour is Pres. Noted Mar. 9.

The contract has been awarded for the construction of a 2-story, 96x204-ft. factory at Detroit, Mich., for the Briggs Manufacturing Co., manufacturer of auto trimmings. Estimated cost, $75,000.

The Grand Rapids Salvage Co. has leased a building at Grand Rapids, Mich., and will remodel it for a machine shop and for the manufacture of baling machines.

The Metal Office Furniture Co. has awarded the contract for the construction of a 96x125-ft. addition to its plant at Grand Rapids, Mich. Estimated cost, $10,000.

Plans are being prepared for the construction of a 2-story, 55x100-ft. factory at Scribner Ave. and Blumrich St., Grand Rapids, Mich., for the Glendon A. Richards Co., manufacturer of sheet metal and roofing.

The Ford Motor Co., Detroit, Mich., has awarded the contract for the construction of an addition to its plant at Highland Park, Mich. Estimated cost, $800,000. Noted Mar. 9.

We have been advised that the contract has been awarded for the construction of a foundry at Lansing, Mich., for the Novo Engine Co. Noted Mar. 9.

F. B. Hart will build a garage at Union City, Mich.

S. M. Hastings, 336 West Madison St., Chicago, Ill., has awarded the contract for the construction of a 1-story garage at 4069 Broadway, Chicago. Estimated cost, $13,000.

The contract has been awarded for the construction of a forge and axle plant at 21st St. and Brady Ave., East St. Louis, Ill., for the Bytanic Metal Co.

The Cadillac Co. has awarded the contract for the construction of a 2-story, 100x150-ft. garage, sales and service station on Main St., Peoria, Ill. Estimated cost, $35,000.

The contract has been awarded for the construction of a factory at Springfield, Ill., for the Sangamo Electric Co., manufacturer of electric meters. Estimated cost, $100,000. Noted Mar. 23.

Work will soon be started on the construction of an addition to the plant of the Gardner Machine Co. at Beloit, Wis. The company is in the market for engine, boilers and electric generator. Estimated cost, $35,000. L. Waldo Thompson is Secy. Noted Mar. 16.

The Obenberger Drop Forge Co. is constructing a 1-story, 75x75-ft. forge shop on Packard Ave., Cudahy, Wis.

Plans are being prepared for the construction of a factory at Janesville, Wis., for the Janesville Tractor and Engine Co. Estimated cost, $12,000.

The Peter Pirsch & Co., manufacturer of fire apparatus, plans to construct an addition to its plant on Market St., Kenosha, Wis.

Plans are being prepared for the construction of a 1-story, 75x200-ft. addition to the plant of the Kohler Co., manufacturer of enameled plumbing ware, at Kohler, Wis. Noted Mar. 23.

The Chalmers Motor Co., Jefferson St. and New Belt Line, Detroit, Mich., plans to construct a 4-story, 60x400-ft. plant with a 40x60-ft. wing at La Crosse, Wis. Estimated cost, $150,000.

The Pawling & Harnishchfeger Co., manufacturer of cranes and hoists, has awarded the contract for the construction of a 2-story addition to its pattern shop at Milwaukee, Wis. Noted Mar. 23.

We have been advised that work will soon be started on the construction of a 2-story, 140x200-ft. plant for the Wisconsin Iron and Wire Works, 186 East Water St., Milwaukee, Wis. Estimated cost, $20,000. George H. Norris is Pres. Noted Mar. 16.

We have been advised that work will soon be started on the construction of a 3-story, 83x150-ft. addition to the plant of the Automatic Cradle Manufacturing Co. at Stevens Point, Wis. The company is in the market for a full line of woodworking machinery and 2 elevators. Estimated cost, $35,000. Noted Mar. 16.

WEST OF THE MISSISSIPPI

Plans are being prepared by C. B. Zalesky, Arch., 601 Security Bank Bldg., Cedar Rapids, for 2 garages at Cedar Rapids, Iowa. Estimated cost, $88,000 and $16,000.

Thorstenson Bros., Plentywood, Mont., plan to construct a commercial garage and repair shop at Plentywood.

The Mississippi Valley Iron Co., recently incorporated with $5,000,000 capital stock, will construct a plant at Carondelet, Mo. Estimated cost, $500,000.

The Bichler Manufacturing Co., St. Louis, Mo., recently incorporated with capital stock of $17,000, will equip a machine shop at St. Louis. Nicholas Bichler and Frederick Shamrod, St. Louis, are interested.

The contract has been awarded for the construction of a garage at St. Louis, Mo., for the Easton Taylor Trust Co., 4474 Eastern Ave., St. Louis. Estimated cost, $75,000.

The plant of the Kraushaar Brass Manufacturing Co., St. Louis, Mo., recently destroyed by fire will be rebuilt and new equipment installed.

The Platifrice Chemical Co,. St. Louis, Mo., recently incorporated with $25,000 capital stock, plans to equip a plant for the manufacture of dentral machinery and fixtures. Wesley A. Chamberlain is interested.

The St. Louis Frog and Switch Co., St. Louis, Mo., is building a manganese foundry. Estimated cost, $30,000.

The National Enameling and Stamping Co., St. Louis, Mo., will construct a steel plant. Estimated cost, $200,000.

We have been informed that the Wagner Electric Manufacturing Co., St. Louis, Mo., is building 2 new additions to its plant on Plymouth Ave. W. A. Layman is Pres. Noted Feb. 3.

Roy Haskett and Guy Mace plan to construct a 50x200-ft. garage on St. Louis St., Springfield, Mo.

The Texas Motor Co., Texarkana, Ark., recently incorporated, will establish a garage and machine shop. J. K. Waddy and B. W. Anthony are interested.

The K. A. Auto Supply Co., San Angelo, Tex., has awarded the contract for the construction of a 1-story, 50x150-ft. garage. Estimated cost, $13,500.

The contract has been awarded for the construction of a garage at Oklahoma, Okla., for the Paige Motor Co. Estimated cost, $10,000.

The Willys-Knight Overland Co., Toledo, Ohio, plans to establish a distributing plant at Denver, Colo.

WESTERN STATES

The Gerlinger Motor Car Co. plans to construct an assembling plant at Centralia, Wash.

R. Becker, Portland, Ore., will construct a 2-story, 50x60-ft. garage at Corbett, Ore.

The Electric Foundry Co. will rebuild its plant at Portland, Ore., which was recently destroyed by fire.

Plans have been prepared by A. C. Meyer for the construction of a 50x105-ft. garage at Derby and McClellan St., Portland, Ore.

The contract has been awarded for the construction of a 1-story, 100x175-ft. garage at Colorado St. and El Molino Ave., Pasadena, Calif., for C. Y. Knight. Estimated cost, $17,780.

The contract has been awarded for the construction of a 1-story, 100x175-ft. garage, salesroom and service station at Pasadena, Calif., for the Willys-Overland Co., Toledo, Ohio. Estimated cost, $17,580. Noted Mar. 2.

Plans are being prepared for the construction of an electrical repair plant on 8th St., San Diego, Calif., for the Auto Electrical Equipment Co., National City.

H. M. Mickish plans to construct a garage and machine shop at 2d and C St., San Diego, Calif. Estimated cost, $10,000.

The Hecht Investment Co. has awarded the contract for the construction of a garage on Post St, San Francisco, Calif. Estimated cost, $30,000.

W. T. Steele and O. F. Brigham plans to build a garage and machine shop at Saticoy, Calif.

CANADA

The Joliette Steel Co., Ltd., is constructing an addition to its plant at Joliette, Que., and will be in the market for machinery.

Fire recently damaged the plant of the Canadian Metal Manufacturing Co., Ltd., St. James and Richmond St., Montreal, Que. Loss, $15,000.

Joseph Gertler, 676 Drolet St., Montreal, Que., plans to construct an addition to its foundry at Montreal.

The Regal Motor Co. plans to construct a factory at Berlin, Ont.

The London Foundry Co., Ltd., will construct an addition to its plant at London, Ont. Estimated cost, $10,000. E. Grobb is Mgr.

Plans are being prepared for the construction of an addition to the plant of the Crow Auto Co., Mt. Brydges, Ont. New machinery will be installed. Estimated cost, $25,000.

Fire recently damaged the foundry of the Ottawa Steel and Iron Works, 137 Broad St., Ottawa, Ont. Loss, $3,500.

Fire, Mar. 14, destroyed the plant of the Renfrew Machinery Co. at Renfrew, Ont. Loss, $100,000.

The contract has been awarded for the construction of an addition to the plant of the Sheet Metal Products Co. of Canada, Ltd., at 199 River St., Toronto, Ont. Estimated cost, $20,000. Noted Mar. 9.

GENERAL MANUFACTURING

NEW ENGLAND STATES

The Willard H. Griffen Shoe Co. has awarded the contract for the construction of a 4-story, 45x150-ft. factory at Manchester, N. H. Estimated cost, $35,000. Noted Mar. 2.

The Harris, Emery Co. operating the Dustin Island Woolen Mills plans to build a weave shed at Penacook, N. H.

The contract has been awarded for the construction of a factory at Portsmouth, N. H., for the Morely Button Manufacturing Co. Noted Mar. 23.

The Foster Spinning Co. has awarded the contract for the construction of a mill at Fall River, Mass. Francis A. Foster, Boston, is interested.

Fire, Mar. 15 destroyed the factory at Fall River, Mass., of Smoss Bros., manufacturer of rope. Loss, $30,000.

The contract has been awarded for the construction of an addition to the factory of the Momomet Mills Co. at New Bedford, Mass. Estimated cost, $575,000. Noted Mar. 16.

The Otter River Yarn Co. has purchased the plant of the Turner Mills at Otter River, Mass., and will equip it for the manufacture of yarn.

The Ideal Coated Paper Co., Brookfield, Mass., plans to construct a 1-story, 100x300-ft. factory at Ware. Estimated cost, $50,000.

The Warren Cotton Mills has awarded the contract for the construction of a 2-story, 26x125-ft. dye house at Warren, Mass. Estimated cost, $20,000.

MIDDLE ATLANTIC STATES

Plans have been prepared for an addition to the plant of the Schoellkopf Aniline and Chemical Works, Inc., Abbott Rd., Buffalo, N. Y. Estimated cost, $16,000.

The Du Pont Fabrikoid Co., Wilmington, Del., plans to construct an addition to its plant at Newburgh, N. Y.

The American Sugar Refining Co., New York, N. Y. (Borough of Brooklyn), plans to construct an addition in connection with the Havemeyer Plant on Kent Ave. Estimated cost, $1,000,000.

Plans are being prepared by Benjamin Driesler, Arch., 153 Remsen St., New York, N. Y. (Borough of Brooklyn), for 1-story, 75x140-ft. building on Ditmas Ave. for William Beckers Aniline and Chemical Co., Brooklyn. Estimated cost, $12,000.

The contract has been awarded for the construction of a factory for the National Sugar Refining Co., Dock St., New York, N. Y. (Borough of Queens).

The contract has been awarded for the construction of several additions to the plant of the Butterworth-Judson Co., Ave. R, Newark, N. J., manufacturer of chemicals. Noted Jan. 6.

The Seton Leather Co., Newark, N. J., will construct 2 additions to its plant on Verona Ave. Estimated cost, $25,-000.

L. H. Gilmer Co., Philadelphia, Penn., will build a 3-story belting factory. Harry C. Eisenbise is Engr.

The Mifflin Chemical Co., Philadelphia, Penn., will build five 2-story buildings.

The C. C. Young Dye Works, 324 Federal St., N. S., Pittsburgh, Penn., has awarded the contract for constructing an addition to its plant. Estimated cost, $6,000.

Plans are being prepared for a 3-story plant for Wilson Chemical Co., Tyrone, Penn. George C. Wilson is Pres.

E. Sutro & Son Co., Elkton, Md., plans to build additions to its plant or install new machinery for the manufacture of hosiery.

SOUTHERN STATES

The Maxwell Hosiery Mills, Suffolk, Va., plans to enlarge its plant.

Plans have been prepared for a plant at Benwod, W. Va., for the Gasoline-Oil Supply Co.

Liledoun Manufacturing Co., Taylorsville, N. C., manufacturer of knitting yarns, will enlarge its plant. J. A. Miller, Jr., is Pres.

The Southern Aseptic Fiber Co., Columbia, S. C., recently incorporated with $50,000 capital stock, will construct three 2-story factory buildings for the manufacture of absorbent cotton, etc.

The Clark Pratt Cotton Mills, recently incorporated with a capital stock of $100,000 will make extensive improvements to its plant at Prattville, Ala.

J. M. Hays & Co., Memphis, Tenn., will organize a company to construct a cotton compress and warehouse. Estimated cost, $250,000.

MIDDLE WEST

The McGraw Tire and Rubber Co. plans to construct additions to its plant at East Palestine, Ohio.

The contract has been awarded for the construction of a factory at Niles, Ohio, for the Grasselli Chemical Co., Arcade Bldg., Cleveland, Ohio. Noted Feb. 10.

The Standard Oilcloth Co. has increased its capital stock from $7,000,000 to $9,000,000, and plans to enlarge its plant at Youngstown, Ohio.

Ernest G. Reece is forming a company to build a canning plant at Waldron, Ind.

The Holland Canning Co. will build an addition to its plant at Grand Rapids, Mich.

The National Photo Paper Co., recently incorporated, plans to construct a factory at Grand Rapids, Mich., in the spring.

The Edwards & Chamberlin Hardware Co. plans to construct an addition to its plant on East Main St., Kalamazoo, Mich. A. K. Edwards is Pres. and Gen. Mgr.

The Carrom-Archarena Co., manufacturer of games, etc., plans to build a factory at Ludington, Mich.

Plans are being prepared for the construction of an addition to the plant of the Manistee Manufacturing Co., manufacturer of furniture, at Manistee, Mich. Noted Mar. 16.

The Wolverine Paper Co. has awarded the contract for the construction of an addition to its plant at Otsego, Mich.

The contract has been awarded for the construction of a 4-story factory at 3522 Iron St., Chicago, Ill., for the Central Bag Manufacturing Co. Estimated cost, $125,000. Noted Dec. 23.

WEST OF THE MISSISSIPPI

The Lake City Button Co., Lake City, Minn., plans to enlarge its plant.

Press reports state that the Heil Packing Co., St. Louis, Mo., plans to construct an addition to its plant. Estimated cost, $40,000.

The Independent Tire Co., St. Louis, Mo., plans to equip a plant for the manufacture of tires and tubes for automobiles. William Chorlis, 3150 Locust St., St. Louis, Mo., is interested.

The Linde Air Products Co., 30 East 42d St., New York, N. Y., has awarded the contract for the construction of a plant at Harwood and Gould St., Dallas, Tex. Estimated cost, $30,000.

Taylor Bros., Denton, Tex., plan to construct a cotton gin. Estimated cost, $10,000.

Edgar Van Slyke and associates, Gainesville, Tex., plan to construct a woolen mill at Gainesville.

Press reports state that the W. E. Smith Manufacturing Co., manufacturer of waterproof roofing, etc., Cleveland, Ohio, plans to construct a branch plant at San Antonio, Tex.

The Sealy Oil Mill and Manufacturing Co., Sealy, Tex., has increased its capital stock from $40,000 to $50,000 and will improve its cotton-seed oil mill.

The Mohawk Refining Co., Oklahoma, Okla., plans to rebuild its oil refinery at Ringling, Okla.

The J. S. Cosden Co., Tulsa, Okla., plans to construct an addition to its oil refinery.

The National Plaster Co., Dayton, N. M., plans to enlarge its plant and also install new machinery.

WESTERN STATES

The Boise Valley Packing Co. plans to construct an addition to its plant at Tagle, Idaho.

The Amalgamated Sugar Co. plans to enlarge its plant at Ogden, Utah. Estimated cost, $150,000. J. F. Ellis is Supt.

The Ogden Packing and Provision Co. plans an expenditure of $300,000 for improving its packing plant on 24th St., Ogden, Utah.

J. A. Gumm and associates plan to construct a canning plant at Benson, Ariz.

The National Infusorial Earth Co., Ellensburg, Wash., is in the market for crushing and drying machinery.

The Ferndale Canning Co. plans to construct a plant at Ferndale, Wash.

The Pacific Sea Food Co., La Conner, Wash., will rebuild its cannery recently destroyed by fire with a loss of $15,000.

The Walla Walla Pickling Works contemplates enlarging its canning plant at Walla Walla, Wash.

A. F. Adams and W. A. Schaffner is constructing a 1-story, 26x60-ft. fruit processing factory at Hood River, Ore.

The Lakeview Oil Co., No. 2 Maricopa, Calif., plans to construct a treating plant on South Midway property.

CANADA

Work will soon be started on the construction of a plant at Drummondville, Que., for the Aetna Chemical Co. of Canada, Ltd. Estimated cost, $300,000.

Work will soon be started on the construction of an addition to the plant of the McLagan Furniture Manufacturing Co., Ltd., 93 Trinity St., Stratford, Ont. Noted Mar. 16.

The Jeffries Furniture Co. will rebuild its plant at Welland, Ont., which was recently destroyed by fire with a loss of $4,800.

The Union Carbide Co., Ltd., will build an addition to its drum shop at Welland, Ont. Estimated cost, $20,000.

Classified Advertising

The Classified Ad... ...ising section appears on pages 153, 154, 156, *of this issue and will in futur... ...n the same relative position in the paper.*

American Machinist

Volume 44, No. 14
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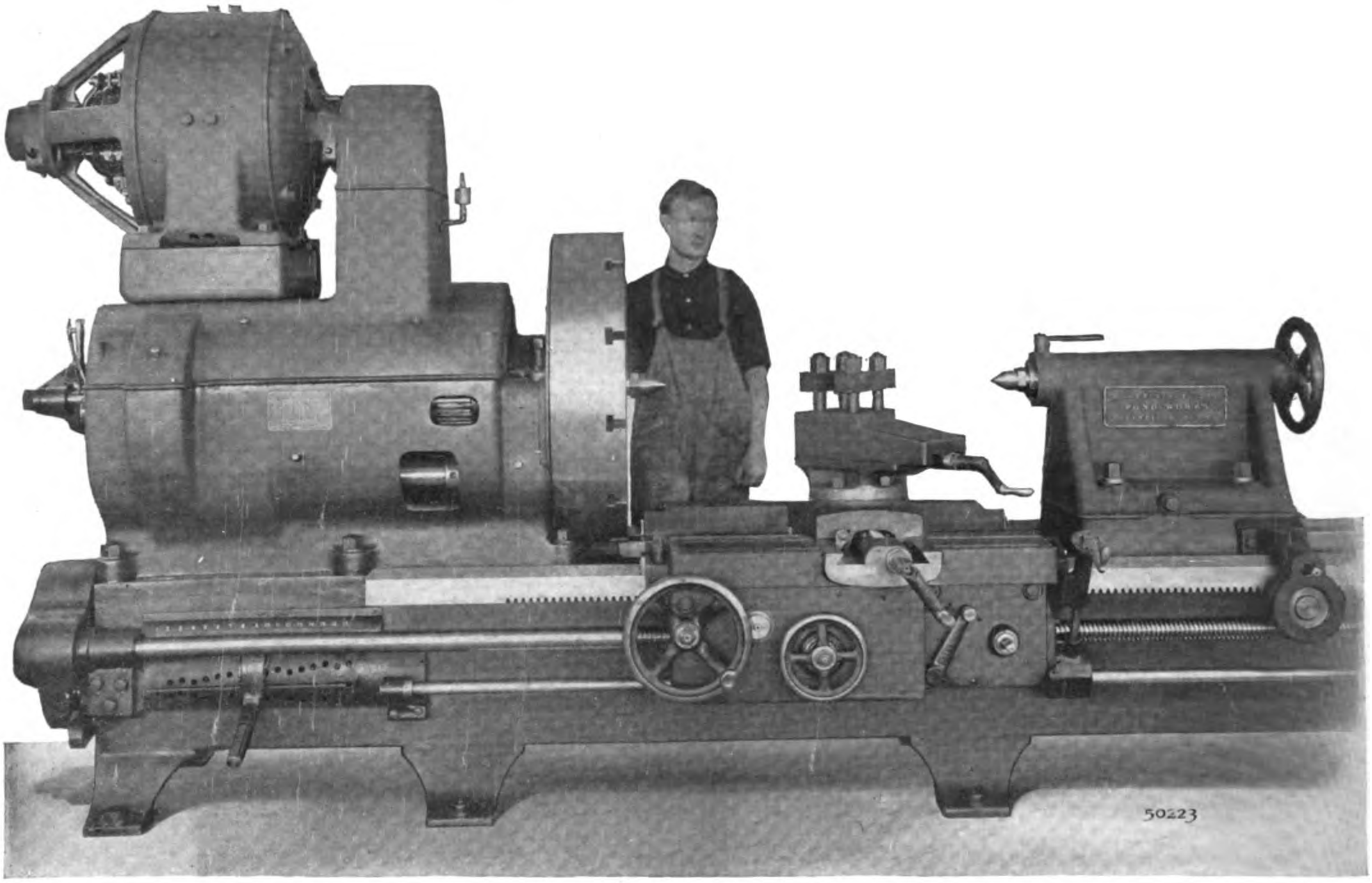
NEW YORK, APRIL 6, 1916

Price, 15 Cents
Contents, First Page
Advertising Index, Last Page

For Short Delivery

We Offer a Number of Our Standard



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On motor-driven lathes the speed may be varied through a wide range by the handle on the right side of the carriage. Thus the operator does not have to leave his work and is more apt to use the proper speed for his job.

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VOLUME 44 — APRIL 6, 1916 — NUMBER 14

CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormay processes, protected by United States patent issued June 22, 1915, and another pending

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Under-Advertising of the Steel Business

By George H. Jones,
Vice-President and General Manager of Sales, Inland Steel Company, Chicago

ENGLAND has raised the greater part of an army of four millions by advertising, using newspapers, bill-boards, omnibuses and other methods. This was considered the most effective way and its application is almost universal.

This is an object lesson to the iron and steel manufacturers who have been in the habit of saying about advertising, "When the demand for our products is good there is no need for it, and when the demand is poor there is no use of it."

The steel manufacturers can pave the way to make depressions less severe by stimulating a demand for the products of the steel mills. The way many of us advertise is to place what amounts to a business card in a trade paper and let it go at that. It will do once in a while to call attention to a full list of our products, but it possesses little sales value. We want our advertisements to be read. We must, therefore, give truthful information of value to a prospective customer, and whenever possible the matter should be well illustrated. One product only should be treated in one advertisement. Sizes, quality, capacity and other special advantages we have to offer should be stated and enlarged upon. We should answer the readers' questions before they are asked.

About six years ago five men in the south each put up $260 into a fund to advertise red gum in an architectural journal, after dint of much hard work on the part of a representative of that journal.

Though they were men of wealth, this $260 came hard because they really did not believe that anything would come of it.

But the result of that $1.300 venture was the sale of red gum aggregating $350,000 with three successive $2. jumps in price per 1,000 feet in a single year. This campaign has continued year after year, as high as $40,000 a year being spent in it. The result is the widespread use of red gum wood for fancy interior finish—a wood that had previously been in the railroad tie class.

This campaign started the Southern Cypress Association into action, and their annual advertising expenditure far exceeds that of the Red Gum Association.

Let us acknowledge that, as a class, the steel industries of the country are the most clumsily and inadequately advertised of all our industries.

I almost feel safe in saying that more advertising money has been spent in *tooth paste* than all of us combined have expended in all of our products.

And our total expenditure would look like small change beside the bank roll expended annually by the chewing - gum profession, the soap artists or the baking powder family.

Yet steel products as a group are just as susceptible to the power of publicity as any of these; because just as universal in consumption and vastly more important to the public welfare.

Extracted from an Address before the American Iron and Steel Institute.

Motorcycle Frame and Tube Work

By Ethan Viall

SYNOPSIS—Many of the bending, pinning, brazing and other fixtures used in the construction of a well-known model of motorcycle frame are here shown. The bending fixtures are hand-operated, but so constructed as to produce commercially accurate work as speedily as the operator can handle it. Attention is called to the taper-pin clamping method frequently employed.

The frame of a modern motorcycle is a rather complicated assemblage of specially shaped or bent tubing so designed and joined as to hold up under the weight it is to carry and to stand the shocks and vibration of service. Though the general outlines of the various makes are nearly the same, each maker has his own particular and distinctive type of frame construction. Naturally, the size and shape of a motorcycle frame are largely governed by the kind of motor used. The Henderson Motorcycle Co., Detroit, Mich., uses a 12-hp. four-cylinder motor in its machines. These machines have a 58-in. wheelbase and weigh close to 300 lb., so that especial care and skill must be employed in the design and construction of a frame that will give satisfactory service.

A Henderson motorcycle practically completed is shown on an assembling stand in Fig. 1. This view will give the reader a good idea of the position of the motor, the shape of the frame and other details needed to follow the mechanical descriptions of this article. Incidentally, attention is called to the assembling stands, one of which appears more in detail in Fig. 2. A small bench is set under the machine between the standards. It holds all the parts that go to make up a motorcycle. Along the sides of the bench are pockets for holding the various bolts, nuts, screws and other small parts. These benches are filled from stock for each machine and save the assemblers considerable time.

No attempt will be made to show other than the principal operations in the making of a frame, and for several reasons they will not be given in the order of shop procedure. The first fixture illustrated is in Fig. 3 and is the one used to hold the frame while brazing the various joints. The type of gas torch employed is shown at *A*. It will be readily seen that the construction of the frame does not lend itself to the dip-brazing process. A few of the frame parts are brazed on before being placed in the frame assembly, but the main joints are brazed here.

The two lower tubes of the frame rest in pillow blocks formed to receive and hold them correctly. The clamping blocks are locked down by taper pins *B* and *C*, which

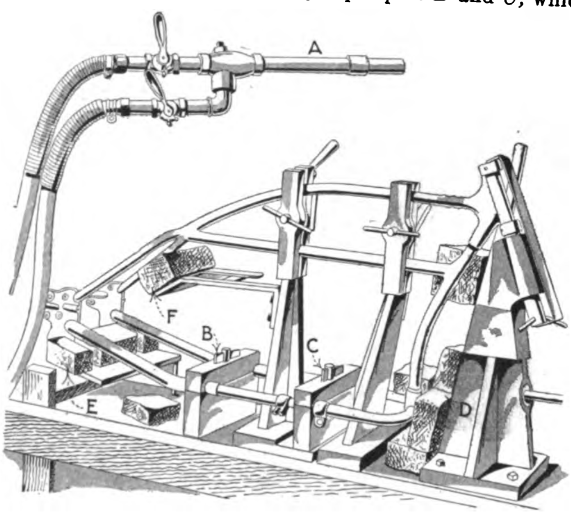


FIG. 3. FRAME-BRAZING FIXTURE

are run through slots in the holding pins. Vertical standards hold the upper tubes of the frame and head. Firebrick are placed on special holding brackets at *D*, *E* and *F*, to back up the flame in heating the parts. Another view of this same fixture may be seen in Fig. 5. For some of the upper joints firebrick are placed at *G* on a stand *H*, which can be moved back out of the way when inserting or removing a frame from the fixture or when brazing other joints. The heavy pin used to line up and hold the head is shown at *I*. The clamping

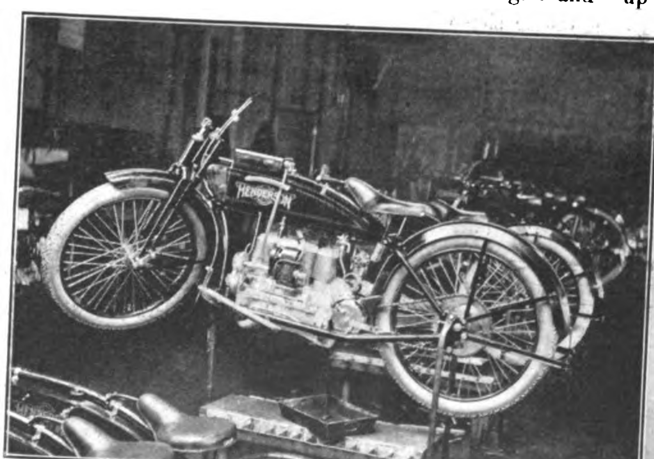


FIG. 1. MOTORCYCLE ON ASSEMBLING STAND

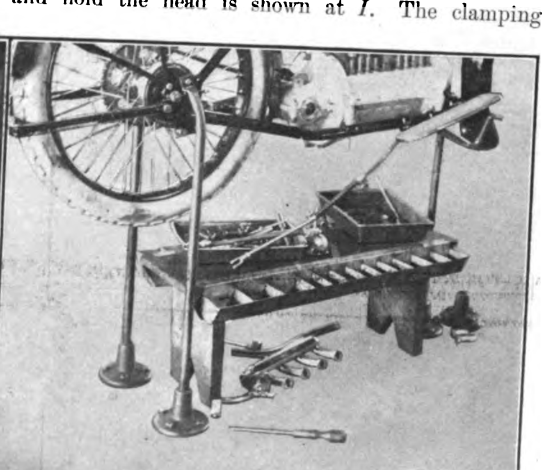


FIG. 2. ASSEMBLING STAND AND PARTS HOLDER

blocks J have convenient handles K. When in place they are locked by slotted pins that go through holes in the uprights, into which taper pins such as L are thrust and tapped in with a hammer.

After a frame has been brazed and filed, some of the small holes are drilled. The frame is held on pillow block similar to those in the brazing fixture, Fig. 4. The same method of clamping down by taper pins is employed also, as indicated at A. A drill jig or templet for the saddle bracket holes is shown clamped to the frame at B. Pins set into the templet give the correct position on the frame fork and upper tube. The holes are drilled with the air drill C.

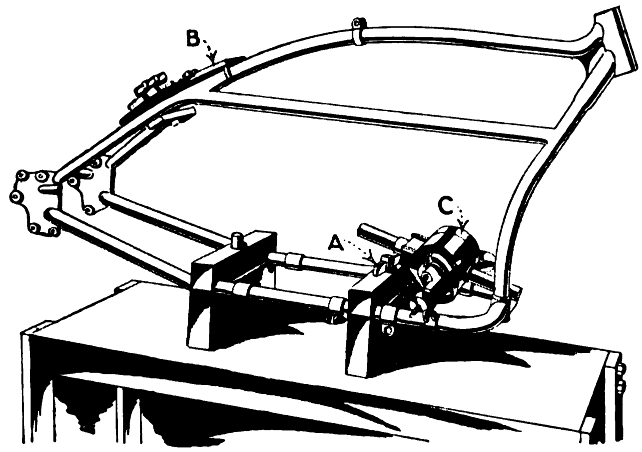


FIG. 4. HOLDING FIXTURE FOR SMALL DRILLING

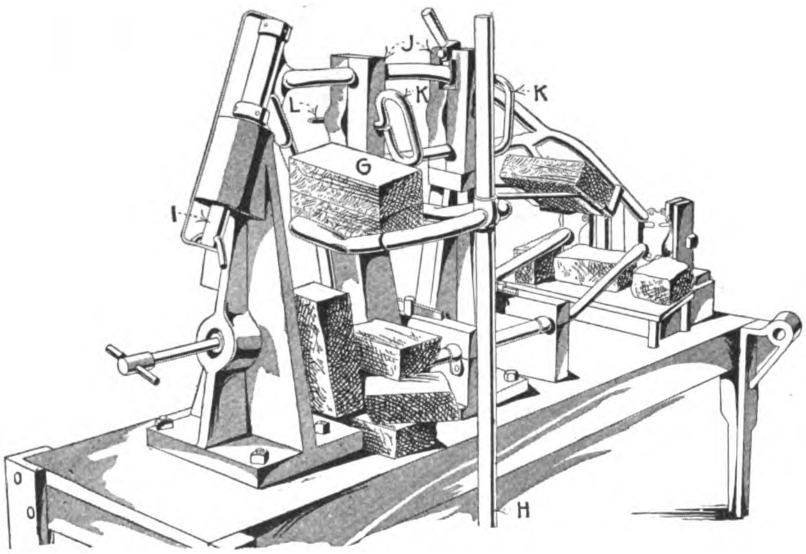


FIG. 5. ANOTHER VIEW OF BRAZING FIXTURE

Most of the bending on the main frame tubes is done with the device illustrated in Fig. 6. This consists of several lever-operated sets of forming jaws carried on a vertical plate. This plate is mounted on a heavy base fitted with small truck wheels, so as to be easily moved to advantageous positions near the heating furnaces or run out of the way when not in use. One of the side tubes for the lower frame fork is shown in the jaws at A. The heated tube is thrust in between the jaws against a stop, and a firm downward pressure on the lever quickly gives the desired bend. After the main bend is made, a slight side bend is given the tube. This is done by holding down on the lever, taking the outer end of the tube and forcing it over by hand, using the gage C to indicate the amount of the bend. As these fork sides are made right and left, the gage has two wings on it so as to be available for either side.

Previous to the bending, these side tubes have some of the brackets and joints braced on them, which is done in a special holding fixture. One of the tubes with the brackets braced in place is shown at D. Another set of forming jaws is seen at E. On the opposite side of the plate are two more forming-jaw sets, as in Fig. 7.

Where the bending angle of a tube is not great, no filling is needed; but where the bend is as sharp as that shown on the end of the fork side, the tube is filled with sand previous to heating. This bend is made in the fixture illustrated in Fig. 8. The tube is heated about where the bend is to be and is then thrust down so that the end rests on the stop A. The clamp is next tightened by turning the screw B. The tube is then pulled over into the forming groove by hand. There is naturally a little spring in the tube, so that it will not fit down snugly into the channel by merely pulling on the outer end. This difficulty is remedied by placing a swage a few inches back of the bend and driving down with a hammer until the tube rests in the channel, as shown. Two of the tubes in the front forks are flattened on the lower ends and these ends given a rather sharp bend. The first flattening of the ends is done in the die in Fig. 9. One of the tubes with the

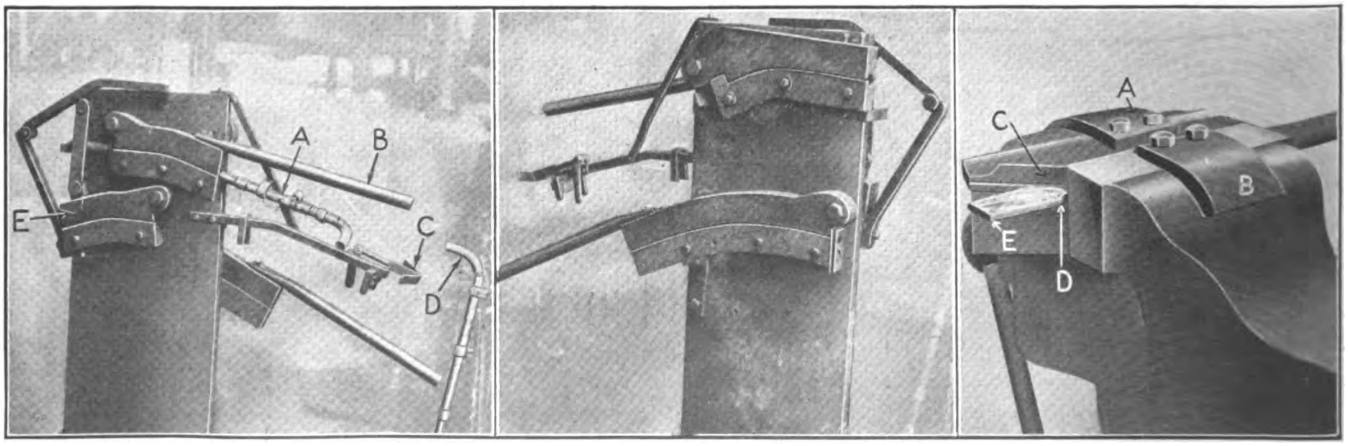


FIG. 6. TUBE-BENDING DEVICE FIG. 7. OPPOSITE VIEW OF BENDER FIG. 10. BENDING DIE IN VISE

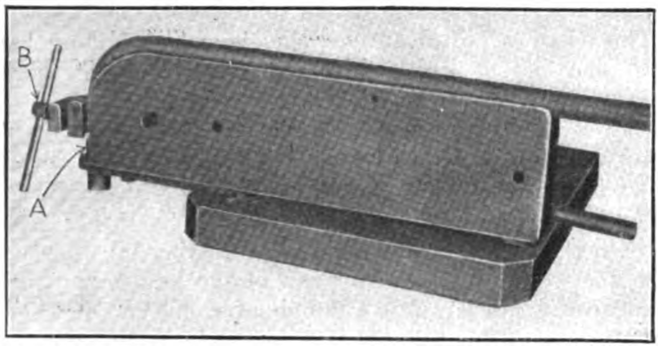


FIG. 8. ANOTHER TUBE BENDER

end flattened is shown at *A*. Before a tube is placed in the die, the mandrel *B* is thrust into it and the cross-handle butted against a forked stop. The use of this mandrel prevents the tubing being crushed or flattened back of the desired point and gives a nicely rounded shoulder. One of the tubes with a flattened and bent end may be seen at *C*. This bend is obtained in the device shown in Fig. 10.

It consists of two formed jaws set into an ordinary vise. Hooked straps *A* and *B* bolted to the jaws hold

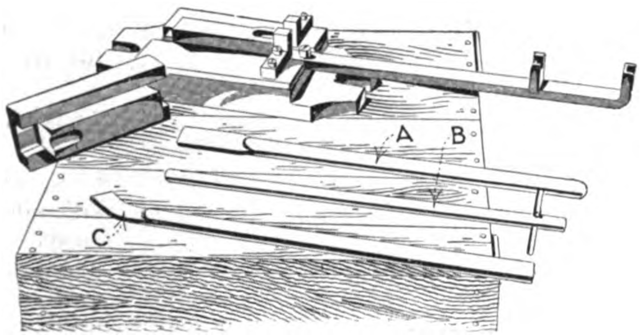


FIG. 9. FLATTENING DIES AND MANDREL

them to the vise jaws. The parts of the false jaws that close in on each other are grooved to receive the round part of the tube. The outer end of the jaw *C* is beveled to the angle of the bend and grooved to receive the flattened part of the tube. The flat part is notched in at *D* with a round file and then heated. It is then placed in these jaws and the end *E* pounded into the groove with a hammer. Afterward the uneven edge on the notched side is trimmed off in a heavy-duty shear.

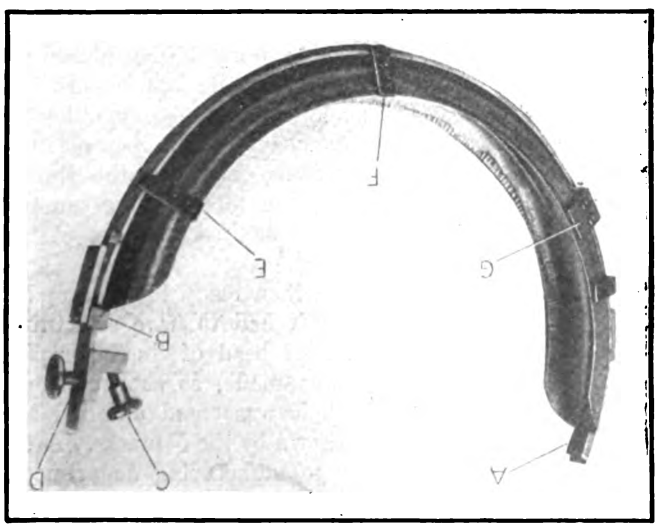


FIG. 11. REAR-GUARD DRILLING JIG

After being shaped, rear mud guards are drilled for the attaching rivets, in the jig shown in Fig. 11. The end of the guard to be drilled is butted up under the block *A*. Then the slide *B* is run down so as to clamp the other end. This slide is held in place and locked by

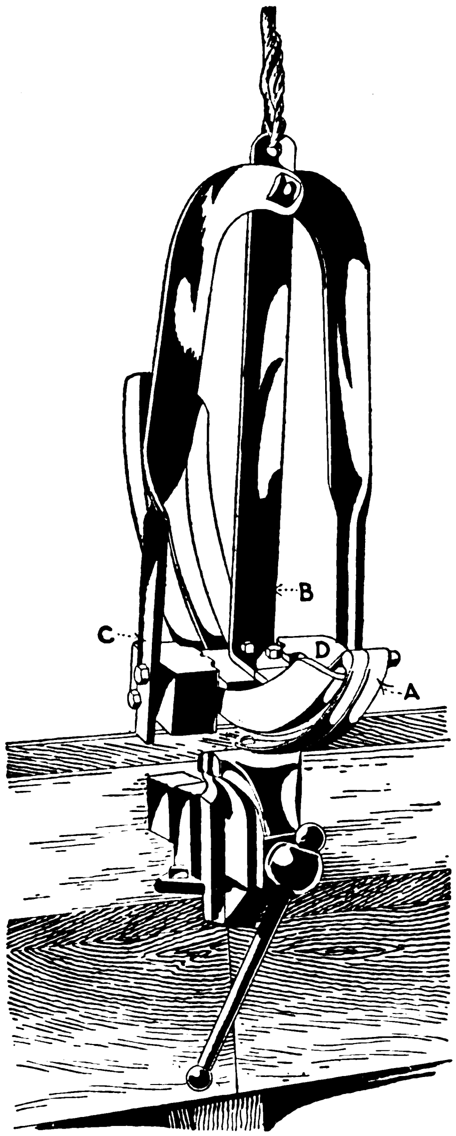


FIG. 12. FRONT-GUARD SWAGING DIE

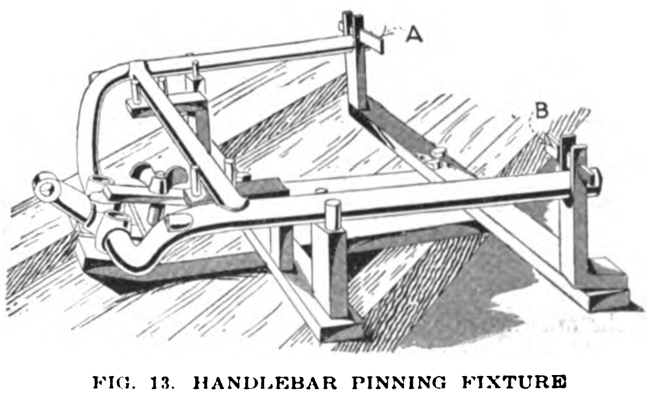


FIG. 13. HANDLEBAR PINNING FIXTURE

the handscrew *C*, which is carried in an adjustable block *D*, to accommodate different lengths of guards. The drill bushings are carried in small brackets riveted to the body of the jig at *E*, *F* and *G*.

Front mud guards are swaged in the device in Fig. 12, to give front-fork clearance. A center piece is clamped

in a bench vise. This center piece has a loop arrangement *A*, into which the guard may be thrust to a stop. An inside forming swage is fastened to the upper end of the loop and is also carried by bar *B*. With the guard in place, the two outer swages *C* and *D* are rammed against it, which bends the thin metal to the inner swage. The entire device is counterbalanced. When not in use, it may be removed from the vise and held suspended against the wall, from where it can be easily set into the vise at any time.

A handle-bar truing and pinning jig is shown in Fig. 13. It holds the various brackets and fittings in place, as well as the crossbrace. The taper-pin clamps are used in this jig also, as seen at *A* and *B*.

Drilling Two Half-Holes in a Time-Fuse Ring

By D. Baker

The illustrations show a jig for drilling two half-holes in a time-fuse ring, these holes being shown at *B*, Fig. 1. At first glance it seems a simple operation, but because of the fact that there were large limits on the preceding operations, it was found to be a difficult matter to locate these rings in proper relation to the drill bushings.

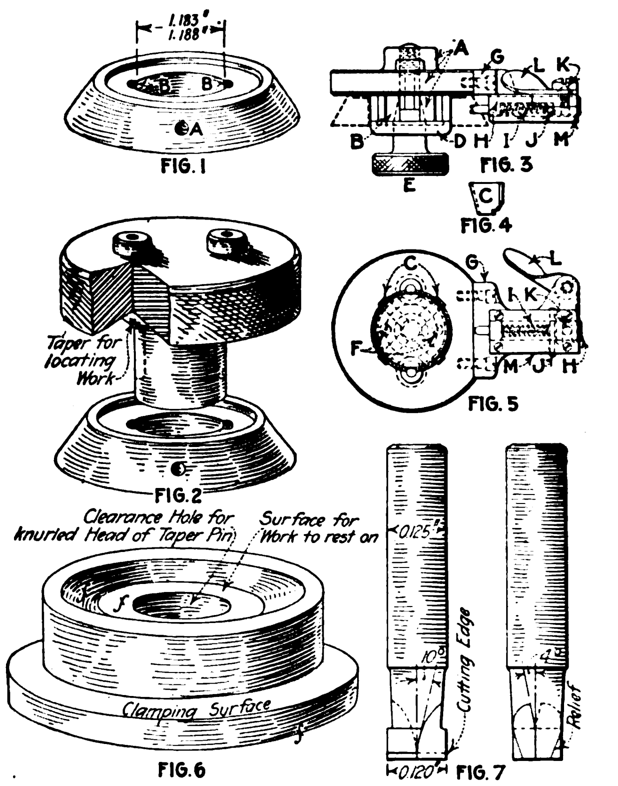
We could not locate from the tapered part outside of the ring, because it was finished in a separate operation from the bore and could not be depended upon to run true with it. We first tried locating from the inside. However, the plug that located the work had to be made to the low limit of the ring, which was 0.005 in. smaller than the high limit. In working on the larger rings, the drills, operating as they were on only half-holes, crowded the work to one side, so that when it was taken out of the jig it would not go on the gages, the holes being too close together.

To overcome this difficulty, we next made a jig with a locating plug having, as shown by Fig. 2, a short, stiff, tapered portion. This tapered part was depended upon to locate the work central. This plan might have been all right, had not the bore been previously burred, or chamfered, with a hand tool that left it irregular and so threw it off center.

To construct a jig that was both rapid and accurate, the following design was gotten up: Referring to the drawing, *A*, Fig. 3, is the body of the jig, which was made of machine steel. *B* is a part of the body that was turned about 0.003 in. smaller than the low limit of the bore of the rings. In this part four slots were milled, into which the four hardened blades *C* were inserted, and held from falling out by the cap *D*. These blades were made, as shown by Fig. 4, with a stiff taper on the inside. *E* is a hardened and ground taper pin, threaded at one end and having a large knurled head at the other. On each end of the taper is a part of the pin which is ground straight. One end has a bearing in the jig body; and the other has a bearing in the cap *D*, which is also hardened and is held central by a shoulder turned on the body, as shown. It is kept in place by the two screws *F*, Fig. 5.

Attached to the jig body is a device for locating the ring in relation to the hole *A*, Fig. 1. It consists of a machine-steel body *G*, which is fastened to the jig proper with two fillister-head screws and dowels, not shown. This piece is milled out to take the square sliding bar *H*, one end of which is turned round and acts as a locating pin, as shown. The bar has several thousandths play vertically, to allow for various thicknesses of rings, but does not permit any rotary movement. It is slotted out to take the coil spring *I*, one end of which rests on the pin *J*, driven through the body. This spring gives the needed tension for holding the locating pin in place in the work. In the outer end of the locating-pin bar is driven a pin *K*. *L* is a thumb lever, one end of which engages with this pin. *M* is a thin plate, fastened to the body with screws, as shown, for holding the locating-pin bar in place.

To operate this jig, it is first picked up in the left hand, with the thumb on the thumb lever, which holds



DRILLING HALF HOLES IN TIME-FUSE RING

the locating pin out of engagement with the work. Then with the right hand, the taper pin *E* is screwed out, releasing the blades *C* and letting them fall back a few thousandths into the body. The work is then picked up and placed on the jig, passing over the knurled head of the taper pin, which is made small enough to allow it to pass freely. It is then turned to the proper position for the entering of the locating pin, and the thumb lever is released, after which the taper pin is screwed tight, forcing the blades *C* out against the bore of the ring, bringing it exactly central.

The jig, with work in it, is then ready to place under the multiple drill head. As it had to have something to stand on besides the knurled head of the taper pin, a simple cast-iron fixture was made, as shown clearly in Fig. 6. The clearance hole was cored out and the casting finished only where shown by the *F* marks. After turning the jig over to the manufacturing department, we began to have difficulties in getting cutters to stand up to the work. We tried out all kinds of cutters and

drills without much success. If they were the least bit dull, they would crowd over against the bushing, which was meant to be a support for them, so hard that they soon lost their size, besides wearing out the half-bushings.

The final development, which is proving a success, was to make the bushings so that they acted as guides only and did not extend down into the work. Then we made up cutters from Novo high-speed drill rod, Fig. 7. It will be noticed that the drill rod is 0.125 in. in diameter. The cutting end only is ground down to 0.120 in. after hardening, and the side relief is ground on, free hand. The end is relieved by resting the cutters in a V-block, which is set up in front of a grinding wheel in such a way that the center of the V comes on a line with the edge of the wheel.

This arrangement enables the operator to grind one cutting edge, then revolve the cutter in the V and grind the other, regulating the amount of clearance given by setting the V-block either higher or lower.

The cutters made in this way are practically end mills and act as such. If for any reason they are crowded to one side when being fed into the work, they will on the return feed have a tendency to clear themselves and thus leave a clean, true hole.

Milling cuts run exactly to center, but are given 10 deg. angle one way and 4 deg. the other, to strengthen the cutter back of the cutting edge. When grinding, if the center gets too thick, it is stoned up again.

These jigs in the hands of a skilled operator have a capacity of over 200 pieces per hr., two half-holes to the piece, while the cutters have done over 500 pieces without regrinding.

Piston Jigs and Tools

By E. V. Allen

Two wrist-pin hole jigs are shown in Fig. 1. They are used in the shop of the Caille Perfection Motor Co., Detroit, Mich., for work on the pistons of portable boat motors. The one at the left has a piston in place ready to drill and ream. The one at the right is shown empty. In putting a piston into one of these jigs, it is inserted with the center hole of the closed end over the point of the screw *A*. The locating plug *B* is then inserted through the large bushing in the opposite end. This plug is located correctly in the bushing by the key *C*, which fits snugly in a keyway. The formed end of the plug butts under and against the wristpin bosses inside the piston and lines them up so that a drill run through the guide bushings will make a hole through the center of the bosses. A final tightening of the screw *A* completes the setting of the work.

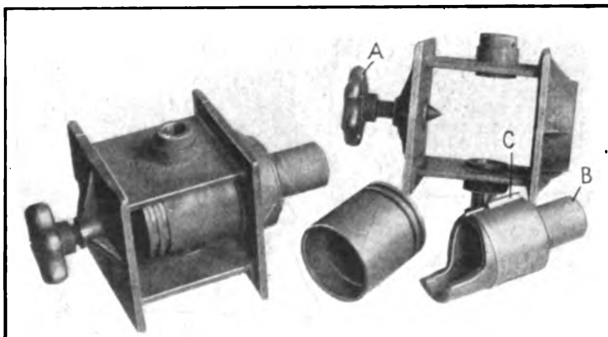


FIG. 1. PISTON DRILLING AND REAMING JIGS

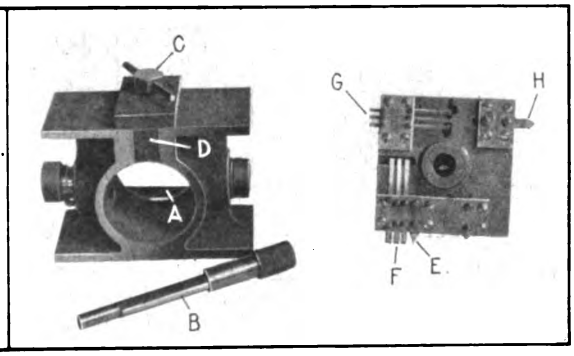


FIG. 2. REAMING JIG AND SPECIAL TURRET

Though the holes are drilled and reamed in the type of jig just shown, they are finish-reamed in the jig seen at the left in Fig. 2. The piston is put into this jig and butted against the stop *A*. The wristpin hole is then lined up approximately with the guide bushings. The ground setting plug *B* is next run through the bushings and wristpin hole, lining them up as closely as possible. The piston is locked in place by turning the screw *C*, which operates the clamp slide *D*. In order to facilitate the lining up of the wristpin hole with the bushings, where the wristpin hole may be slightly out of line, the plug *B* is considerably flattened where it goes through the piston. Two edges of it, however, are ground to size, so that by turning the plug the hole may be lined up as nearly as possible. A hand reamer is then run through and the hole accurately lined up and sized.

At the right is a turret used on the cross-slide of a lathe for grooving and chamfering pistons. The chamfering tool is shown at *E*, the rough-grooving tools are seen at *F* and the groove-finishing tools at *G*. A turning tool is carried at *H*.

A Simple Method of Preventing Injury to Charts

By E. J. Gibson

Authors of some of the latest reference books, being awake to the need of presenting data in the most convenient form, have prepared elaborate charts to meet this demand. Unfortunately, constant use will in time deface some of the graduations, and the surface of the chart is impaired while the rest of the book is in good condition. Particularly is this true in cases which require the use of dividers to obtain the desired information.

It has been found that this trouble is avoided by inserting in the book, next to the page containing the chart, a piece of tracing cloth the size of the page. The tracing cloth is pasted along the inner edge, so that it virtually becomes one of the leaves of the book. When the chart is in use, it can always be covered with the tracing cloth, through which every detail can easily be seen.

In addition to the preservation noted the dull side of the tracing cloth is handy for making reference notes.

Tools for Machining Details for a Press Feeder

By Robert Mawson

SYNOPSIS—In this article are shown some of the small tools—jigs—used in machining the details on a printing press. In most cases the drilling operations follow the milling, and the casting rests on finished pads in the jigs. The tools are designed with quick-acting locating and holding devices, such as V-blocks and pin-headed screws. Where covers are used on the jigs, they are fitted with open-sided washers which, swinging under shoulders on the locating pins, are quickly located and hold the cover in the correct position.

On page 58 was shown and described the two-sheet rotary printing press manufactured by the United Printing Machinery Co., Woonsocket, R. I. Various machining operations and the tools used are illustrated on pages 56, 138, 232, 318, 458 and 492. Herewith are shown four other details and the jigs used in machining them. This article, as well as the former articles, illustrates examples of high-grade small-tool construction where the production is comparatively small.

In the jig used when drilling the cut-out ratchet holder the tool has been designed with two screws set at an angle of 45 deg. which are used as locating surfaces for the boss on the casting. As the castings are liable to vary owing to foundry conditions the screws are made adjustable to take care of such variations. The tool used for machining the conveyor drive clutch lever is made with tool steel spacing block against which the arms of the casting are placed. This affords not only a locating means but also supports the ends of the arms against the machining stresses.

The boss on the casting rests on pins which place the surface at the correct height for the hob to be drilled and reamed through the boss. The single arm of the piece is placed in a cut-out recess in the jig.

The conveyor drive gear yoke is drilled after being completely milled. To locate the casting properly in the jig a finished steel block is used which fits between machined surfaces on the two internal bosses.

The jig, Fig. 6, is of the open type, the casting being located by a V-block on the other three tools. After the piece is in position covers are dropped down.

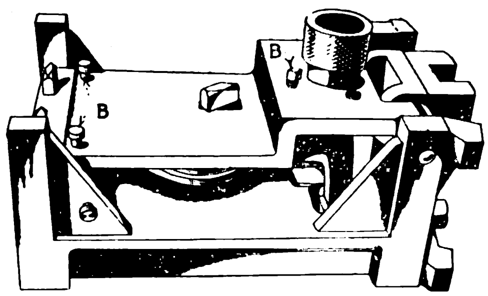


FIG. 2

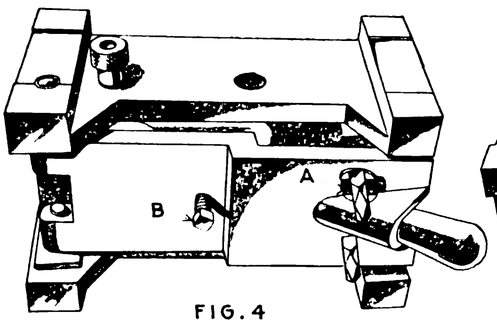


FIG. 4

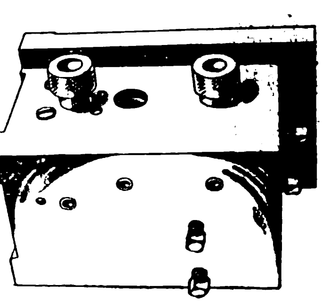


FIG. 6

DRILLING JIGS USED IN MACHINING PRINTING-PRESS FEEDER DETAILS, WITH WORK SHOWN IN POSITION

FIGS. 2 AND 2-A

Operations—Drilling and reaming cut-out ratchet holder, Fig. 1. The milled casting is located against two adjustable screws placed to form a V. It is forced against these with the pin-headed screw. The clamps are then tightened onto the part to hold it securely. The cover is afterward dropped over the pig, located by two pins and held down with the three screws B.

Holes Machined—One $1\frac{31}{64}$-in. drilled and reamed to $1\frac{1}{2}$ in., one $\frac{1}{4}$-in. drilled, one $\frac{13}{32}$-in. drilled and $\frac{3}{4}$-in. spot-faced, and three $\frac{17}{64}$-in. drilled.

FIGS. 4 AND 4-A

Operations—Drilling and reaming conveyor-drive clutch lever, Fig. 3. The rough casting is located against pins, being forced against them with knurled-head screws. The cover is then dropped down, being held with the thumb-screws A. The screw B is then tightened onto the piece to hold it securely.

Holes Machined—One $\frac{47}{64}$-in. drilled and reamed $\frac{3}{4}$ in., one $\frac{19}{64}$-in. drilled and reamed to $\frac{5}{16}$ in., and one $\frac{3}{16}$-in. drilled.

FIGS. 6 AND 6-A

Operations—Drilling and reaming bracket support for sheave wheels, Fig. 5. The milled casting is located against a machined block, being forced back with a setscrew inside the jig body. The cover is then dropped down and held with the thumb-screws. A setscrew tightened on the piece holds it securely.

Holes Machined—Three $\frac{31}{64}$-in. drilled and reamed $\frac{1}{2}$ in. and two drilled to suit a No. 20-18 thread.

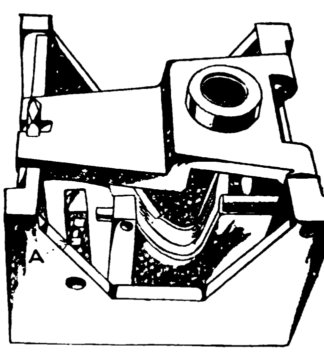
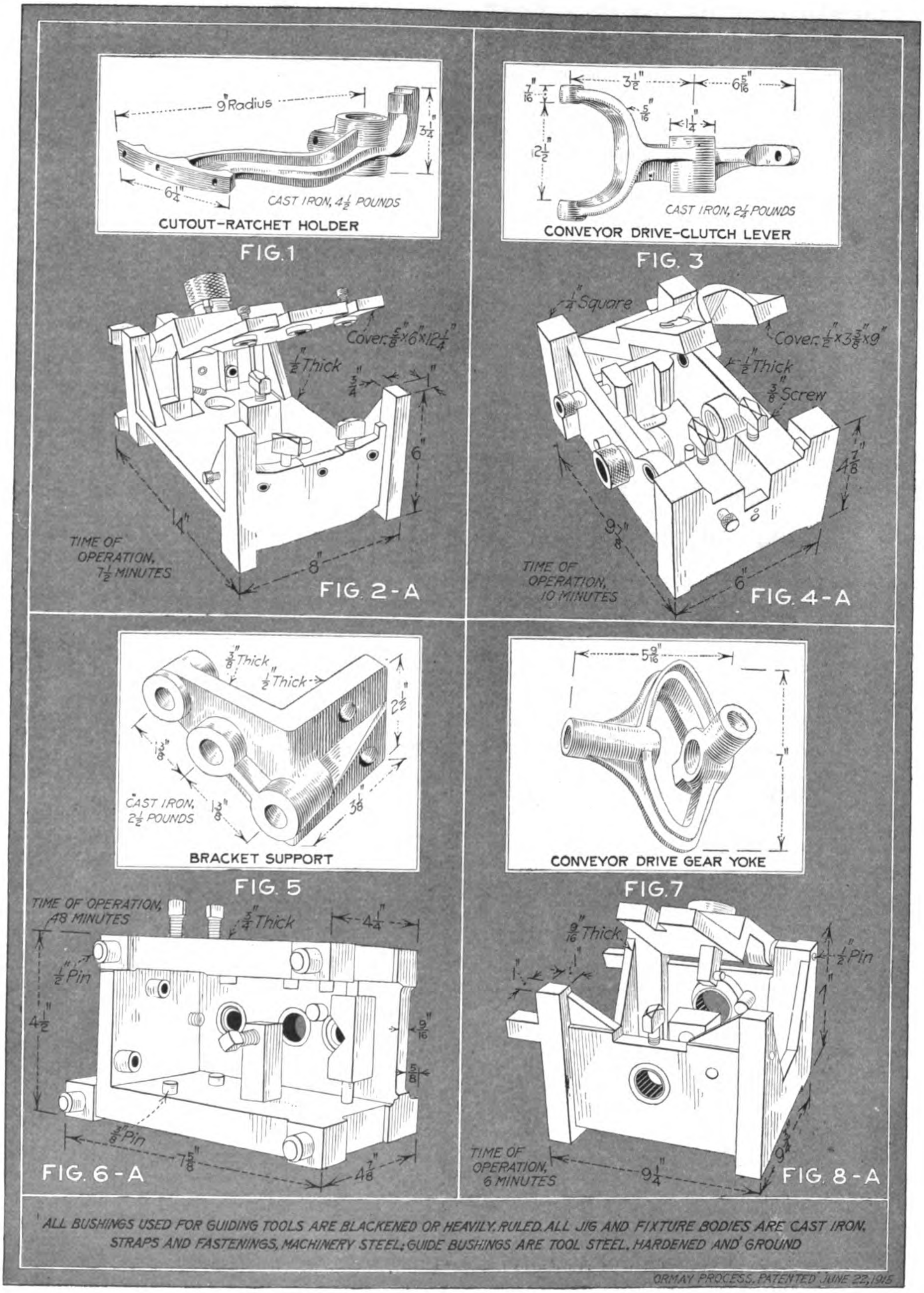


FIG. 8. JIG FOR DRILLING AND REAMING CONVEYOR-DRIVE GEAR YOKE

FIGS. 8 AND 8-A

Operations—Drilling and reaming conveyor-drive gear yoke, Fig. 7. The milled casting is located in the jig by a machined steel strip which fits into a finished slot. It is forced back and held in position with the setscrew A and one at the end. The cover is then swung down and fastened with the thumb-screw as shown.

Holes Machined—One $\frac{47}{64}$-in. drilled and reamed $\frac{3}{4}$ in., one $1\frac{23}{64}$-in. drilled and reamed $1\frac{3}{8}$ in., one $\frac{55}{64}$-in. drilled and reamed $\frac{7}{8}$ in.



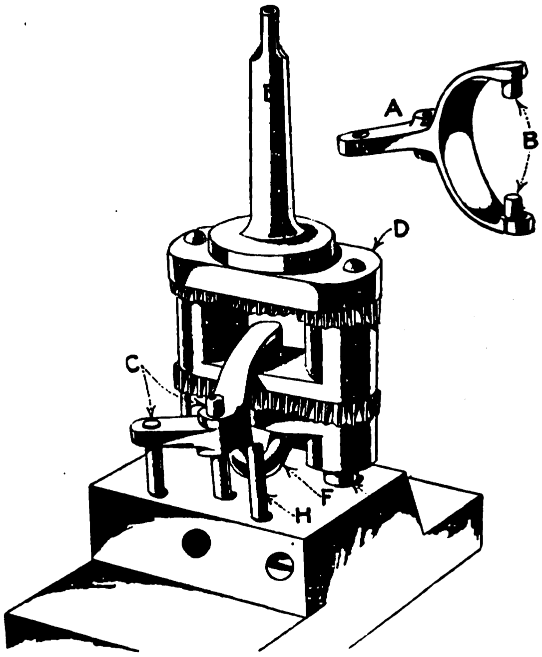
DETAILS OF DRILLING JIGS USED IN MACHINING PRINTING-PRESS FEEDER PARTS

Machining Pins Inside a Fork

By E. A. Thanton

An ingenious method of machining pins on the inside of a small brass fork is here shown. This process is employed in the shop of the Caille Perfection Motor Co., Detroit, Mich. One of the finished forks, shown at *A*, will give a good idea of the work, which is indicated by the arrows at *B*.

Two holes are first drilled in the fork in a drilling jig. These holes are used both to hold and to locate



MACHINING PIN INSIDE A FORK

by, as will be seen where a fork is shown set over the pins *C*. The pins on the inside of the fork are machined by a hollow mill carried in the frame *D*. The taper shank *E* fits the drilling-machine spindle, and the hollow mill at *F* is driven through the gears shown.

The frame carrying the gears and the milling cutter is made to slide on two posts set into the base, like that of a subpress. One of these posts is partly shown at *G*. In putting a fork into the fixture the frame is raised on the posts and the fork is put into approximate position; then frame and fork are lowered until the fork is held securely on the locating pins *C* and the lower part of the fork rests on the bedplate. The milling cutter can now be used to finish the fork pin. For the pin on the other side of the fork the piece has to be turned over and the outer hole set over pin *H*.

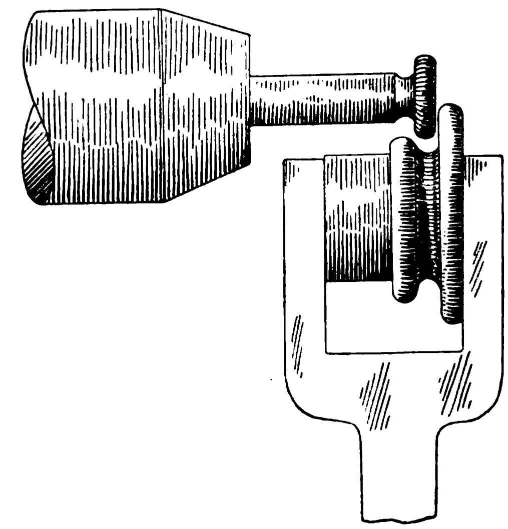
Method of Knurling Brass Cup

By W. R. Armstrong

Two or three years ago the firm I was with needed a large number of brass cups.

The method of production was to blank and draw the cup from 0.25-in. thick brass and redraw to $\frac{13}{32}$ in. in diameter by ½ in. long. Blanking the cup was done at 85 per min. and the redraw at 80 per min. on a table-feed press.

Beading the end and knurling form the interesting part. This work was done in an ordinary speed lathe at the rate of 10,000 to 12,000 pieces in 10 hr. The apparatus consisted of an arbor shaped as the piece required and small enough in diameter to let the cup be taken off after knurling, and a knurl or roll, with a flange as shown, held in the tool post of a lever-feed slide on the lathe.



METHOD OF KNURLING BRASS CUP

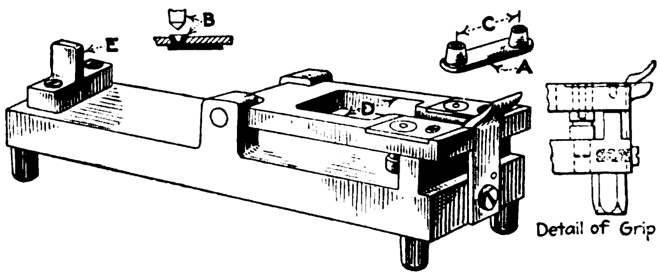
At first, trouble arose in getting cups to come round and at the some time getting production enough per day. At my suggestion the arbor was knurled on the bead. No further trouble developed, and production almost doubled—to the quantity mentioned. As I remember, these cups were annealed lightly before knurling. The lathe was run at 900 or 1,000 r.p.m.

An Interesting Drill Jig

By Harold E. Greene

The accompanying illustration is of a drill jig that solved a vexing problem.

The pieces shown at *A* were drop-forged number plates for typewriters, and were fastened to the frame of the machines by spreading the lugs with a punch after drill-



A FLEXIBLE DRILL JIG

ing, as shown at *B*, which necessitated an even thickness of wall so that they would turn evenly. The center distance *C* of the lugs varied enough so that with a fixed center distance of the drill bushings an even thickness of wall was not possible; therefore a leaf as shown was made which would spring enough at *D* to allow for the variation. The taper holes in the lower end of the bushings were made to fit the lugs as closely as possible.

Another feature of the jig is the block *E*, which acts as a knockoff for the pieces when the leaf of the jig is unlatched and thrown back in the loading position.

Manufacturing 12-In. Shrapnel--II*

By Robert Mawson

SYNOPSIS—The operations of turning the inside and the outside form of the shell, machining the back end, turning the outside copper-band channel, knurling the channel, forcing and machining the copper band to the correct contour are described in this article. The various stages are illustrated.

After the shell has been nosed and returned to the machine shop, the next operation is turning the inside form. The shell is held in the chuck, Fig. 4. The boring bar and tool are shown in Fig. 25. The bar is held in the tool carriage of the lathe in the usual manner. The desired contour on the shell is obtained by the guide pin *A*, Fig. 26, which is attached to the bracket tee *B* and follows the path between the two former cams *C*. The latter are fastened on the cam bed *D*, which is held on the brackets *E*, fastened on the side of the lathe bed. The bracket tee is attached rigidly to the tool carriage of the lathe.

The manner in which the attachment is used on the lathe may be observed by reference to Fig. 27. The gage for testing the machined inside contour is illustrated in Fig. 28. A diagrammatical view of the operation performed may be seen in Fig. 29. The open end of the shell is next faced, the correct length being obtained from the powder chamber with a gage and straight-edge, as in Fig. 30. The hole is then bored to 8.23 in. in diameter, the pin gage, Fig. 31, being employed to test the machined bore.

A thread is machined in the bored hole, to suit the partly machined adapter, the manufacture of which will be treated in another article. Fig. 32 shows the lathe set-up for boring and machining the thread, and in Fig. 33 are given in diagrammatical form the surfaces machined. It will be observed that the shell is held in the chuck as in Fig. 4. The adapter is screwed into the shell, using the clamp, Fig. 34, in the way illustrated in Fig. 35.

After the shell has been placed in the lathe as just described, the chuck, Fig. 36, is screwed into the end of the adapter and the lathe center set up in the countersunk hole of the chuck. The outside of the adapter and also part of the outside of the shell are then turned to the correct contour. For this operation the link, Fig. 37, is attached to the bracket tee with the stud *A*, Fig. 37, after the guide pin has been removed. The fulcrum pin *B* is placed in position, fitting into a machined hole in the cam bed. The arrangement of the attachment may be seen in Fig. 38.

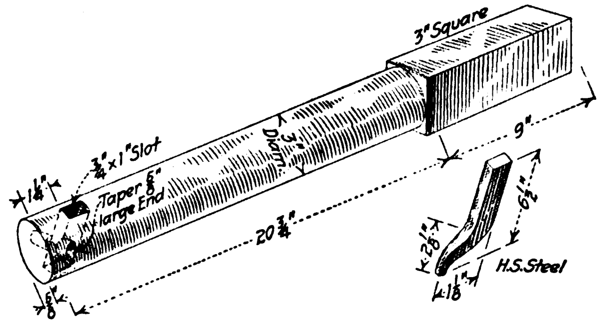


FIG. 25. BORING BAR—INSIDE OF SHELL

The turning tool is held in the carriage of the lathe. As the carriage is fed forward with the shell revolving, the link, fulcruming on the pin, draws the carriage and turning tool on an arc. Thus the desired contour of the part is obtained. The gage for measuring the length of the machined surface appears in Fig. 39. Fig. 40 shows the lathe set up for performing the machining operation, and in Fig. 41 is shown in diagrammatical form the work done.

The gage in Fig. 42 is for testing the machined contour while the shell is in the lathe with the chuck in position. Fig. 43 depicts the tool employed as the final profile test gage after the chuck has been removed.

In Fig. 44 is a special double-ended lathe designed for the work of machining the inside and outside profile surfaces on the shell. It will be observed that the operators work face to face, the tailstocks being placed in the center and the drives being at the outer ends of the lathe. This arrangement has proved advantageous, cutting down the floor space. As the machines are of the one-purpose type and the required length of lathe bed is thus known, the tools have been designed accordingly.

For the next operation the first suboperation is machining a surface

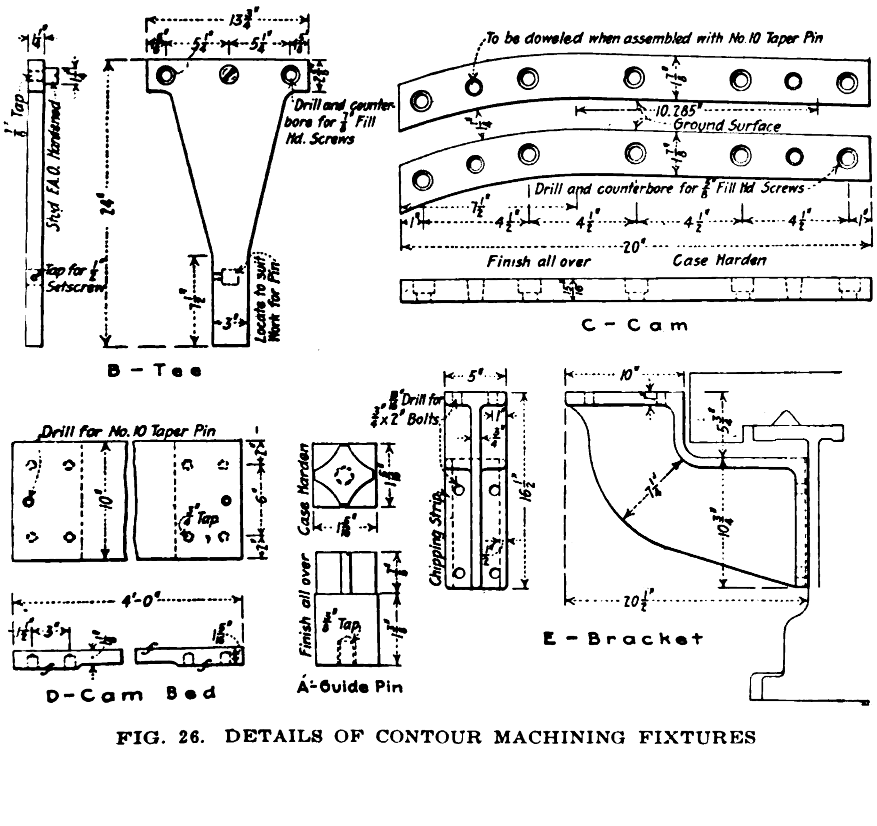


FIG. 26. DETAILS OF CONTOUR MACHINING FIXTURES

*Previous installment appeared on page 537.

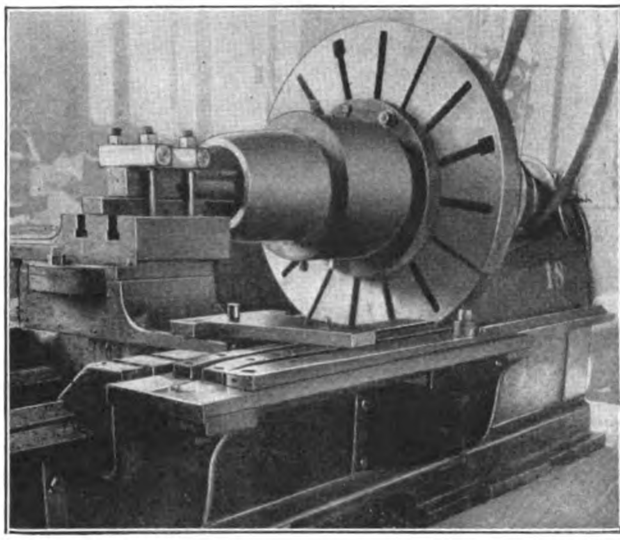


FIG. 27. TURNING INSIDE CONTOUR

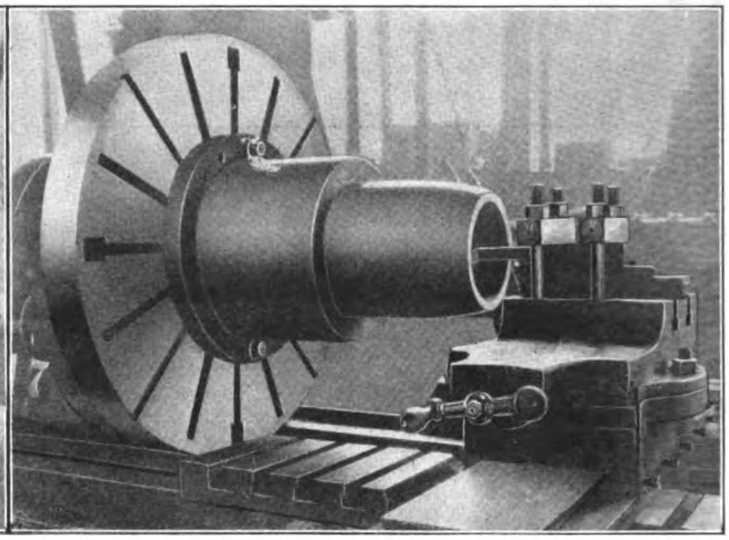


FIG. 32. BORING END AND MACHINING THREAD

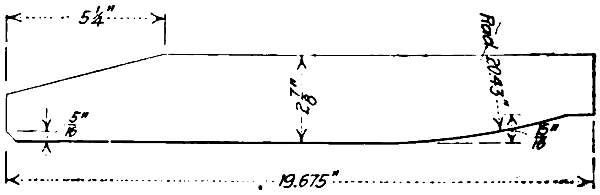


FIG. 28. GAGE FOR INSIDE CONTOUR

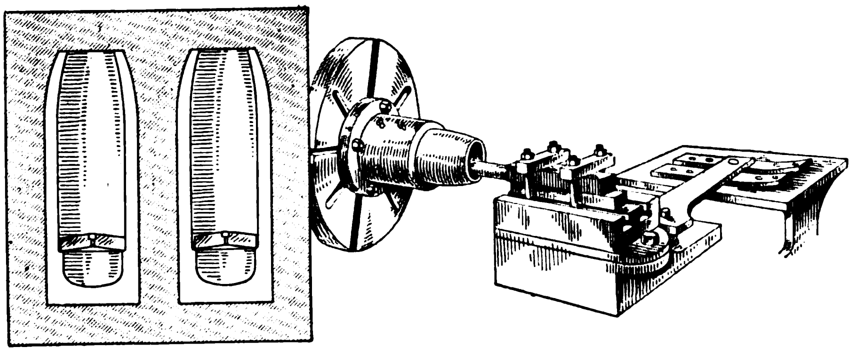


FIG. 29. OPERATION 9: TURNING INSIDE FORM

Machines Used—Fitchburg and special.
Special Fixtures—Chuck, boring bar and radius attachments.
Gages—Form.
Production—One in 4 hr.
Lubricant—None.
Note—Between grindings of tool, 3 shells. Lathe operates at 20 r.p.m. with feed of 1/32 in. per revolution.
References—Figs. 4, 25, 26, 27 and 28.

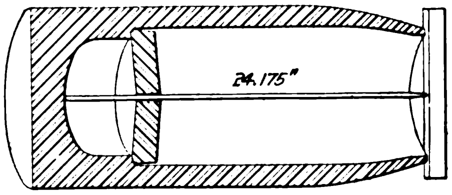


FIG. 30. GAGE AND METHOD OF USING IT TO TEST DEPTH OF BORE

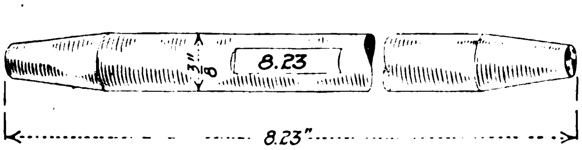


FIG. 31. GAGE FOR OPEN END OF SHELL

to suit the steadyrest, Fig. 8, and at right angles to the end already faced. The chuck, Fig. 45, is screwed into the open end of the shell after the adapter has been removed. A strap held on the faceplate of the lathe comes in contact with one of the lugs on the chuck, thus providing the driving medium. The chuck, Fig. 46, is placed on the base end, and the shell is adjusted with the four setscrews until it runs concentrically. A surface is then machined to suit the steadyrest. This operation is illustrated in Fig. 47. The chuck is then removed, and the base of the shell is faced to length, using the gage, Fig. 48, in the manner shown.

The gage, Fig. 69, is for testing the radius on the corner of the base and for turning the outer periphery. A notch is cut to suit the 0.9-in. section and to serve as a guide from which the channel will be machined.

The operation is shown in Fig. 50 and in diagrammatical form in Fig. 51. The outer periphery is also turned at the same setting to 11.94 in. for a width of about 1 in. The gage for the diameter is given in Fig. 52.

The chuck, Fig. 53, is slid on the turned portion at the base end and the lathe center set up. The steadyrest

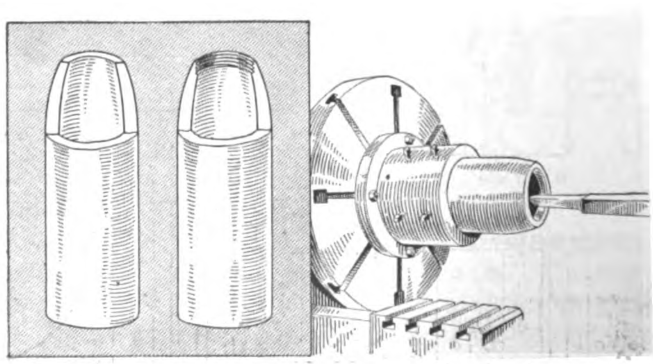


FIG. 33. OPERATION 10: FACING OPEN END AND CUTTING THREAD

Machines Used—Fitchburg and special.
Special Fixtures—Chuck, facing and thread-cutting tools.
Gages—Depth.
Production—One in 1½ hr.
Lubricant—None.
Note—Between grindings of tool, 4 shells. Lathe operates at 20 r.p.m. with feed of 1/32 in. per revolution.
References—Figs. 4, 30, 31 and 32.

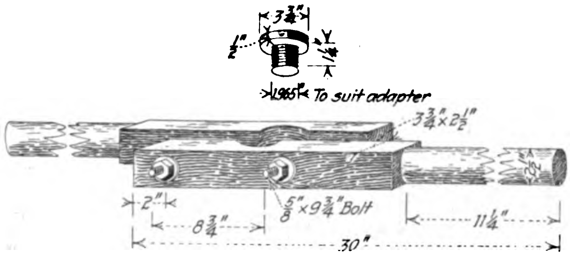


FIG. 34. DETAIL OF CLAMP

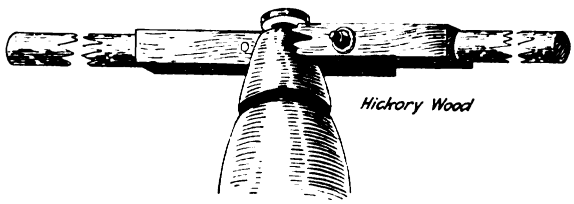


FIG. 35. METHOD OF USING THE CLAMP

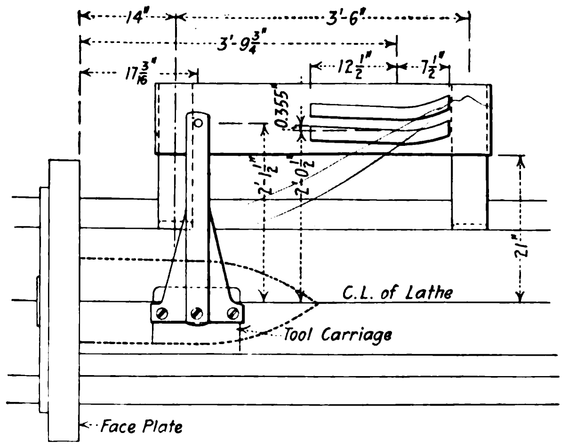


FIG. 38. ARRANGEMENT OF PROFILING FIXTURE

is thrown back out of the way for the next suboperation—turning the remainder of the body. The gages for the turned diameters are seen in Figs. 52 and 54. The lathe set-up for performing the turning operation is shown in Fig. 55 and in diagrammatical form in Fig. 56.

In turning and knurling the channel the shell is held as described for the previous operation. It is, however, supported with the steadyrest, Fig. 8. The channel is machined with an undercut or bevel, on each side. For this purpose left- and right-hand side tools are set at the correct angle and held in the tool post of the lathe. The gage for testing the bottom diameter of the channel is shown in Fig. 57; the width and contour gage, in Fig. 58.

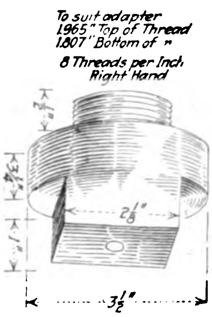


FIG. 36. CHUCK FOR ADAPTER END OF SHELL

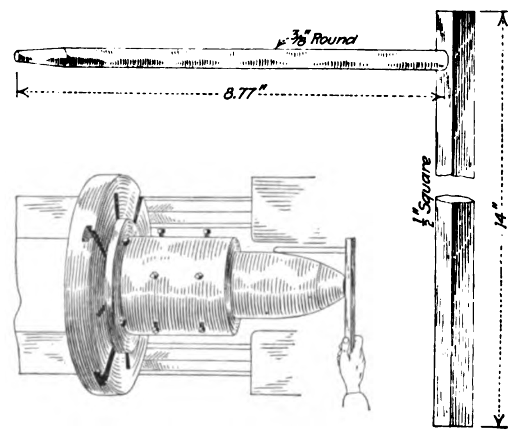


FIG. 39. GAGE FOR MEASURING LENGTH OF MACHINED CONTOUR

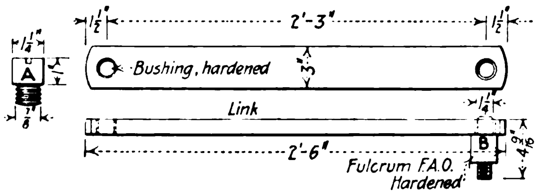


FIG. 37. DETAIL OF LINK

The next suboperation is knurling the channel. The tool, Fig. 59, for this operation is held in the tool carriage of the lathe and fed across the surface of the turned channel, with the shell revolving, until the desired depth of knurl is secured.

A view of the lathe set-up for performing the knurling operation is given in Fig. 60. The operation is shown in diagrammatical form in Fig. 61. The shell is then transferred to the forge shop, to have the copper band

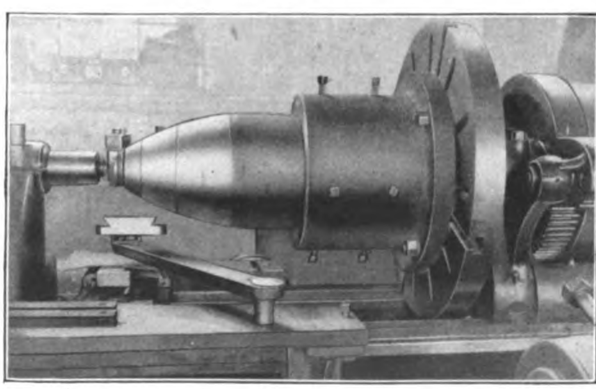


FIG. 40. TURNING OUTSIDE CONTOUR

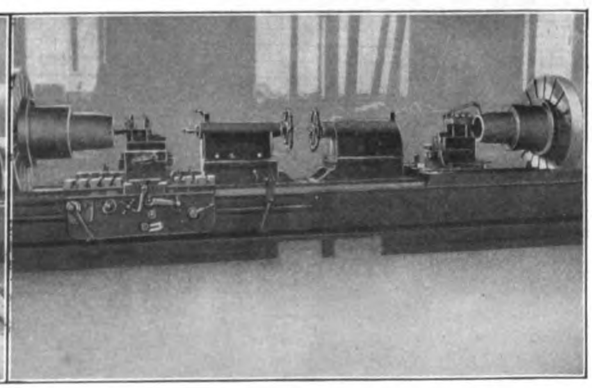


FIG. 44. SPECIAL LATHE FOR PROFILING SHELLS

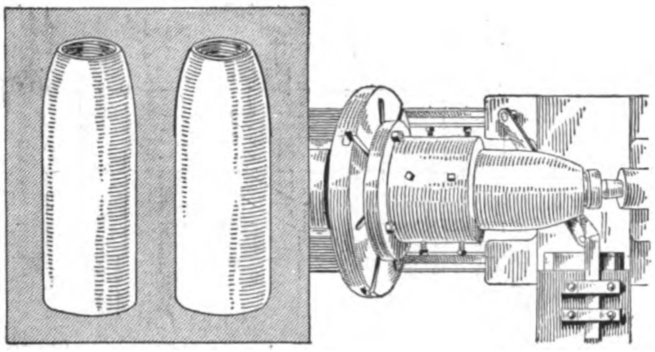


FIG. 41. OPERATION 11: FORMING THE OUTSIDE

Machines Used—Fitchburg and special.
Special Fixtures—Chuck, link and radius attachments.
Gages—Form.
Production—One in 5 hr.
Lubricant—None.
Note—Between grindings of tool, 5 shells. Lathe operates at 20 r.p.m. with $\frac{1}{32}$-in. feed.
References—Figs. 4, 26, 36, 37, 38, 39, 40, 42 and 43.

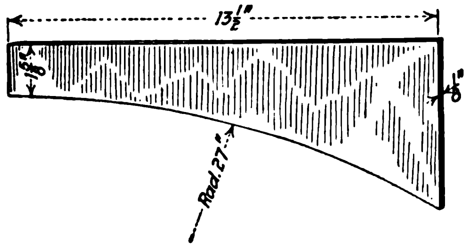


FIG. 42. GAGE FOR RADIUS OF HEAD

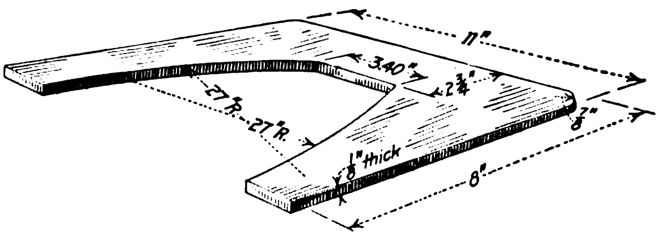


FIG. 43. GAGE FOR PROFILE OF HEAD

compressed on. Fig. 62 is a detail of the band as received at the plant.

To compress the band on the shell, the band is first slipped on and the shell placed between the dies, Fig. 63, which are attached to the steam hammer. With the shell in position the upper die is fed down until the copper band has been forced, or compressed, firmly into the machined channel.

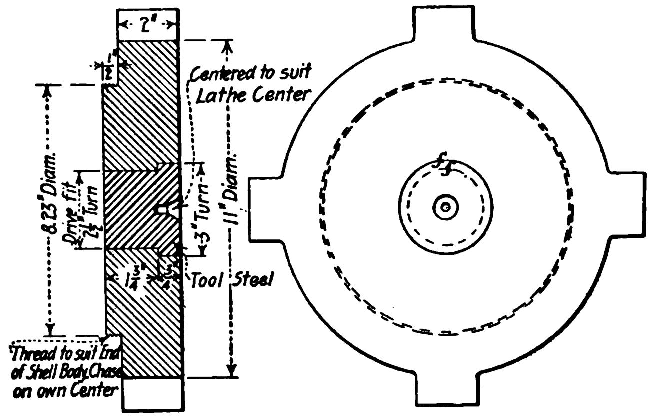


FIG. 45. CHUCK FOR OPEN END OF SHELL

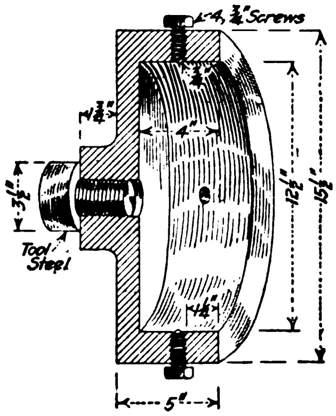


FIG. 46. CHUCK FOR BASE END OF SHELL

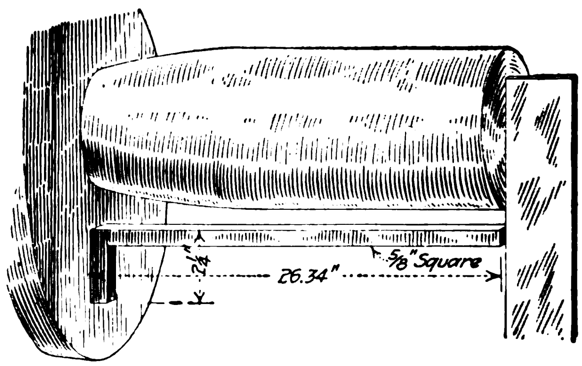


FIG. 48. GAGE FOR OVERALL OF SHELL

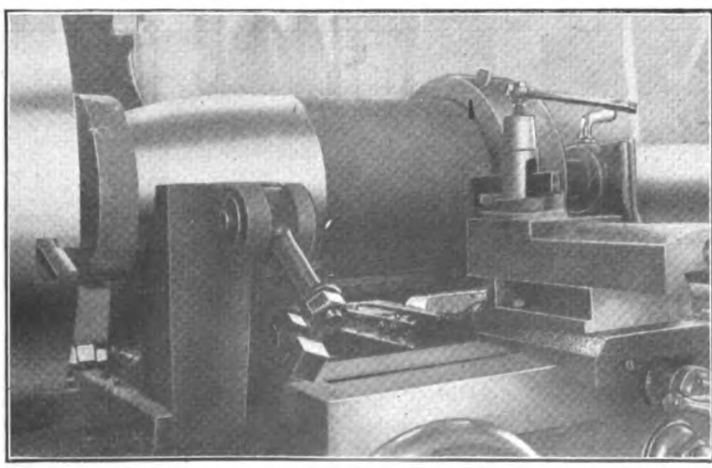


FIG. 47. MACHINING SPA[illegible] STEADYREST BEARING

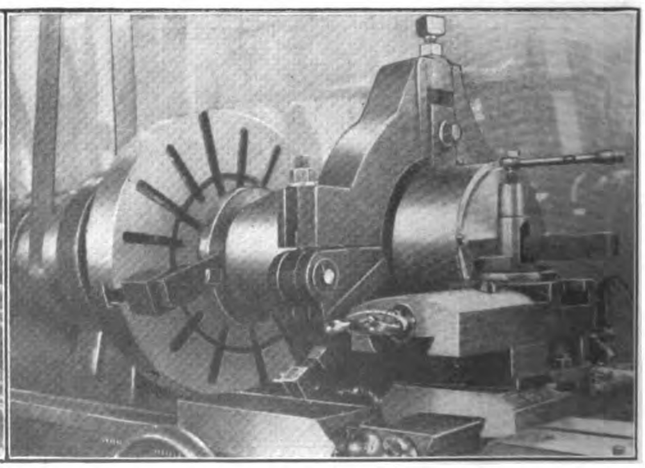


FIG. 50. FACING BACK END OF SHELL

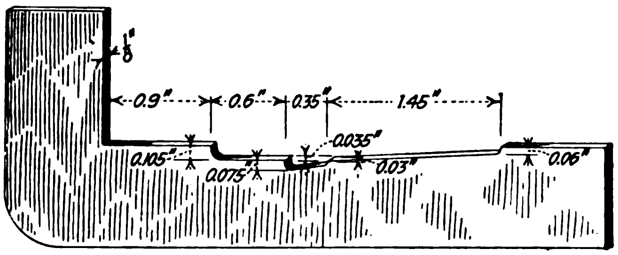


FIG. 49. GAGE FOR BAND

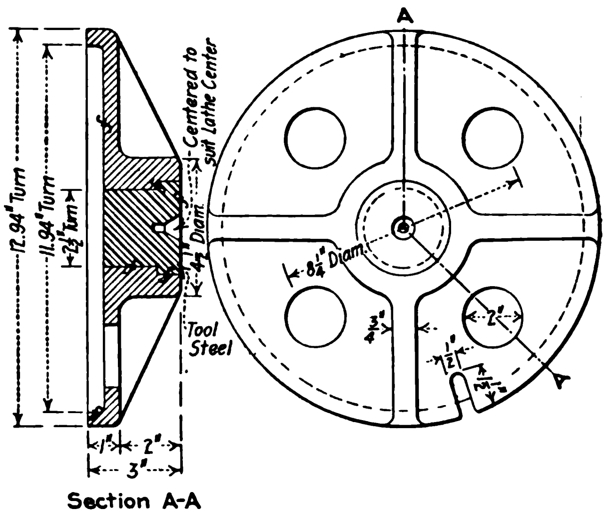


FIG. 53. CHUCK FOR BASE END OF SHELL

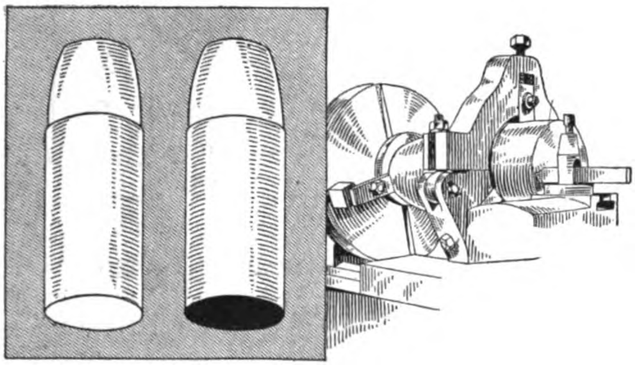


FIG. 51. OPERATION 12-A: FACING BACK END OF SHELL
Machines Used—New Haven, Boye & Emmes and special.
Special Fixtures—Threaded chuck and steadyrest.
Gages—Length and snap.
Production—One in 3 hr.
Lubricant—None.
Note—Between grindings of tool, 1 shell. Lathe operates at 20 r.p.m. with feed of $\frac{1}{8}$ in. per revolution.
References—Figs. 8, 44, 47, 48, 49, 51 and 69.

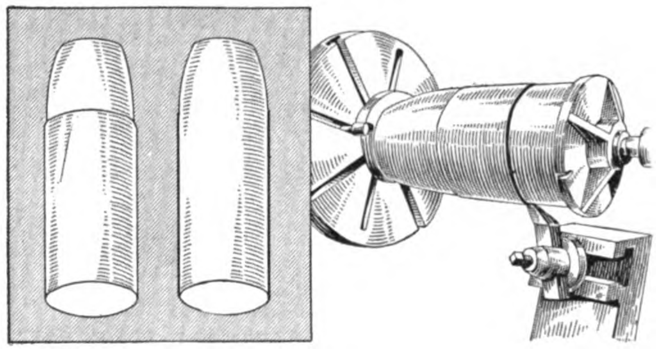


FIG. 56. OPERATION 12-B: TURNING REST OF BODY
Machines Used—New Haven, Boye & Emmes and special.
Special Fixtures—Chucks.
Gages—Snap.
Production—One in 2 hr.
Lubricant—None.
Note—Between grindings of tool, 2 shells. Lathe operates at 20 r.p.m. with feed of $\frac{1}{8}$ in. per revolution.
References—Figs. 50, 52, 53 and 54.

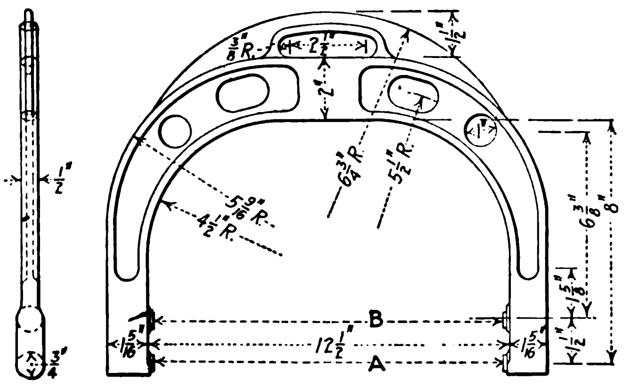


Fig. No.	A	B
57	11.46	11.43
77	12.31	12.30
54	11.97	11.96
52	11.94	11.90

FIGS. 52, 54, 57 AND 77. SNAP GAGES

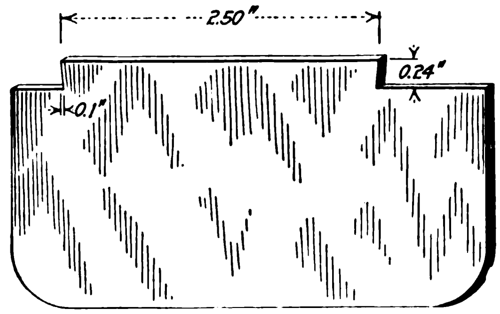


FIG. 58. GAGE FOR BAND GROOVE

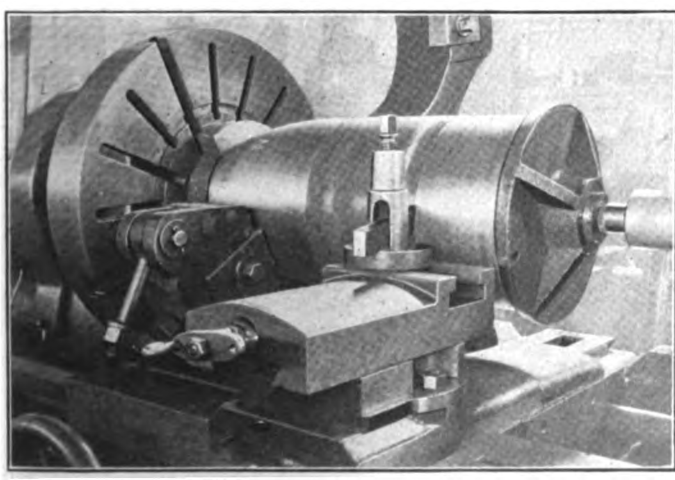


FIG. 55. TURNING REST OF BODY

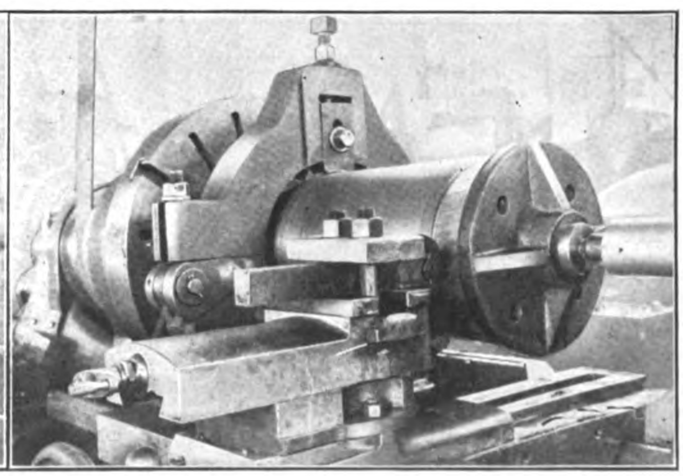


FIG. 60. KNURLING THE CHANNEL

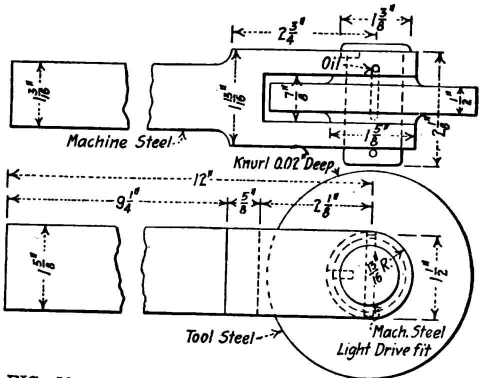


FIG. 59. THE KNURLING TOOL FOR CHANNEL

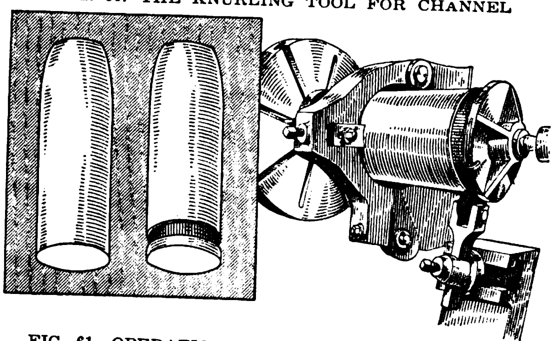


FIG. 61. OPERATION 13: TURNING AND KNURLING
Machines Used—New Haven, Boye & Emmes and special.
Special Fixtures—Two chucks and steadyrest.
Gages—Snap and form.
Lubricant—None.
Note—Between grindings of tool, 2 shells. Lathe operates at 20 r.p.m. with feed of $\frac{1}{16}$ in. per revolution.
References—Figs. 8, 56, 57, 58 and 59.

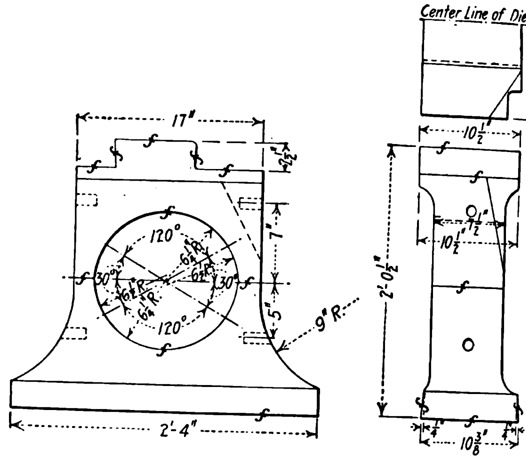


FIG. 63. DIES FOR COMPRESSING BAND

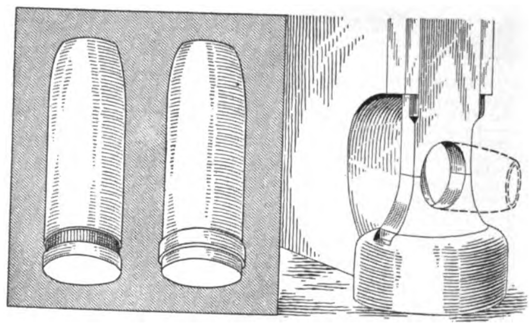


FIG. 65. OPERATION 14: COMPRESSING THE COPPER BAND
Machine Used—Niles-Bement-Pond steam hammer.
Special Fixtures—Dies fitted to steam hammer; special screw bar and clamp for turning shell between dies; trucks to convey between forge and machine shop.
Gages—None.
Production—Six per hour.
References—Figs. 61, 62 and 63.

The gang employed in compressing the band on the shell numbers three—one adjusting the crane that supports the shell, one operating the hammer and the other turning the shell around between the dies. For this purpose the rod that screws into the end of the adapter has a clamp fitted with handles, as shown. A leather cover is slipped over the shell, around which the crane sling is placed, so that the turned shell will not be damaged. A view of the steam hammer with a shell having the copper band compressed is presented in Fig. 64. A diagrammatical illustration of the operation appears in Fig. 65.

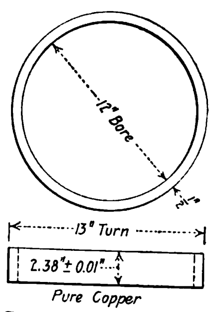


FIG. 62. DETAIL OF COPPER BAND

The shell is next returned to the machine shop for the operation of machining the copper band. The chuck, Fig. 53, is placed on the base end of the shell, and the threaded chuck, Fig. 66, is screwed into the threaded end

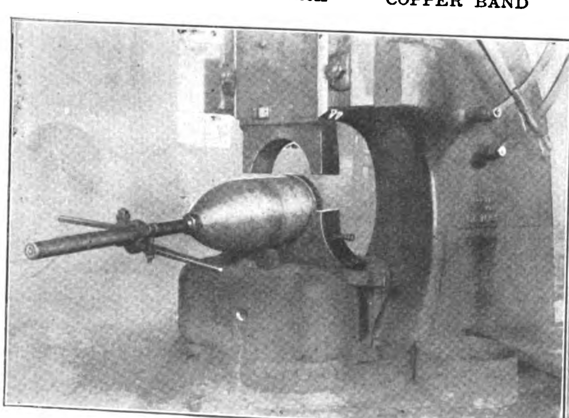


FIG. 64. COMPRESSING BAND ON SHELL

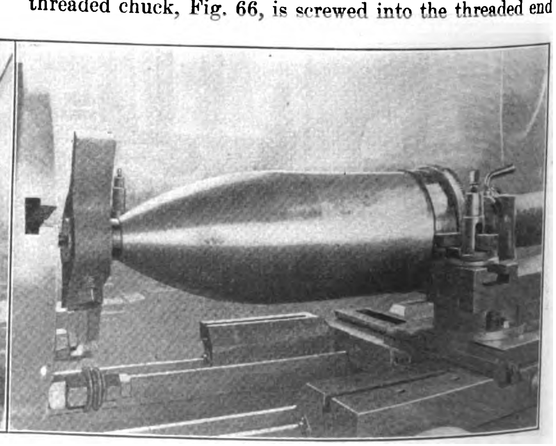


FIG. 70. MACHINING THE BAND

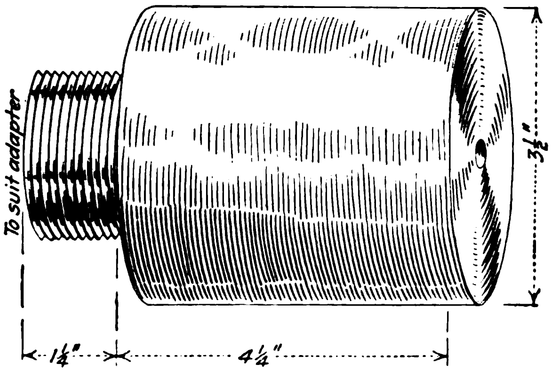


FIG. 66. CHUCK FOR ADAPTER END WHEN TURNING END

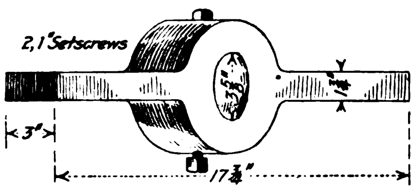


FIG. 67. DRIVING DOG FOR NOSE END OF SHELL

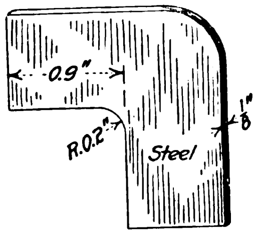


FIG. 69. RADIUS GAGE FOR BASE

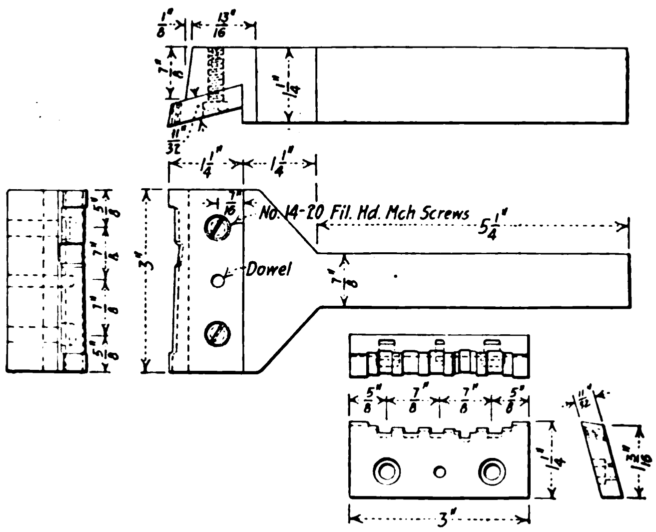


FIG. 68. BAND-TURNING TOOL

of the adapter. The dog, Fig. 67, is fastened on the threaded chuck. A plate held by a bolt on the faceplate of the lathe comes in contact with one of the arms on the dog and thus furnishes the driving medium. The form tool for machining the band is illustrated in Fig. 68.

The gage for testing the machined contour of the band is shown in Fig. 69, while the lathe set-up for machining the band is given in Fig. 70 and again in diagrammatical form, in Fig. 71. The shell is now ready for the final inspection before loading, weighing and shipping.

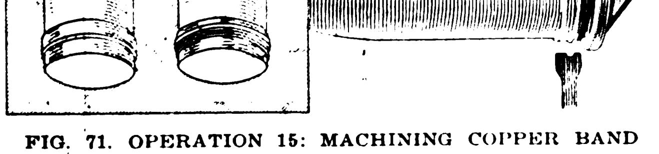
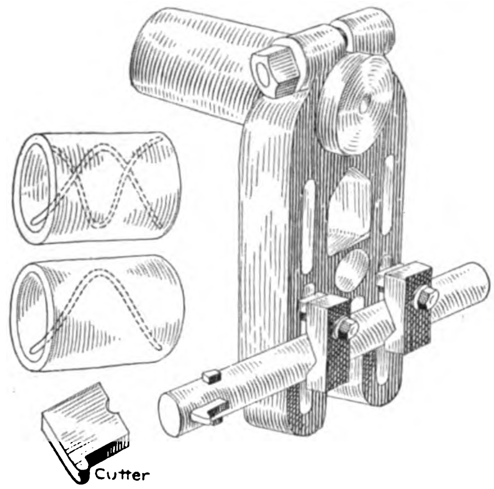


FIG. 71. OPERATION 15: MACHINING COPPER BAND
Machine Used—Boye & Emmes.
Special Fixtures—Threaded-plate chuck and form tool.
Gages—Form.
Production—One shell per hour.
Lubricant—None.
Note—Between grindings of tool, 2 shells. Lathe operates at 150 r.p.m., and feed is by hand.
References—Figs. 49, 52, 65, 66, 67 and 68.

Cutting Oil Grooves in the Miller

By C. E. Applegate

One of the propositions presented to all shops is to cut oil grooves in bushings. The work is frequently done in a lathe department, with a lathe fitted up with special leads. I find that the index head on a miller will serve as well, the spindle of the miller not being used for anything except feeds. A boring bar is clamped on the arm, as shown, and the tool is used in the same way as



CUTTING OIL GROOVES IN THE MILLER

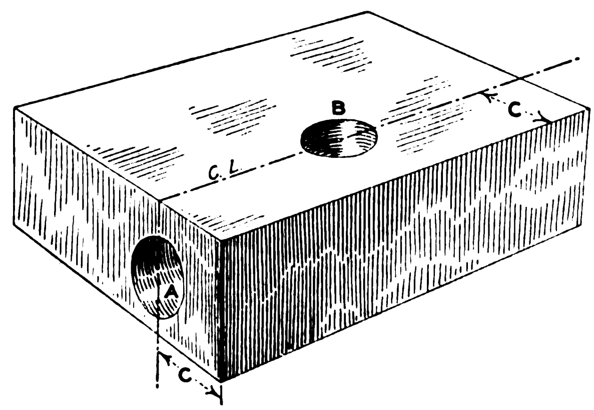
on a lathe. The only difference is that the table instead of the tool holder travels.

If a double oil groove is required, it will call for the second idler gear. For instance, 50 bushings are to be cut. Cut them with one idler gear, then rechuck in the universal chuck and turn the bushing halfway around, to recut and cross the first oil groove.

Drilling Central Crossholes in Round Bars

By W. D. Dawson

A tedious and common operation in the machine shop is the drilling of a hole accurately in a shaft or round pin at right angles to its axis. I need not explain any



THE JIG FOR DRILLING THE HOLES

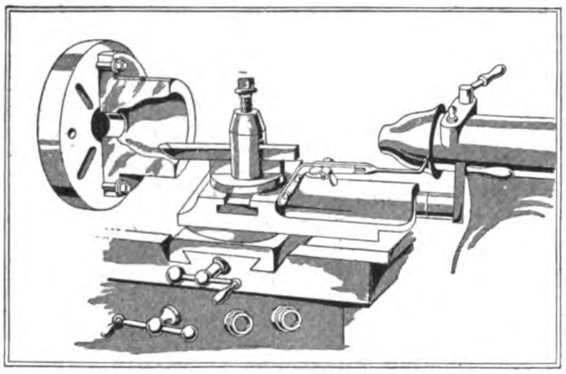
of the many methods of laying out with V-blocks. The illustration herewith explains a tested method.

The holes *A* and *B* are accurately laid out and drilled on the same center line. *A* is drilled the size of the shaft or pin; *B* is drilled the size of the desired hole, after which the work is placed the required distance in *A*.

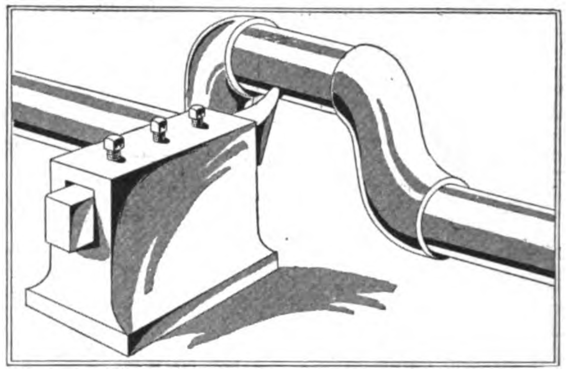
From a Small-Shop Notebook

By John H. Van Deventer

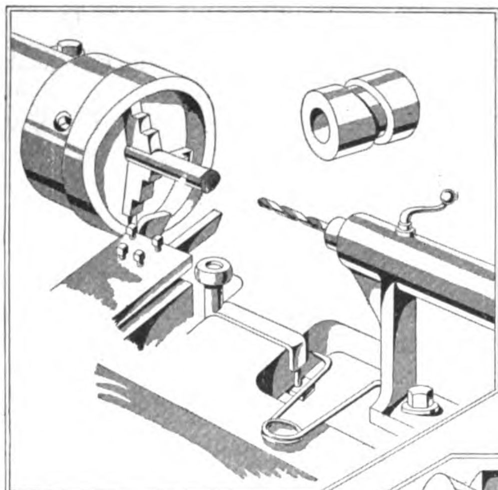
Profile Boring with Tailstock Templet



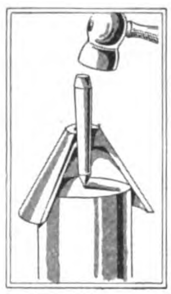
A Special Tool Post for Crank Pins



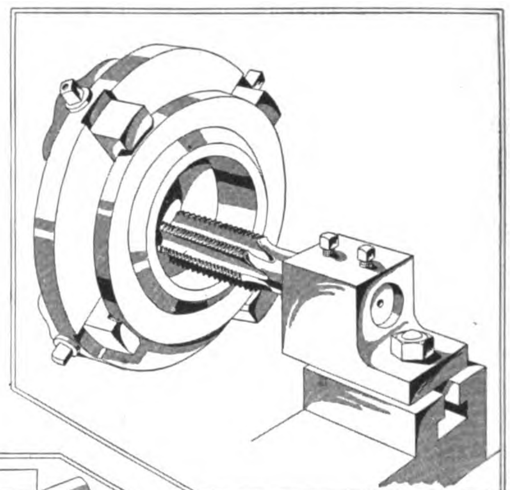
A Screw-Machine Job in the Lathe



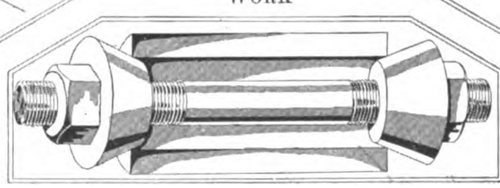
Simple Centering "Machine"



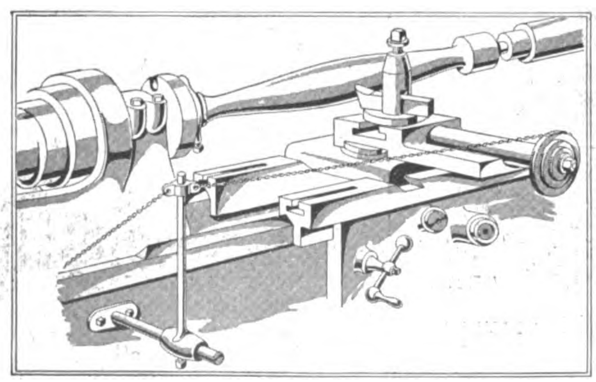
Using a Pipe Tap as a Chaser



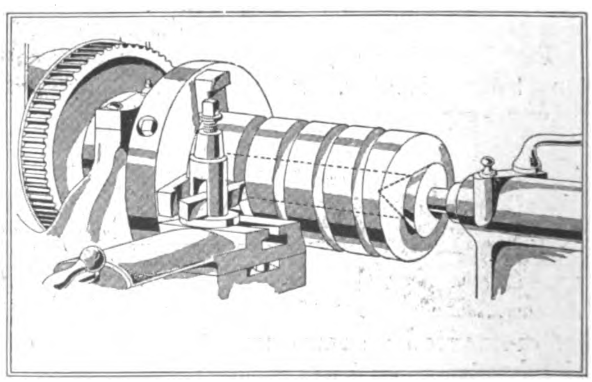
Adjustable Arbor for Heavy Work



Turning a Curve Without Templet

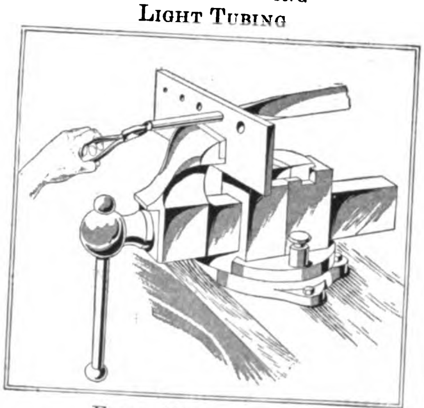


One Way to Make a Heavy Spring



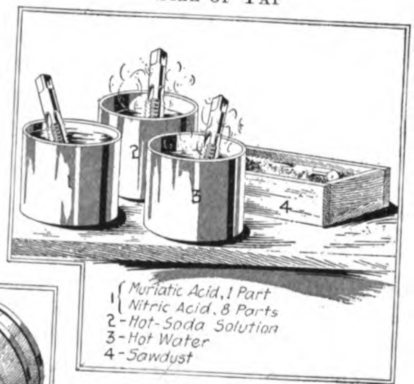
DEVICES THAT MAKE LATHES PROFITABLE

Die for Drawing Light Tubing

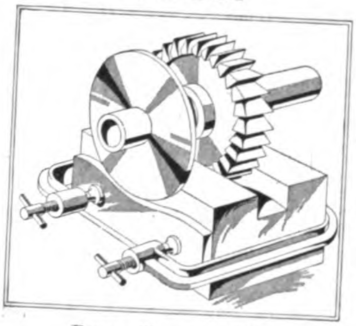


Tumbling "Barrell"

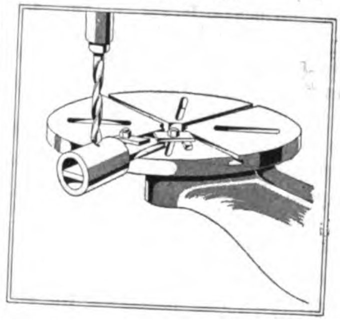
This Gives Reduced Size of Tap



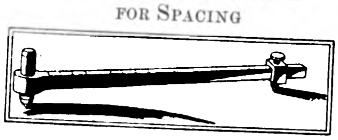
Form Milling to Templet



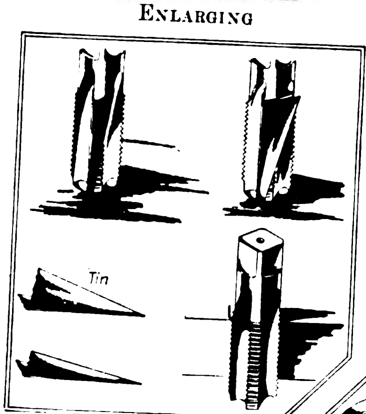
Saves Time on Bushings



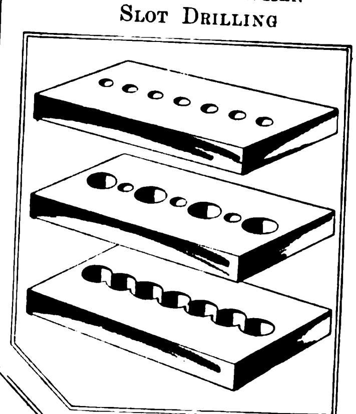
Graduated Punch-Bar for Spacing



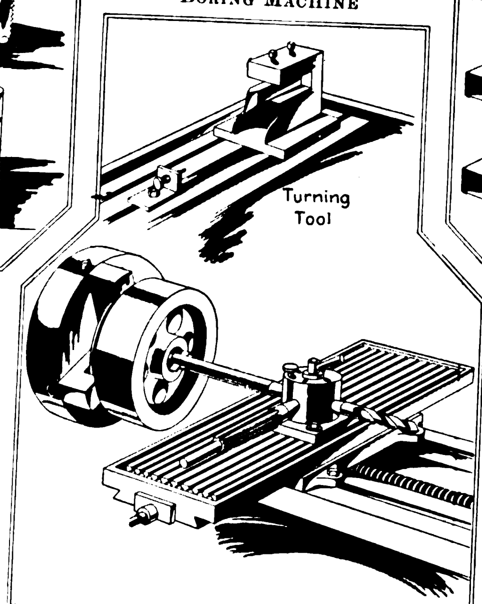
Bent Tin for Tap Enlarging



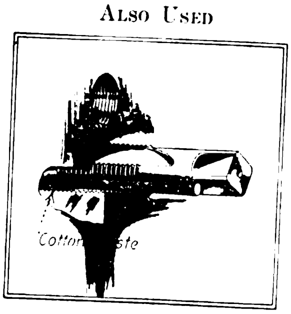
Saves Tools When Slot Drilling



Turret Work on Boring Machine



Cotton Waste Is Also Used



Heating the Tap Enlarges It

A VARIETY OF TIME-SAVING KINKS

Good Toolroom Arrangement and Equipment

By F. C. Mason

Figs. 1 and 2 show two views of a toolroom that I installed for the Bissell Carpet Sweeper Co., Grand Rapids, Mich. In it are manufactured tools, dies, fixtures and special machinery, most of which is semiautomatic or full automatic. The accompanying pictures were taken on a dark day, and it will be noticed that the building it not of modern construction.

The points to be observed are the cleanliness and facilities for convenience, a few of which I think are novel. First, we had things arranged in such a manner that there was nothing on the floor; but everything is in its place and at least 12 in. above the floor, so that the floor can be kept clean. This floor is of hard maple and is scrubbed once a week. The machinery and benches are so placed as to get the best possible natural light.

Details that I desire to call attention to are found in Fig. 2. First, the benches are individual and extend outward from the window. They are made of a cast-iron top plate that weighs 450 lb. and are designed according to surface-plate construction. The top plate is 1 in. thick, ribbed to a depth of 3 in., and is supported on 2-in. iron-pipe legs that are tapped into corner bosses. The top and sides are planed and squared in a first-class manner, thus making the bench a squared surface plate for layouts. This feature can be readily appreciated by active mechanics. The vise is on the right-hand corner, and the workman can turn it in any manner.

To procure the best light, each bench has an adjustable lamp holder of the McCrosby type, which can be readily placed in any position desired. Each man also has a tool cabinet and a stock bench with three shelves, both of which can be plainly seen. These wall cabinets are made of maple, 20x24 in. by 10 in. deep, opened in the middle and locked with a regular chest lock when opened. They have two separate full-sized compartments—one about 3 in. deep and the other 5 in. deep. The shallow one is for the file rack; the back, or deep, one has a small drawer in the bottom and a shelf. These cabinets are furnished with the following tools: A full set of files and handles, two sets of drills—1 set 60 to No. 1; the other, No. 1 to $\frac{1}{2}$ in. by sixty-fourths—a full set of taps 4-36 to $\frac{5}{8}$ standard and two tap wrenches. These tools are charged to the employee and are replaced when necessary.

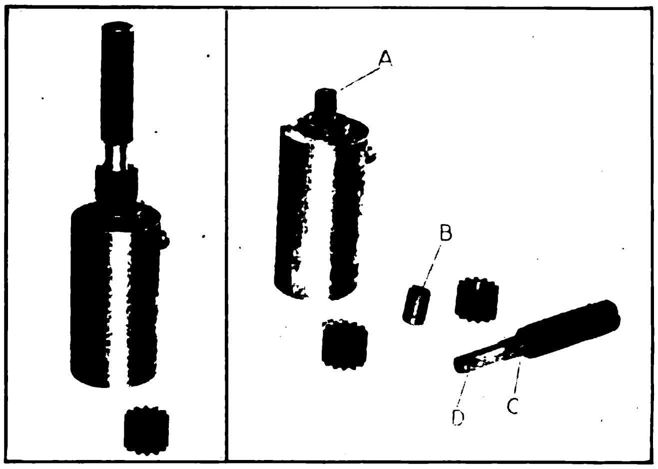
For the benefit of others I would say that the iron benches cost as follows:

Casting, 500 lb., at 3c.	$15.00
Planing	3.00
Pipe for legs, 11 ft., at 17c.	1.87
Four reducing couplings for feet	1.50
	$21.37

The total cost was somewhat more than that of a wooden bench; but when finished, it is always a real asset that can be moved to any place without tearing down, as in the case of a wooden bench.

Bushing a Small Pinion

A method of forcing bearing bushings into small steel pinions is shown in Fig. 1. These pinions are used in a speed-changing mechanism on Henderson motorcycles.



FIGS. 1 AND 2. FORCING A BUSHING INTO A PINION

At first, trouble was experienced in getting the bushings started straight, so this device was made.

As may be seen in Fig. 2, the pinion is placed over a centering sleeve *A*. A bushing *B* is then placed on the forcing pin at *C*. The pilot *D* fits down inside the sleeve *A*. As the pin and bushing are forced downward, the sleeve recedes, allowing the bushing to enter the hole of the pinion. As soon as the work is removed, the sleeve is again pushed upward by a spring underneath, assuming the position in which it is shown. By using this device the bushings are accurately guided the full length of the pinion bore and are not distorted or marred in any way.

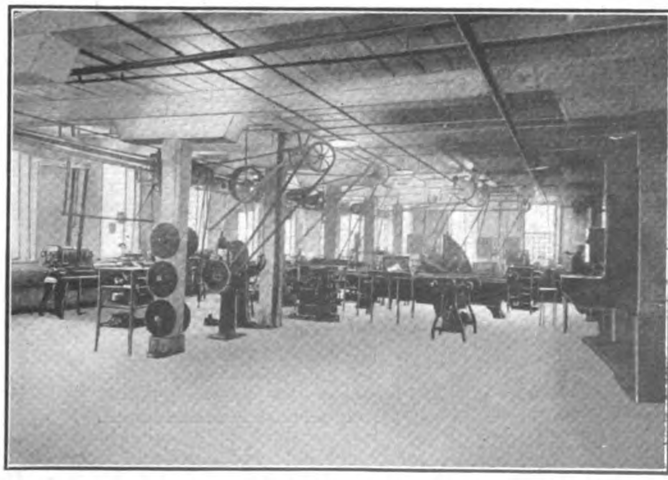


FIG. 1. ARRANGEMENT OF MACHINES

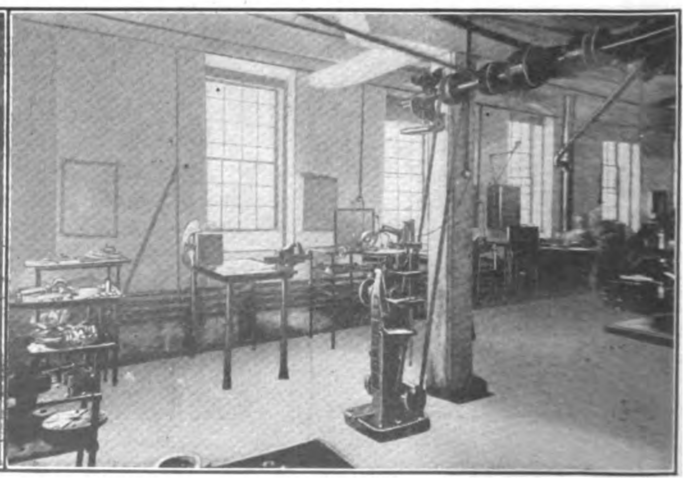


FIG. 2. ARRANGEMENT OF BENCHES

Standard Product Inspection in a College Shop

By J. A. De Turk and G. H. Radebaugh*

SYNOPSIS—The methods and tools used in inspecting the parts of an 8-hp. marine-type gas engine in the shop of an engineering school. Material, both raw and semifinished, all component parts and the assembled units and machines are gone over in detail.

A vital requirement for the successful making of a machine is that the manufacturer deliver it into the hands of the user as nearly free from defects, according to his standard, as is possible. This involves close inspection of component parts, such inspections serving the double purpose of giving the buyer a good product and of eliminating unnecessary manufacturing expense by preventing the application of processes to parts whose eventual rejection is determined at a previous stage of construction. Defects may be discovered at any one of the three following stages of manufacture: (1) Design; (2) material; (3) workmanship. It is not within the scope of this paper to discuss the first two at any length, although it might be well to mention a few points that must be considered in inspection at these stages.

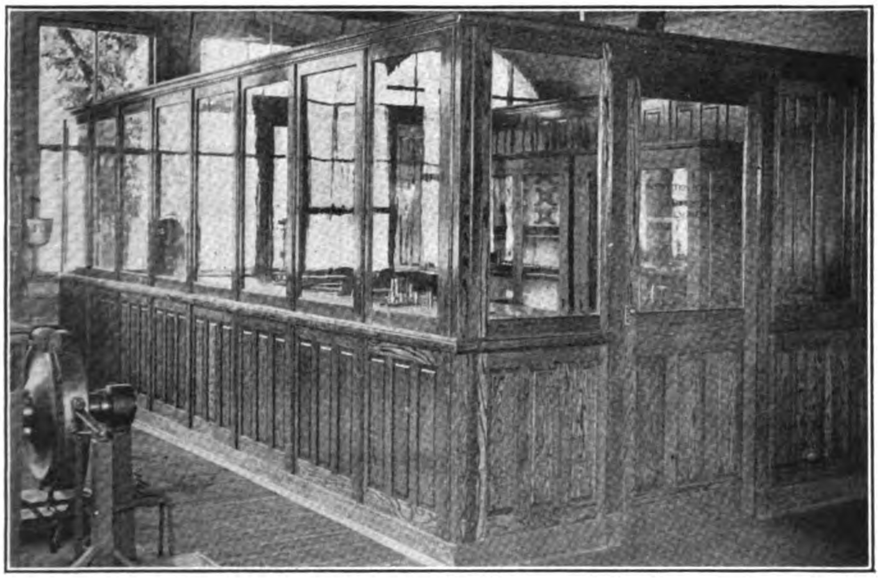


FIG. 1. VIEW OF INSPECTION DEPARTMENT THROUGH WHICH EACH PART MUST PASS

It is inclosed to prevent the workmen from disturbing the inspector or influencing his decisions

The questions arising under design will be somewhat as follows: Have the actual conditions been accurately noted when specifications were drawn up? Have the specifications been correctly interpreted? Have the calculations been checked as to correct assumptions and the factors of safety under which the machine is to give service chosen? Have calculations been checked as to correct formulas and with a view to detecting possible errors? Are the correct dimensions given on the drawing as required by specifications and calculations? Have the pattern, foundry, forge and machine departments been duly considered in the making of the drawing for economical manufacture? Are the drawings accurate, clear and conventional as to views, dimensions, notes, specification of materials and required number of parts?

If the parts are purchased, some consideration must be given to market conditions and to whether the parts may be bought from standard stock or whether they must be ordered as special.

The material to be inspected divides itself into two classes: First, that purchased in either raw or finished form; and, second, that on which the manufacturer does some work later. Before the order for purchased parts is placed, requisitions should be carefully checked. Upon the receipt of the parts, the shipment should again be checked for both quality and quantity. The quality must be determined by general appearance, physical and chemical tests, name and trade-mark, dimensions and weight. Damage in shipment, etc., should be carefully gone into.

Many of the material inspections may be more properly described under workmanship defects, because it is only raw, unalloyed elements of material that man accepts as nature provides. These defects may be classified according to the department in which they arise. Classification of departments depends of course entirely upon the nature of the final product. We may justly assume that the organization required for proper workmanship inspection is larger and more complex, although not more important, than any one of the other three mentioned. This is owing to the fact that there is a larger and more varied human element to consider, this element entering as parts are formed to proper shapes and sizes. The question as to the sources for procuring men sufficiently versed in the foundation of modern inspection to be capable of organizing and directing such a department in any of its modified forms becomes a pertinent one to the manufacturer.

There is no doubt in our minds that colleges and universities should keep abreast of the times and endeavor to give sufficient training along manufacturing lines to enable manufacturers to draw from the graduates men who have at least a fair conception of logical and scientific production. Dean W. F. M. Goss, of the College of Engineering at the University of Illinois, in his paper before the Boston convention of the Society for the Promotion of Engineering Education in 1912, emphasized the fact "that changing conditions in industry and engineering demand the consideration of educators." B. W. Benedict, director of the shop laboratories at the same

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institution, further stated in his paper before the same society at its meeting in Ames, Iowa, in 1915, that "the old formulas which served so well in the pioneer day of industry no longer fit in the new order of things, and failure on the part of educators to grasp the significance of the upheaval going on in the industrial world would be disastrous to the shop and correlative subjects" and, furthermore, that "industry in the past was effective, but not efficient."

In compliance with these convictions a standard product of manufacture in the form of an 8-hp. two-cylinder four-cycle marine-type gas engine was adopted as a product of manufacture at "Illinois." All the parts of this engine, with the exception of the timer and a few auxiliary parts, originate and are developed in the proper correlative departments. The work of the shop is carried on in a rather intense manner, the object being not to attain quantity, but to illustrate the method of modern and scientific manufacture and to give actual practical problems for solution in each department.

MOVE Box No. 27

Part Piston Stock No. 106
Ord No. 35 Lot No. 3 No. in Lot 6

Route	From Mach No	To Mach No	No	Date
1	Stock	23	6	10 10 28
2	23	123	6	11 13 44
3	123	36	6	15 14 50
4	36	120	5	17 16 72
5	120	191	5	19 13 78
6				
7				
8				
9				
10	To Stock Room			

J. Smith
Routing Asst

Form 196 (1-15-5M)
University Of Illinois
Shop Laboratories
Machine Dept
Inspection and Move Card

FIG. 2. SPECIMEN MOVE CARD

Its presence is an indication for the routing assistant to move the job either to the inspection department or to another machine

INSPECT

Route	Man No	Pass	Reject	Work Over	To Move Total	To Move Date
1	225	6	0	0	6	11 08
2	220	6	0	0	6	13 46
3	237	5	1	0	5	15 16 72
4	235	5	0	0	5	8 44
5						
6						
7						
8						
9						

Work Over Report

John Doe
Inspection Asst

FIG. 3. SPECIMEN INSPECTION CARD

It records the result of the inspection and indicates what corrections, if any, must be made in work that has failed to pass

One of these problems is inspection. Each of the four departments (pattern, foundry, forge and machine) maintains its own inspection department. The object of this instruction in inspection is fourfold—first, to illustrate methods of modern inspection; second, to insure the rejection of an imperfect part before a succeeding department has expended labor upon it; third, to prevent an imperfect part from finding its way into the finished product; and, fourth, to furnish data for calculating each student's efficiency and grading his individual work.

Pattern Shop and Foundry Inspection

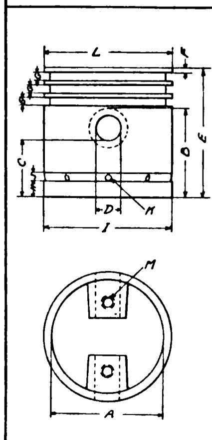
In the pattern department each pattern is inspected for defects of dimensions according to drawing figures, defects in quality and color of painting according to color table specifying a particular metal, defects in glued joints and in shrinkage, draft and finish allowances. Core boxes and core prints are compared with the pattern, to insure proper matching. It must be noted whether dowel pins and rapping plates are sufficient and properly located, fillets sufficient in size and securely held and pattern number correct and securely attached.

In the foundry the raw materials are subject to such inspection as will guarantee the proper selection of molding and core sands, core binders, flasks, fuel and the raw metals. The molds are inspected before they are closed, to insure properly tamped sand, cleanliness of mold, proper setting of cores, venting and location of chaplets. Gages are used to test the accuracy of the cores, thus eliminating filing and fitting by the molder. The mixtures and the temperature of the pouring metal must pass inspection before the metal may be poured. Knock-out and a trimming inspection are made to avoid the cleaning of an imperfect casting. The first casting from the pattern is checked with the drawing, to determine if shrink and finish allowances are correct. The following questions are tabulated, and each casting is checked for each item before it is delivered to the machine or assembly department:

Card No. **1-6**. Pattern No. 1-24A Stock No. A106
Part Piston Metal Aluminum
Article Gas Engine Wt. Finish 1 1/4 Lbs.

Inspection Standards
Machine Dept.
Shop Laboratories
University of Illinois

Sketch of Part



	Gage Type	Gage		Size	Limits Max.	Limits Min.	
1	Internal Limit	Ga 16.194	A	3 1/2"	3 1/2+1/64	3 1/2	B4
	Rule	Ru 19.5	B	2 11/16"	2 11/16+1/32	2 11/16-1/32	B4
2	Rule	Ru 19.5	C	1 3/4"	1 3/4+1/64	1 3/4-1/64	B4
	Plug Limit	Ga 16.195	D	27/64"	27/64+.000	27/64-.000	B4
3	Rule	Ru 19.5	E	4"	4+1/64	4-1/64	B4
	Rule	Ru 19.5	F	5/32"	5/32+1/64	5/32-1/64	B4
	Snap	Ga 3.1	G	1/4"	Fit	Fit	B4
	Rule	Ru 19.5	H	1/2"	1/2+1/32	1/2-1/32	B4
	Caliper Limit	Ga 12.16	I	4 1/32"	+.005	-.005	B4
	Rule	Ru 19.5	J	1/4"	1/4+1/64	1/4-1/64	B4
4	Rule	Ru 19.5	K	3/16"	3/16+1/64	3/16-1/64	B4
5	Caliper Limit	Ga 12.17	I	3995"	3995	3994	B2
	Caliper Limit	Ga 12.37	L	3992"	3992	3990	B2
6	Test Plug	Ga 20.6	M	5/16-18	Fit	Fit	B4
	Plug	Ga 16.58	D	3/8"	Fit	Fit	B4

FIG. 4. A TYPICAL INSPECTION CARD

There are 167 of these cards standardized for inspecting the main parts of the engine

(1) Is the material the kind specified? (2) Are cores and core rods properly removed? (3) Are castings properly cleaned and chipped? (4) Are there any overlapping parting lines? (5) Do any cold shuts or shrink cracks exist? (6) Have any of the cores shifted? (7) Are there any sand or blow holes? (8) Does the casting have a solid and nonporous appearance? (9) Has there been any filing, painting or calking done to cover defects? After each casting has passed these requirements, it is further tested with templets and solid fixed gages for accuracy of important "close" and "finish" dimensions. The final inspection is entirely on the quantity delivered to the machine or assembly departments.

The inspection of purchased materials plays a large and important part in the forge department. All bars, tubing, sheet metals, etc., are examined for both quality and quantity. The various grades of steels are marked and tabulated according to composition. The finished

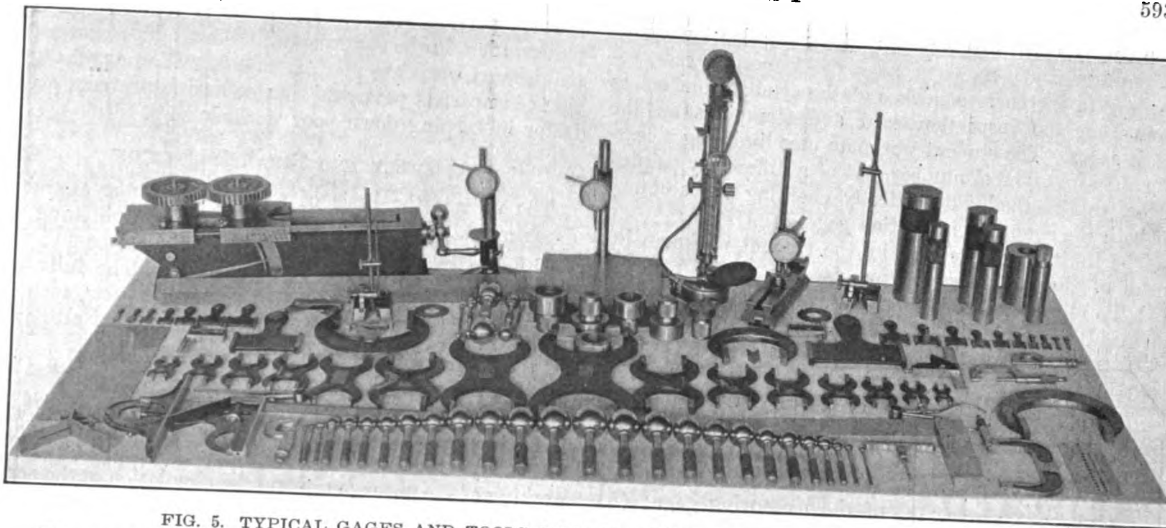


FIG. 5. TYPICAL GAGES AND TOOLS USED FOR INSPECTING THE STANDARD PARTS
The gear-testing machine, scleroscope, celluloid templets and dial gages are clearly shown. Each tool bears a symbol number, the corresponding number being specified on the shop instruction and inspection cards

forging is examined according to the following questions: (1) Is it made of specified material? (2) Are there any pipings or seams? (3) Are there any faulty welds? (4) Was the metal overheated to such a degree as to leave any burns? (5) How do the dimensions compare with those of the drawing? (6) Is there a sufficient allowance of metal where the forgings have to be finished? (7) Do the templets and gages fit properly? (8) Are there any cracks or is there any warping of annealed or hardened parts? Samples of annealed and hardened pieces must be taken from each heat and tested for hardness with the scleroscope, according to the adopted standards of the Society of Automobile Engineers, before these pieces are delivered to the machine or assembly departments.

The machine shop necessarily requires a larger inspection department than does any one of the other three mentioned, owing to the numerous operations and extremely accurate dimensions required on many parts. It is necessary to bring out, and often to use, one or more of the following styles of inspection: (a) First piece, (b) selective, (c) operation and (d) final; the nature of the part and operation determining which style or styles must be used. These may be applied on the floor, at the machine or in the inspection room, Fig. 1. The operation and inspection-room styles play an important part in the college shops.

Assuming that a student is assigned to grind a lot of five pistons, he is directed by his work-order card to the machine, where he finds his stock in the tote-box. On the outside of the box is a card holder bearing the letter of the section and the "move" card, Fig. 2, properly filled out. Since grinding is the fifth operation, we find the grinder number indicated in the corresponding fifth-route column.

On the completion of the five pistons the student secures another job. The routing assistant takes the pistons to the inspection department, where he reverses the "move" card, bringing the "inspection" side front, Fig. 3. This is an indication for the inspector to examine the pistons.

The inspector turns to this particular stock number in his inspection book and inspects the items *G* and *H* under the operation No. 5, as shown by the inspection instruc-

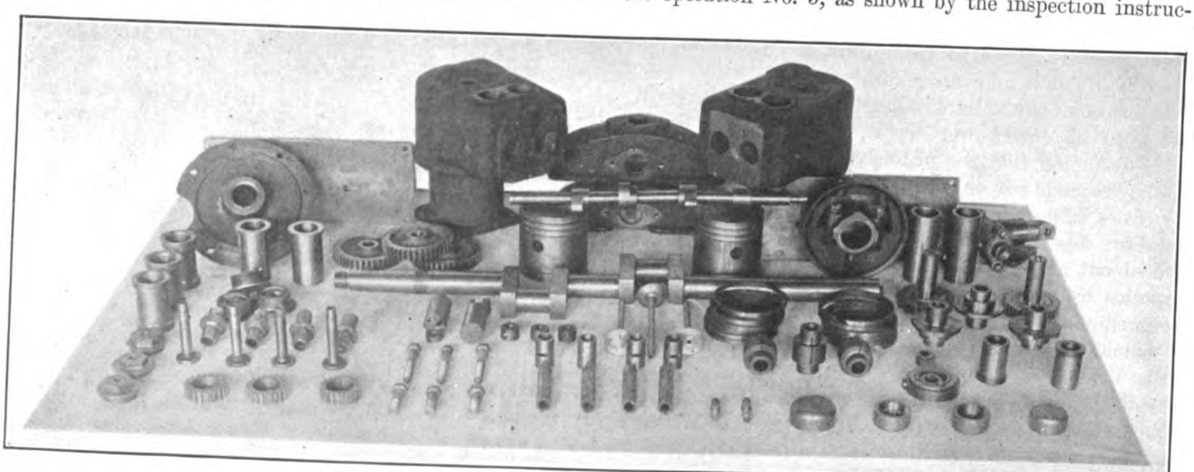
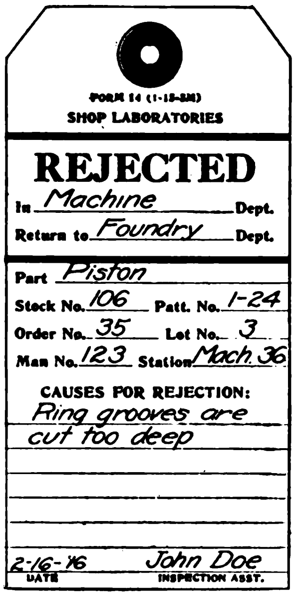


FIG. 6. TYPICAL SET OF PARTS FOR INSPECTION
Each embryo student inspector is required to inspect and report the errors in this set. The pieces are improperly finished gas-engine parts

tion card, Fig. 4. He looks for the inspection tools, Fig. 5, required and gets them from the inspection case, according to the correspondence of the symbol numbers as shown on the inspection card and stampings on the limit gages. The student workman uses limit gages bearing the same symbol number, but of a differently painted color, this method automatically checking the accuracy of both the shop and inspection gages.

The limit gages are used by the student workman instead of the customary micrometer for several reasons: (1) To eliminate the personal judgment of "feel"; (2) to avoid the accidental use of a strained or inaccurate micrometer; (3) to save the micrometer from rough usage, thereby avoiding frequent testing for inaccuracy; (4) to increase production by eliminating the adjusting of the measuring gage; (5) to obviate possible mistakes due to setting or reading a micrometer inaccurately.


SHOP LABORATORIES

REJECTED

In Machine Dept.

Return to Foundry Dept.

Part Piston

Stock No. 106 Patt. No. 1-24

Order No. 35 Lot No. 3

Man No. 123 Station Mach. 36

CAUSES FOR REJECTION:

Ring grooves are cut too deep

2-16-16 John Doe

DATE INSPECTION ASST.

FIG. 7. DEFECTIVE WORK TAG

Each part found defective, due either to material or workmanship, is tagged with one like this. Replacement orders are placed according to the tabulated information given by these tags.

The grade of finish required is designated by one of the finish symbols; for instance, *B2* calls for a "smooth machine-ground" finish. That the new inspector may acquire a degree of confidence, skill and judgment and at the same time become familiar with the instruction book, he is required to inspect a few sample parts.

A few of the engine parts, Fig. 6, have been purposely machined to prevent their coming to required dimensions. Some such imperfect pieces for inspection are too large, others too small; some have parts out of round or threads cut left hand instead of right hand. General appearances in finish and polish are usually correct, in order that the student may have some idea of the requirements. It may be noticed that there were originally six pistons in the lot, but that one piston failed to pass the inspector on operation No. 3. Had the failure to pass been due to an oversize dimension, the inspector would have indicated that fact on his "work-over report," Fig. 3. Assuming that the piston was beyond redemption on account of the groove s being turned too deep, the inspector tags it with a rejection card filled out as shown in Fig. 7. Parts spoiled by wrong workmanship are so tagged and placed in plain view of the shopmen. The psychological effect of the display is believed to decrease the spoilage. The tags are collected, and the information recorded on them is tabulated. Replacement orders are placed per information on thees cards. After inspecting the last operation of a part, the inspector directs correctly finished parts to the storeroom. The routing assistant places orders in the storeroom as the assembly department requires. Curves are plotted, Fig. 9, section against section of imperfect parts, this device having proved a great factor in keeping down poor workmanship.

Assembly and Final Inspection

The unit is the basis of assemblage in the assembly department. Each unit is inspected for tightening of nuts and bolts, form and location of oil grooves and for assurance that no part has been omitted. The fully assembled engine is inspected for the missing parts, such as oil cups, priming valves, etc., and to insure that all parts are securely and properly held.

The final assembled engine is next subject to a test or inspection under its own power in the testing department. Here, the heat of the bearings, the valve settings, etc., are accurately examined and adjusted if necessary. The working of the water pump and the circulation of the cooling water through the cylinders are carefully observed. After the bearings are sufficiently worn, the engine is coupled to the dynamometer, as shown in Fig. 8, a brake-horsepower test is made, and the curves are plotted under various conditions. Later, the engine is inspected for filling and painting and for shipping finish on polished surfaces. In shipping inspection it is necessary to see that polished parts are properly covered with nonrusting preparations, that the name plate is correctly stamped and securely attached, that the engine is suitably crated and that all the specified loose parts are securely packed. A few of the vital parts of the engine are periodically selected at random and taken to the physical-inspection department. Here they are placed in a 20,000-lb. testing machine and tested for tensile, compressive and bending strength.

The reader no doubt realizes that the inspection of the standard product is only a small part of the general inspection problems and that the necessity and methods of inspecting equipment, forms of belting, oils, machines, special tools, jigs and fixtures, safety devices, fire protection, sanitary conditions, transportation facilities, etc., present problems worthy of the closest consideration.

In conclusion, it may be well to state that the inspection department should be entirely separate from the production department. The chief inspector should have

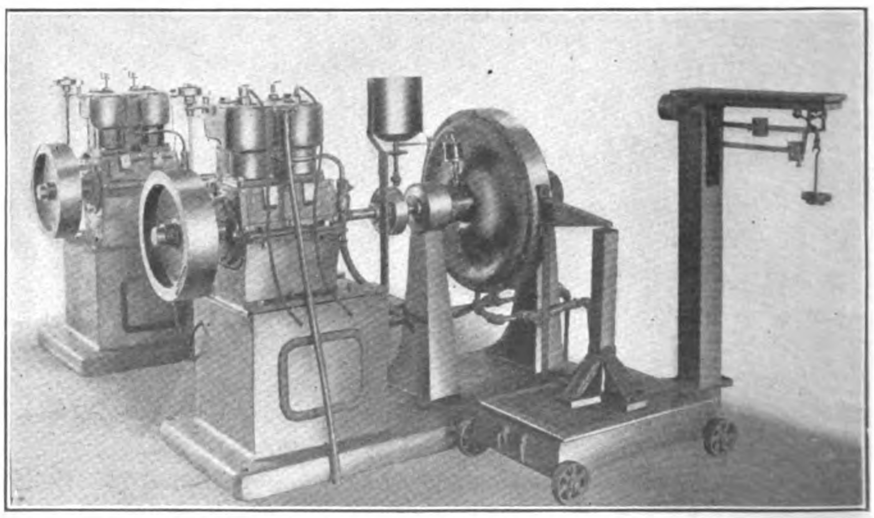


FIG. 8. VIEW OF THE TESTING BLOCK

Each engine is coupled to the Richards hydraulic dynamometer, which is bolted on one end of the test base

absolute and final say as to whether or not a part comes up to specifications, he alone being responsible for this matter to the general work manager. To be a good inspector, a man must work with the production department, not

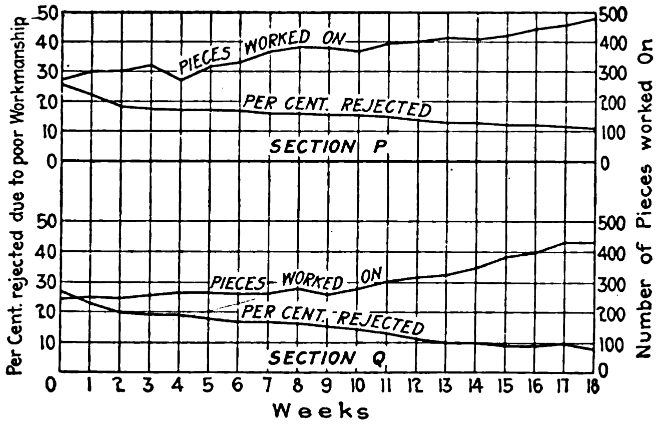


FIG. 9. SPOILED WORK REPORT

Curves similar to these are plotted weekly for each section or shift and posted in a conspicuous place. The rivalry created between sections to keep down the spoilage and increase the production more than warrants the expense for upkeep of the curves

against it; he must be a good mechanic and must be decisive in character; he must be even-tempered, firm, fair-minded and—a gentleman.

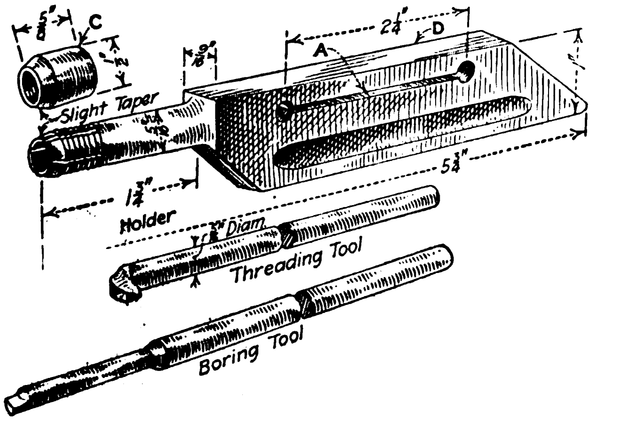
Boring-Tool Holder

By H. M. Darling

The tool holder in the accompanying illustration is intended for tool makers' use. It saves using clumsy, inefficient forged tools for light, accurate boring operations in the lathe.

The holder is made of tool steel, hardened and drawn to a spring temper. A $\frac{5}{16}$-in. hole passes clear through it lengthwise. At A is a $\frac{1}{8}$-in. slot, $2\frac{1}{4}$ in. long. The tapered nose B is split by four $\frac{1}{32}$-in. saw cuts.

The tools are made of $\frac{5}{16}$-in. drill rod. In use, one of these tools is inserted in the $\frac{5}{16}$-in. hole, with the cutting point projecting the proper distance. The knurled



TOOL HOLDER FOR LIGHT BORING OPERATIONS

nut C is screwed tightly on the tapered nose B, thus securely clamping the tool at that point. The holder is then placed in the tool post of the lathe. The tool-post screw clamps tightly at about the point D. The slot A permits considerable spring in the holder at this point, which causes the tool-post screw to secure the inserted tool very tightly. Thus, a boring tool is made as rigid as, and much more useful than, a forged tool.

Sammy's Shop—Time Keeping and Cost Keeping

By W. Osborne

Sammy did not really own the shop, but it was the place that he had possession of in his working hours to make a living in. It was a little shop, and Sammy was the foreman. A number—yes, a number of men and boys—worked there, and Sammy was the responsible working head of the working force. Mr. Brown, who owned the shop, expected Sammy to know enough to have things done right and material used right; and all matters of discipline were turned over to him.

If an employee came in late and Mr. Brown saw him, it was put up to Sammy; if a customer did not like the way his job was done or the size of his bill, it was put up to Sammy; and if a workman did not like the work he got or the amount of his pay, it was put up to Sammy; and if—but space is scarce, and some of you know the kinds of things that are put up to a fellow who is between the upper and the lower millstone, or the devil and the deep sea, or something like that, and they were all put up to Sammy.

You see, it was a little shop, and Sammy was the only one that there was to put these things up to, and so they came up from the bottom and down from the top. Really, though, Sammy was not much of a foreman; he had not served time enough to learn the business. To tell the plain truth about him, he had never served under instructions at it. It was a good thing for him that it was a small shop without much experience, either.

Mr. Brown wanted to make money from the shop. He took work from anyone that came along and made cornshellers or things like that, too. Each workman filled in a little slip of paper each day, to show what he had been doing. The time book was filled in from these slips, and the customer was charged from them. Sammy took these slips and looked them over enough to see that they stated facts. Then Mr. Brown did the rest of the office work with them.

Mr. Brown was a real captain of industry, for he spent all of his time with that shop. He could go out and hunt for work, and often hunt harder yet for the money that paid for it, attend to all of the office work and lend a hand in the shop when he was needed—and some fellows used to think that he lent a hand at times that made it embarrassing.

These things made him competent to ask a lot of questions about the work and the time it took to do it and all that sort of thing. Sammy soon found that he had to know how long it took to do each of the jobs that were done more than once, and of course that applied to all of the parts of the cornshellers. Sammy had a lot of things that he carried in his head and lots more that he put into private notebooks.

The shop grew—the corshellers were good ones—and Mr. Brown got so busy selling them and doing other things that he hired a bookkeeper. Then he began to ask the bookkeeper all sorts of questions about costs that the bookkeeper did not know anything about, but which it embarrassed him to have Mr. Brown ask for.

At first it seemed very easy to get the cost on a cornsheller. All one had to do was to charge up all of the material, labor and other things and add it up, and there

it was. Mr. Brown very readily called the bookkeeper's attention to it. In fact he called the attention of several bookkeepers to it. It seemed strange, but somehow bookkeepers did not get up much enthusiasm along that line; or if they did, it did not stay with them. Some of them got figures that were too good in results to be true, and some got figures that were too bad in results to be true, and some got only figures, without getting results.

Finally, one bookkeeper explained to Mr. Brown that cost getting required a cost keeper and not a bookkeeper. Mr. Brown was willing to agree, from his experience, with the last part of it. He got a cost keeper. Mr. Brown at once understood that a bookkeeper and a cost clerk were entirely different. The salary account showed it to him.

Sammy began to have troubles of a new kind. For a cost keeper to operate, he must have information. This information must come to him in a way that he determines. It *must* come to him. It *must* be in the form that he says. This is reasonable. As steam is to a steam engine, so is proper information to a cost keeper; and the supply should be regular and constant, just like the supply of steam to the engine. Sammy got his kind of information from the time slips. He thought that the cost keeper should be able to do the same. No, No! They were primitive, inadequate and some more things, but they were no good.

Sammy found that the shop now had two bosses. The one that must be pleased was the one that required the new records, and Sammy found that the records kept by himself—the boss who had to get out the work—showed not as well as they had been doing. He at once contended that the difference should be charged to cost keeping. He was shown how ignorant he was of such things; but not being able, or willing, to understand, there was nothing for the cost keeper to do but declare war against him. Then Sammy thought he had to fight back. Mr. Brown was drawn into the matter and was forced to give some attention. Fewer cornshellers were now being built by the same number of men working the same number of hours. Sammy said that it was caused by the records taking so much time and attention.

The cost keeper said that the shop had been running slipshod before, that the men did not like system and were trying to queer his work. Sammy asked Mr. Brown to fill out the records and time himself. The cost keeper explained to Mr. Brown that, if the shop was run as a shop should be run, fewer records would be needed. Sammy replied that he was not responsible for the way Mr. Brown got the orders. He would be very glad to have them come in bunches, but so far they never had.

Mr. Brown could not understand why cost keeping needed to interfere in any way with getting out the work. Sammy and his force were to get out the work. That was what they were there for. The cost keeper had been put on to give certain information that was needed by the sales department and was entirely separate and apart from the doing of the work. If the cost keeper needed more help, he should get it; and it should be subject to his orders and to his only.

To carry out such a plan, the cost keeper put on a clerk who went around once an hour and made records. It was very hard to get a man who could do this. A man who was clerk enough to do it would be without shop experience and mix things up. A man who had shop experience would not be clerk enough. Many ways were tried. Many men were tried. Many cost clerks were tried. Many systems were tried. The perfect cost keepers and the perfect systems were the ones that had not yet been tried. All of them had good points, and all of them had bad points.

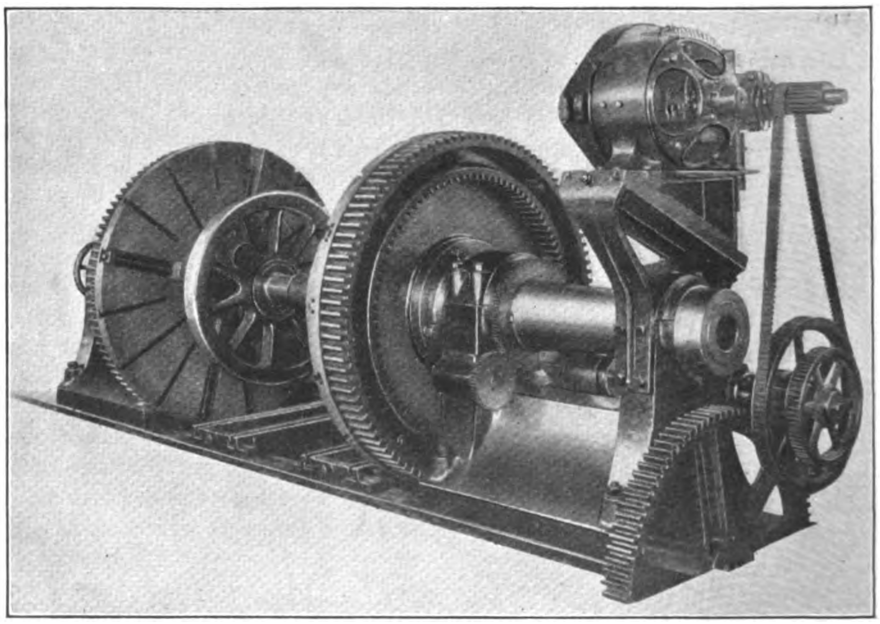
Mr. Brown has acquired a nice library that tells of many systems and is now using a sort of mongrel system that is full of faults and does not please anybody, but is the best compromise that he has been able to work to fit the shop conditions that he is able to supply. Perhaps if he had nerve enough and money enough, he could make some of these other systems work much to his profit. Sammy has not seen any system that is as good as his own for helping him get out the work.

First Wheel Lathe in Brazil

The illustration shows what is believed to be the first wheel-turning lathe that went to Brazil. It is of Niles-Bement-Pond make and was shipped in 1902 to the shops of the Mogyana Ry., at Campinas, in the State of Sao Paulo, Brazil.

The superintendent, Charles Stevenson, has introduced individual motor drive on nearly all his large machines, the method of applying it in this case being clearly shown at the right. The motor bracket is fastened to the outer bearing support and has an incline on which the motor base is supported. This arrangement makes it easy to adjust the different distances between belt centers so as to take up any slack, by simply moving the motor up or down the incline.

The motor is geared to the driving pinion shown, and two ranges of speed can be obtained.



THE FIRST WHEEL LATHE IN BRAZIL—INSTALLED IN 1902

Machine-Shop Small Tools*

By W. Rockwood Conover†

SYNOPSIS—An outline of the economic considerations underlying the design, making and stocking of small tools in the machine shop. Importance of insisting that wornout or broken tools be returned before new ones are issued is emphasized. The recutting of files is referred to as a questionable economy. It is pointed out that the standardization of tool heat-treatment is of vital importance to the manufacturer.

To discuss the subject of tools from the standpoint of the tool specialist would require a volume devoted exclusively to it. The subject offers opportunity, however, to suggest certain economies that may be effected through proper care and methods in the distribution and handling of tools, and to call attention to certain advantages, such as increased production and reduced labor costs, that may be gained through the installment of improved standard and special machine tools. To the manufacturer whose factory is not fully equipped with modern labor-saving tools or who has not already given the subject of equipment, care and use of tools exhaustive investigation and consideration, it is hoped some suggestion may prove of value and aid in saving no small percentage of waste and loss during the year.

In large manufacturing plants, and in those of lesser size as well, the central tool stockroom, under the supervision of a competent person, provides for the limitation of orders to a point within the demands of the several departments. It also permits the purchase of standard tools in such quantities as will secure the lowest market prices and prevents the accumulation of excessive stocks of duplicate tools in the various shops. In general, the keeping of tools in individual departmental stockrooms, except such standard tools as may be in frequent or constant use or such as are specially designed or purchased for specific purposes within the department, is uneconomical and tends to waste.

All orders from the department foremen for standard tools or special tools to be purchased from outside manufacturers and dealers should pass through the hands of the central toolroom keeper for his scrutiny and approval. A considerable percentage of these can be filled from stock on hand. It will also be found in frequent instances that orders placed by a foreman for tools for a new job can be filled with tools previously purchased for a partly, if not entirely, similar purpose, which are lying idle in some other department or shop and which may be adapted to the special work. The central toolroom keeper is in a position to know from his records whether or not such tools are on hand and to make investigation with the greatest facility and least delay.

All the tools of the individual shop department, except such as are in constant use, should be kept in the toolroom, arranged in systematic order so that they are easily accessible on requirement. It is bad practice to allow the workman to leave his tools lying about the benches or on the shop floor about his machine, awaiting another job requiring their use.

Special tools, such as special cutters, special hobs, etc., which have been ordered or made for occasional use in a given department, but which may be adapted to the work of another department, should be sent to the central toolroom on completion of operations, in order that they may be available for use wherever needed and save unnecessary duplication of orders either on the tool-making department or on the outside manufacturer. The same is true in reference to gages that are used only occasionally in a given department. Gages that are in constant use in any department may be kept to advantage in the toolroom of that department, but they should be sent to the central toolroom regularly at the end of each week for calibration or inspection. This practice will frequently avoid serious errors in dimension, which are otherwise likely to occur. Large special gages may also be retained to better advantage in the toolroom of the department where they are used, if not adapted to the work of any other department.

All standard-tool orders or applications presented to the tool stock-keeper by the workmen should be signed by the foreman and accompanied by the worn-out or broken tool that is to be replaced. This practice will prevent new tools being given out unnecessarily before the old have become sufficiently worn to require replacement. In the case of files there is always a tendency on the part of the workmen to obtain new ones before the old have become fully used or worn. If the worn file is taken to the foreman with the order to be approved, it gives the foreman opportunity for inspection and rejection of the order, if deemed necessary.

All new tools furnished individual employees should be given out on the check system and a record made of such delivery by the toolroom keeper. Each new employee engaged should be provided with a sufficient number of checks to obtain from the central toolroom a complete set of such tools as he requires for his work. On leaving the employ of the company his quit blank is checked with the record and bears the signature of the head tool-keeper, as evidence that the tools supplied him have been returned to the toolroom.

Designing and Making New Tools

In the making of new tools there is a large field, practically without limit, in which the designer or specialist may accomplish many important economies. The manufacturer who is confident that his tool account is already reduced to the lowest limit possible to attain and that his equipment is all that could be desired will find in frequent instances that tools of a different style, shape or dimension from those he has been purchasing, or from those previously made and in present use, are possible of design, which will not only do better work, but permit increased speed and consequent increased productive output. While these cases may not always be readily discovered by the average shop foreman, it is here that the man specially fitted and trained will, through long experience, effect many valuable substitutions.

*Prepared for the author's forthcoming book on "Industrial Economics." Copyright, 1916, Hill Publishing Co.

†Factory economist, General Electric Co.

The making of new tools should always be covered by a separate shop-order number or job number, against which all labor and material can be charged, in order that an accurate cost may be obtained. These data are valuable also in cases where it becomes necessary to make duplicate tools for the same purpose or similar tools for other purposes and are frequently the means of effecting a reduction in the amount of time required for the work.

It is often advisable to have one or more tool makers located in each department for doing work that can be more advantageously attended to close at hand, and also where frequent trying of samples or repeated fitting is required in the making of special fixtures or tools. This is equally true in the case of repairs, which, more often than otherwise, call for immediate attention. Although tool designing and tool making are in the largest degree specialties, there are many simple tools and appliances for facilitating his work that can be made by the average mechanic at a much lower cost than by the high-grade tool maker; and much valuable time may thereby be saved and long stoppages of machine tools be prevented.

Draftsmen as Tool Department Assistants

One or more draftsmen should always be located in the main, or larger, tool-making department as assistants to the tool foreman. The value of this suggestion is evident. Frequently, the shop foremen requesting tools to be made are able to furnish a rough sketch only, with oral explanations as to what style of tool is wanted or the work it is desired to do. These rough sketches should always be reduced to working drawings before they are turned over to the tool maker. It will quite often be found during the process of making these drawings that important changes can be substituted that will not only reduce the cost of producing the tool itself, but that will render it of better and more practical service to the department ordering it.

The employment of a draftsman is also necessary for doing a large amount of sketching or drawing in connection with various tools which the foreman of the tool department may design for new work or to increase production or for changes and improvements that may be discovered possible in tools already in use in the shops. A correct working drawing or sketch placed in the hands of the tool maker saves a large amount of time, which is usually wasted in studying rough pencil sketches, and enables him to proceed promptly and intelligently with his work.

It is well to divide the work of the tool department, assigning separate gangs of men to the various processes of machining—such as operations on lathes, shapers, surface grinders, boring mills and planers, millers and universal grinders—and other groups to the processes of finishing and assembling. By following this practice the machine tools are kept more nearly constantly busy and the work of the department is conducted more economically as a whole.

Regular weekly or monthly reports, showing the amount expended in the various departments, both for tools made and for those purchased or drawn from stock, should be furnished the central tool-keeper, the superintendent and the foremen of the shops. These statements should be prepared in comparative form, so that any increase in one period over another will be readily discovered. Data of this character in conjunction with reports on the direct labor output will be found valuable in revealing any excessive consumption of tools that the rate of production does not warrant. Consideration must be given to tools made to increase production or for closer precision or for special processes, which would tend to increase the consumption above the normal average.

A report of the labor and material charges on special shop orders for new and special tools, replacements, repairs, etc., which have been issued on the request of the foreman, should be sent to the superintendent weekly, as the charges appear on the payroll and in the accounting department. This system gives him an opportunity to follow up the cost of all such tools to see that they are built to the best advantage and that the expenditure does not exceed the original estimate which he has approved.

A most important feature in the economic control of tool stocks and tool consumption is that of keeping a card record in each department of all tools made or purchased for the department, except such tools as standard drills, taps, cutters, etc., which are kept in stock for frequent renewals on standard work. The reasons for this are evident. A proper record of each tool made or purchased enables the foreman to know, without loss of time or delay in searching, whether he has on hand the necessary tools to produce any specific piece of apparatus or to perform any individual set of operations. It will also prevent the making unnecessarily of duplicate tools, not only in his own department, but also in a contributing department, when such contributing department is called upon to furnish him with some part or all of a given line of work. The card record should show the drawing number, part number, name of part and number of shelf or bin in the toolroom where each tool is kept and such other classifications as may be necessary to designate it fully for accurate and rapid reference. Without such systematic keeping and recording of tools the manufacturer is subject to constant loss of time and delay.

Stocks of Duplicate Cutting Tools

A sufficiently large stock of duplicate cutting tools of all the various shapes should be carried in the central toolroom to supply all departments promptly on request and upon the return of the worn or broken tool.

Blueprints illustrating the different styles or shapes of cutting tools in use in the factory, each individual type having its own separate number, should be placed in the foreman's office of each machine department, where they will be accessible for ready reference. The workman can thus select the particular style of tool he requires and order or procure the same by messenger from the central toolroom by its identification number. This system is an excellent one. It avoids confusion of orders and precludes the necessity of the workman's leaving his machine and consuming valuable time in going, himself, to the toolroom to select the particular shape he desires.

There is always a tendency to accumulation of lathe and planer cutting tools about the workmen's machines and tool cabinets on the machine floor. Frequent investigations should be made and all tools not in use returned to the central tool stock department or to the forge shop or grinding room for repointing and sharpening. The desirability of following this practice in shops where high-

speed steel tools are in use is emphasized by the relatively greater cost of these steels.

The grinding of tools, particularly in large machine shops, is an important item of expense and deserves consideration. Whenever practicable, this work should be centralized as much as possible. Under this plan the number of grinding machines, and the number of grinders as well, may be limited more nearly to actual requirements; and the men will naturally become more rapid and proficient in their work.

Most skilled workmen prefer to do the final grinding on their finishing tools specially for the work they are doing, in order to obtain a special angle or one best suited to the particular cut they wish to take. The preliminary work on these tools, however, up to the point of the final operation, should always be done in the tool grinding room by the regular force of grinders assigned to the work.

There is also a large class of workmen capable of performing certain machine operations or of operating one or more machine tools, who are not practical or skilled tool grinders. Because of this fact they are often unable to take the full depth of cut possible without overheating the tool. Tools improperly ground not only give unsatisfactory results, but require more frequent grinding, which tends to increase the expense of the department. They are also a frequent cause of increased labor costs. The grinding of roughing-out tools, milling and profiling cutters, counterbores and similar jobs can be most economically done in the tool grinding room, and the leaving of machines for this purpose by the workmen should not be permitted except under some special and unusual condition or requirement. All cutting tools for each of the various classes of lathe, planer and boring-mill operations should be kept ground in the same shape, so far as the preliminary portion of the work is concerned. They should not be ground in irregular or special shapes to suit the peculiar judgment and ideas of the individual workman.

The central grinding room should be connected with the central tool stockroom and should be located within as convenient distance as possible of all the departments of the plant.

Importance of Proper Hardening and Standardization of Heat-Treatment

The operation of hardening tools should receive careful attention. Tools that have been too highly tempered are liable to breakage, and this should always be kept in mind when new tools are made or partly worn tools are reshaped or repointed. Different qualities of metals require varying degrees of hardness in the cutting tool, as in high-carbon tool steels as compared with the softer grades of steel. In like manner tools cutting yellow metals and tools operating on cast iron would, in general, require different heat-treatment.

The standardization of different heat-treatments for different types of tools is therefore of vital importance to the manufacturer. So far as present knowledge goes, it does not appear probable that a standard practice can be set up which could be advocated as capable of general or universal application, because of the variation in physical conditions.

The carbon properties of the steel of which the tool is made, the tensile strength and hardness of the metal to be cut, the conditions of operation must all enter into the character of the heat-treatment. Certain grades of high-speed steel can be preheated with good results at a temperature of 1,300 deg. C. (2,370 deg. F.) and drawn back after quenching at a temperature of 450 deg. C. (840 deg. F), while other steels would require treatment varying in degree, according to quality and conditions. Some of the ordinary grades of carbon tool steel commonly used for lathe centers, chisels, etc., may be preheated at 775 deg. C. (1,425 deg. F), and drawn back after quenching at 550 deg. F. These temperatures, however, cannot be set down as universal guides in practice.

The Influence of a Few Degrees Variation in Quenching and Annealing Temperatures

The exact point at which different heat-treatments can be carried out with the assurance of obtaining satisfactory results is difficult of determination and requires the most critical analysis and observation. A few degrees of variation in the quenching and annealing temperatures influence the results to a vast extent, as represented in the great physical differences that are observed.

Certain physical changes develop in the material itself at various stages of the process, which render it vitally important that these points of change be recognized and recorded. If we conduct the treatment to a point either above or below the critical point, modifications in tensile strength and hardness are certain to be produced. Experience demonstrates that the size of the material must also exert an influence on the results obtained.

It appears evident therefore that, in general, it is necessary for the individual manufacturer to establish such standards as will most satisfactorily and scientifically meet the conditions and requirements of his own shop. Also, in purchasing high-speed steels for making tools it is obviously essential that effort be made to obtain steel of uniform quality, as far as possible.

Recutting Files a Questionable Economy—Improper Tool Setting a Cause of Breakage

Recutting of files, which is a more or less common practice, is open to question as a matter of economy. The cost of freightage (usually large where the manufacturer is located at a distance from the file makers), added to the price of recutting, precludes any very considerable saving over the purchase price of new files. Files that have been discarded by the workman as unfit for further use can be cleaned by dipping in acid or by sand blasting, and this practice is followed by some manufacturers. It must be borne in mind, however, that the best quality of the file has been utilized during the first stage of its service, and it is therefore of relatively less value for efficient duty.

The improper setting of tools is often a frequent cause of breakage, and the operator, in addition to seeing that his tool is properly set, should make sure that the tool holder is in good condition, in order to avoid breakage from this source. The incompetent or careless workman is a constant cause of unnecessary expenditure; and the foreman, when selecting his machine hands, should give special attention to the matter of proper care and setting of tools and should make these two of the chief requisites for entering service in his department.

Tact in the Machine Shop

By Robert J. Spence

Very little tact is used in the shop. As a rule, we are a blunt, outspoken lot among ourselves. Very many unpleasantnesses, ill feelings and budding enmities might as easily be avoided in the shop as elsewhere by the display of tact. But some way or other, in our factory life we use a different set of rules in this respect than we do in our outside social life. Many a good man has been lost to a shop through lack of discernment on the part of the foreman, when a little skill in the choice of words would have conveyed the proper reprimand without arousing the workman's ire.

If a man has spoiled his first piece of work in six months, his future interest in the company is not improved by the foreman's raucous voice yelling at him from the center of the room: "You, Bill, can't you read a scale? If you can't do any better than this," (holding up the piece for all to see) "go get a job tarring roofs." Instead, a simple statement from the foreman, letting Bill know that he had found a spoiled piece, would have been sufficient.

One time a few cents were taken from my pay envelope for two small spoiled bushings. If I live to be one hundred years of age, I believe the untactful deduction will still rankle. If the job I was on had not been a stepping stone in my plans for the future, I should have left on the spot. As it was, my interest in the company thereafter was purely a selfish one.

Idiosyncrasies of Workmen

Nearly every workman has his idiosyncrasies, and the foreman who has the rare commonsense to overlook them, to an extent, without compromising himself or the company, will have a roomful of men coöperating with him. I remember one young toolmaker who pasted a few camping pictures on the inside of the cover of his tool chest. Whenever the chest was open, the pictures could be seen; but the young fellow never lost time looking at them. One day the foreman tore the pictures off. After a few heated words, in which they both lost their tempers, the young man packed up his tools and quit. A few years later this same young man was given a position in a neighboring city, where he needed a few good tool makers immediately. Naturally, he sought men whom he knew, with the result that he acquired the services, under contract, of the majority of his old shopmates; and the poorer tool makers, who remained with his old firm, had to be paid higher wages to be retained.

Tact is the peculiar skill of appreciating and accomplishing whatever is required by circumstance, in the shop or out of it.

Every man looks forward to a raise in pay. If he does not, he is not the man you want. This common trait in human nature offers a big target for the exercise of tact. A tactful voluntary raise of even ten cents a day, at intervals, is a judicious thing and goes very far toward promoting the best of good feelings.

Tact will get more out of men than driving or threatening in machine-shop work, or in fact in any work requiring the same high degree of intelligence. The day of the driver has gone. The value of tact has become so well recognized that employers give it an equal consideration with talent in choosing their shop foremen. Tact does not require profound wisdom or great talent. Neither is it a studied attainment. It is simply the exercise of horse sense to fit the occasion.

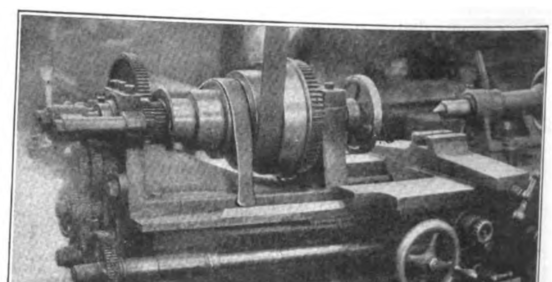
The brightest incident of original tact that I ever witnessed occurred in a small model-room adjoining a toolroom in a fair-sized factory. This model-room was the acme of cleanliness. The four men took pride in the appearance of the bench, the machines and the floor. The floor was always well scrubbed by the men themselves; but every time the owner of the factory came into the room he spat on the floor, not only once, but often. Being an eccentric man with sudden flashes of temper, the workmen hesitated about roiling him with regard to his disgusting practice. Possibly it meant the loss of a job; maybe it did not. At any rate, the gamble was a little too uncertain. They were afraid to ask him to refrain from spitting on the floor.

One day he entered the room and, according to schedule, expectorated as usual. The toolroom errand boy happened to be near. Then occurred the bit of tact to which I refer. Quickly taking a piece of chalk from his pocket, the errand boy stooped and with a deft motion drew a significant circle on the floor around the offending spit. The owner of the factory looked at the boy, looked at the circle, looked back at the boy, but said nothing. He never spat on the floor again.

A Time-Saving Simple Brake for the Lathe

By H. D. Holcomb

In studying and analyzing the individual operations performed in one of the largest industrial plants in this country it developed that over 10 per cent. of the lathe operator's time was lost, or wasted, on account of the length of time he waited for his lathe to stop after shutting off the power. This lost time was not so noticeable in the lathes that were driven by individual motors, but the majority of machines were driven from the main shaft by belt and the ordinary tight and loose pulley and belt shifter. At first it was thought necessary to equip each machine with a power brake, but one of the workmen solved the problem in the inexpensive manner shown in the illustration, which has been found a time-saver under practical conditions.



SIMPLE BRAKE FOR LATHE

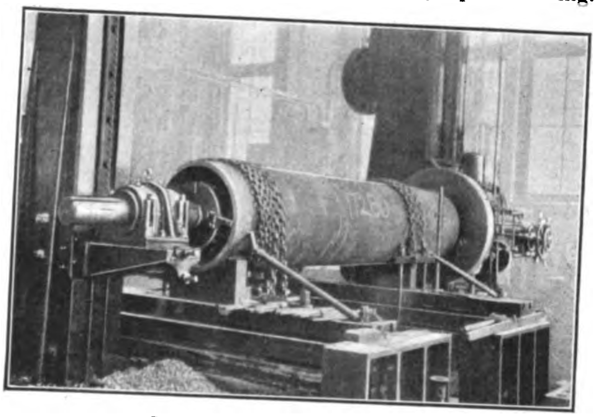
An old piece of leather belt is fastened to the back gear shaft; when it is desired to stop the machine, the piece that hangs over the front part of the lathe is given a slight pull.

Letters from Practical Men

Boring a Steel Casting

One of the awkward jobs that come to a machine shop doing general work is machining the inside surface of a cylindrical casting.

The accompanying illustration shows the machining of the inner surface of a cast-steel dredge-spud covering.



BORING A STEEL CASTING

This casting was machined 30 in. in inside diameter and 14 ft. in length over all. It was fastened to the blocking of the mill by means of chains, in the manner clearly indicated in the picture.

The long boring bar and the tool head were part of the standard shop equipment, and no special apparatus of any sort was employed. J. WALTER SWAREN.

Hayward, Calif.

Two Thread-Cutting Wrinkles

Here are a couple of thread-cutting stunts that I have tried out with success as well as with a great saving of time—no cut-and-try method, no calipers required. In cutting a thread, instead of setting thread calipers to the bottom of the thread of the size plug and calipering for each succeeding cut, then trying on the nut a few times, all that needs to be done is this: Grind a thread tool to gage, swing the compound around to 30 deg. for V or U.S.S. threads, set the tool up to the work, and set the dial at zero. Now multiply the depth of thread to be cut by the secant of 30 deg., or 1.155, which will give the required distance to feed in with the compound.

Example—Cut 5 threads per inch. Depth = 0.130 U.S.S.; 0.130 × 1.155 = 0.150, the amount to feed the compound.

For Acme Standard or 29-deg. threads swing the compound 14½ deg. The depth of thread times the secant of 29 deg., or 1.033 equals the distance to feed in the compound.

Example—Cut 5 Acme Standard threads. Depth = 0.110; 0.110 × 1.033 = 0.114, the amount to feed in the compound.

In threading nuts the same rule will apply, except that the tool is to be fed out.

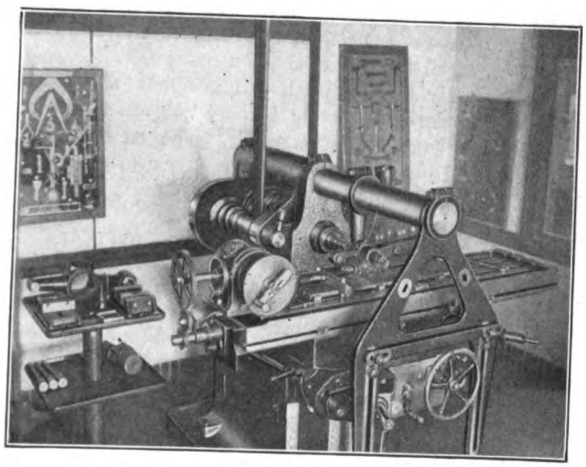
Another stunt I have tried: I saw a man cutting a triple thread and counting the teeth in the change gears to make the divisions. As he was feeding the tool in with the crossfeed screw, I suggested that he swing his compound around to 90 deg., set the dial at zero, cut his first thread, then advance the tool, using the compound one-third of the lead, which would be one-third of 0.333, or 0.111. Next, cut the second thread, then advance the tool, again using the compound one-third of 0.333, or 0.111, and cut the last thread. There is no fussing with gears, etc. O. F. PHILLER.

Beloit, Wis.

[With both of these methods dependence is placed on the accuracy of the compound-rest screws. These are seldom accurate.—Editor.]

Accurate Spacing of Rack Teeth

Anyone who has cut racks on a miller, using the graduated dials to get the tooth spacing (circular pitch), will agree at once that to get 0.3927-in. pitch on a long rack



ACCURATE SPACING OF RACK TEETH

or to get 0.2618 in. each time for 115 times is a difficult thing to do.

If, then, it is a hard job for a careful machinist, and you have to change men on the job every few hours, it is a safe bet that you would not get much perfect work.

Recently at Wentworth Institute we had about three dozen 12-pitch racks to cut 30½ in. long. After several different methods had been tried with very poor results, the following scheme was suggested by M. W. Hartmann:

A dividing head was placed on one end of the miller table, as shown, and geared up to the lead screw of the miller. In our case we used a ratio of 3 turns of the screw to 1 of the spindle in the head (84 teeth on the spindle and 28 teeth on the gear), but the computation

is much simplified by using a 4 to 1 ratio, as is shown later.

Given a dividing-head ratio 40 to 1 and a lead screw with ¼-in. lead, then

$$\frac{1}{40} \times \frac{3}{1} \times \frac{1}{4} = \frac{3}{160}\, in.$$

advance of table to one turn of the crank.

$$\frac{0.2618}{\frac{3}{160}} = \frac{0.2618 \times 160}{3} = \frac{41.888}{3} = 13.96266$$

turns of the crank for each spacing. To find the proper fraction equivalent to the decimal 0.96266, the easiest method is to look up a table of decimal equivalents of gear ratios. In such a table I found $0.9623 = \frac{51}{53}$. Now $13\frac{51}{53}$ turns of the cranks times $\frac{3}{160}$ equals 0.26179 in.

However, the lead screw itself averages 0.0005 in. long for each 6 in. of length, as found on final inspection at the factory. This would give an error of 0.0025 in. too long in 30 in. length of rack. By choosing a decimal slightly smaller than 0.9626—say, 0.9615—the pitch would be 0.261778 in., or 0.000022 in. short for each tooth. In cutting 115 teeth the total error would be

$$115 \times 0.000022 = 0.00253 \text{ in.}$$

short, which would compensate for the 0.0025-in. error of the machine screw. Since there is no 26 circle, we can use the 51 circle, as follows: 12-pitch; 13.9608, or $13\frac{49}{51}$, turns; error, 0.004 in. short in 115 teeth; net error, 0.0015 in.

This point of correcting for the error of the machine itself is put in, not because it is necessary to take such precautions in any ordinary work, but because it is just as easy to choose a decimal a few thousandths of a crank turn small in each case when one knows his lead screw is slightly long in pitch. It is almost always as easy and far more interesting to do a job exactly right than to slight even the little points. The racks we cut by the method outlined herewith were so nearly perfect that, after straightening, two could be meshed together, the teeth fitting in the entire length.

Using a 4 to 1 gearing ratio, we have $\frac{1}{40} \times \frac{4}{1} \times \frac{1}{4}$, or 0.025 in. to one turn of the crank.

For a 10-pitch rack, circular pitch 0.31416,

$$\frac{0.31416}{0.025} = 12.5664 = 12\frac{30}{53}\ turns;$$

error, 0.001 in. short in 96 teeth.

For an 8-pitch rack,

$$\frac{0.3927}{0.025} = 15.708 = 15\frac{41}{58}\ turns;$$

error, 0.0022 in. short in 76 teeth; net error, 0.0003 in.

For a 14-pitch rack, 8.9756 turns ($8\frac{40}{41}$); error, 0.001 in. short in 134 teeth.

For a 12-pitch 10.472 ($10\frac{16}{34}$) turns of the crank; 0.0041 in. short in 115 teeth; net error, 0.0015 in.

Having obtained the turns of the crank for accurately spacing 8-, 10-, 12- and 14-pitch, we can get the proper turns for 4-, 6-, 16-, 20- or 24-pitch, without even the slight trouble of the foregoing calculations, as follows:

For 6-pitch, $20\frac{32}{34}$ turns of the crank; error, 0.004 in. short in 58 teeth; net error, 0.0015 in.

For 24-pitch $5\frac{8}{34}$ turns of the crank; error 0.003 in. short in 230 teeth; net error, 0.0005 in.

For 16-pitch, 7.8511 turns; $7\frac{40}{47}$ error; 0.003 in. short in 152 teeth; net error, 0.001 in.

At first thought this method of spacing may seem complicated. Actually, it was practical and also easily carried out.

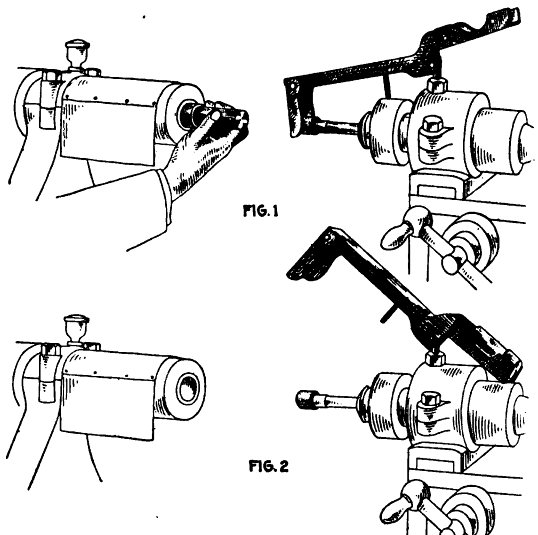
LEIGH J. RODGERS.

Boston, Mass.

Guarding Users of Internal Grinding Wheels

The two illustrations show different positions of a type of guard we have recently put in use to cover the spindles of our internal grinding machines. Fig. 1 shows the guard down over the wheel as the operator places the test plug in the bushing. This is where we have been continually having trouble with our workmen grinding their fingers. The view illustrates clearly how this may be prevented.

On the extreme right-hand end of the sheet-metal guard there is a small pocket, or receptacle, in which the operator places the plug gage as soon as it is removed from the bushing. The weight of this plug raises the



GUARDING INTERNAL WHEEL GROOVES

guard above the wheel as shown in Fig. 2, giving free access for the grinding operation. When the gage is removed the guard drops over the wheel.

Since this guard has been put in use grinding accidents on these machines have been entirely eliminated. This suggestion may be of benefit to others who may have had similar trouble.

CHARLES E. CARSON.

Allegan, Mich.

Drawing a Motorcycle Handle-Bar Sleeve

In the illustration, Fig. 1, are shown the successive drawing operations required for making a handle-bar sleeve, as manufactured and used by a motorcycle concern.

A combination blanking and drawing tool is used for the first operation, to be put in a blank-holder press. The

blank holder punches the blank and holds it while the drawing punch is coming down to accomplish the drawing part. The drawing punch, in Fig. 2, is shown in a position where it just begins to work. The second and third operations are performed with ordinary single-acting reducing dies and tools, shown in Figs. 3 and 4. Tools

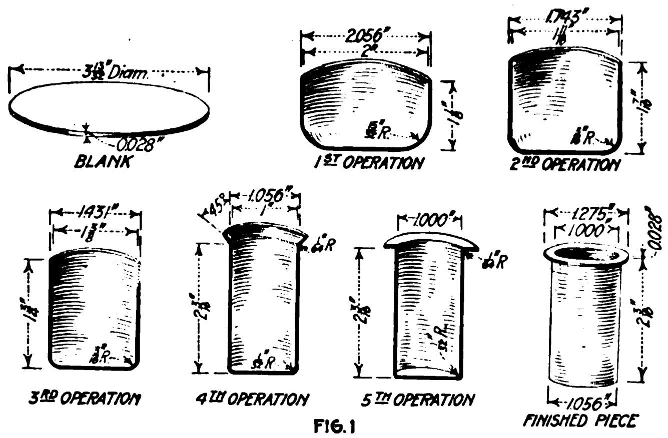
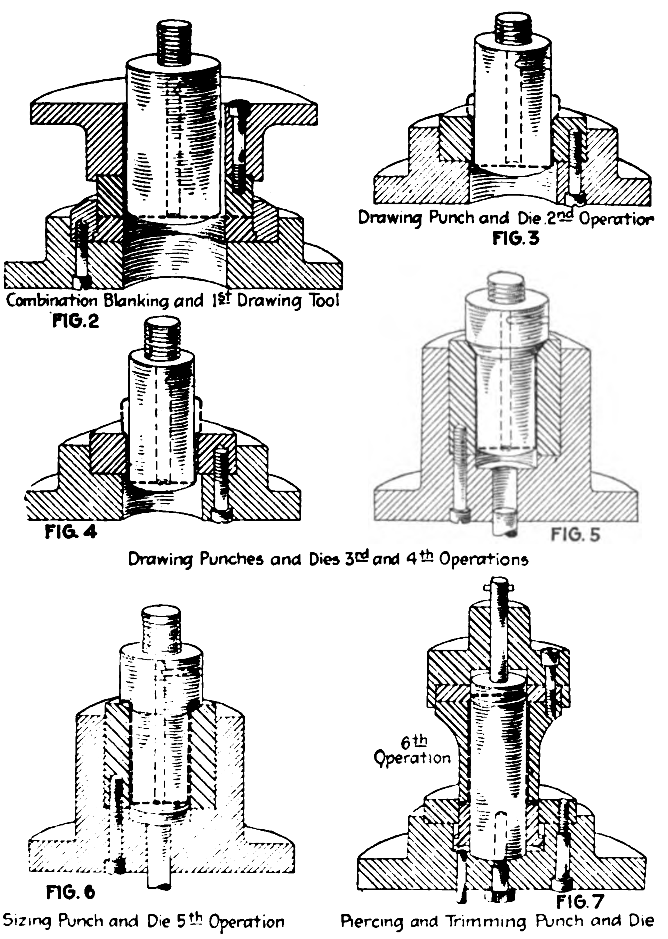


FIG. 1



DRAWING A MOTORCYCLE HANDLE

for the fourth operation are shown in Fig. 5. The manner of working is made clear in the illustrations.

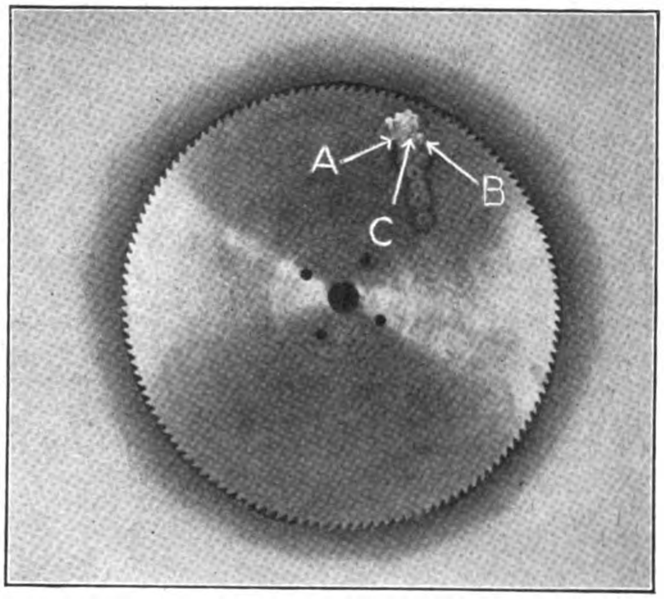
Tools for the fifth operation, which consists chiefly of sizing up and flanging after the fourth operation, are shown in Fig. 6. After the fifth operation the drawn cup is annealed in a furnace. Then the flange has to be trimmed and the bottom of the cup punched out. Both operations are done with a combination trimming and piercing punch and die, shown in Fig. 7. The job is thus completed and ready for the stockroom.

Milwaukee, Wis. P. Baldus.

Spot-Welding a Coldsaw

The illustration shows a saw blade 19 in. in diameter, made of "Semhi" steel and used for coldsawing. It was broken as shown and mended by electric welding in both sides a piece of soft steel 5/8x1/8 in., as at *A, B, C*.

It was spotted at *A* and *B* first and allowed to cool, which closed the crack; then it was spotted at *C* and at



SPOT-WELDING A CRACKED COLDSAW

several places along the line of fracture. The excess of metal was removed. The saw has been in constant service for some time. S. A. Eaton.

Worcester, Mass.

Savings That Mean Profits

It has been said that saving in small things has been the making of some of our most successful men, and the neglect of the little things in some of our manufacturing plants is the cause of small profits, if not actual loss.

In the pattern shop one of the little things that run into dollars faster than the average foreman or owner of plant realizes is the making of round core prints for locating the core in the mold.

It is customary in many shops for the patternmaker, when he has a hole to core out in a pattern, to make a pair of core prints for the job. This means the sawing of a piece of wood large enough to turn the required diameter and lengths, the centering of both ends of the block, hunting up and sharpening turning tools, setting up the lathe for the work and then making.

The two prints, the size of the dowel for locating the print on the pattern and the taper of the top, or core, print are made big or little, according to the individual's idea.

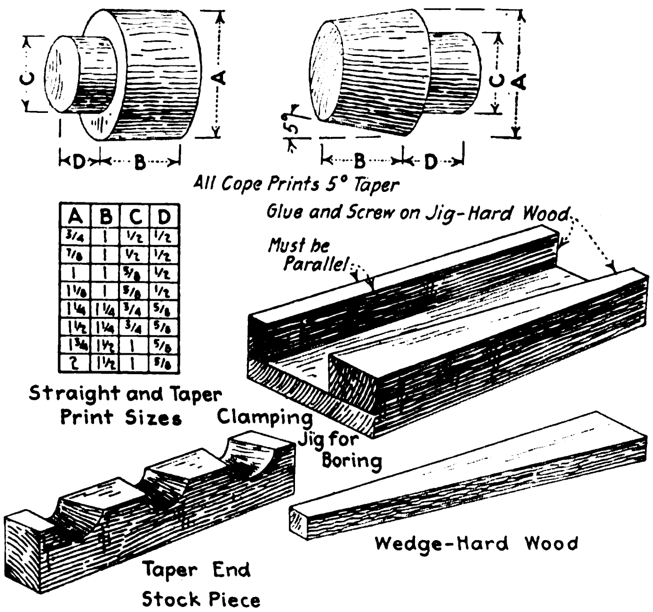
Several years ago I decided to emulate more modern methods of making core prints and standardize the sizes to cover the length, the taper of core prints, the size and length of the dowel and to make them in quantities, so as to have them on hand when needed.

I found that the advantages of having a standard size were many: There was a great saving by making the core prints in quantities, and having standard sizes

always on hand enabled me to get a hurry-up pattern into the foundry for the day's cast; if a core print was lost in the pattern storage or foundry, it could be quickly replaced from stock or by taking a print of the same diameter from another pattern already in the foundry, thereby saving sending the pattern and core box to the pattern shop to have another print made, with the consequent delay and cost.

As a further saving for this work I had a set of taper reamers made to fit the taper of the core print for making the taper hole in special boxes. The stock was first planed in thickness to the length of the prints and then planed parallel in width. Two pieces were clamped in the wood jig, shown, with the taper wedge driving it firmly in place. The small diameter of the hole was bored exactly on the joint between the two pieces. After boring, the taper reamer was put in the boring machine and the holes reamed to fit the prints. By this method I got a standard taper end for the core box and greatly reduced costs. JOHN J. EYRE.

Boston, Mass.



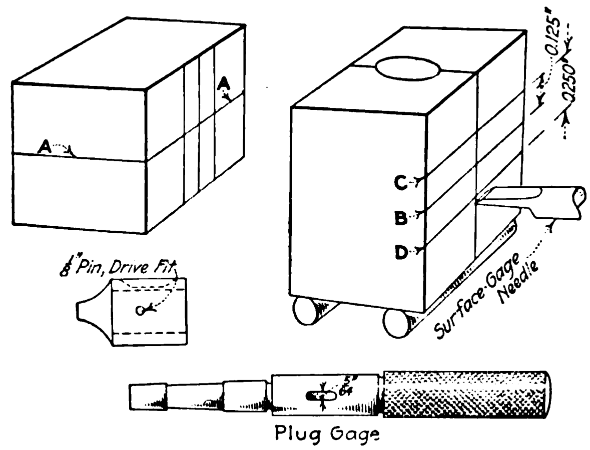
A	B	C	D
3/4	1	1/2	1/2
7/8	1	1/2	1/2
1	1	5/8	1/2
1 1/8	1	5/8	1/2
1 1/4	1 1/4	3/4	5/8
1 1/2	1 1/4	3/4	5/8
1 3/4	1 1/2	1	5/8
2	1 1/2	1	5/8

TABLE AND DETAILS OF CORE PRINTS

Laying Out a Jig for a Gage

In the construction of the taper plug gage shown it was necessary to have a jig for drilling the $\frac{1}{8}$-in. hole in the sleeve and also three $\frac{1}{8}$-in. holes in the gage itself. It was essential that the holes be drilled as nearly as possible through the center of both the sleeve and the gage body. While there is $\frac{1}{64}$ in. allowed for error in the location of the hole in the sleeve and the slot in the body, lack of truth of the body after hardening may cause the slot to become more or less out of center in the gage body. Therefore, it was important to drill the holes as nearly through the center as possible.

There were 26 of these gages to be built, so the simple jig shown was made for the job. The first interesting feature in the making of the jig was the squaring of the block, which was done in a small engine lathe, as no other machine was available at the moment. By swinging the piece in the lathe, strapped to an angle plate, which in turn was strapped to the faceplate, the six sides were faced off, flat and square, in a reasonably short time. The points for boring were laid out accurately with a surface gage, as follows: Line A was laid off at one setting, and line B was next marked off. Then two short pieces of 0.125-in. drill rod were placed under the surface gage, and the line C was marked off. The drill rod was removed from under the surface gage, the pieces were placed under the jig block and the line D marked off. The various points were prick-punched and bored in the ordinary fashion. It was necessary to have the hole on the line B a trifle smaller than $\frac{1}{8}$ in. in order



LAYING OUT A JIG FOR A SPECIAL GAGE

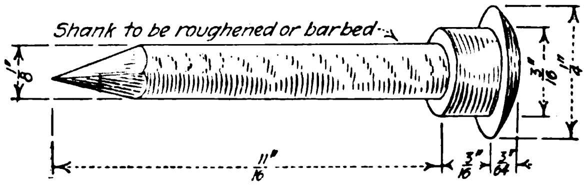
that there might be a wall between the holes. The large hole was bored to fit the sleeve, and a bushing was made to fit over the gage body and also fit the jig.

I have greatly improved my surface-gage needle, as shown. With such a point a tool maker may feel surfaces and mark lines in the same manner as when using a height gage, and by using parallel pieces, as described, a fair degree of accuracy may be obtained.

Newark, N. J. GUSTAVE A. REMACLE.

Who Can Make This Nail?

The illustration shows a special nail that has been submitted by us to about 75 manufacturers in the United States, all of whom have stated that they cannot supply it made to the measurements given.



THE NAIL TO BE MADE

We at first thought that it could be made by an upset die operation, but are beginning to believe that it cannot be turned out in this way. We should like to know who can manufacture this article in ton lots and how it can be made commercially. F. P. RONNAN.

Halifax, N. S.

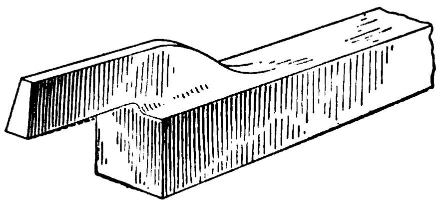
Oxyacetylene Cutting Played an Important Part in the dismantling and removal of fourteen large boilers at the plant of the Union Electric Light and Power Co., St. Louis, Mo. Each boiler was 11 ft. in diameter by 21 ft. long. The oxyacetylene blowpipe permitted the cutting up of the boilers into small sections, such as could be easily removed without the necessity of tearing down a part of the building.

Discussion of Previous Question

Cutting Downward in the Lathe

On page 432 there are a sketch and a description of a parting tool to be used on a lathe running backward. I notice that the cutting edge of the tool has not the proper shape. The correct shape is as in the accompanying illustration.

I have secured exceptionally good results from such a tool when properly made; but considerable care should be exercised in using it, since the chuck is apt to become loose when the material is not supported by a dead-center, as the pull is in the opposite direction to a right-hand thread on the spindle. J. H. MADGETT.



GOOSENECK LATHE TOOL

New York City.

Best Way To Do Certain Things

John E. Sweet struck the "keynote" when he sent in his little article on page 936, Vol. 43, telling how to secure a machine part on the end of a shaft. His method of describing the thing he had in mind impresses me more forcibly than the thing itself. He gives a vivid word picture enabling one to see clearly and to understand without a sketch just what he himself sees.

It is just as important a matter to tell correctly how to do a thing as it is to do the thing in the right way. If all information that goes to the workman could be made as clearly understandable as Mr. Sweet's article, it is probably safe to say that about 90 per cent. of the blunders made would be eliminated. Most of the disagreement and misunderstanding between office and shop, engineering departments and factory, bosses and men would disappear if as much attention were given to the "telling" as to doing things.

It is a well-known fact that what is good practice under some circumstances is very poor under others. Where a taper hole is secured on a taper spindle nose, with a threaded end on which a washer and nut or a threaded collar is screwed, as in the Brown & Sharpe cutter grinder, a good method was adopted and one which in that case gives splendid results.

Under entirely different usage and conditions a similar spindle nose on another make of machine is not good design, because the length of the taper in proportion to the diameter is not enough to insure a chuck or faceplate always running true after being used a few times. Then, too, in the case of the Brown & Sharpe grinder the taper hole in the grinding-wheel hub can be cleaned and placed true on the spindle, while the other lathe chuck will retain chips that persist in getting in the taper hole and causing trouble every time the chuck is screwed on the spindle.

I am speaking from my own experience and mention these two cases more to emphasize the fact that care and judgment should be used by those who adopt the good points of one machine to use on another.

I am of the opinion that much can be done to simplify technical information, so that a clear understanding can more easily be gained by those without the advantage of good schooling or manual training.

A great deal of shop information and many calculations can be "brought to their lowest terms"—made easily understandable. When this is done and a move made to standardize the right way of manufacturing machine parts, the workman's burden will be lessened and the bosses will do less worrying GEORGE G. LITTLE.

Rochester, Minn.

Manufacturing Rifle Cartridges

Mr. Dinger's criticism, on page 475, of my article on the manufacture of rifle cartridges has come to my notice. In reply I should like to quote from the original manuscript as it was sent to the *American Machinist*.

"The indenting operation forms or indents a small depression in the center of the head for a seat for the primer, and pierces a small hole through the head for the percussion to travel to the explosive with which the cartridge is loaded. This indented impression is of a great variety of sizes, depth and shape dependent upon the size and style of primer used.

"For different charges different primers are used; that is, percussion material used in the primer differs with the different powders used, such as black powder, semi-smokeless, etc. The many brands of powders on the market differ so in their characteristics, such as amount used, density, rapidity of combustion, chamber pressure, etc., and all this tends to vary the size and shape of the indented impression," etc.

If Mr. Dinger will notice the primer cap of a cartridge loaded with the common black powder, he will see at once that it is different from one of the same caliber that is loaded with dense smokeless powder. If he opens that primer, he will find that a different material is used and the primer constructed differently with the different powder used. The piercings are all a very simple operation, either alone or in conjunction with other operations.

If Mr. Dinger will send a letter to me addressed in care of the *American Machinist*, I will tell him where he can see in operation any or all of these machines that I have described in my articles.

J. S. Glew's suggestion on the same page is a very timely one, and I should say a valuable one. I have been in the habit of annealing old dies and reboring them for the next larger size of redrawing tools, thus saving a good deal, but I think this idea is possibly better.

Pittsfield, Mass. G. R. SMITH.

Side Shield for Emery Wheels

I notice another article, on page 344, about and against the use of the side of a common tool-grinding emery wheel. I have been working in, or in charge of, machine shops for the past 20 years and have seen a good many articles against the use of the side of a wheel, but I have never been able to figure out why. I have never once seen any reason, good or bad, given for not using the side, simply the arbitrary statement that it is dead wrong. Will someone tell me why?

Personally, I use the side of the wheel fully as much as the face, simply because it gives better results or is handier for a great deal of grinding. In grinding a V-point tool it is always easier to grind one side on the face and the other on the side. A small blanking die or punch that is not very dull can be ground on the side of a wheel just as well as, and faster than, on a surface grinder.

In my own shop I had no surface grinder for a number of years, and got along very nicely, grinding all my dies on the side of a wheel. I was never in a shop where all the men did not use the side of a wheel constantly—why not?

Of course, the side may be all grooved up, but so may the face. That is the normal condition in some shops. One can be kept in good condition just as easily as the other. The grinding-stand makers seem to expect the side to be used, for most of them furnish an L-support to be used either for the face or the side.

There is certainly nothing in the composition of the wheel to prevent side grinding.

Plymouth, Mich. W. B. GREENLEAF.

Machinist Instruction in the Public Schools System

The discussion concerning prevocational and trade schools is of great interest to the man who is unable to visit these schools. The interchange of views by instructors also affords a comparison of methods as well as gives an opportunity to the shopman to express his ideas in regard to their utility.

Several letters indicate that some foremen are prejudiced against the school graduate. My contact with the students has been pleasant. Those working with me display a thoroughness, an intelligent interest and a desire to make good that are greatly to their credit. After they lost the desire to explain how work would be done in the school and became accustomed to the swing of machine-shop methods with the somewhat ancient tools in use, they went along O.K.

One correspondent states that each boy is supplied with certain tools, among them a monkey wrench. This implement is quite essential in the kit of the repairman or farmer, but in a trade school it is quite out of place. In these days of good machine wrenches at such reasonable cost every machine should be furnished with a complete set within easy reach. This equipment will be educational as well as economical.

Two young men whose foundation for the trade was laid in one of the large corporation trade schools told me that the only wrench they had for the Almond chuck of the sensitive drill was a blunt chisel and hammer. Such conditions are directly the fault of the instructors.

One difficulty is in securing for the students commercial work that can be disposed of upon favorable terms. I would suggest circularizing manufacturers to provide steel screws, bolster plates for holding dies and other articles used in manufacturing establishments.

South Acton, Mass. I. K. MACKENZIE.

A Flat-Sided Brass Lap

I am afraid that the brass lap described by Mr. McIntyre on page 414 is likely to be misleading to the majority. It seems like a very easy way to make a lap. Probably grinding the sides on a rough wheel instead of milling would be quicker. I do not doubt that the lap would do as good a job if it were ground, but I do doubt its turning out accurate work either way. No doubt, Mr. McIntyre knows that a lap made of that shape would not make a round hole, but would all the readers looking for information in your paper know this fact?

It is generally recognized among those who have done much lapping that, to get a round hole, the lap must be as round and straight as possible. It does not seem to me as if the tool referred to could be straight after peening, and it is not round to begin with. Therefore, I

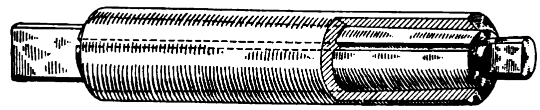


Fig.1

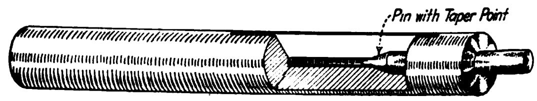


Fig.2

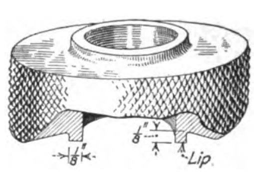


Fig.3

LAPS FOR ROUND HOLES

do not see how even a satisfactory job could be done in a ring gage. I have found that for lapping holes requiring as much accuracy as possible, from ¼-in. diameter up, a lead lap on a taper arbor, as in Fig. 1, is the most accurate, as it can be rapped on the arbor and expanded to hold the size. For holes smaller than ¼ in. I use a diamond lap.

I have made satisfactory small laps as in Fig. 2. If laps are slit from the end, they will always bell-mouth, as the spreading all comes on the end. I have always made ring gages with a lip, Fig. 3, which is ground off after lapping to the correct dimensions. They then close in slightly, according to size, and are lapped again to the proper measurements. This method leaves very little bell mouth, apparently none. The lap should be at least 2½ times as long as the work. In cylindrical work this ratio should be reversed; that is, the work should be 2½ times the lap. J. C. STUART.

Hartford, Conn.

Armored Motor Truck

The International Motor Co., New York City, in co-operation with the Carnegie Steel Co., has developed the armored car shown in the illustrations. The design is the result of considerable experiment, and full detailed drawings have been prepared of the various elements.

In Fig. 1 are shown the internal construction of the frame and also the streamline body. A view of the truck with the plates raised to show the accessibility to the power plant and accessories is given in Fig. 2. A short description of the unit parts and their approximate weights should be interesting.

The truck is of standard Mack 2-ton worm-drive pattern, with the steering and controls arranged to allow the driver to sit very low, thus permitting the guns to be fired over his head. The weight of the chassis is 5,000 lb. The electric equipment comprises a Bosch electric starting and lighting system with inclosed drive for generator and to flywheel. The ignition system is a Bosch magneto with dry batteries and a vibrator coil fitted for starting.

A 10-in. Gray & Davis searchlight is supplied and so arranged that it can be shut into the driver's cab, away from damage. The lamp is operated by a separate switch for signaling purposes. Two small headlights are fitted in the front of the car. They are arranged so as to concentrate the light low, eliminating any reflection on the sides of the car.

Two rear side and tail lights are placed on the extreme lower corners, and there is a dash light to enable the driver to read the gages. The engine is fitted with a special Newcomb carburetor.

Description of the Armor Plate

The armor plate is of special steel, heat-treated, and is proof against regulation army-rifle fire at 50 yd. It was manufactured by the Carnegie Steel Co. and cannot be machined or drilled without annealing. The armor plate weighs 2,400 lb. and is supported by a light iron framework built up in four units—one covering the motor, another forming the driver's cab and two rear units for the guns, ammunition and men. The parts are first riveted together, then the four units are joined by bolts into one complete structure.

The two rear units can easily be dismounted without disturbing the floor. This provision is convenient, as it furnishes a plain platform body for transportation purposes. The platform consists of metal cross-members with a wooden floor and steel wheel boxes and weighs 200 lb. The weight of the framework is 600 lb.

The towing arrangement is attached to the main chassis, which takes the strain directly through a spring to the main chassis frame. An eye suitable for chain or rope extends beyond the armor.

Position of Portholes and Motor Protection

The portholes are suitably placed for the operation of the car and for taking outside observation without harmful exposure. They are arranged as follows: One on each side of the driver's cab, two on each side of the body and one in the door at the rear, making a total of seven. The porthole doors, of armored steel, are made to slide and have anti-rattling latches. The truck is entered through the rear door.

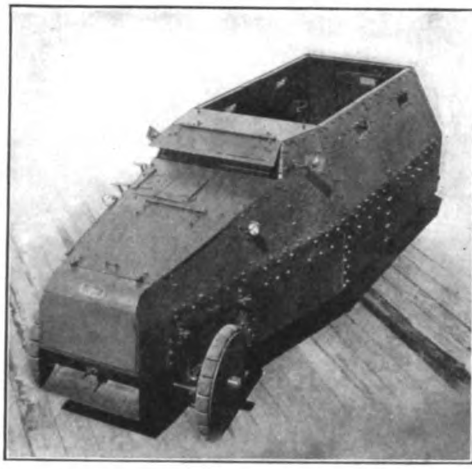


FIG. 1. PLAN VIEW OF TRUCK

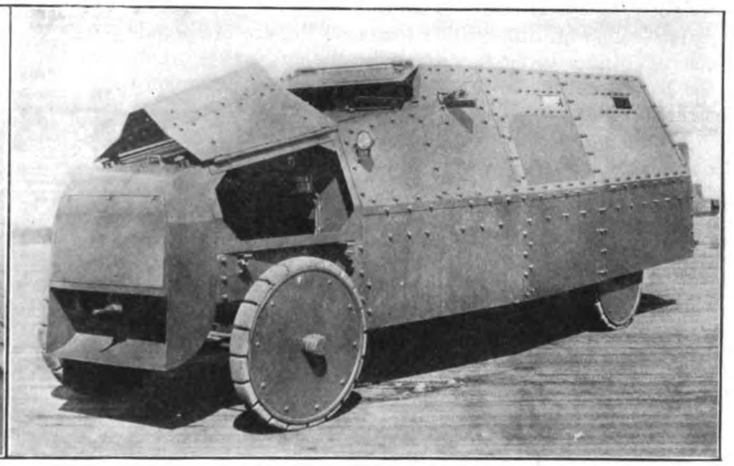


FIG. 2. VIEW OF TRUCK, SHOWING ENGINE

The driver is protected by a complete armored cab. The front door opens with adjustable racks, so that a larger or smaller vision can be obtained. Over the head of the driver and extending the full width of the cab is an adjustable trapdoor. It can be opened or closed at will, in order to cool the car when it is not under fire. Each of the four wheels is protected with armored plate attached to the felloe.

The motor is shielded by an armored hood that can be divided into a top, sides and protection behind the wheels for stopping bullets intended for the crank case. The top of the hood consists of hinged armor plate, which can be raised so as to reach the radiator. An anti-rattling device is fitted to hold the plate down.

The hood has sloping sides in two pieces, hinged on the top edge. They can be raised to allow ready access to either side of the motor. The doors can be folded back on top of the hood; and when they are closed the top can be lifted without disturbing the sides. The lower protection behind the wheels is of such shape as to give wheel clearance in turning.

An unusually large radiator is provided to cool the engine. There is a special device, weighing 120 lb., for radiator protection, so that air can be introduced without permitting bullets to be deflected into the radiator itself.

The gasoline supply consists of a special tank fitted behind armor plating and mounted below the floor. The gasoline is supplied to the carburetor by a Stewart vacuum system. The weight of the tank, piping and fittings is 50 lb.

The storage battery is mounted behind armor plating and becomes part of the electric starting and lighting system, but not part of the ignition system. Therefore, if the battery should be depleted, ignition would not be interfered with. The weight of the battery and mounting is 67 lb..

As the armor is all on a slope, to turn bullets, it is very difficult to make a perfect butt joint with the armor plate. To overcome any defects in this direction, butt straps are put on all exposed plates, thus preventing a bullet from breaking off the edges of a plate. The weight of the butt straps is 250 lb.

The bolts and nuts, which weigh 60 lb., are of special steel, the nuts being heat-treated and hardened so that the bolts will not be shot away, thus injuring the construction.

In order to provide for special rifles or rapid-fire guns, detachable barbettes are supplied. They are supported on bronze brackets, which in turn rest on adjustable tripods on the floor. There are two of these rapid-fire gun mounts. The total weight of the armored car is 9,052 lb.

This description covers the first of the units of the armored train that has been given to the New York State National Guard for the protection of New York.

The makers of the car, owing to their experience in designing and supplying a large number of motor vehicles to the Allies, were picked to manufacture this truck.

Assembly Record Form Used in Manufacturing Lathes

By H. B. McCray

The problem of parts inspection is generally worked out to a fairly satisfactory degree in most small and medium-sized shops, but the manufacture of machine tools adds a further complication—inspection during assembly. The successive operations are interdependent to such an extent that poor workmanship or misalignment in any one seriously impairs the accuracy of the completed machine. If no readily accessible record is kept of these operations, it is next to impossible to locate the careless or ignorant workmen, especially where two crews are at work on the same lot of machines.

Such a condition is always a source of a great deal of trouble; in our case, with a considerable number of inexperienced men, it assumed grave proportions. Various schemes were tried and finally resulted in the adoption of the form shown herewith. It is printed on a medium-weight card and is held by spring clips in a light-weight sheet-iron back or container, similar to those used in cash-register accounting systems. This form is attached to the machine when the legs, pan and bed are set up and stays with it until the machine passes final inspection and goes into the car.

When a workman has completed an operation, he calls an inspector, who must pass on it and sign up for it before the next operation is begun. The workman then signs his name and number and is given a credit slip by the timekeeper, if the work is on a piecework basis. If an operation is unfinished when the crews are changed, the inspector decides that part is completed and notes this on his card, but does not O.K. it until the work is done.

ASSEMBLY RECORD

Machine No......... Series........ Series No.........

	Bed		
1	Top bed scraped by..................	No......	O. K.......
2	Sides bed scraped by................	No......	O. K.......
3	Lower bearing scraped by............	No......	O. K.......
4	Caps fitted by......................	No......	O. K.......
5	P. feed gears by....................	No......	O. K.......
6	P. feed gear cover by...............	No......	O. K.......
7	W. feed rack by.....................	No......	O. K.......
8	W. feed rack fitted by..............	No......	O. K.......
9	Wormshaft fitted by.................	No......	O. K.......
	Saddle		
10	Ind. stop fitted by.................	No......	O. K.......
11	Bottom scraped by...................	No......	O. K.......
12	Front side scraped by...............	No......	O. K.......
13	Lower gib fitted by.................	No......	O. K.......
14	Bed caps fitted by..................	No......	O. K.......
15	Top scraped by......................	No......	O. K.......
16	Sides scraped by....................	No......	O. K.......
17	Pawls fitted by.....................	No......	O. K.......
18	Turnstile fitted by.................	No......	O. K.......
19	Feed gear and trigger fitted by......	No......	O. K.......
	Slide		
20	Bottom scraped by...................	No......	O. K.......
21	Sides scraped by....................	No......	O. K.......
22	Rear gib fitted by..................	No......	O. K.......
23	Front gib fitted by.................	No......	O. K.......
24	Caps fitted by......................	No......	O. K.......
25	Lock bolt and gib scraped by........	No......	O. K.......
26	Timed by............................	No......	O. K.......
27	Turret bearing scraped by...........	No......	O. K.......
28	Ind. stop pinion and rack fitted by....	No......	O. K.......
	Turret		
29	Turret fitted by....................	No......	O. K.......
30	Ratchet fitted by...................	No......	O. K.......
31	Index ring fitted by................	No......	O. K.......
32	Timing checked by...................	No......	O. K.......
33	Binder hdl. fitted by...............	No......	O. K.......
34	Ind. stop cam fitted by.............	No......	O. K.......
	Cutoff Slide		
35	Slide scraped by....................	No......	O. K.......
36	Saddle scraped by...................	No......	O. K.......
37	Assembled by........................	No......	O. K.......
38	Attached by.........................	No......	O. K.......
	Finishing		
39	Spindle nose ground by..............	No......	O. K.......
40	Turret bored by.....................	No......	O. K.......
41	Turret faced by.....................	No......	O. K.......
42	Cleaned by..........................	No......	O. K.......
43	Ind. stop timed by..................	No......	O. K.......
44	Hardening by........................	No......	O. K.......
45	Tumbler, ratchet pawl, trip, lock bolt, star, W. feed pawl...............	No......	O. K.......
46	Wire feed dogs......................	No......	O. K.......
47	Final assembly by...................	No......	O. K.......
48	Finish-painted......................	No......	O. K.......
49	Greased.............................	No......	O. K.......
50	Crated..............................	No......	O. K.......
51	Accepted	Blank Manufacturing Co.	

Per.................Inspector.

If the work is "day rate," there is usually no discussion; if "piece rate," the number of unfinished operations is surprisingly small.

The adoption of this plan not only ended our troubles in final inspection, but effected a marked improvement in the quality of work.

Tool Builders' Conference

In view of the exceptional activity in the machine-tool building industry the Executive Committee of the National Machine Tool Builders' Association has decided to forego the regular spring convention.

In its place an informal conference of members will be held at the Hotel Astor, Apr. 29. This date has been selected as the most convenient, as it immediately follows the convention of the National Metal Trades Association, for which many members will no doubt be in New York.

Editorials

Metric System in Export Trade

An editorial in these columns in last week's issue pointed out what appears to be a carefully prepared attempt to commit the United States to the metric system for export trade. Manufacturing and commercial interests became aroused, and several cablegrams of protest were sent to Secretary of the Treasury McAdoo. The one from the National Association of Manufacturers, signed by George Pope, president, reads as follows:

Hon. William G. McAdoo, care of the American Embassy, Buenos Aires, Argentina: Many manufacturers, including some using metric system in their export trade, protest against any change of present status of United States laws as between systems now in use here.

These actions indicate the attitude of responsible manufacturing and commercial interests of the country toward any attempt to change the present status of our weights and measures.

Take Double Warning!

Too late for insertion in our last week's issue, we learned of the introduction in Congress of a bill for the compulsory use of the metric system. *Read Section 4. The Congressional Record* has the following:

"Mr. Dillon introduced in the House of Representatives on December 6, 1915, the following bill, which was referred to the Committee on Coinage, Weights and Measures and ordered to be printed:

"A BILL

"to establish the metric system as the standard for weights and measures for other purposes.

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the weights and measures of the metric system shall be the sole standard of weight and measures in the United States on and after July first, nineteen hundred and twenty: Provided, That in the meantime such metric system shall be permissive.

"Sec. 2. That all equivalents between the units of the metric system and the system now in common use throughout the United States shall be calculated from the fundamental relation, one meter being equivalent to 39.37 inches and one kilogram being equivalent to 2.204622 avoirdupois pounds.

"Sec. 3. That the Director of the Bureau of Standards, with the approval of the Secretary of Commerce, shall prescribe rules and regulations for carrying out the provisions of this Act, and shall prepare and promulgate tables based upon the fundamental relation established in section two showing the equivalents of the weights and measures of the metric system to those of the system in customary use in the United States.

"Sec. 4. That any person, corporation, company, society, or association who shall use, or offer and attempt to use, in any industrial or commercial transaction in the sale or purchase of any commodity any other weights and measures than those of the metric system on and after July first, nineteen hundred and twenty-four, shall be guilty of a misdemeanor, and upon conviction thereof in any court of competent jurisdiction shall be punished by a fine of not more than $500 or by imprisonment for not more than three months, or by both such fine and imprisonment."

One does not need the gift of second sight to recognize the connection between this bill and the plan for committing the Government to the adoption of the system through the action of the Joint High Commission on Uniform Law now in session at Buenos Aires. Full particulars of this scheme were given in our editorial of last week.

The following is our interpretation of this connection, which we submit to the judgment of our readers:

1. The pro-metric party had this bill introduced early in order to give time to work on the Committee on Coinage, Weights and Measures through hearings or, more probably, by lobbying with individual members.

2. It expects to secure action at Buenos Aires committing this Government to the adoption of the metric system.

3. It expects to have the committee convinced of its wisdom and to have the bill reported to the House of Representatives at the opportune moment.

4. This opportune moment will arrive when Secretary McAdoo returns from the meeting of the Joint High Commission with resolutions committing the participating governments to the metric system.

5. It then expects to rush the bill through Congress with a hurrah and as an act of good faith with the South American republics.

According to an article in *Munsey's Magazine* for April, Doctor Stratton has already secured the favorable impression of the committee.

Read Section 4!

Conduct of Salesmen in South America

No discussion of the possibilities and methods of South American business would be complete without comment upon the proper conduct for salesmen who visit the countries of that great continent and perhaps even a few words of friendly advice to them. As regards personal habits: Live clean, be abstemious; get on the water wagon and stay there. More northern salesmen have failed in South America because of dissipation than from any other one reason.

The necessity of knowing the languages used in business intercourse has already been emphasized. No salesman should expect to make a circuit of South America unless he can speak both Portuguese and Spanish.

The old saying, "When in Rome do as the Romans do," applies with peculiar force to the attitude and methods employed in reaching South American customers. The men whom the northern salesman will call upon are well

read, educated, cultivated, and gracious in manner. They very properly expect to be treated as they treat others. Thus the northerner, when he approaches them, must be equally polite, courteous and affable. At the same time he must ring true; he must be genuine. If he has this attitude and feeling toward his customers and is possessed of all the necessary technical qualifications, selling goods in South America should be easy. It is perhaps not going beyond the bounds of truth to say that the South American business man dislikes to say "No." He would rather buy of you than not, if you approach him in a proper manner; and even when he does refuse your offer, he will in most courteous fashion ask your forgiveness for not being able to give you an order.

The general attitude of the South American business man toward his North American visitor is one of appreciation and admiration for North American energy and practicability. This prepossession at once paves the way for cordial relations, if the approach and business interview are properly handled on the part of the caller. There are some things that must be absolutely avoided. A patronizing attitude is at once resented. The rough and ready methods of the north must be completely dropped. When an office is entered, the caller must remove his hat at once. When he greets his customer, it must be in a formal way. Never slap a South American business man on the back; do not lean back in your chair in his office; do not call him by his first name; do not aim your cigar at the ceiling—or better still, do not have a cigar in evidence when you enter. All these things, which are a part of the North American game of bluff, are exceedingly distasteful. So much are they despised and so greatly is familiarity resented that the American word "bluff" has been adopted bodily into South American Spanish as describing these disagreeable traits of conduct.

Hospitality, as invitations to dinner or the theater, must be sparingly and judiciously offered. If they are refused, the invitation should never be pressed. This comment applies to the native South American and not to the executives of foreign birth, as men from the United States, England and Germany. The latter expect to be entertained in about the same way as in this country.

The personal appearance of the salesman counts more in South America than it does here. At all times he must be neatly and tastefully dressed. A walking stick is a common detail of his business equipment; and if his personal wishes are not offended, a flower in the buttonhole may perhaps have its effect. Not only do these small things aid when the salesman has reached his prospect, but they are of direct service in passing those minor barriers with which every business man is surrounded.

It is always necessary to ask for an appointment in business dealings in South America, and these engagements are usually fixed for the hours of 7 a.m., 11 a.m., 2 p.m. and 5 p.m. There is no uniformity either as regards industries or localities. The personal wishes of each man who is to be approached must be consulted and his convenience met. This is one of the reasons why business goes as slowly as it does in those countries. The hustle of the north must be completely laid aside, and the salesman must adapt himself to the traveling, living and business conditions that he finds. He cannot change them, and his own attitude must be one of patient tolerance with the delays that are inevitable.

As regards his technical equipment, it must be of the best. The northern salesman who purposes to make a South American trip must have a thorough knowledge of his line down to the most minute details. Many unfortunate occurrences in the past have been due to salesmen's mistakes in making quotations, figuring exchanges, transposing dollars to South American currency and changing English units of weight and measure to the metric equivalents. Much of this work has to be done on the spot and, of course, with celerity and certainty.

A journey to South America down the west coast and up the east, or in a reverse direction, should take about nine months from New York to New York. It is better, as a rule, for the salesman to confine himself to the coast towns, for the customers whom he will meet there consider the interior as their legitimate market. They are apt to be unfriendly and hostile, if they know that a salesman purposes to travel to inland cities. The expenses of such a trip will run about $100 per week, which will include a reasonable amount of entertainment for foreign employees of the South American houses. The climate is, of course, trying, and care must be taken to guard against its effect. Gastric troubles are common, and it is wise for the northern salesmen to eat freely of fresh vegetables and of the native fruits, after judicious trial has proved that they agree with him personally, and to drink nothing but bottled water.

Finally, in all dealings with South American business men never under any circumstances knock a competitor or his product.

Attempt To Kill Time Study

Another attempt is being made in Congress to prohibit time study, motion study, the setting of tasks and the paying of bonus to any employee in the Government service. This is a continuation of the attack made last year, which resulted in adding riders to the army and navy appropriation bills prohibiting the use of any of the money there appropriated for these purposes. Bill H. R. 8665, introduced by Mr. Tavenner, reads as follows:

That it shall be unlawful for any officer, manager, superintendent, foreman or other person having charge of the work of any employee of the United States Government to make or cause to be made with a stop watch or other time-measuring device a time study of any job of any such employee between the starting and completion thereof or of the movements of any such employee while engaged upon such work. No premiums or bonus or cash reward shall be paid to any employee in addition to his regular wages, except for suggestions resulting in improvement or economy in the operation of any Government plant.

That any violations of the provisions of this act shall be deemed a misdemeanor and shall be punished by a fine of not more than $500 or by imprisonment of not more than six months, at the discretion of the court.

The other bill, presented by Mr. Van Dyke, applies to employees in the postal service and is similar in wording to the first.

It is needless to enumerate the pernicious effects that would follow the passage of these bills. Readers of the *American Machinist* appreciate these results without any detailed explanation. Once such bills become law for Government plants, kindred efforts will be made to enforce similar prohibitions in the shops of private manufacturers who are working on Government contracts. This is the danger behind the present attack.

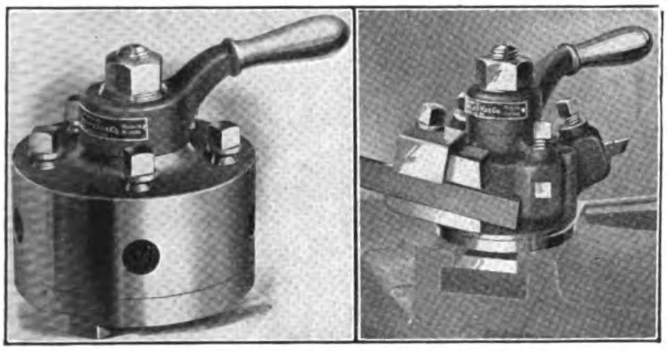
Communicate at once with your Congressional representatives, stating your opposition to these bills.

Shop Equipment News

Turret Tool Holders

The type of tool holders illustrated were designed to provide the advantages of several ordinary tool holders and a turret.

The form shown to the left is especially designed for inside work, such as drilling, boring, reaming, etc. It is readily attached directly to the compound rest similarly to a regular tool post. An indexing plunger is actuated automatically with the loosening and tightening of the clamping handle. This form is provided with five holes, unless otherwise specified.



TURRET TOOL HOLDERS

The one shown to the right is three cornered, having two square bits and a cutoff tool. The cutoff tool may be removed, if desired, and another square bit inserted.

These turret tool holders accommodate ordinary toolholder bits and represent a recent line developed by the McCrosky Reamer Co., Meadville, Penn.

Lubricant-Circulating Pumps

The illustrations represent a line of geared circulating pumps recently developed by C. F. Roper & Co., Milford, Mass., for pumping oil, lubricants or water to the cutting tools on machines, for cooling engines and for other similar purposes.

The type shown in Fig. 1 is designed to be used on machines where the cutting tools operate in one direction only. It is simple, consisting of two accurately cut steel gears running in an accurately machined casing. A relief valve forms an integral part of the mechanism, by which it is possible to shut off the delivery of oil without stopping the pump. This relief valve is instantly adjustable by means of a knurled thumb-screw on the outside of the pump. While the construction is such that the oil is held in the pump when it is not in operation, thus making priming unnecessary, the manner of attaching the suction and delivery pipes to the top and bottom of the pump avoids a complicated piping system.

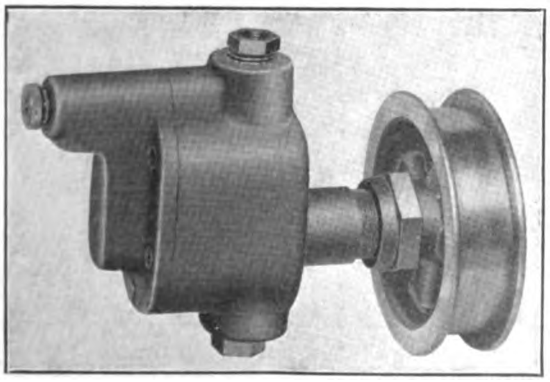


FIG. 1. GEARED LUBRICANT-CIRCULATING PUMP

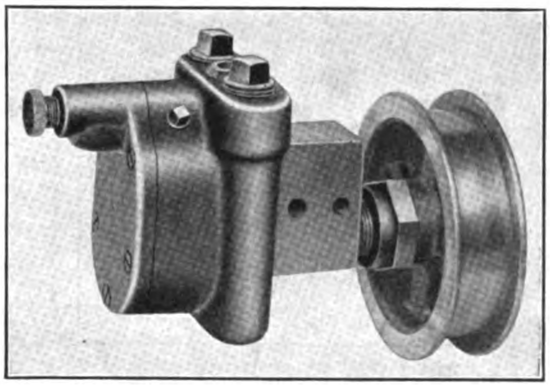


FIG. 2. REVERSING LUBRICANT PUMP

The pump shown in Fig. 2 is of an automatically reversing type especially adapted for use on machines in which the cutting tools operate in both directions. In general, the design and construction are similar to those of Fig. 1.

Both styles are made in five sizes, with capacity for delivering from $2\frac{1}{2}$ to 46 qt. per min.

Compact Electric Hoist

The latest form of electric hoist made by the Franklin Moore Co., Winsted, Conn., is shown in the illustration. In the design, steel has been substituted for cast iron on all parts subjected to tensile stresses, and all superfluous metal has been eliminated in order to construct a light-weight compact hoist.

In the new line of hoists represented by the illustration each size is built up and planned for an individual size of motor. All-steel cut gears are used, and the shafts are babbitt bushed. The gears operate in a bath of oil, and the drum is supported by roller bearings. Owing to its mechanical features this hoist, when equipped for direct current, is said to offer a smooth speed control especially adapted for foundry practice in the handling of molds.

The hoist is equipped with two brakes—a solenoid brake and a mechanical brake of the multiple-disk friction type. It also has an upper automatic stop that cuts off the power instantly when the lower hook reaches its upper limit of travel.

To provide accessibility in case of repairs, the construction has been made such as to permit the removal of either the motor end or the mechanical end without disturbing the other parts or taking the hoist down.

COMPACT ELECTRIC HOIST
Capacity, 500 lb.; lifting speed, 45 ft. per min.

The hoist is built either in the hook type or in combination with plain, geared or motor-driven trolleys, floor or cab control. This type of hoist is made in a variety of sizes ranging in capacity from 500 to 10,000 lb.

Special-Purpose Lathes for Machining Projectiles

Three special-purpose lathes for machining shrapnel and high-explosive shells are being manufactured by H. C. Dodge, 176 Old Colony Ave., Boston, Mass. The largest of these is a turret lathe for performing turning, boring and waving operations on 3 to 6-in. diameter shells of both shrapnel and high-explosive types. A smaller turret lathe is made for the principal operations on 3-in. and smaller shells, while the third machine is a special speed lathe for filing and polishing 3-in. shrapnel.

The 6-in. machine, known as the "Dodge Special," is shown in Fig. 1, which illustrates the turret set-up for the boring operations. The spindle is of unusual size, as will be noticed from the specifications under Fig. 1; and an even better idea of its proportions may be had from Fig. 2, which shows the spindle suspended above the main bearing housing.

This machine is of the constant-speed drive type, two speeds being obtained by gears mounted upon a Johnson friction clutch within the headstock, operated by the lever seen near the top of the headstock. An additional pulley on the countershaft provides for two more speeds, but they are not ordinarily required in the machining operations on the 6-in. shell. The headstock bearings are of compressed babbitt. The feed box is of the tumbler-gear type and contains three feed changes. The feed shaft is driven from a pulley on the rear end of the spindle, and a weighted idler pulley is furnished to give proper belt tension and to act as a preventive of gear breakage in cases of overloading. One of the interesting features of this lathe is the carriage-stop mechanism, at *A* in Fig. 1. The adjustable stops are so arranged as to disengage the feed clutch at a predetermined distance from the fixed stop, so that, after the power feed is off, the tool that is cutting may be advanced by hand to secure a smooth finish.

The apron gearing may be seen in Fig. 3. The worm gear is of bronze, running in oil.

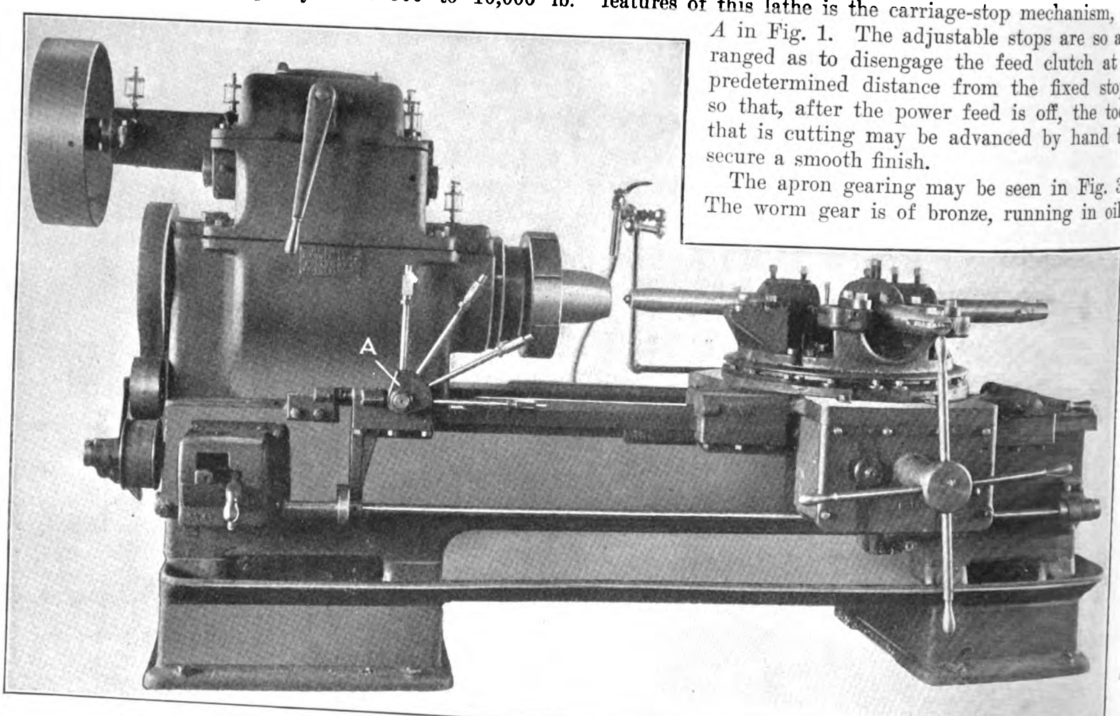


FIG. 1. DODGE SPECIAL-PURPOSE LATHE FOR MACHINING OPERATIONS ON 6-IN. SHELLS
Length of bed, 8 ft. 6 in.; width of bed, 27 in.; length of carriage on V, 40 in.; extreme travel of carriage, 30 in.; front bearing, 9½ in. diameter by 8 in. long; rear bearing, 7½ in. diameter by 7 in. long; swing over ways, 24 in.; swing over turret, 6 in.; diameter of turret, 24 in.; floor space, 10 ft. by 4 in.; drive pulley, 20x5½ in.; weight, 8,000 lb.

and the spur train is of steel. A fiber friction disk locks the feed. The turret locking pin, which of the wedge type, is released by the hand lever at A.

The carriage has a V-guide in front and a flat guide at the rear, as shown in the end elevation, Fig. 4. The tooling on this machine has been worked out so as to balance cuts by opposing front and back tools, as far as is possible. Consequently, neglecting the cam action that arises from eccentric shell forgings, there is slight tendency for the cuts to lift the carriage. Notwithstanding this fact, however, heavy flat gibs have been provided at front and back.

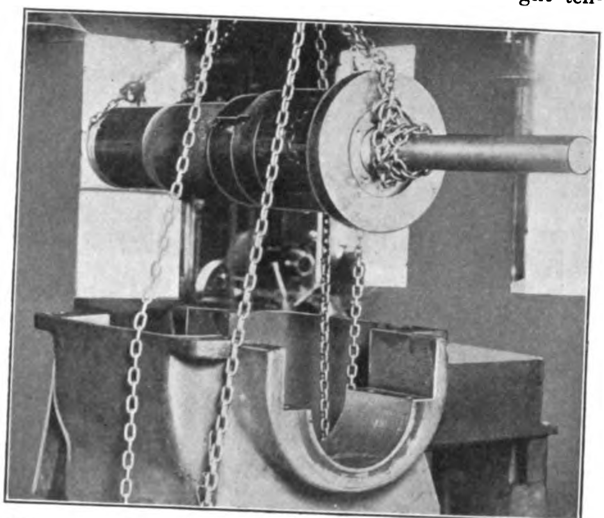


FIG. 2. MAIN SPINDLE OF "DODGE" SPECIAL-PURPOSE SHELL LATHE

The turret tooling varies for the type and size of shell being finished. In the case of the 6-in. high-explosive four different set-ups take care of the entire machining, except the nose threading and the band turning. Three of these toolings are illustrated in Fig. 5, the fourth, not shown, finishing the contour of the bessemer steel fuse plug after it is inserted in the shell.

For the first operation the shell is chucked by the nose end. The sequence of suboperations may be seen by in-

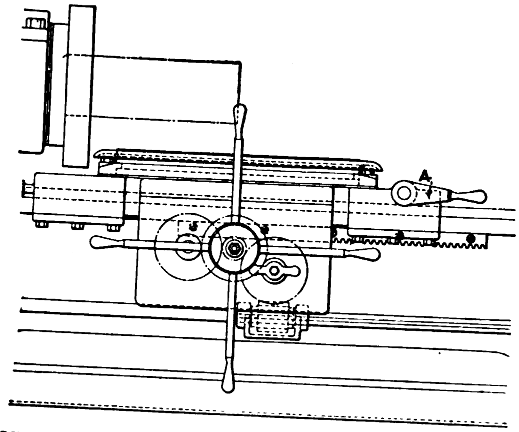


FIG. 3. APRON GEARS AND TURRET RELEASE OF DODGE LATHE

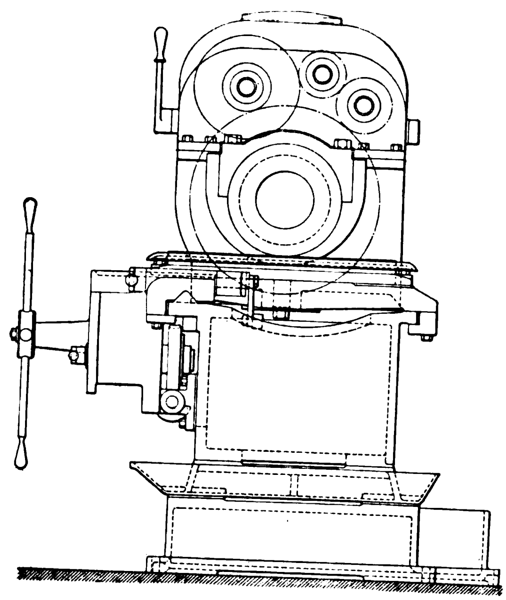


FIG. 4. END ELEVATION OF 6-IN. SHELL LATHE

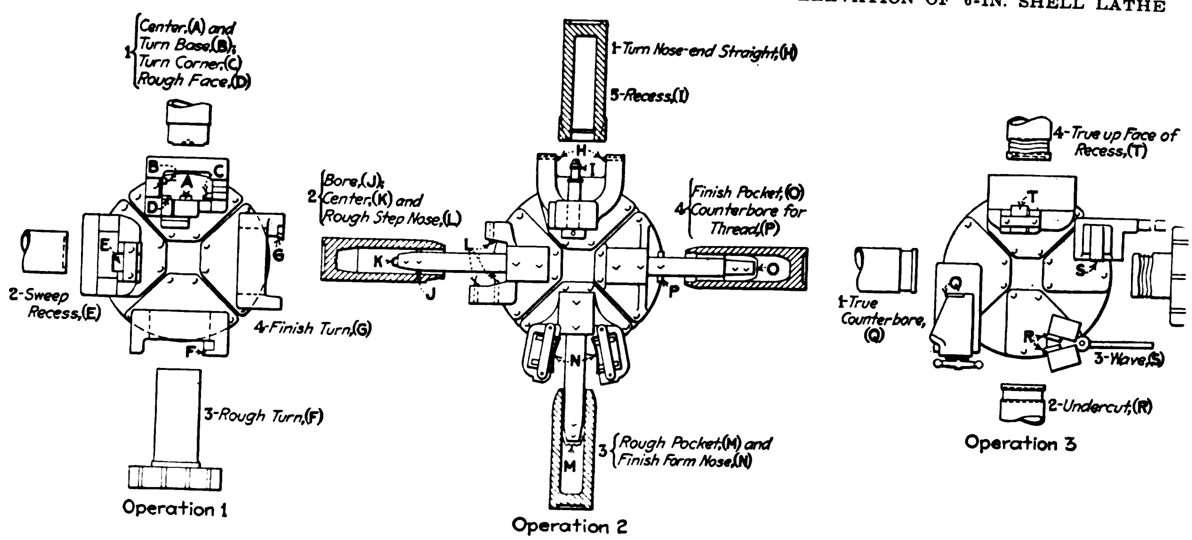


FIG. 5. TOOLING OF DODGE LATHE FOR MACHINING 6-IN. HIGH-EXPLOSIVE SHELLS

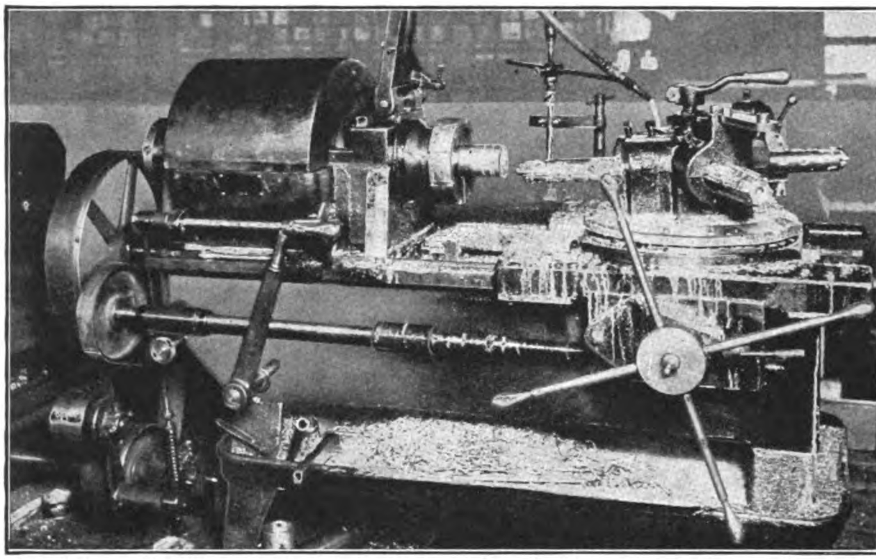


FIG. 6. SPECIAL-PURPOSE "BLOOD" LATHE FOR 3-IN. AND SMALLER SHELLS

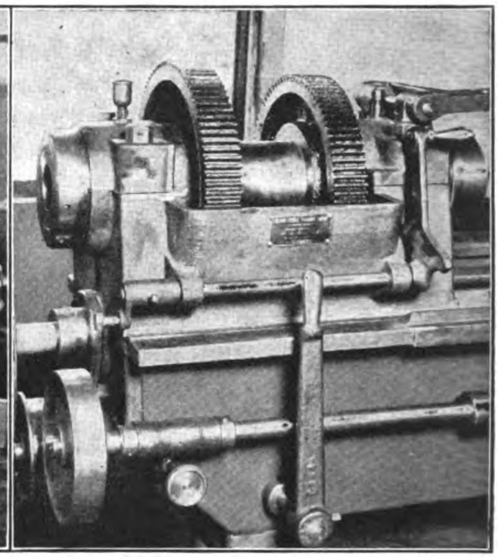


FIG. 7. HEADSTOCK OF "BLOOD" LATHE WITH COVER REMOVED

Swing over turret face, 4 in.; swing over shears, 20 in.; size of front spindle bearing, 5½ in. diameter by 6 in. long; size of rear spindle bearing, 5½ in. diameter by 5 in. long; maximum hole through spindle, 3¼ in.; maximum carriage travel, 12 in.; weight, 2,800 lb.; driving pulley, 20x4½ in.

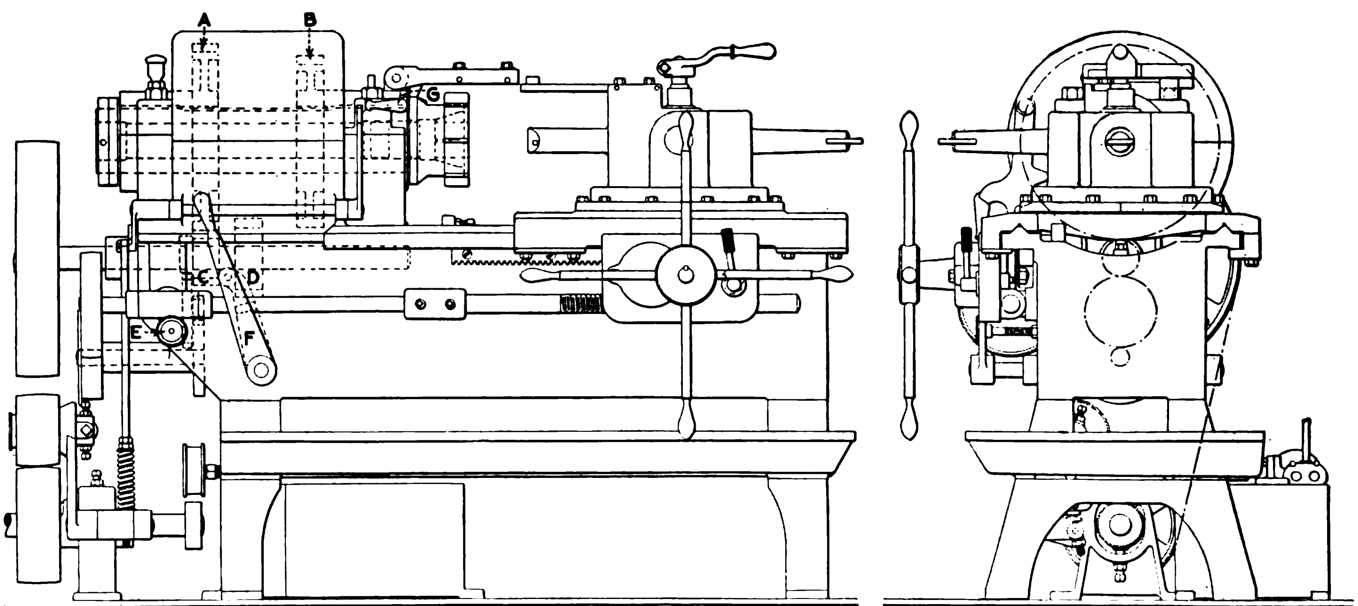
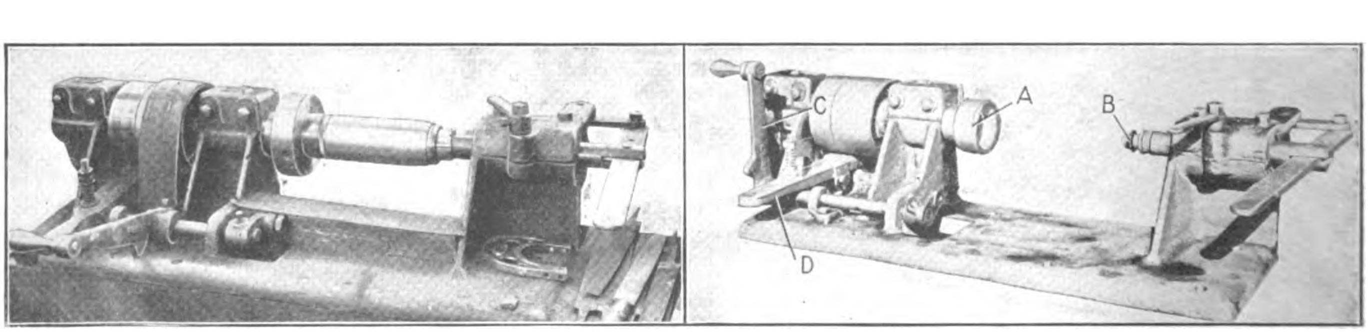


FIG. 3. OUTLINE DRAWING SHOWING ASSEMBLED ELEVATION AND END VIEW OF SPECIAL-PURPOSE "BLOOD" TURRET LATHE FOR 3-IN. AND SMALLER SHRAPNEL AND HIGH-EXPLOSIVE SHELLS



FIGS. 9 AND 10. SPECIAL SPEED LATHE FOR FILING AND POLISHING 3-IN. SHELLS

Swing, 10 in.; length between centers, 10 in.; weight, 250 lb.; driving pulley, 6x3½ in. Base plate may be extended so that the length between centers will accommodate 14 in. when required

spection of Fig. 5, the tools for each one being indicated by reference letters. The second chucking is on the base end, this operation finishing the shell bore and profiling the nose. An ingenious set-up permits a four-station turret to serve five stations, the first and fifth suboperations taking place on the same turret face. On the first position, second operation, the tools *H* rough-turn the nose end, as shown by the full lines on the shell, simply taking a parallel cut over the stock that was left for chucking from the first operation. After the fourth sub-operation the shell nose has the shape shown by the dotted lines and hence is not touched by the tools *H* on the fifth suboperation. At *I* is a recessing tool, mounted on an eccentric spindle. This enters the shell the proper distance to cut the recess back of the thread seat, thus completing the cycle on the same turret face on which it was begun.

The third chucking holds the shell for undercutting, wave cutting and base finishing. The waving tool *S* is oscillated by a roller on a faceplate cam on the spindle. The facing tool *T* merely takes a slight scraping cut in the recess. This machine is driven either by overhead or floor countershafts. The cutting coolant is distributed by an independently driven geared pump, the reservoir being in the base of the headstock, which is fitted with a chip strainer.

Special Purpose Turret and Polishing and Filing Lathes

The 3-in. special-purpose turret lathe, which is shown in action in Fig. 6, was designed by Charles W. H. Blood, of the S. A. Woods Machine Co., and is known as the "Blood" lathe. The machine here illustrated is tooled up for boring 3-in. Russian shrapnel shells, but the same lathe with different tooling is used for body turning, base finishing, band-groove machining, nose finishing, tapping, etc. Several hundred of these lathes have been in use for the past year in plants turning out Russian shells, and production records obtained on them were published in the series of articles beginning on page 89.

These machines are preferably driven by floor countershafts, through belts having spring-actuated idler pulleys, which are used for starting and stopping, by tightening or loosening the driving belt. There are two speeds, obtained through sliding gears in the headstock. The spindle gears may be observed in Fig. 7, which is a view of the headstock with the gear cover removed.

In Fig. 8 are side and end elevations of the Blood lathe, showing these same gears at *A* and *B*, the sliding pinions at *C* and *D*, the belt-tension adjustment at *E*, the gear-shift lever at *F* and the starting and stopping lever at *G*. In both of these turret lathes the turret face is set extremely low, bringing the tool centers close to the ways, thus insuring rigidity.

The special polishing and filing lathe may be seen in Figs. 9 and 10. The shell is held and driven through friction by the cup chuck *A*, which centers its base end, the shell being pressed into this chuck by the ball-bearing spring-actuated tailstock *B*. The drive on this machine is also preferable from a floor countershaft, the lever *C* starting and stopping the machine by varying the belt tension. Owing to the high speed at which a machine of this kind is operated, a hand brake *D* is provided for the purpose of quickly bring the spindle to a stop with considerable saving in time.

Cleveland Twist Drill Co.'s Plant Uninjured

In our department devoted to "New and Enlarged Shops," on page 76 of the American issue of Mar. 2, we incorrectly stated that the Cleveland Twist Drill Co., Cleveland, Ohio, was about to rebuild its plant, which had been destroyed by fire. This erroneous information was sent us by our Cleveland representative. As a matter of fact, the fire was confined to an unused shed, and the damage was trifling.

In our issue of Mar. 9 (American edition), on page 439, in the column devoted to "Business Items" we published a correction. Unfortunately, our original notice has been widely copied and quoted, and in a further effort to correct our mistake these paragraphs have been written.

The injury to the plant of the Cleveland Twist Drill Co. was slight, and regular production has not been interfered with in any way.

PERSONALS

William Arend has become general superintendent of the Cisco Machine Tool Co., Cincinnati, Ohio, succeeding George Spinner.

F. L. Cone, for more than 20 years associated with the Windsor Machine Co., Windsor, Vt., for the past 11 years as general superintendent, has resigned.

C. Earle Hoover has been elected president of the Hoover, Owens, Rentschler Co., Hamilton, Ohio, filling the vacancy caused by the death of his father, J. C. Hoover.

A. B. Hutchison, formerly machine and tool foreman of the Buckeye Traction Ditcher Co., Finley, Ohio, is now superintendent of the Dayton Pipe Coupling Co., Dayton, Ohio.

James McIlvrid, for many years manager of the Cockburn Co. and its successor, the Standard Gas Power Corporation, has resigned, in order to establish the Mutual Iron Works, Jersey City, N. J.

C. J. Hopkins, until recently a member of the engineering department of the Deere & Co., Moline, Ill., has been appointed production superintendent of the Curtis & Co. Manufacturing Co., St. Louis, Mo.

J. R. Stine has been appointed chief of the routing and controlling department of the Bullard Machine Tool Co. Mr. Stine was for several years head of the production department of the Locomobile Co.

Ross Anderson has resigned as factory superintendent of the Flannery Bolt Co., Bridgeville, Penn., to accept the position of factory manager with the Poole Engineering and Machine Co., Baltimore, Md.

Boyd Nixon, who for many years was connected with Harron, Rickard & McCone, San Francisco, Calif., has joined the selling organization of the Niles Tool Works Co., with headquarters in Cleveland, Ohio.

J. D. Cudney, who for some time past has been sales manager of the Alberger Gas Engine Co., Buffalo, N. Y., and its subsidiary companies, Alberger Heater Co. and the Howard Iron Works, has recently resigned to become sales manager of the Rathbun-Jones Engineering Co., Toledo, Ohio.

Arthur Falkenau, vice-president of the Hooper-Falkenau Engineering Co., New York City, has become acting consulting engineer of the Canadian Car and Foundry Agency which is carrying on the production of Russian munitions in more than eighty plants in the United States and Canada.

BUSINESS ITEMS

Modern Tool Co., Erie, Penn., has appointed the Walter H. Foster Co., 50 Church St., New York, agents for the Eastern territory for its grinding machines.

Rickert-Shafer Co., manufacturer of tapping machines and self-opening dies, moved on Apr. 1 into its new and larger shop at West 12th and Cherry St., Erie, Penn.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points indicated:

	Mar. 31, 1916	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$15.00	$15.00	$9.00
No. 2 X Northern foundry, New York	20.50	19.75	14.25
No. 2 Northern foundry, Chicago	19.00	18.50	13.00
Bessemer, Pittsburgh	21.95	21.45	14.55
Basic Pittsburgh	19.20	18.95	13.45
No. 2 X, Philadelphia	20.25	20.00	14.25
No. 2 Valley	18.50	18.25	12.75
No. 2, Southern Cincinnati	17.90	17.90	12.15
Basic, Eastern Penn.	20.00	19.50	13.50
Gray forge, Pittsburgh	18.45	18.45	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger from jobbers' warehouse at the places named:

	New York				
	Mar. 31, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Steel angles, base	3.10	2.95	1.85	3.25	3.10
Steel T's, base	3.15	3.00	1.90	3.25	3.10
Machinery steel (bessemer)	3.10	2.95	1.80	3.25	3.10

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse at the places named:

	New York				
	Mar. 31, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
No. 28 black	3.50	3.50	2.60	2.95	3.20
No. 26 black	3.40	3.40	2.50	2.85	3.10
Nos. 22 and 24 black	3.35	3.35	2.45	2.80	3.05
Nos. 18 and 20 black	3.30	3.30	2.40	2.75	3.00
No. 16 blue annealed	4.30	3.75	2.35	3.00	3.45
No. 14 blue annealed	4.20	3.70	2.25	3.60	3.35
No. 12 blue annealed	4.15	3.65	2.20	3.55	3.30
No. 28 galvanized	5.65	5.65	4.00	5.50	5.50
No. 26 galvanized	5.35	5.35	3.75	5.20	5.20
No. 24 galvanized	5.20	5.20	3.55	5.05	5.05

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot:

	Black		Galvanized	
	Mar. 31, 1916	One Yr. Ago	Mar. 31, 1916	One Yr. Ago
¾ to 2 in. steel butt welded	72%	80%	53½%	69½%
2½ to 6in. steel lap welded	71%	79%	52½%	68½%
Diameter, In.				
¾	3.12	2.30	5.35	3.51
1	3.91	3.40	7.91	5.19
1¼	6.44	4.60	10.70	7.02
1½	7.70	5.50	12.79	8.39
2	10.36	7.40	17.21	11.29
2½	16.97	12.29	27.79	18.43
3	22.19	16.07	36.34	24.10
4	31.61	22.89	51.78	34.34
5	43.12	31.08	68.30	46.62
6	55.68	40 32	91.20	60.48

Bar Iron—Prices are as follows in cents per pound at the places named:

	Mar.31, 1916	One Month Ago
Pittsburgh, mill	3.45	2.40@2.50
New York	2.70	2.60
Warehouse, New York	3.10	2.90
Warehouse, Cleveland	3.25	...
WarehouseWarehouse, Chicago	3.10	2.90

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-size lots, the following quotations hold:

New York	10% above list price
Cleveland	20% above list price
Chicago	List price

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York.... $4.75 Cleveland.... $5.05 Chicago.... $4.10

In coils an advance of 50c. is charged.

Boiler Tubes—From Pittsburgh, the following are the less-carload basing discounts for lap-welded boiler tubes:

1¾ and 2 in.	51%	3½ to 4½ in.	60%
2¼ in.	48%	5 and 6 in.	53%
2½ and 2¾	54%	7 to 13 in.	50%
3 and 3¼	59%		

These discounts apply to standard gages and to even gages not more than 4 gages heavier than standard. For long tubes charge 10% net extra as follows: 1¾ in. size over 18 ft. and not exceeding 22 ft.; 2 to 3 in. sizes over 22 ft. and not exceeding 24 ft.; 3¼ to 13 in. sizes over 22 ft. and not exceeding 25 ft.

Swedish Steel Sheets—To consumers requiring fair-sized quantities tool steel sheets sell at 16c. base and spring steel sheets at 12c. base. These prices are f.o.b. warehouse, New York.

High Speed Tool Steel containing from 10 to 18% tungsten sells as follows per pound:

Billets .... $2.35 Bars $3.00

METALS

Miscellaneous Metals—The present quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	New York		
	Mar. 31, 1916	One Month Ago	One Year Ago
Copper, electrolytic (carload lots)	27.00	27.25	16.00
Tin	49.00	47.00	48.50
Lead	8.50	6.50	4.20
Spelter	17.62½	20.15	9.25
ST. LOUIS			
Lead	8.40	6.50	...
Spelter	17.50	20.00	...

At the places named, the following prices in cents per pound prevail:

	New York				
	Mar.31, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Copper sheets, base	35.50	35.00	20.75	34.50	34.50
Copper wire (carload lots	35.50	35.00	16.60	34.50	36.00
Brass rods, base	37.50	37.00	16.30	36.00	37.00
Brass pipe, base	41.50	41.00	19.15	43.00	45.00
Brass sheets	37.50	37.00	16.30	36.00	37.00
Solder ½ and ½ (case lots	30.75	29.37½	31.25	35.50	31.10

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York		
	Mar. 31, 1916	One Year Ago	Cleveland
Copper, heavy and crucible	23.00	13.10	22.00
Copper, heavy and wire	22.00	12.75	21.00
Copper, light and bottoms	19.00	11.50	18.00
Lead, heavy	6.00	3.75	6.50
Lead, tea	5.50	....	5.50
Brass, heavy	14.00	9.25	18.00
Brass, light	12.00	7.00	12.00
No. 1 yellow rod brass turnings	15.00	...	16.25
Zinc	13.00	5.00	14.50

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	31.50	32.00	32.50	33.00	36.00
¼ to 5/16	31.25	31.75	32.25	32.75	35.75
⅜ to 1⅞	31.00	31.50	32.00	32.50	35.50
1 15/16 to 2⅞	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3 7/16	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3½ to 3 15/16	32.25	32.75	33.25	35.75	36.75
Squares					
3 1/16 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4 15/16	33.00	33.50	36.00	36.50	37.50
5 to 6 15/16	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Aluminum—Quotations in cents per pound are as follows for ton lots:

No. 1 virgin 98-99%	59.00@61.00
Pure 98-99% remelt	58.00@60.00
No. 12 alloy remelt	48.00@50.00

Jobbers usually charge 2c. per pound over these figures.

Antimony—Chinese and Japanese brands are quoted in cents per pound for spot delivery duly paid:

New York.... 45.00 Cleveland.... 50.00 Chicago.... 45.00

Copper Bars from warehouse sell as follows in cents per pound:

New York.............. 40.00 Chicago.............. 38.50

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places named:

	New York	Cleveland	Chicago
Best grade	55.00@60.00	59.00	60.00
Commercial	25.00@30.00	22.50	30.00

Copper Sheets—In New York hot rolled 16 oz. (large lots) base per lb. is 35.50c.; cold rolled 14 oz. and heavier add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

SHOP SUPPLIES

Nuts—From warehouses at the prices named, on fair sized orders the following amount is deducted from list:

	New York	Cleveland	Chicago
Hot pressed square	$2.75	$3.75	$3.70
Hot pressed hexagon	2.75	3.75	3.80
Cold punched square	2.50	3.00	3.25
Cold punched hexagon	3.00	3.75	4.00

Semifinished nuts sell at the following discount from list:

New York....65% Cleveland....70.10% Chicago....70%

Machine Bolts—For fair-sized orders from warehouses at the places named the following discounts hold:

	New York	Cleveland	Chicago
⅜ by 4 in. and smaller	50 and 10%	65 and 10%	65 and 5%
Larger and longer up to 1 in.			
1 in. by 30 in.	45%	50 and 15%	50 and 20%

Length	New York			Cleveland			Chicago		
In.	¼	½	1	¼	½	1	¼	⅝	1
2	$0.81	$2.13	$8.80	$0.57	$1.22	$4.04	$0.59	$2.23	$6.40
2½	0.84	2.27	9.30	0.60	1.30	5.32	0.62	2.38	6.76
3	0.88	2.41	9.79	0.63	1.38	5.61	0.65	2.54	7.12
3½	0.91	2.55	10.29	0.67	1.41	5.89	0.68	2.69	7.48

Carriage Bolts—From warehouses at the places named the following discounts from list price are in effect:

	New York	Cleveland	Chicago
⅜ by 6 in.	50 and 5%	65%	65%
Larger and longer	40 and 5%	50 and 5%	50 and 15%

At this rate the net prices are as follows:

Length,	New York			Cleveland			Chicago		
In.	¼	½	¾	¼	½	¾	¼	½	¾
1½	$0.48	...	...	$0.35	...	...	$0.35	...	...
2	.53	...	...	.38	...	...	.38	...	...
2½	.57	$1.85	$4.85	.42	$1.55	$4.04	.42	$1.38	$3.61
3	.62	1.41	5.16	.45	1.68	4.27	.45	1.50	3.82
3½	.67	2.17	5.42	.49	1.81	4.51	.49	1.62	4.04

Wrought Washers—From warehouses at the places named the following amount is deducted from list price:

New York.... $4.25 Cleveland.... $6.20 Chicago.... $6.30

At this rate, the net prices follows:

Diameter, In.	New York	Cleveland	Chicago
5/16	$9.25	$7.20	$7.70
¾	7.45	5.40	5.90
⅞	6.65	4.60	5.10
1	5.75	3.70	4.20
1¼	4.95	3.10	3.50
1⅜	4.45	2.65	3.10
1½	4.35	2.50	3.00
1¾	4.25	2.40	2.90
2, 2¼, 2½, 2¾	4.05	2.30	2.80
3, 3¼	4.25	2.40	2.70
3½, 3¾	4.25	2.70	2.90
4, 4¼, 4½	4.75	2.70	3.20

For cast-iron washers the base price per 100 lb. is as follows:

New York.... $2.50 Cleveland.... $1.75 Chicago.... $1.90

Bolt Ends—Fair-sized orders of bolt ends with hot-pressed nuth, from warehouses at the places named sell at the following discount from list price:

New York... 45% Cleveland... 60% Chicago..50 and 20%

Rivets—The following quotations are allowed for fair sized orders from warehouse:

	New York	Cleveland	Chicago
Steel 7/16 and smaller	60%	60, 10 and 10%	60%
Tinned	60%	60, 10 and 10%	60%

Button heads ¾, ⅞, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.:

New York.... $4.75 Cleveland.... $3.25 Chicago.... $3.50

Cone heads, same sizes:

New York.... $4.85 Cleveland.... $3.35 Chicago.... $3.60

For the following sizes, the extras over the above prices in cents per 100 lb. are as follows:

1⅛ to 1⅞ in. long, all diameters	$0.25
⅝ in. diameter	0.15
½ in. diameter	0.50
1 in. long and shorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

Coach of Lag Screws—For fair-sized orders, the discount from list at warehouse is as follows:

Chicago..............65, 10 and 5%

New York.......... 60% Cleveland.......... 65 and 10%

Nails—Wire nails f.o.b. Pittsburgh sell at $2.40; galvanized, 1 in. and longer, $4.40, and shorter, $4.90. These prices are to regular customers and delivery is made at the mill's convenience. From warehouse wire and cut nails sell as follows:

	New York	Cleveland	Chicago
Wire	2.90	2.95	2.70
Cut	2.90	2.85	2.70

Copper Rivets and Burs sell at the following rate:

	Rivets	Burs
Cleveland	List price	List price
Chicago	List price	List price
New York	List price	List price

MISCELLANEOUS

Seamless Drawn Tubing—The base price in cents per pound from warehouse is as follows:

	New York	Cleveland	Chicago
Brass	41.50	44.50	39.00
Copper	42.50	45.50	42.00

For immediate stock shipment the following prices hold:

	Copper			Brass		
	New York			New York		
Diameter, In.	Mar. 24, 1916	One Year Ago	Cleveland	Mar. 24, 1916	One Year Ago	Cleveland
¾ to 2½	45.50	22.50	44.50	43.50	19.50	45.50
3	45.50	22.50	44.50	43.50	19.50	45.50
3½	46.50	23.50	44.50	45.00	20.50	45.50
4	47.50	24.50	45.50	46.00	21.50	46.50
4½	49.50	26.50	47.50	48.00	23.50	48.50
5	51.50	28.50	49.50	50.00	25.50	50.50
6	52.50	29.50	51.50	51.00	26.50	52.50
7	54.50	31.50	51.50	53.00	28.50	52.50
8	56.50	33.50	55.50	55.10	30.50	56.50

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire

3/8, 11/32, 3/16, ¼, 7/32, 3/16	8.50
No. 8, 3/32 and No. 10	9.25
⅛	10.00
No. 12	11.00
3/32, No. 14 and 1/16	12.00
No. 18	14.00
No. 20	16.00

Special Welding Steel

⅛	33.00
5/32	30.00
3/16	28.00

Cast-Iron Welding Rods

¼ by 19 in. long	22.00
3/16 by 12 in. long	26.00
⅜ by 19 in. long	20.00
½ by 21 in. long	20.00

Vanadium Wire in Coils or Sticks

1/16	15.50
3/32	15.00
⅛	14.00
5/32	12.00
3/16 and larger	11.00

Tin Plates—The following prices are in effect from warehouses at the places named:

Coke tin plate, 14x20:	New York	Cleveland	Chicago
100 lb.	$5.00	$5.00	$5.00
I. C. 107 lb.	5.15	5.15	5.15

Terne plate, 20x28:

Base Weight	Net Weight	Coating	New York	Cleveland	Chicago
100 lb.	200	8	$9.50	$9.10	$8.20
I.C.	214	8	8.90	9.35	8.80
I.X.	270	8	11.80	11.60	10.55
I.C.	218	12	12.00	10.25	10.30
I.C.	221	15	13.00	10.50	11.25
I.C.	226	20	13.50	12.50	12.05
I.C.	231	25	14.25	13.50	13.30
I.C.	236	30	15.50	14.50	14.30
I.C.	241	35	17.00	15.75	15.75
I.C.	246	40	19.00	16.75	16.55

Cotton Waste—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	11.00@13.00	9.50@13.00	11.00@12.00
Colored Mixed	8.00@10.00	7.50@10.00	9.00@10.50

Sal Soda sells as follows per 100 lb.:

New York.............. $1.25 Cleveland.............. $2.25 Chicago..............$1.90

Roll Sulphur in 360-lb. bbl. sells as follows per 100 lb.:

New York.... $2.25 Cleveland.... $2.60 Chicago.... $2.85

Zinc Sheets—The following prices in cents per pound prevail:

Carload lots, f.o.b. mill.............................. 25.00

	New York	Cleveland	Chicago
In casks	26.00	26.00	27.00@27.50
Broken lots	26.50	26.50	28.00

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Mar. 11	Mar. 18	Mar. 25	Apr. 1
Prompt furnace	$3.50@3.75	$3.50@3.75	$3.50@3.75	$3.25@3.75
Prompt foundry	3.75@4.00	3.75@4.00	3.75@4.00	3.75@4.00

Linseed Oil—These prices are per gallon:

	New York	Cleveland	Chicago
Raw in barrels	$0.81	$0.82	$0.84
5-gal. cans	0.91	0.90	0.99

Boiled, it is 1c. per gal. higher.

White Lead, dry and in oil, in cents per pound sells as follows:

100-lb. keg	10.50
25- and 50-lb. kegs	10.75
12½-lb. keg	11.00
1- to 5-lb. cans	12.50

Red Lead, dry, in cents per pound sells as follows:

	Dry	In Oil
100-lb. keg	10.50	11.00
25- and 50-lb. kegs	10.75	11.25
12½-lb. keg	11.00	11.50

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

Plans are being prepared for the construction of a garage on Forest Ave., Portland, Maine, for the Mank Motor Car. Co., 9 Forest Ave. Estimated cost, $70,000.

Plans have been prepared for the construction of an addition to the plant of the Adams Needle Co. at Franklin, N. H.

We have been advised that the W. J. Murphy Co. is constructing a 3-story bronze factory at Amesbury, Mass. Estimated cost, $50,000. Noted Mar. 23.

The contract has been awarded for the construction of a garage at Boston, Mass., for Chauncey Thomas. Noted Jan. 20.

Robert T. Fowler, 702 Center St., Boston, Mass. (Jamaica Plains), will build a 1-story, 65x120-ft. garage at Jamaica Plains. Estimated cost, $85,000.

The Farrel Foundry and Machine Co. has awarded the contract for the construction of a 2-story, 40x100-ft. addition to its plant at Ansonia, Conn.

The C. G. Garrigus Machine Co. has awarded the contract for the construction of a 2-story, 80x96-ft. addition to its plant on Riverside Ave., Bristol, Conn. Noted Mar. 9.

The Stanford Steel Products Co. has awarded the contract for the construction of a steel rolling mill at Milford, Conn.

Arrigoni Bros. plans to construct a 2-story, 48x50-ft. garage on Liberty St., Middletown, Conn.

Bids will soon be received for the construction of a 6-story, 45x110-ft. factory on Main St., New Britain, Conn., for the Beaton and Cadwell Manufacturing Co., manufacturer plumbers' supplies. Estimated cost, $25,000.

The Rowe Calk Co. has awarded the contract for the construction of a 1-story, 50x60-ft. addition to its forge shop at Plantsville, Conn. Estimated cost, $20,000.

The O. K. Tool Holder Co. has awarded the contract for the construction of a 4-story, 40x80-ft. addition to its plant at Shelton, Conn.

The contract has been awarded for the construction of an addition to the plant of the Excelsior Needle Co. on Field St., Torrington, Conn. Noted Mar. 16.

MIDDLE ATLANTIC STATES

The Morrow Manufacturing Co., manufacturer of tools, machine and automobile parts, is constructing a factory at Elmira, N. Y.

Plans have been prepared by John H. Holler, Jr., Arch., 82 Wall St., New York, N. Y. (Borough of Manhattan), for a 1-story garage on President St., Brooklyn, for Arthur Anderson, 924 2nd St., Brooklyn. Estimated cost, $10,000.

Plans are being prepared by Louis Allmendinger, Arch., 926 Broadway, New York, N. Y. (Borough of Brooklyn), for a 1-story, 160x162-ft. factory at Heywood Ave. and 4th St., for Meurer Bros., 575 Flushing Ave., Brooklyn, manufacturer of sheet iron and metal goods. Estimated cost, $10,000.

E. C. Burns, 201 West 71st St., New York, N. Y. (Borough of Manhattan), has awarded the contract for the construction of a 6-story garage on 57th St. near 3rd Ave. Estimated cost, $20,000. Noted Jan. 20.

Plans are being prepared by Lansing C. Holden, Arch., 103 Park Ave., New York, N. Y. (Borough of Manhattan), for a 9-story factory and a 5-story addition to the present factory at 431 Greenwich St., Manhattan, of the R. E. Dietz Co., manufacturer of lanterns. Noted Jan. 27.

The Stewart-Warner Speedometer Co., 1828 Diversey Parkway, Chicago, Ill., will build a plant on Jackson Ave., Long Island City, New York, N. Y. (Borough of Queens).

Bids are being received by M. J. French, Arch., Snow Bldg., Syracuse, N. Y., for 2-story wire mill for Crucible Steel Co. of America, Syracuse.

Smith & Caffrey, Syracuse, N. Y. manufacturer of metals, etc., is having plans prepared for a factory. Estimated cost, $25,000. W. A. Smith, 621 North Salina St., is in charge.

Plans are being prepared by M. E. Granger, Arch., Syracuse, N. Y., for enlarging the plant of the U. S. Hoffman Co., Temple St., Syracuse, manufacturer of clothes pressing machinery.

The contract has been awarded for the construction of a garage at Butler, N. J., for Morris and Warren Kinney. Estimated cost, $45,000. Noted Feb. 3.

A commercial garage and machine shop will be established at Newark, N. J., by the Huberts-Becker Garage and Machine Co., recently organized.

The Ideal Fire Detector Co., Newark, N. J., has acquired a site on Plane St. and will establish a plant for the manufacture of a patented fire detecting apparatus. Charles H. Keyser is Gen. Mgr.

The Roberts Tool Co., Inc., plans to establish a plant at Newark, N. J., for the manufacture of tools and implements.

Signore & Guari[illegible], Newark, N. J., will construct a commercial garage [illegible] shop on Charlton St.

The Mycock Machine Co. plans to build a 1-story machine shop on Lincoln Ave., Trenton, N. J.

The contract has been awarded for the construction of a 2-story garage on Hudson Ave., West New York, N. Y., for O. & S. Siersema. Estimated cost, $12,000.

The plant of Thomas A. Edison, Inc., West Orange, N. J., recently damaged by fire with a loss of $15,000, will be rebuilt.

The National Tube Co. plans to enlarge its plant at Ellwood City, Penn.

The Hershey Machine and Foundry Co., Lancaster, Penn., will build a 58x150-ft. machine shop at its plant.

F. M. Weaver, Lansdale, Penn., will construct 1-story machine shop.

According to press reports the Underground Steel Cable Co., Perth Amboy, N. J., will construct a plant in Moon Township, Monaca, Penn., on a site purchased by the Colonial Steel Co. of Pittsburgh, Penn.

The Pennsylvania Engineering Co., New Castle, Penn., plans to construct a 100x180-ft. addition to its foundry. E. W. Beadel, Gen. Mgr.

The American Bridge Co., Philadelphia, Penn., is constructing a 1-story machine shop on Main St. Estimated cost, $20,000.

The American Radiator Co., Taylor and Wharton St., Philadelphia, Penn., will build an addition to its plant.

The Hess-Bright Manufacturing Co., manufacturer of ball bearings, Front St. and Erie Ave., Philadelphia, Penn., has awarded the contract for the construction of an addition to its plant. Estimated cost, $50,000. Noted Mar. 9.

Bids are being received by the Ford Motor Co., Detroit, Mich., for a 3-story, 100x170-ft. service building at Scranton, Penn. Estimated cost, $25,000. Noted Jan. 20 and Feb. 10.

Fire, Mar. 24 destroyed the plant of the Union Furnace Shovel Works at Union Furnace, Penn. Loss, $50,000.

The Universal Manufacturing Co., Washington, Penn., recently organized, will take over the plant of the Standard Sheet Metal Manufacturing Co. and equip it for the manufacture of steel barrels. R. C. Buchanan, Wylie and Jefferson Ave., Washington, is interested.

The Friction Hinge Co., Williamsport, Penn., will construct a 1-story factory building.

SOUTHERN STATES

The Norfolk Southern Railroad Co., Norfolk, Va., plans to construct shops at Carolina Junction. F. L. Nicholson, Norfolk, is Ch. Engr.

C. L. Weisman plans to equip a factory at Keyser, W. Va., for the manufacture of washing machines.

F. B. Merry and J. D. Ware plan to organize a company at Savannah, Ga., to build a plant for the manufacture of a patented lathe machine. Estimated cost, $10,000.

S. B. Gren, Daytona, Fla., plans to construct a 2-story garage. Estimated cost, $20,000.

The Chattanooga Steel Co., Chattanooga, Tenn., has awarded the contract for the construction of a blooming mill. Noted Mar. 23.

E. Van Winkle, Chattanooga, Tenn., plans to establish a plant at Chattanooga for the manufacture of parts and assembling motor trucks.

The Louisville Steel and Iron Products Co., recently incorporated at Louisville, Ky., with $1,125,000 capital stock, has acquired a plant at South Louisville formerly occupied by the Louisville Bolt and Iron Co. and will equip it for the manufacture of bar and sheet iron. O. C. Carter, Chicago, Ill., Pres.

The Southern Fire Apparatus Co., recently organized, plans to establish a plant at Louisville, Ky., for the manufacture of fire fighting apparatus.

The contract has been awarded for the construction of a garage at Sturgis, Ky., for the Bradburn-Truitt Motor Co.

MIDDLE WEST

Preliminary plans are being prepared for the construction of an addition to the plant of the Enterprise Manufacturing Co., manufacturer of fishing tackle and metal specialties, at Akron, Ohio. Estimated cost, $25,000. E. A. Pfluger is Pres.

Plans are being prepared for the construction of an addition to the plant of the Twentieth Century Heating and Ventilating Co. at Akron, Ohio. Noted Feb. 24.

The Canton Sheet and Mill Co. plans to build a 3-story, 50x55-ft. and 97x172-ft. addition to its plant at Canton, Ohio.

Bids are being received for the construction of a 2-story, 35x80-ft. factory at Cincinnati, Ohio, for the Cincinnati Lathe and Tool Co. Estimated cost, $20,000. Noted Mar. 16.

The Elmwood Castings Co. plans to construct a 114x200-ft. addition to its plant at Murray Rd. and Cleveland, Cincinnati, Chicago & St. Louis Ry., Cincinnati, Ohio.

The Gruen Watch Manufacturing Co. has been granted a permit for the construction of a 2-story, 60x160-ft. factory on McMillan St., Cincinnati, Ohio. Estimated cost, $30,000. Noted Jan. 20.

The contract has been awarded for the construction of a 1-story, 130x140-ft. addition to the plant of the Ajax Manufacturing Co., manufacturer of nut and bolt machinery, at Cleveland, Ohio. Noted Mar. 23.

Plans are being prepared by George S. Rider & Co., Arch., 512 Century Bldg., Cleveland, Ohio, for the construction of a factory on Harvard Ave., Cleveland, for the Cleveland Wire Spring Co., Hamilton Ave. Estimated cost, $100,000. Noted Mar. 23.

Bids have been received for the construction of a 2-story, 150x160-ft. addition to the factory of G. F. Mitchell & Son, manufacturer of sheet metal work and die stamping, at Cleveland, Ohio. Estimated cost, $20,000.

The Newburgh & South Shore Ry. plans to construct a machine shop at 4190 East 71st St., Cleveland, Ohio. H. L. Scheular, Western Reserve Bldg., Cleveland, is Ch. Engr.

The Overland Cleveland Co., 6604 Euclid Ave., Cleveland, Ohio, has awarded the contract for the construction of a 4-story garage, service and sales building on Euclid Ave., Cleveland. Estimated cost, $200,000. Noted Nov. 18 and Feb. 17.

The Packard-Cleveland Motor Co., 5206 Prospect Ave., Cleveland, Ohio, plans to construct an addition to its plant at Cleveland. Estimated cost, $100,000.

The Republic Structural Iron Works Co., 1270 East 53rd St., Cleveland, Ohio, plans to enlarge its plant on Lakeside Ave., Cleveland. Estimated cost, $250,000.

The Pittsburg Sheet and Tin Plate Co. has purchased the old steel mill at East Norwood, Ohio, Cincinnati post office, and will remodel it into a tin plate mill.

The American Shipbuilding Co. plans to construct a foundry addition to its plant at Lorain, Ohio.

Plans are being prepared for the construction of a factory at Loudonville, Ohio, for the Flexible Side Car Co.

The American Sheet and Tinplate Co., Wheeling, W. Va., plans to improve its plant at Martins Ferry, Ohio. Estimated cost, $100,000.

Plans have been prepared for the construction of a factory at 1787 East 40th St., New Haven, Ohio, for the American Stove Co. Estimated cost, $50,000.

The American Steel and Wire Co. will rebuild its plant at Salem, Ohio, recently destroyed by fire with a loss of $10,000. R. W. Ney is Gen. Mgr.

Carl F. Baker, 63 East 74th St., New York, N. Y., has purchased the plant of the Cyclops Steel Works at Titusville, Ohio, and plans to build additions.

The National Malleable Casting Co., 2126 Front St., Toledo, Ohio, will construct a garage at Toledo.

Bids will soon be received for the construction of a 1-story, 80x250-ft. factory at Brazil, Ind., for the Wood Turrett Machine Co. David Wood is Mgr. Noted Nov. 11.

Plans are being prepared for the construction of three 2- and 3-story, 65x150-ft. factory buildings for the General Electric Co. at Ft. Wayne, Ind. Estimated cost, $200,000. F. S. Hunting is Gen. Mgr.

The contract has been awarded for the construction of a 1-story, 50x120-ft. garage on North Mitchell St., Cadillac, Mich., for George F. and Clarence F. Williams.

The contract has been awarded for the construction of a factory at 2nd and Amsterdam Ave., Detroit, Mich., for the Chicago Pneumatic Tool Co.

The Stewart-Warner Speedometer Corporation, 1828 Diversey Parkway, Chicago, Ill., plans to construct a factory on Woodward Ave., Detroit, Mich.

The Brownwall Engineering and Pulley Co. has awarded the contract for the construction of a 2-story, 50x100-ft. factory at Holland, Mich. Estimated cost, $22,480. F. A. Wall is Mgr. Noted Mar. 9.

The Chicago Link Belt Co., 329 West 39th St., Chicago, Ill., will construct a 2-story addition to its plant at Chicago. Estimated cost, $35,000.

A. Finkel & Sons, 1322 Cortland St., Chicago, Ill., will build a 1-story, 25x110-ft. machine shop at Chicago. Estimated cost, $4,000.

F. W. Gehrer, Lincoln and North Ave. Chicago, Ill., plans to build a 2-story factory at Chicago for the manufacture of metal specialties. Estimated cost, $7,000.

The Illinois Steel Co. has awarded the contract for the construction of a 1-story garage at 1653 McHenry St., Chicago, Ill. Estimated cost, $15,000. Noted Mar. 16.

Plans are being prepared by Albert P. Dippold, Arch., 1330 East 47th St., Chicago, Ill., for the construction of a 2-story, 100x200-ft. garage at Chicago, for the William Rudd & Co.

F. V. Wolcott, 1958 Montrose Ave., Chicago, Ill., plans to construct a 1-story machine shop at 4437 North Lincoln Ave., Chicago. Estimated cost, $8,000.

Wright & Street, 233 West 63rd St., Chicago, Ill., manufacturer of jewelry, plans to construct an addition to its plant at Chicago. Estimated cost, $10,000.

The contract has been awarded for the construction of a 2-story garage at Jerseyville, Ill., for William Simmons. Estimated cost, $19,000.

The contract has been awarded for the construction of a 2-story, 50x139-ft. garage for William Brandt at Winnetka, Ill. Estimated cost, $15,000. Noted Oct. 14.

H. F. Wetter, 22 North Park Ave., Fond du Lac, Wis., has awarded the contract for the construction of a reinforced-concrete garage and machine shop at Fond du Lac. Estimated cost, $12,000.

Bids are being received for the construction of a garage and machine shop for J. C. Harlow at Janesville, Wis. Noted Feb. 10.

Bids will soon be received for the construction of a 2-story, 48x60-ft. reinforced-concrete garage and repair shop at Poynette, Wis., for Jamieson Bros.

Plans are being prepared for the construction of a tin shop at Sheboygan, Wis., for the Prange Geussenhainer Co., 802 North 8th St., Sheboygan, manufacturer of hardware and plumbing.

The Pioneer Manufacturing Co. plans to construct a machine shop and factory at 6703 Greenfield Ave., West Allis, Wis.

WEST OF THE MISSISSIPPI

The Tri City Railway Co. of Iowa, Davenport, Iowa, plans to construct a machine and repair shop at Rock Island, Ill. J. G. Huntoon, Vice-Pres. and Gen. Mgr.

Plans are being prepared for a 2-story garage for the Gohring Auto Co., Iowa Falls, Iowa. Estimated cost, $12,000.

Bids are being received by the King Ventilator Co., Owatonna, Minn., for the construction of a 2-story factory. Estimated cost, $4,000.

C. E. Rossman and associates, Thief River Falls, Minn., plan to construct a garage on North Main St. Estimated cost, $10,000.

Plans are being prepared for a garage for Bloom Bros., Osage City, Kan. Estimated cost, $10,000.

C. F. Sands, Kirksville, Mo., will construct a 2-story garage. Estimated cost, $15,000. W. H. Johns, 4029 Tracey St., Kansas City, Arch.

According to press reports the Wyeth Hardware and Manufacturing Co., St. Joseph, Mo., plans to construct a 6-story saddlery plant at 2nd and Faaron St. Estimated cost, $150,000.

The Missouri, Kansas & Texas Ry. plans to construct car shops at Muskogee, Okla. Estimated cost, $166,000. L. F. Lonnbladh, Dallas, Tex., Ch. Engr.

The Chevrolet Motor Car Co., Flint, Mich., plans to construct an assembling plant at Ft. Worth, Tex.

The Colorado Motor Car Co., Pueblo, Colo., plans to construct a garage at 9th and Main St. Estimated cost, $20,000.

WESTERN STATES

The contract has been awarded for the construction of a 50x100-ft. garage and machine shop on Woodlin Ave., Chelan, Wash., for Hendricks & Braden.

Yakima County plans to construct a garage at North Yakima, Wash.

Harris Bros., Ritzville, Wash., plans to construct a garage and machine shop at Ritzville.

The Gerlinger Motor Co., Portland, Ore., will construct a factory at Tacoma, Wash.

The North Bank Railroad Co., Vancouver, Wash., plans to build a plant for reclaiming scrap iron, enlarge its roundhouse and purchase new machinery. Estimated cost, $20,000.

The J. A. McEachern Co. plans to construct a shipbuilding plant at Astoria, Ore. W. W. Clark is Mgr.

The J. C. Braly Auto Co. plans to construct a machine shop at 19th and Washington St., Portland, Ore.

Plans being prepared by Arthur G. Lindley, 310 Hollingsworth Bldg., Los Angeles, Calif., for garage and machine shop on West Broadway, Glendale, Calif., for L. E. Brockman, 1102 West Broadway, Glendale.

Plans are being prepared for the construction of a factory on Boyle Ave., Laguna Beach, Calif., for the Cochise Machine Co., 405 Aliso St., Los Angeles.

The contract has been awarded for the construction of a 1-story factory at Folsom and Ritch St., San Francisco, Calif., for the Johnson Gear Co.

CANADA

Plans are being prepared by L. H. Taylor, 13 St. George St., Brantford, Ont., for the construction of a garage at Brantford, for C. J. Mitchell, 53 Darling St. Estimated cost, $20,000.

The Stanley Steel Co., recently incorporated, will build a plant at Hamilton, Ont. E. A. Moore, New Britain, Conn., is Pres.

The E. T. Wright Co., manufacturer of tinware, plans to construct an addition to its plant on Cathcart St., Hamilton, Ont.

Plans are being prepared for the construction of a plant at Harrow, Ont., for the W. Clark Canning Co., Montreal, Que. Estimated cost, $25,000.

The Brown Copper and Brass Rolling Mills, Ltd., is constructing a brass rod and shape mill at New Toronto, Ont. Estimated cost, $125,000.

The Galbraith Co., Ltd., plans to install new machinery in its plant at Owen Sound, Ont., for the manufacture of toys. E. Galbraith is Pur. Agt.

The Renfrew Machinery Co. will rebuild its plant at Renfrew, Ont., recently destroyed by fire with a loss of $100,000. Noted Mar. 30.

GENERAL MANUFACTURING

NEW ENGLAND STATES

Plans are being prepared for the construction of additions to the woolen mills at Franklin, N. H., of the M. T. Stevens Co.

The contract has been awarded for the construction of a 2-story, 32x150-ft. factory at Gardner, Mass., for Nichols & Stone Co., manufacturer of chairs.

The contract has been awarded for the construction of an addition to the plant of the Nonotuck Paper Co. on Mosher St., Holyoke, Mass.

The Wattaquottoc Worsted Co. plans to construct a 1-story, 75x180-ft. addition to its plant at Hudson, Mass.

The Boston Duck Co., Bondsville, Mass., plans to construct a 5-story, 130x400-ft. mill at Palmer, Mass.

The contract has been awarded for the construction of a 4-story factory at Bridgeport, Conn., for the Holmes & Edwards Silver Co., 874 Crescent St., Bridgeport. Estimated cost, $50,000.

The Vincent-Doyle Hat Co. contemplates rebuilding its factory at Danbury, Conn., recently destroyed by fire with a loss of $30,000.

MIDDLE ATLANTIC STATES

The contract has been awarded for the construction of a 3-story factory at 3rd and Walnut St., Niagara Falls, N. Y., for the Defiance Paper Co. Estimated cost, $175,000. Noted Jan. 13.

The Niagara Electrochemical Co., Niagara Falls, N. Y., will reconstruct the 4 buildings of its plant at Buffalo Ave. and 24th St., recently destroyed by fire. H. R. Carveth is Gen. Mgr.

R. Neumann & Co., Hoboken, N. J., manufacturer of leather goods, has acquired a site on Ferry St. on which it plans to build a plant. Robert T. Heitemeyer is Pres.

The Union Terminal Cold Storage Co., 13th and Provost St., Jersey City, N. J., has awarded the contract for a 7-story addition to its plant.

Plans are being prepared by Lee & Hewitt, Arch., 1123 Broadway, New York, N. Y., for 3-story factory on Union Ave., Paterson, N. J., for Harris Bros. Silk Co., 25 Manchester Ave., Paterson. Estimated cost, $20,000.

The plant of the William F. Taubel Hosiery Co., Trenton, N. J., recently destroyed by fire, will be rebuilt. Contract has been awarded. Estimated cost, $80,000. Noted Feb. 24.

The Susquehanna Cut Glass Co., Altoona, Penn., will construct an addition to its plant.

The contract has been awarded for the construction of a 2-story factory for the Swiss Cleaners and Dyers and the International Bag Co., Bethlehem, Penn. Estimated cost, $10,000.

The Mt. Holly Paper Co., Mt. Holly Springs, Penn., contemplates an expenditure of $100,000 for improving its plant.

Plans are being prepared for a loom factory at North Wales, Penn., for L. H. Gilmer Co., 52 North 7th St., Philadelphia, Penn. Estimated cost, $10,000.

D. G. Berry, Olyphant, Penn., manufacturer of silks, will build an addition to his plant on Lincoln Ave. and Main St.

The contract has been awarded for the construction of a 3-story factory at Emerald St. and Allegheny Ave., Philadelphia, Penn., for the Cleveland Worsted Mills, 5932 Broadway. George Hodgson is Gen. Mgr. Noted Mar. 23.

The Pennsylvania Shipbuilding Co., 407 East Tulpehacker St., Philadelphia, Penn., plans to construct a plant on the Delaware River. George S. Hoell is Secy. and Treas.

The contract has been awarded for the construction of a plant at Allegheny and Front St., Philadelphia, Penn., for the Philadelphia Tapestry Mills. Estimated cost, $15,000.

The Atlantic Refinery Co., Pittsburgh, Penn., has awarded the contract for the construction of a 12-story building on Duquesne Way.

SOUTHERN STATES

The Kessler Manufacturing Co., Salisbury, N. C., manufacturer of sheeting, plans to construct an addition to its plant.

The P. H. Hanes Knitting Co., Winston-Salem, N. C., has awarded the contract for the construction of an addition to its plant. Estimated cost, $90,000. Noted Oct. 14.

The Huntley Furniture Co., Winston Salem, N. C., plans to construct a 4-story addition to its plant.

John D. Wylie, Lancaster, S. C., plans to construct a knitting mill at Lancaster. Estimated cost, $25,000.

The Star Hosiery Mills, Spartanburg, S. C., recently incorporated, has awarded the contract for the construction of a 2-story mill. Estimated cost, $50,000. Noted Mar. 23.

The Yargan Rosin and Turpentine Co., Brunswick, Ga., plans to rebuild its plants recently destroyed by fire. Estimated cost between $400,000 and $500,000.

The Mertas Mills, manufacturer of cotton cloth, Columbus, Ga., will soon award the contract for an addition to its plant. Estimated cost, $275,000.

The Grantville Cotton Mills, Grantville, Ga., contemplates an expenditure of $35,000 for improving and enlarging its plant.

The Chattanooga Aseptic Cotton Co., Chattanooga, Tenn., will rebuild its plant recently destroyed by fire with a loss of $75,000.

MIDDLE WEST

The Glidden Varnish Co. has awarded the contract for the construction of a 4-story, 50x108-ft. factory at Cleveland, Ohio. Estimated cost, $80,000. Noted Feb. 24.

H. E. Hyman has purchased a site on East 79th St., Cleveland, Ohio, and plans to build a 150x160-ft. rubber factory.

The Incandescent Lamp Works will construct an addition to its plant on Collamer Ave., Cleveland, Ohio.

The contract has been awarded for the construction of a 2-story, 45x55-ft. addition to the plant at Greenville, Ohio, of C. R. Patterson, manufacturer of carriages.

The Champion Coated Paper Co. plans to build an addition to its plant at Hamilton, Ohio. Estimated cost, $10,000.

The Marion Tire and Rubber Co. plans to build a plant at Marion, Ohio. Estimated cost, $20,000. J. Wilbur Jacoby is Secy.

The Evansville Veneer Co. plans to reconstruct its plant at Evansville, Ind., which was recently destroyed by fire. Estimated cost, $10,000.

The Olds Soap and Chemical Co., 534 West McCarty St., Indianapolis, Ind., will rebuild its plant recently destroyed by fire with a loss of $15,000. Charles E. Sheets is Pres.

The contract has been awarded for the construction of a 4-story, 80x120-ft. packing and cold-storage plant at New Richmond, Wis., for the Inter-County Co-operative Packing Co. Estimated cost, $100,000. Noted Mar. 9.

The E. I. Du Pont de Nemours Powder Co. contemplates an expenditure of $225,000 for improving its Barksdale plant at Washburn, Wis. F. T. Beers, Gen. Supt.

WEST OF THE MISSISSIPPI

Plans are being prepared for a factory for the Nelson Dry Cleaning Co., Ft. Dodge, Iowa. E. O. Damon, Jr., Mason Bldg., Arch.

The contract has been awarded for the construction of a 4-story factory on 9th St., St. Paul, Minn., for Maendler Bros., 42 East 3rd St., manufacturer of brushes. Estimated cost, $50,000. Noted Feb. 10 and Mar. 9.

The Carey Salt Co., Hutchinson, Kan., plans to construct a 1-story, 160x200-ft. packing plant. Estimated cost, $30,000.

Plans are being prepared by C. W. Terry, Arch., Wichita, Kan., for a 2-story addition to the factory of the Daniel Shoe Co., 415 South St., Wichita. Estimated cost, $15,000.

Plans are being prepared by Klipstein & Rathmann, Arch., Chemical Bldg., St. Louis, Mo., for a 2-story factory for the American Manufacturing Co., 220 North 4th St., St. Louis, manufacturer of cordage and bagging. Estimated cost, $25,000.

The Newark Canning Co., Newark, Ark., plans to construct a canning plant.

We have been advised that the Western Gin Co. will rebuild its plant at Seymour, Tex., which was recently destroyed by fire with a loss of $20,000. Noted Mar. 23.

The American Beet Sugar Co., Denver, Colo., plans to improve its plant at Rocky Ford, Colo. Estimated cost, $75,000.

WESTERN STATES

The Du Pont Powder Co., Stanfield, Ore., contemplates the construction of a plant at Meacham, Ore.

Press reports state that the Knight Packing Co., 474 East Alder St., Portland, Ore., contemplates constructing a canning plant at Medford, Ore. C. L. Knight is Pres.

The Long Fruit Products Co. has leased a 2-story factory at Portland, Ore., and will improve and install new machinery. Estimated cost, $20,000. Frank A. Long is interested.

Plans are being prepared for the construction of a 7-story packing plant at Portland, Ore., for the Union Meat Co. Estimated cost, $150,000. C. C. Colt is Mgr. of the company's interests at Portland.

Eugene Bosse, Salem, Ore., contemplates constructing a plant at Roseburg, Ore., for retting and scutting flax.

The Sonoma Valley Canning Co. plans to construct a cannery at Sonoma, Calif. Estimated cost, $20,000. T. A. Van Guredy is Supt.

The Western Meat Co., San Francisco, Calif., has awarded the contract for the construction of a 5-story, 75x95-ft. cold-storage plant at South San Francisco.

The Foothill Orange Grove Co. plans to construct a packing plant at Strathmore, Calif. Estimated cost, $100,000. W. L. Crowe is Mgr.

CANADA

The Ontario Yarn Co., Markham, Ont., will construct a factory at Hamilton, Ont., and will be in the market for machinery estimated to cost, $20,000. J. A. Kammerer, Toronto, is Pres.

The York Knitting Mills Co., 993 Queen St. W., Toronto, Ont., plans to construct a factory at Toronto. Estimated cost, $40,000.

Classified Advertising

The Classified Advertising section appears on pages 226, 227, 228, of this issue and will in future appear in the same relative position in the paper.

American Machinist

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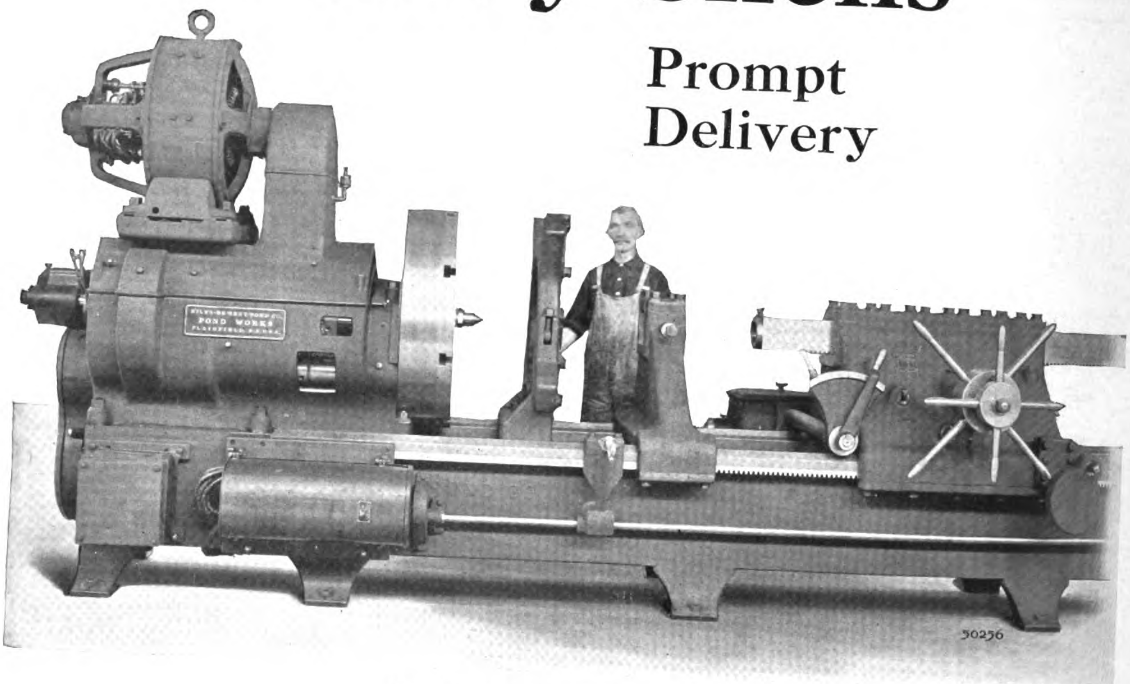
Contents, First Page
Advertising Index, Last Page

Lathes for Boring Heavy Shells

Prompt Delivery



36-In. Heavy Lathe with boring tailstock.

All Steel Gears

Lathes are equipped throughout with steel gears and are driven by 20-hp. motors. Rear end of spindle is provided with a special thrust bearing of heavy construction to take the end thrust due to boring large holes.

Boring Tailstock

The boring ram is forged steel 6-in. square, and has a very long bearing in the tailstock. The ram feed is driven from the feed shaft, at the rear of the bed, through worm and worm wheel giving a smooth motion for boring. By means of two levers, four feeds can be obtained without changing any gears. These levers are attached to the tailstock and hence are always in a convenient position.

Supports for Work and Boring Ram

A steady rest is provided to support the shell or other work. There is also furnished a special rest to support the end of the boring ram. This rest moves along the bed with the ram as it feeds.

Specifications, Delivery, Prices, etc., Promptly Furnished on Request.

Niles-Bement-Pond Co.

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CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormsy processes, protected by United States patent issued June 22, 1915, and another pending

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Golden Rule is the Law of Success*

By Elbert H. Gary
Chairman of the Board, United States Steel Corporation
**Extracted from a recent address*

"But after all differences are adjusted, the nations now or to be engaged in this colossal conflict, though terribly crippled, will take a new start and in many respects a new course, and will begin immediately to build on a better and firmer and more permanent basis for success and high achievement in everything that adds to national wealth, power, energy and enterprise.

"These nations will not remain inactive or despondent or indifferent.

"We shall see the most active and persistent efforts to rebuild and extend and to succeed in the international race for supremacy that the world has ever witnessed.

"From adversity will come greater prosperity than ever before. From necessity will spring thought and study and effort that will enable the survivors to reach greater heights of success than has been supposed to be within the reach of humankind.

"Now, what should the United States prepare for? If we conduct our affairs properly, if we make the most of our opportunities, if we cooperate with one another, if the government and governmental agencies and the business people are allies one with the other, we shall become stronger and richer and more potential in our influence, and we shall be able to take a place in the van of nations, progressing toward results more satisfactory than ever before.

"Assuredly we may build our hopes and expectations on the opportunities which this country offers.

"It seems to me at this moment the outlook for improvement in our lines of activity are better than they have been for more than a year. This is undoubtedly in part the result of increased exportations at fair prices, due to the European wars, but in my opinion also because of a change in sentiment toward business, which now seems apparent.

"Now the time is come when the business man, even if he represents large interests, may speak frankly and freely about any of the important questions which affect him or those whom he represents.

"When and while our attitude and conduct are above reproach, others will be willing to heed what we may say concerning any question in which they or we may be interested.

"The captain of industry is again to be popular in the United States and this has been brought about by the effort of business men to satisfy the public in regard to their reasonable demands.

"The individual, or aggregation of individuals, or the nation, whose standard of conduct conforms to the golden rule will on the average secure the largest pecuniary success.

"The clouds of distress, suspicion and hostility are breaking. In the rift we may see the sunlight of better things and better conditions."

Automatic Double-Spindle Surface Grinder

SYNOPSIS—This machine is not merely a double-end grinder, but it is fitted with two separate spindles and other mechanism that make it in reality two distinct machines on a single base. This construction gives a minimum of floor space covered and at the same time allows two operators to work independently of each other.

To be successful, a machine must be designed with the thought of the work it has to do, the way a workman will use it and the ease with which the various parts can be manufactured. Of course, there are other things to keep in mind; but the three mentioned are extremely important, and one or the other is frequently overlooked by designers without practical or shop experience. The grinder described in this article is the product of a shop engineering staff accustomed to making precision gages, dies, jigs and fixtures of all kinds where accuracy is essential. At the outset it was realized that, owing to the numerous adjustments, a universal type of machine was not desirable for very accurate work. For this reason something along the lines of the plain surface grinder was decided upon. The average toolroom is unusually crowded for space, so for both toolroom and manufacturing purposes the grinder is of the duplex type, carrying two distinct machines on a single base. Made in this way, it embodies the advantages of two separate machines.

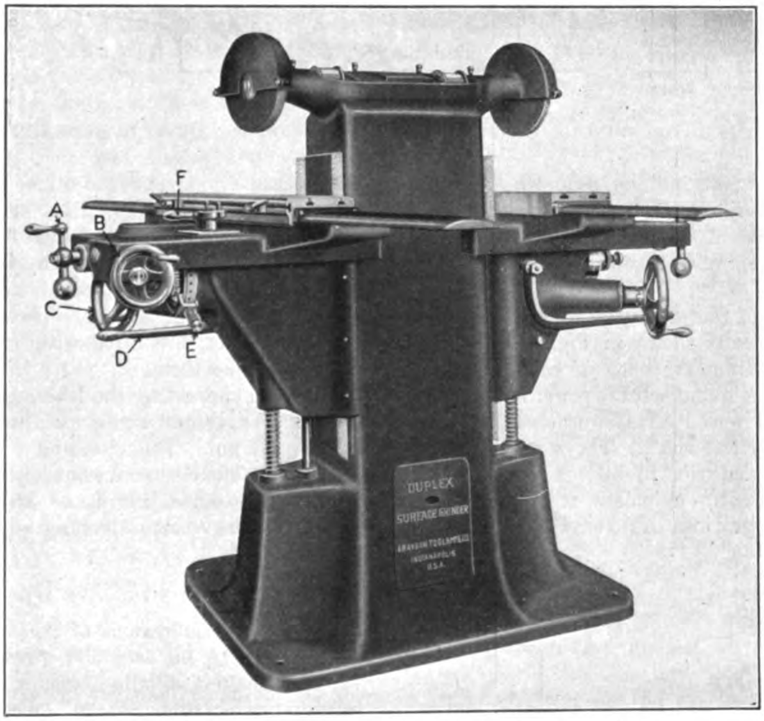


FIG. 1. AUTOMATIC DUPLEX SURFACE GRINDER

This grinder, which is shown in Fig. 1, is the design of the Grayson Tool and Manufacturing Co., Indianapolis, Ind. Briefly stated, the main features are ample weight and proportions to give the required rigidity, long knee bearing on the column, automatic and hand feeds, protected bearings throughout, ample table stroke, separate grinding spindles, cushioned table stops to avoid communicating jar to the opposite side, convenient grouping of handles and levers, special wheel-changing sleeves, wipers on all slides and an effective oiling system. The various controlling levers are as follows: *A* is for hand crossfeed; *B*, fine hand crossfeed; *C*, handwheel for elevating screw; *D*, neutral lever; *E*, feed-change lever; *F*, feed-clutch lever.

A single spindle for a double grinder of the type shown is not desirable, for the reason that one operator frequently has to stop his wheel while the other operator is working. This item alone is considerable; but add to this the fact that a bump or a jar on one end of the spindle is almost certain to affect the grinding on the other, and the idea of a single spindle at once becomes untenable where accurate work is required.

By referring to Fig. 2, where the spindle construction is shown in detail, the way the idea has been carried out is evident at once. The two spindles are duplicates. On one end they carry the grinding wheel and on the other a grooved pulley, from which the feeding mechanism is driven by means of a round belt working on the inside of the column. The spindle itself is of tool steel, hardened and ground, and runs in phosphor-bronze bearings. Oil reservoirs are provided underneath the bearings, from which oil is fed by wipers in direct contact with the spindle. The spindle itself is so made that it may be ground all over, as there is not a thread on the outside of it. The only threads are internal ones in the spindle ends. The adjusting collars are carried on a threaded sleeve that is shrunk on the spindle after it is ground. Both spindles have taper bearings at each end, these tapers being of uniform angle.

The thrust collars are hardened and ground steel, and the bearing dust caps are provided with felt washers. The bearings are long enough, and the adjusting collars are suitably placed, so that play may be taken up and still have a cool-running spindle. A feature is that all grinding wheels are carried on $1\frac{1}{4}$-in. sleeves, shouldered and threaded for a locknut. These sleeves accurately fit the tapered end of the spindle, so that special or formed wheels may be used at any time without the necessity of re-dressing each time. A number of extra sleeves are furnished with each machine.

A special spindle attachment is also provided for carrying a smaller wheel than the usual run. This attachment fits the end of the spindle and will hold wheels ⅛ in. or less in thickness and 3 in. in diameter. With a wheel of the size mentioned, slots $\frac{3}{32}$ in. may be ground out. From these small wheels others up to ¾x8 in. may be used. The countershaft has three speeds, so that a 3-in. wheel may be run at 4,300 r.p.m., a 5½-in. wheel at 3,200 r.p.m. and an 8-in. wheel at 2,150 r.p.m. This gives very closely the right number of feet per minute of peripheral speed. The countershaft may be stopped for each spindle without interfering with the other in any way.

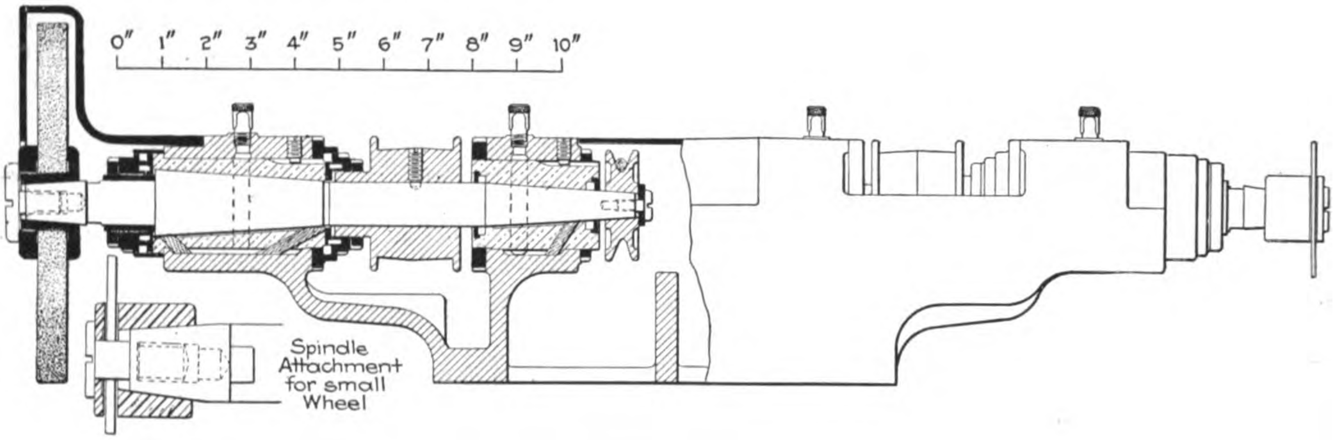


FIG. 2. DETAIL OF SPINDLE CONSTRUCTION OF AUTOMATIC DUPLEX SURFACE GRINDER

The arrangement of the principal parts of the feeding mechanism is graphically shown in Fig. 3. The round belts leading down from the ends of each spindle are easily seen. From the round belt the power is transmitted to a cross-shaft and worm. This worm meshes with a worm gear on a vertical shaft. The worm and worm gear are hardened and run in oil. A neutral clutch lever throws out the entire automatic feed when desired. Other clutches are provided for throwing either table traverse or crossfeed in or out. The table automatic traverse is regulated by adjustable stops, which are cushioned to prevent the jar of the reverse from being communicated to the other parts of the machine.

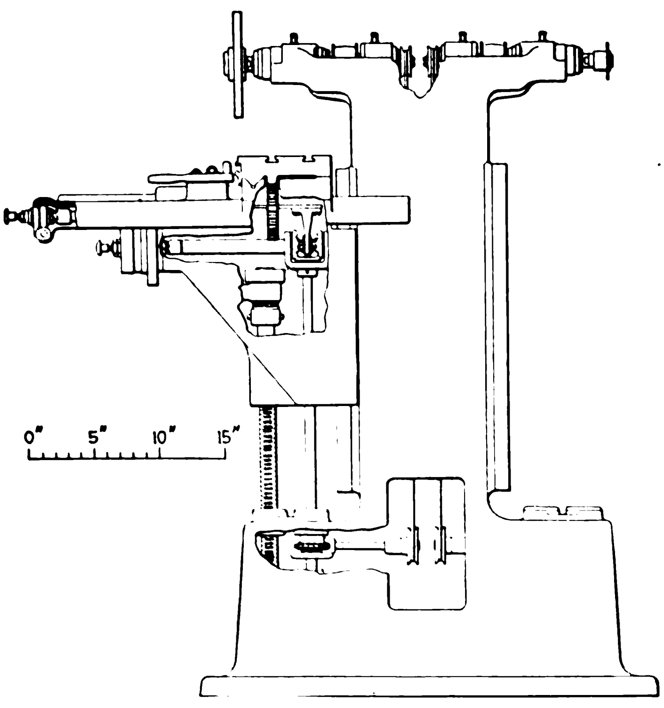


FIG. 3. DETA... AND DRIVE MECHANISM

There are ten changes of crossfeed available, regulated by a stationary and a movable dog on a perforated disk in front of the knee. For hand crossfeeding, two means are provided: One is by direct crossfeed screw turning, with a ball crank, and the other—for fine work—is by a geared handwheel that gives an extremely fine feed. The crossfeed and elevating screws are provided with dials graduated to read in thousandths, for convenient setting. The table has long way guards bolted to each end to protect the bearing surfaces. These, as well as all other sliding surfaces, are fitted with wipers to prevent grit from damaging them.

The knee supporting the table and mechanism is made especially heavy and rigid, with unusually long bearings on the column. The elevating screw has ball-bearing thrust and felt wipers. A convenient handwheel, angling out from the knee, affords an easy means of elevation without unnecessary stooping on the part of the operator.

Machine Specifications

The main specifications of the machine follow: Spindles, each 14½ in. over all; greatest spindle diameter. 1¼ in.; smallest spindle diameter, $\frac{9}{16}$ in., at inner end: front taper bearing, 3¾ in. long; rear taper bearing. 2¼ in. long; regular wheel sleeves, 1¼ in. in diameter where wheel goes on; spindle pulleys, 1-in. bore, 2½ in. in diameter and $1\frac{1}{16}$ in. between flanges; maximum distance from top of table to center of spindle, 14½ in.; width of table, 7 in.; table traverse, 18 in. with hand or automatic feed; crossfeed, 6½ in.; table T-slots, ½ in. wide; ten crossfeeds ranging from 0.025 to 0.250 in.; three spindle speeds, 2,150, 3,200 and 4,300 r.p.m., intended for 8-, 5½- and 3-in. wheels respectively; elevating screw, 1¼ in. diameter; column ways, 24½ in. long; knee bearing on column, 13¼ in.; base of machine, 24x35 in.; outspread of levers, handles and all, 6x5½ ft.: height over all, 50 in.; weight, about 1,200 lb.

⌘

The Sensitiveness of the Human Eye and its ability to distinguish color were made the subject of an interesting experiment by Professor Nichols, of Cornell University. Ninety-two different shades of blue were placed before 54 observers, and the general average for placing these shades in proper relation was over 95 per cent.

Limiting Improvements in the Small Shop

By John H. Van Deventer

SYNOPSIS—Dave Hope tells of the small-shop experiences of two of his acquaintances. One of them was a "stick-in-the-mud" who became a Captain of Industry; the other, a brilliant but erratic individual, finished up as he began—in a nut factory. This article explains why some of us are not millionaires.

"No, sir! It's a very promising machine, but I don't want to make it."

Dave Hope was delivering this ultimatum to a young mechanic and inventor who had worked out an ingenious device and wanted Dave to manufacture it. The lad had brought for inspection a working model that was beautifully finished and that went through its motions in such an unusual yet precise way that no real mechanic could have examined it without being interested. In fact, the interest that Dave had displayed and the way that he had fingered the model had raised the inventor's hopes to a high point, and his keen disappointment at the final decision was evident.

"I'm too much of a mechanic to manufacture a machine of that kind, or in fact to manufacture anything at all," said Dave, taking note of the young man's feelings. "That is why I stick to contract work and to making experimental machines to order. No machine that I could manufacture would ever suit me, and I should be adding and improving all the time, which would be fatal to the finances."

"If a good mechanic won't manufacture a good machine, who is a fellow to go to?" asked the inventor despondently, reaching for his model.

"Wait a bit—don't go yet," said Dave. "I want to tell you about Jones and Jenks; perhaps it may help to answer your question.

Albert Jones, the Natural Improver

"Albert Jones was one of the smartest mechanics that ever lived. It came natural to him to improve things, and when he was in a shop he was always suggesting better ways of doing things. At night he'd spend his spare time thinking up new machines and making sketches of them, just for fun, throwing them away after they were all completed.

"Al got a job as 'improver' in a big shop. He was right at home at this work and made himself valuable. One day, perhaps, he'd be figuring a new way to chuck pistons and the next be sketching up an attachment to convert a drilling machine into a die sinker. Variety was his spice of life, and he never had to do the same thing twice.

"A man who lived as quietly and got as good pay as Al did couldn't help but save money, and after a few years he had a lump salted away so big that it bothered him to decide what he ought to do with it. Finally, he concluded to open a shop of his own and start manufacturing.

"The day after he had arrived at this decision he was called into the blacksmith department to scheme some way of keeping nuts from bouncing off the helve-hammer bolts and to prevent the bolts themselves from breaking. He sat up until 3 a.m. the next morning, scheming and sketching and scratching his head, and finally invented a shock-absorbing locknut. The following day he quit his job and filed a patent application.

"That locknut was the best thing of its kind that ever was. It would hang on like a suffragette, and its shock-absorbing qualities were without equal. A mighty good thing to start a manufacturing business on, was that nut, because it could be made in three operations by the crudest kind of help and sold for a price that was an inducement, even if it hadn't had such good qualities besides.

Al Gets Busy with Patent Lock Nuts

"Al had his plant going two months before the patent was issued and was forced to add a couple of men every week to keep up with the demand of a public that was hungry for shock-absorbing locknuts. In six months he had designed and built special machines that would turn the nuts out almost as fast as a boy could carry them away. Things looked very rosy indeed for Al—to an outsider.

"There was one big defect in it from his point of view—the thing couldn't be improved upon. It was so simple and perfect that nothing in that line could be any better. An ordinary man would have been very well pleased at such a state of things, but not Al. All of the inventiveness and ingenuity in his system was corked up, so to speak, and was building up a pressure that was bound in time to blow the cork out—that cork being the shock-absorbing locknut! He began to detest the sight of one. 'Why should a man with brains tie himself up for life to a dinky one-piece contraption like that?' he would ask himself. Then he would lay off for the rest of the day, go back to his room, put his stocking-clad feet on the radiator and dream of complicated mechanical stunts that would make an ordinary man dizzy to think about.

William Jenks Parts with Ten Thousand Plunks

"Al was a man who had to act quickly when an idea struck him, so he sold out his shock-absorbing nut business to a boob by the name of William Jenks, who had as much inventive ingenuity as an Eskimo's totem pole, but who seemed perfectly satisfied to give $10,000 for a business worth five times as much. Then our inventive friend turned himself loose again like a colt in a pasture and began to put lines on paper and take a fresh interest in life.

"The result of his mental cyclone was a patented adjustable universal reamer that had a range of something like an inch in diameter for one tool as against the ordinary range of adjustment which begins with a decimal point followed by a naught. Where the locknut had been but a one-piece article, this tool had 37 parts, not

counting the screws, and therefore looked 37 times as good to Al, who saw plenty of opportunity for improvements and evenings filled with enjoyable mechanical meditation.

"It took considerably longer to put the reamer on a paying basis than it had to make a go of the locknut. In fact, it cost Al so much money to start things and improve them a bit that he was forced to take in a partner—a mean man of money without high mechanical ideals, whose motto was, 'Let well enough alone!' Of course, Al couldn't work in harmony with a dub of this kind, so in a year he sold his interest to the dub for $5,000 and breathed freely once more.

A Vertical Lathe for Shaft Turning

"The next venture of friend Al was a duplex lathe that would turn two shafts at once and which, to save room, stood in a vertical position instead of horizontal. Al said that, while there were a number of vertical machines for chuck work, the vertical center-work field needed considerable improving. He produced a design that had several original features, one of them being the feed screw that was exactly in the center of the tool carriage, this latter sliding within the body of the lathe, a pair of headstocks and tailstocks being arranged on each side. He had quite a bit of fun improving this machine, especially in getting oil to stay in the vertical headstock bearings. By the time the sheriff came to the rescue and the last balance sheet was struck, Al came away with $2,500 and a sense of relief at the prospect of tackling something new.

"One of his friends told him that if he wanted a chance to let loose the full power of his wonderful improving ability he should get into the automatic game, where there was a chance to pull off something big. This sounded pretty good to Al; but $2,500 wasn't enough to break into the automatic game with, so he decided not to manufacture the machine, but to design one and get somebody else to build it.

"He had considerable trouble with his landlady, who insisted on getting into his room once a week to pick the papers off the floor, she being afraid to let them accumulate for a longer time than that because of the fire-insurance policy. This upset the inventing process badly, Al needing one or two days after each weekly clean-up to get the papers back on the floor again in their proper order. In spite of this, after a year of scheming and scratching he had an automatic machine that had more improved features than anything made before. It wasn't hard to get a patent on such an original batch of improvements, and a few months later, armed with official documents from Washington, Al started out to find a builder.

Finding a Builder for the Superautomatic

"He called on a man in the automatic business and explained in detail how superior the Jones superautomatic was to the machine produced by the company. He not only told it, but proved it, convincing the engineers and experts who were called in to examine the plans. Evidently, the Jones superautomatic would be a clean sweep! Al was told to leave his plans and to call again in a week.

"He was received very cordially by the president. 'My dear Mr. Jones,' said this gentleman, 'we will offer you an exceptional contract for your invention. We wish the exclusive right to this and all improvements that you may make and in return will pay you a royalty of $500 per machine. At this extraordinary figure we will expect you to act as consulting engineer and give a portion of your time to improving this device. Sign here on the bottom line!'

"I hardly need to say that Al signed. The president's words about 'improving' were even a stronger inducement than the $500 per.

"For several weeks the inventor of the Jones superautomatic lived in the clouds. He worked out all sorts of further improvements and turned them over to the company, which seemed to be rather slow in getting started on the first machine.

"After six months passed in the same way, our friend began to be worried, especially as he was no longer admitted to the plant. He lay in wait for the president one day and accused him of not living up to his contract. 'My man,' said this individual, 'go back and read your contract. We agreed to give you a royalty of $500 for each machine built and so far have lived up to your agreement absolutely.'

"What the president of the company had really done was to get Al out of the automatic field, where he would have been a dangerous man. His endless improvements would have kept things in an everlasting state of change, just as the man who finds out how to turn lead into gold will make a lot of trouble for everybody, including himself.

Al Jones Gets a Government Position

"The last I heard of Al Jones was that he had a Government position with board and lodging, but no pay. He was engaged in making chalk marks on the floor of the harmless ward; and when a visitor to the asylum asked him what he was drawing, he'd say it was an improved automatic automatic-machine-making machine!

"As time went on, the asylum got to be overcrowded and a new building badly needed. Nothing could be done by the state, however, owing to the high cost of legislators, and it remained for a public-spirited Captain of Industry to donate two or three millions for the purpose. Rather a coincidence it was that this money to build a home for harmless nuts should have come from manufacturing shock-absorbing locknuts! But then William Jenks, who gave it, although a boob, was a good-hearted sort of chap."

Dave paused a moment and then continued with specific advice to the young inventor. "Now, if you want to make a success of your machine, find some man with money, but without ideas, to get back of it and push it."

Factory Wastes and Remedies

By F. E. Merriam

In most factories there are many wastes and losses that are usually preventable by the exercise of care and vigilance. A number of the most common are here given, together with simple remedies that have been found effective.

Sweepings, waste paper, soiled wiping waste, etc., are generally considered a nuisance and source of expense, though many factories are finding them a source of profit. Sweepings from machine shops contain babbitt,

brass, copper and other valuable metals in addition to soiled wiping waste and materials that can be segregated and sold. The metals can be separated from the other materials and one another by machinery and hand picking; the waste paper can be picked out and baled and the soiled wiping waste cleaned for further use.

To handle the soiled wiping waste at a profit requires organization and systematic methods. The most effective manner is to have the used waste placed in suitable receptacles and regularly gathered, washed and redistributed. The sweepers should place in the receptacles all waste found on the floor. During the reclaiming process some oil will be saved, which is good enough for rough purposes, although it contains different kinds of oil besides a considerable amount of grit. Wiping towels instead of waste are often productive of saving, since all the towels can be easily recovered, while it is difficult to reclaim over 50 per cent. of the waste. Wiping towels cannot replace waste universally; but wherever suitable, they are economical.

Wooden Barrels Waste Oil

The ordinary methods of handling oil are inefficient and productive of considerable losses, even in small factories. The trouble originates with the wooden barrels in which oil is shipped and stored, since they frequently leak, even when new. This leakage increases and continues as long as any oil remains in the barrel. Every time oil is drawn, some escapes, owing to dripping and often to overflowing. Some waste there will be even with the best of apparatus and arrangements; but it will be very small, if proper equipment is selected.

Proper oil-handling equipment will consist of tank cars or steel barrels for shipping and steel tanks or barrels for storage, together with pipe lines, pumps, etc., for distribution. The quantity of apparatus required depends upon conditions. Where the quantity of oil handled and the distance is considerable, economy requires pipe lines and pumps, since they save handling, expedite conveying and prevent losses.

The ordinary method of filling oil cans, or oilers, is a source of loss, on account of the quantity spilled each time and the frequency with which the oilers need refilling. With a pump and funnel there is almost a certainty of overflowing the oiler; and while some oil runs back into the reservoir, another and considerable portion remains to be wiped off with waste, thus forming a complete loss. The portion that runs back into the reservoir is a source of inefficiency, since it collects dust and dirt, thus contaminating the oil and providing future bearing trouble.

This source of loss can be prevented by the use of a tank with a pump that automatically prevents overflowing by "bypassing" the oil to the reservoir after a definite amount is in the oiler. Such equipment, while more expensive than that ordinarily used, justifies the extra cost.

Handling of Lubricating Oils

In the case of lubricating oils there is usually a considerable loss connected with the oiling of machinery, on account of the careless manner of filling oil holes and oil cups. It is not uncommon to allow them to overflow, regardless of the fact that such an excess serves no purpose except to increase the oil consumption. Poorly fitted bearings permit the oil to waste away, saturating the floor and everything else near-by. Such a condition is wasteful, not only in the matter of oil, but of belting and other equipment that it ruins, besides creating disagreeable surroundings for the workmen. This wasted oil also causes dust and dirt to collect, causing more rapid wear of the machinery. Sometimes the workmen are allowed to clean their hands with oil, in spite of the fact that a suitable soap is cheaper and more satisfactory.

Economies may often be effected by a careful study of the cutting fluids. Not infrequently, equally good results are secured with a water solution of some cutting compound, as compared with oil, since for many purposes it possesses sufficient lubricating properties and, of course, is much more cooling. Any substitution, however, should not be made without a thorough knowledge of the situation and after careful experiments, since a great deal of harm may be done by premature changes, not only to the product, but also by creating prejudice against any improvement. On the other hand, a more expensive fluid may be more economical, on account of decreased tool wear, as well as of the wear of the machine, and an improved product. As a case in point, I have in mind a number of turret lathes that had been running on soda water solution, as a cutting fluid, costing about 1c. per gal. After this solution had been in use for some time, it was found that the machinery had deteriorated considerably, owing to wear caused by soda being deposited on the moving parts. This soda acted as an abrasive, bringing about the rapid impairment of the machinery and increasing the difficulty of handling. A cutting-compound solution costing about 2½c. per gal. was substituted, the wear decreased, and the finish of the product improved. Sometimes it is necessary to go even farther and use a high-grade cutting oil, as is done in the case of automatic machines.

Extracting and Reclaiming Oils

There is a loss connected with machines using cutting oils, unless the oil is extracted from the chips. This saving will be worth while even in the case of such an inexpensive fluid as kerosene, since there will be at least 1 gal. of oil recoverable in 140 lb. of chips as they are found in the pan of the machine. A lathe working on 3-in. diameter steel will easily make 2,000 lb. of chips per day and will thus make possible the recovery of about $1.40 worth of oil. In the case of a regular cutting oil there will be several times as much oil in the chips, and the saving will then be considerably more, on account of the greater value of the fluid. The only machinery necessary is a plain centrifugal oil separator, which is comparatively inexpensive.

Many times there are wastes of tool steel that can be prevented by systematic study. A common mistake is to employ an improper grade of steel. This sometimes occurs because the grade chosen is more easily heat-treated than the more economical one, and money is thus continually being dissipated because of application in the wrong place. This loss is not entirely confined to the use of a too high-grade steel, but frequently to the use of too low a quality. A well-known example is high-speed steel for die parts, in place of less expensive carbon steel. What is true in the case just cited applies even with more simple tools. Sometimes tool steel is used for a machine part where a properly heat-treated piece of machine steel would give equal, if not superior, results.

Punches and Dies for a Door-Hanger Carriage

By Robert Mawson

SYNOPSIS—In this article are shown the punches and dies used on the first four operations in manufacturing the crossbar of a door-hanger carriage. Eight operations are required, of which those described in this article are piercing and blanking, embossing, piercing end holes and trimming.

The carriage is part of the equipment made by the McCabe Hanger Manufacturing Co., New York City, and is used on various types of door hangers. A view of an assembled carriage is given in Fig. 1. It is composed of the crossbar, the making of which is here described, four cones each having a set of balls, four wheels and the uniting rivets. The overall width of the assembled wheels is held to a limit of 0.005 in., which denotes the high-grade work obtained with these tools.

In manufacturing the crossbar plates the first operation is piercing and blanking. The tools for this operation are designed with stops that enable the steel strip, which has been previously cut to the correct width, to be fed against one of the stops. The punch, being forced down, pierces the first plate. The stop is then pulled out and the second stop pushed back. The punch is again forced down with the press and pierces the second plate.

The two stops are then drawn back, and the plate is pushed against the stop at the rear end of the die. The punch, forced down with the machine, cuts off the first blank that was pierced. The operation is then continued. One stroke of the machine thus pierces two blanks and cuts off another.

The next tools in the sequence are those for embossing. The plate is pushed against a stop, and the depressions are formed with the tools shown. The holes at the ends are pierced, and it will be noticed that one of them is made larger than the other. This enables the two plates to be assembled as will be described in a later article.

The last tool illustrated is for trimming the blank. The piece is fed under the stripper plate against a locating stop, and the punch, which is made with a similar contour to that desired for the plate, is fed down on the stock and the operation performed. By examining Figs. 6 and 8 on the opposite page it will be seen that the blank is rectangular in shape until this trimming operation is reached, when it is formed to a contour having rounded ends and a connecting web slightly narrower than the rounded ends.

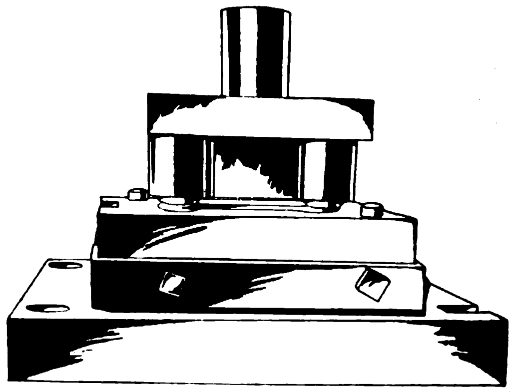


FIG. 9. TRIMMING PUNCH AND DIE

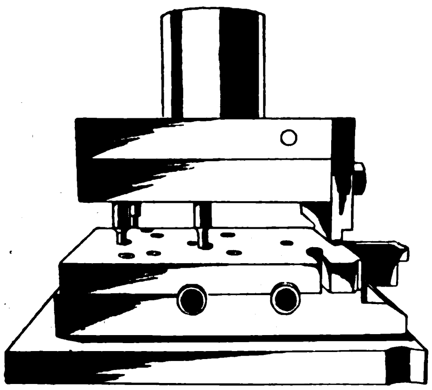


FIG. 3

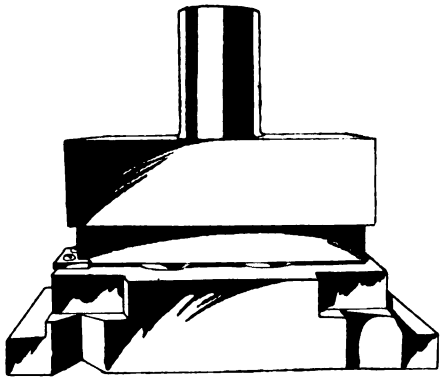


FIG. 5

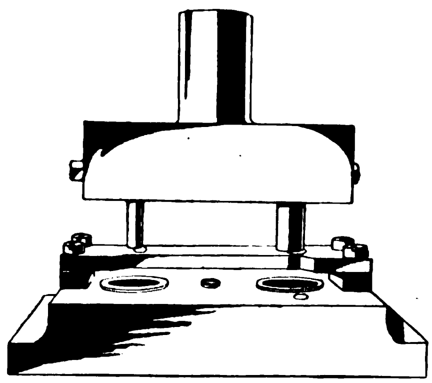


FIG. 7

PUNCHES AND DIES USED IN MANUFACTURING VARIOUS ELEMENTS OF A DOOR-HANGER CARRIAGE, WITH THE WORK SHOWN IN POSITION

FIGS. 3 AND 3-A

Operations—Piercing and cutting off blank, Fig. 2. The stock, which has been cut to width, is fed under the stripper and is first pierced. It is then fed to the next position, obtained by the second stop. The punch is caused to descend, and the second blank is pierced. The stock is pushed in again and the third blank pierced. The fourth position, determined by the stop at the rear, is obtained, and the punch, descending, cuts off the blank to length.

FIGS. 5 AND 5-A

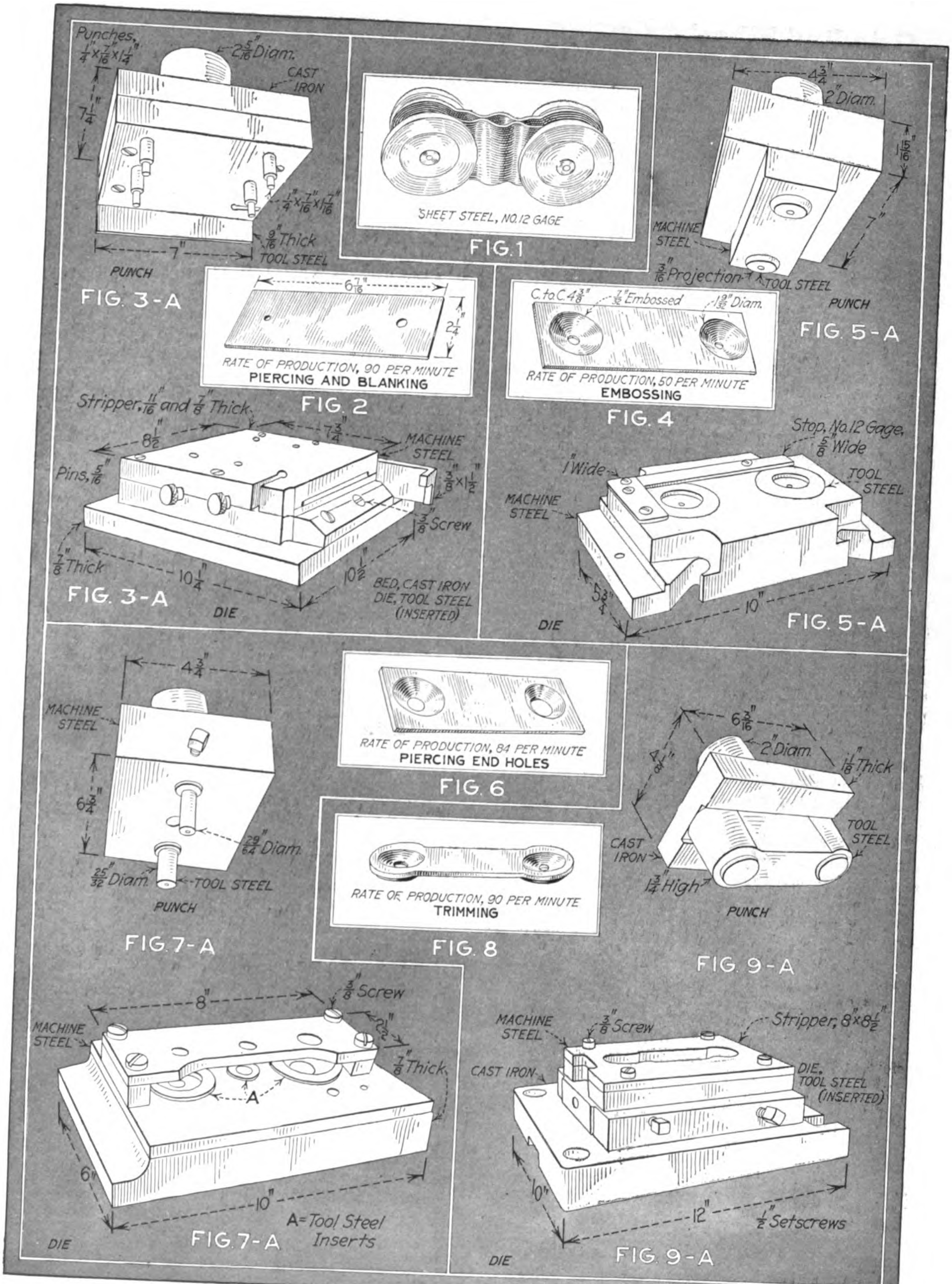
Operation—Embossing the blank, as shown in Fig. 4. The blank is located against the strips at the end and the rear. The punch is then caused to descend, and the cup shape is embossed.

FIGS. 7 AND 7-A

Operation—Piercing end holes, as illustrated in Fig. 6. The blank is located in steel recesses, into which the embossed part fits. With the descent of the punch, the holes are pierced at each end through the center of the embossed recess.

FIGS. 9 AND 9-A

Operation—Trimming the blank to the contour seen in Fig. 8. The blank is pushed in from the end against the locating stop. The punch, which is made to the desired form, is forced down into the die, trimming the blank to the correct shape.



DETAILS OF PUNCHES AND DIES FOR DOOR-HANGER PARTS

Grinding Wheel Selection

By Robert J. Spence

The occasional discovery of better combinations of grains for grinding wheels makes the revision of the grinding-wheel list from time to time practical, but not absolutely necessary. The old list of Norton wheels J, K, L and M, 24 combination, for ordinary machine-shop work, as used on Norton plain grinders, is just as efficacious today as it was 10 years ago.

In fact, in the small shop, where work to be ground comes to the grinder in small lots, it is not advisable to depart from the old list. A continuous changing from one wheel to another to satisfy grinding conditions to a minute degree loses more time in changing wheels and wear of wheel in re-truing than would be lost in the use of a wheel not in absolute harmony with the list employed by the automobile manufacturer who has a large variety of wheels. The old list was as follows:

Wheels for diameters under 4 in.: Soft steel—M, 24 combination alundum; hardened steel—K, 24 combination alundum; cast iron—K, 24 combination alundum; bronze —M, 24 combination alundum.

Wheels for diameters above 4 in.: Soft steel—L, 24 combination alundum; hardened steel—J, 24 combination alundum; cast iron—J, 24 combination alundum; bronze—L, 24 combination alundum.

However, by reason of the constantly increasing demand for greater output from grinders in the automobile industry and in munitions works a new list of grinding wheels has come into being. In this case each wheel has been selected to meet exact conditions and is used on the same machine on the same work day after day. Some of the larger plants even insist on having one man only do all the wheel truing in the entire grinding department. The new list follows:

Wheels for diameters under 4 in.: Soft steel—M, 24 combination alundum; hardened steel—K, 38 combination alundum; cast iron—30 K, crystolon; bronze—30 K, crystolon.

Wheels for diameters above 4 in.: Soft steel—L, 24 combination alundum; hardened steel—J, 38 combination alundum; cast iron—30 J, crystolon; bronze—30 K, crystolon.

In the rough-grinding of automobile crankshafts of soft material a 36 grade O alundum wheel is now used. Six years ago we were able to rough-grind the bearings of only two crankshafts before the wheel had to be retrued. The wheel then in use was the 24 combination O. Today, on shafts of similar material, with a 36 grade O wheel it is possible to rough-grind 10 shafts before re-truing the grinding wheel, and I have known operators to go as high as 75 crankshafts, where the wear on the grinding-wheel fillets was not excessive. Since it takes 110 revolutions of the cross-slide wheel to put the grinding wheel in position for truing and 110 revolutions to bring the grinding wheel back again to the cutting position, it can readily be seen that a great saving of time is effected by the latter wheel. In the finishing of these same crankshafts a 26-18 grade M wheel is now used in preference to the older 24 combination M.

In writing on grinding-wheel selection a person is generally tempted to de[illegible] number of grinding problems that have c[illegible]perience, and the result is that the reader is left in a state of confusion regarding the choice of the proper wheel. The more simple the matter can be made the better it is for all. Neither should an understandable list of grinding wheels for the machine shop contain a complicated assortment of articles that come under the jurisdiction of the pottery works, the optical-lens factory or the like.

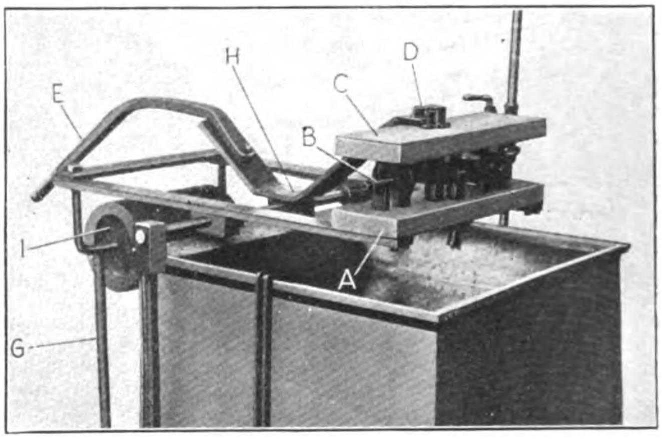
The lists of grinding wheels that I have designated are Norton grinding wheels that have given good service under ordinary conditions on Norton plain grinders.

A Dipping Fixture for Heat-Treating Crankshafts

By E. V. Thomas

All the crankshafts used by the Henderson Motorcycle Co., Detroit, Mich., are heat-treated by heating the crankshaft to a nice red and then quenching in an oil bath. To prevent distortion as much as possible, the crankshaft is held in a special dipping fixture, as shown.

The lower "jaw" *A* of this device has a number of V-blocks set into it, in which the shaft ends and crankpins fit nicely. The heated crankshaft is laid in these



CRANKSHAFT DIPPING FIXTURE

V-blocks as at *B*, and the upper jaw *C* is quickly brought down on it and locked by the taper pin *D*. The upper jaw is fitted with V-blocks to correspond to those on the lower, so that the crankshaft is held solidly between them.

The helper lifts the lever *E* and plunges the work beneath the oil. When the piece is sufficiently cool, the man ceases to push up on the lever, and the counterweight *F* helps to raise the work out of the oil. The weight is prevented from going down too far by means of forked supports *G*. When the taper locking pin is removed, the upper jaw may be lifted by pressing down on lever *E*, as it is hinged at *H*.

The High Polish of Russian Shells has been the subject of much discussion. One reason suggested when the shells were silver or nickel plated was that the plating acted as a resister against rust. And one of our rather sarcastic friends thought that so finished the shells looked better as souvenirs on the top of a grand piano in a drawing room. The subject may now be settled and further discussion cease. We have it from a high Russian authority that this fine finish and polish are to prevent pulling off some lint from the cotton gloves wore by the soldiers who load the guns. A rough surface on the shells would pull off some of this lint, which would fill up the clearance between the shell and the gun bore and impair the accuracy of the firing piece.

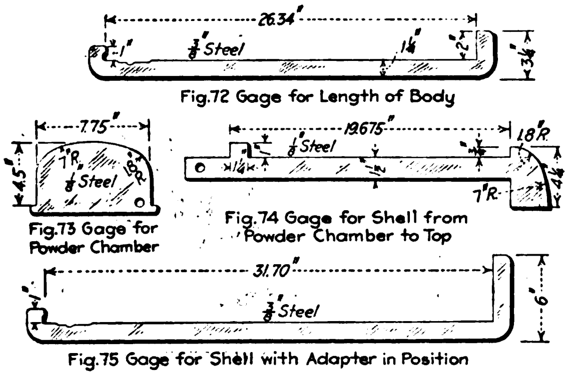
Manufacturing 12-In. Shrapnel--III*

By Robert Mawson

SYNOPSIS—The operations followed in machining the adapter, diaphragm, adapter bottom, adapter plug and powder tube. This article carries the manufacturing of the shell up to the final loading and shipment. The production time, fixtures and special methods employed are described in detail and fully illustrated.

For the final inspection the shell is first tested with the adapter out, the gage shown in Fig. 72 being used. The powder chamber is measured with the gage seen in Fig. 73, and the inside of the shell from the bottom of the powder chamber to the top of the adapter seat with the gage in Fig. 74.

The adapter is screwed down home by a clamp, Fig. 34. The gage illustrated in Fig. 75 tests the overall length of the shell, and the outside form is tested with the contour gage, Fig. 76. For the outside diameters



FIGS. 72 TO 75. LENGTH AND FORM GAGES

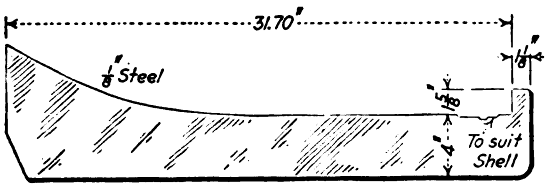


FIG. 76. OUTSIDE CONTOUR GAGE

the snap gages, Figs. 52, 54 and 77 (shown in Part II), and also the ring gages, Figs. 78, 79 and 80, are employed. The final gage for testing the shell is the profile form, Fig. 81.

In Fig. 82 is shown a handy truck that conveys the shells about the machine shop from the various machines to the testing department. In Fig. 83 are shown elements used on the shrapnel. At *A* is the rough-forged adapter as received at the factory, and at *B* is one finish-machined. A diaphragm is shown at *C*, an adapter bottom at *A*, adapter plug at *E*, powder tube at *F*, a number of the balls used in the shell at *G* and some powder pellets at *H*, the only missing elements being the powder and rosin. The manner in which they are placed in the shell will be described in another article.

The first operation in machining the adapter is forming the inside, facing the large end and machining the thread. Fig. 84 is a detail illustration of the adapter forging. For the first operation the rough forging is placed in the chuck, Fig. 85, which is held to the faceplate of the lathe with capscrews. The chuck jaws *A* are tightened against the forging by means of the setscrews *B*, thus holding the part securely. It will be observed that the jaws are operated independently, enabling the operator to hold the forging in the chuck so that it will be concentric.

The link, Fig. 37, is set up and operated in a similar manner to that described for machining the inside of the shell. As the tool carriage is fed forward with the adapter revolving, the link, drawing the carriage on an arc, machines the desired contour on the inside of the part.

The special bracket to hold the link is fitted to the side of the lathe bed, as in Fig. 86. An illustration

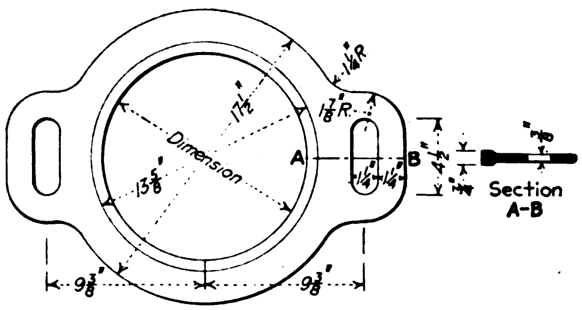


FIG. NO.	MAXIMUM	MINIMUM
78	11.94"	11.90"
79	11.97"	11.96"
80	12.31"	12.30"

FIGS. 78, 79 AND 80. RING GAGES

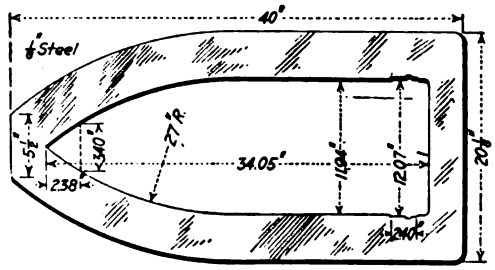


FIG. 81. CONTOUR GAGE FOR SHELL

of the set-up for performing the machining operation is shown in Fig. 87 and in diagrammatical form by Fig. 88. The gage for testing the machined contour is illustrated in Fig. 89.

The link is thrown out of contact, the shoulder of the large end is faced and the thread machined, using tools held in the tool carriage in the usual manner. The ring gage for testing the thread may be seen in Fig. 90. Fig. 91 shows the machine set-up for facing and cutting the thread.

The adapter is screwed into the chuck, Fig. 92, which is held on the faceplate of the lathe. The hole is drilled and tapped at the small end of the adapter, the tools

*Previous installments appeared on pages 537 and 581.

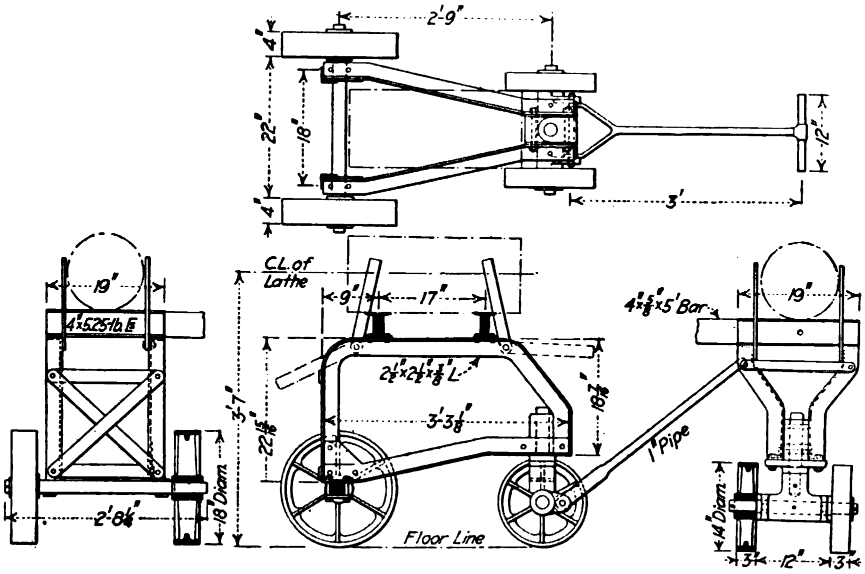


FIG. 82. TRUCK FOR 12-IN. SHELLS

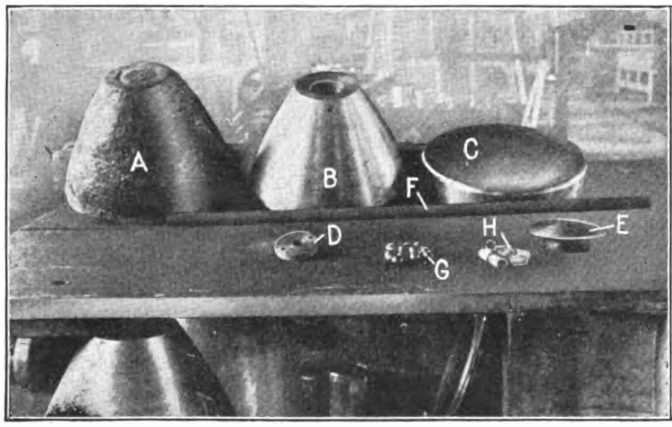


FIG. 83. SHRAPNEL ELEMENTS

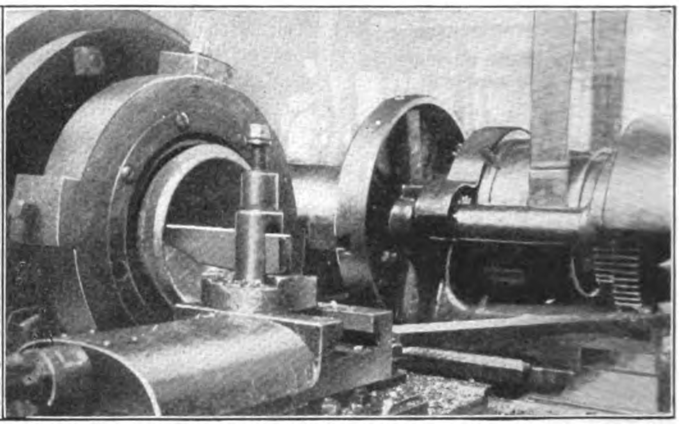


FIG. 87. MACHINING INSIDE CONTOUR OF ADAPTER

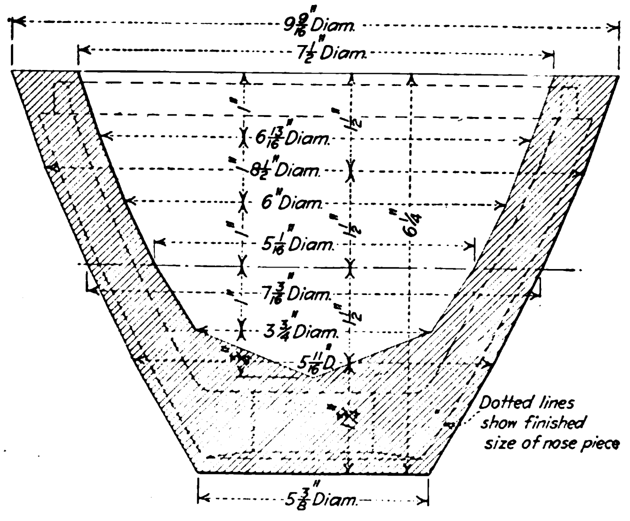
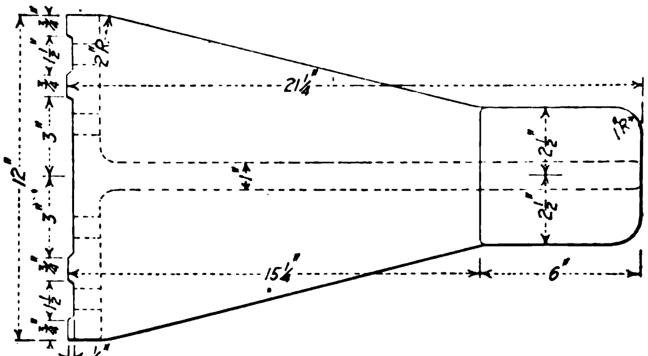


FIG. 84. ADAPTER FORGING



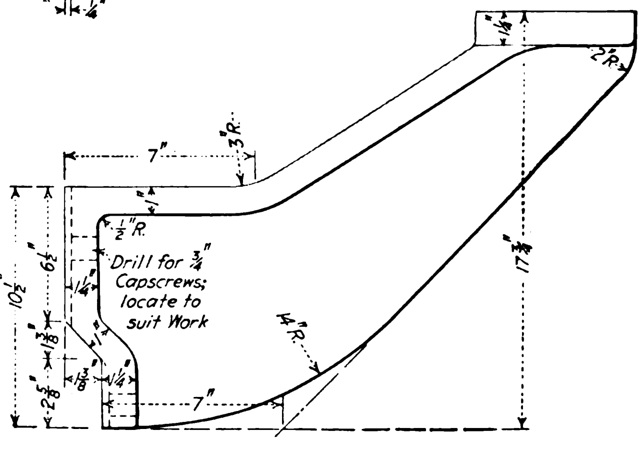


FIG. 86. BRACKET TO FASTEN ON LATHE

being held in the tool carriage of the lathe. The gage for testing the machined thread is shown in Fig. 93. The tool carriage is set over approximately 7¼ deg., and with an ordinary turning tool the beveled surface on the end is machined.

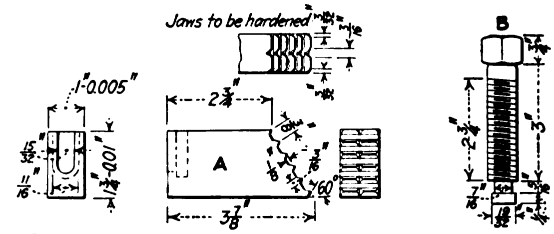
The gage for testing the overall length and contour at the end of the adapter and the manner in which it is used are illustrated in Fig. 94. Fig. 95 shows the lathe set-up for performing the machining operation, and this arrangement is also given in diagrammatical form by Fig. 96.

A detail of the finish-machined adapter may be seen in Fig. 97. The outside of the adapter is machined while it is in position on the shell, as was described on page 584. After the adapter has been completely machined, a hole is drilled for the fuse setscrew. The jig employed for this purpose is shown in Fig. 98.

The diaphragm is made from a steel forging, a detail of a finished piece being given in Fig. 99. The first operation, for which the forging is held in a universal-type chuck, is turning part of the outside and forming radius. The outside is first turned with the tool carriage thrown around approximately 4½ deg. The front edge is faced

with the tool carriage set squarely, the test gage being shown in Fig. 100. The radius tool, Fig. 101, is fastened in the tool carriage and the radius machined on the corner. The gage for testing this radius is shown in Fig. 102 and the gage for testing the entire contour in Fig. 103.

The diaphragm is then reversed and held again in the same chuck for the second operation—turning the rest of the outside, drilling and counterboring the hole.



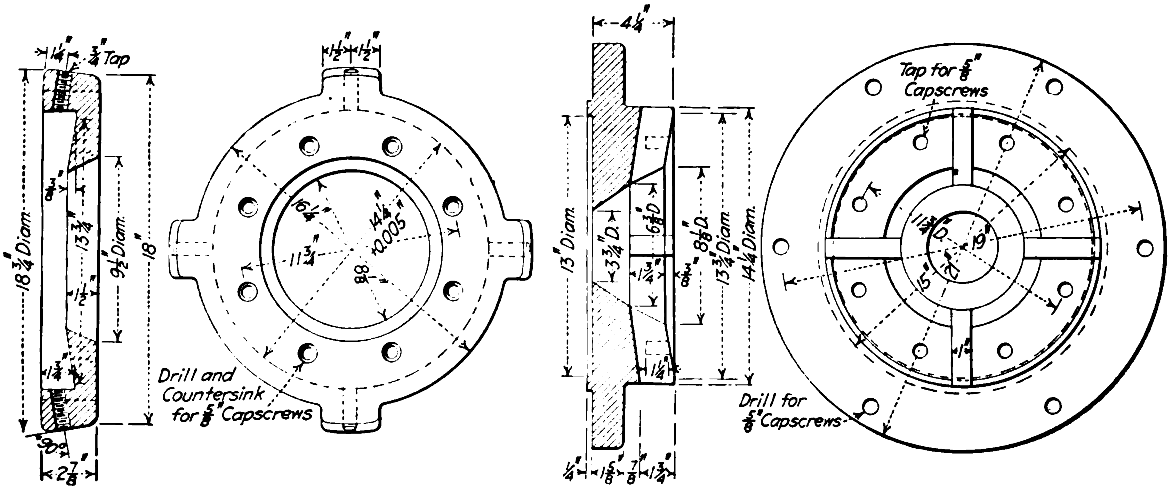


FIG. 85. CHUCK FOR HOLDING ADAPTER IN THE LATHE

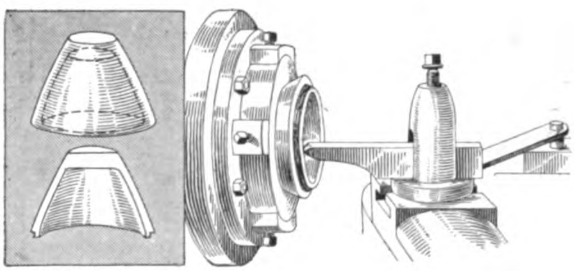


FIG. 88. MACHINING THE ADAPTER—FORMING INSIDE, FACING AND THREADING

Machine Used—Lodge & Shipley.
Special Fixtures—Chuck, link and attachment to lathe.
Gages—Form.
Note—Between grindings of tool, 1 piece; speed and feed of lathe, 42 r.p.m. with feed of $\frac{1}{16}$ in. per revolution.
References—Figs. 37, 85, 86, 87, 89, 90 and 91.

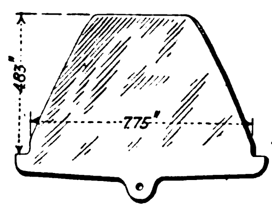


FIG. 89. GAGE FOR INSIDE OF ADAPTER

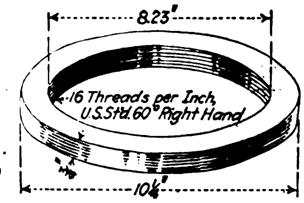


FIG. 90. RING THREAD GAGE

The gage and the method in which it is used to test the depth of the counterbored hole are shown in Fig. 104. In Fig. 105 is the lathe set-up for machining the diaphragm, and the operation is shown in diagrammatical form by Fig. 106 in which the drill feed appears.

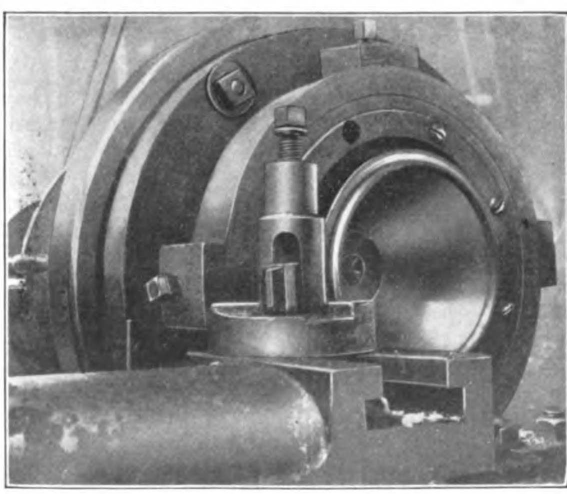


FIG. 91. MACHINING THREAD AND FACING ADAPTER

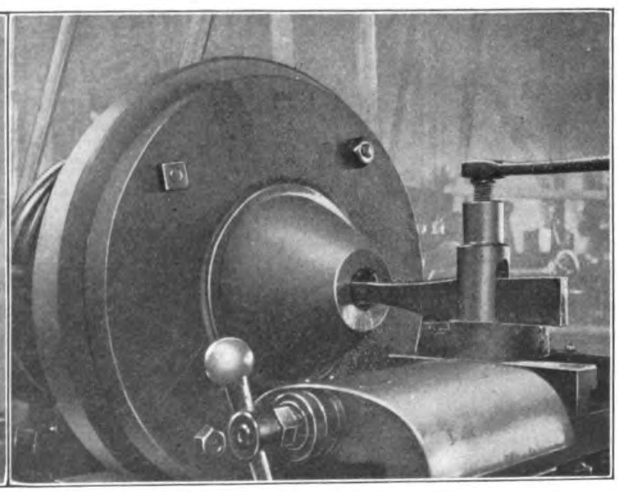


FIG. 95. MACHINING SMALL END OF ADAPTER

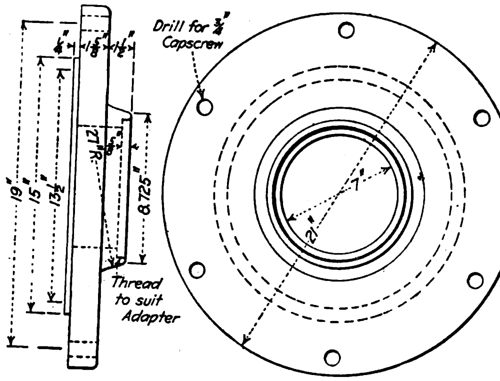


FIG. 92. ADAPTER LATHE CHUCK

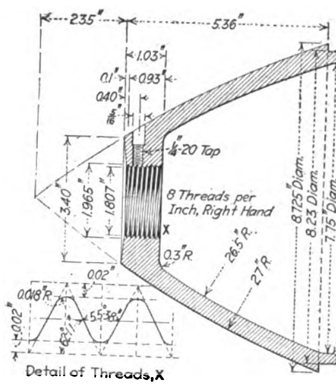


FIG. 97. DETAILS OF ADAPTER FOR 12-IN. SHELLS

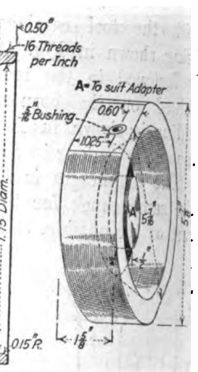


FIG. 98. JIG FOR DRILLING ADAPTER HOLE

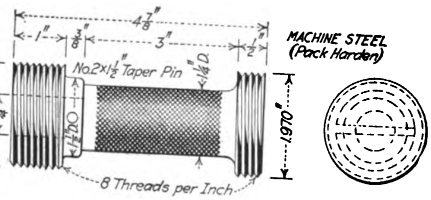


FIG. 93. ADAPTER THREAD PLUG GAGE

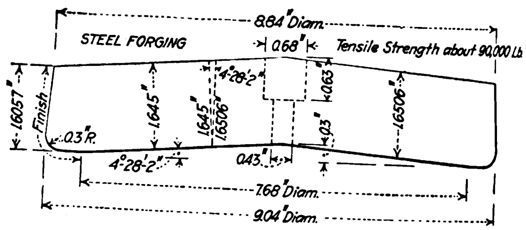


FIG. 99. FINISH-MACHINED DIAPHRAGM

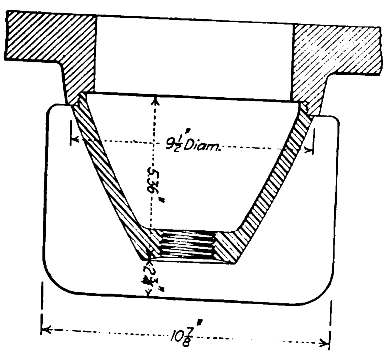
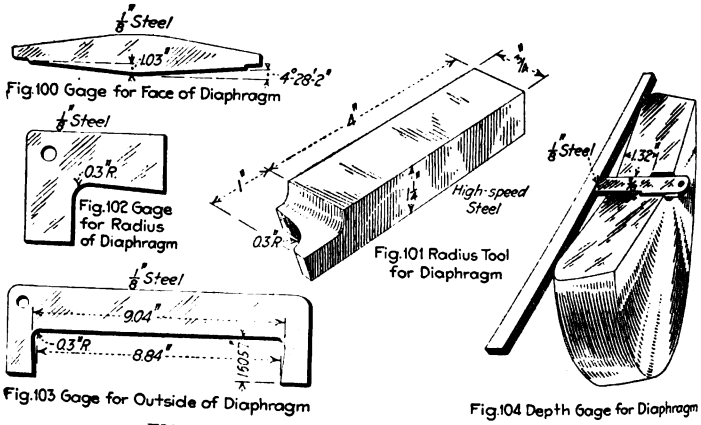


FIG. 94. FORM GAGE FOR LENGTH OF ADAPTER



FIGS. 100 TO 104. GAGES AND RADIUS TOOL

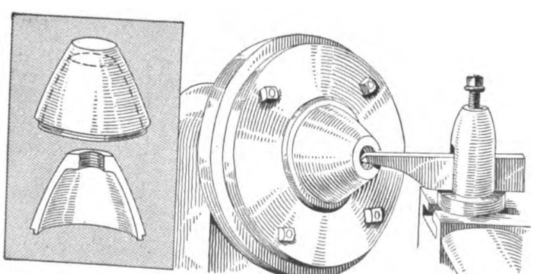


FIG. 96. MACHINING THE ADAPTER—FACING SMALL END, BORING AND THREADING

Machine Used—Lodge & Shipley.
Special Fixtures—Chuck, flat twisted drill and counterbore.
Gages—Thread and form.
Lubricant—None.
Note—Between grindings of tool, 2 pieces; speed and feed of lathe, 42 r.p.m. with feed of 1/8 in. per revolution.
References—Figs. 90, 91, 92, 93 and 96.

The adapter bottom, Fig. 107, is made from 2-in. bar stock. It is held in a universal-type chuck and turned to size and the thread machined. An 0.43-in. hole is drilled through the center and then counterbored to 0.68 in. for 0.15 in. deep. A part is cut off 0.30 in. wide, thus making an adapter bottom. The counterboring and cutting-off operations are carried on alternately to make the parts. The lathe set-up for manufacturing the adapter bottoms is shown in Fig. 108 and in diagrammatical form by Fig. 109.

The gage for testing the thread may be seen in Fig. 110. The pin spanner wrench holes are drilled in the adapter bottom, using the jig in Fig. 111.

The plug is made from 3¾-in. bar stock, the first operation being turning the outside to 3½-in. diameter and forming the shoulder. The shouldered portion is

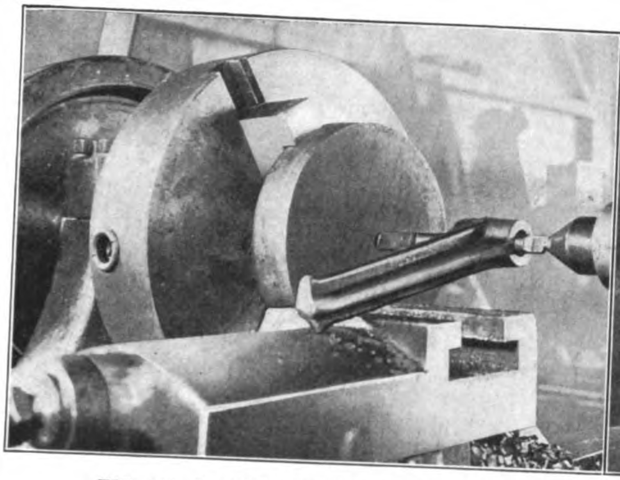


FIG. 105. MACHINING THE DIAPHRAGM

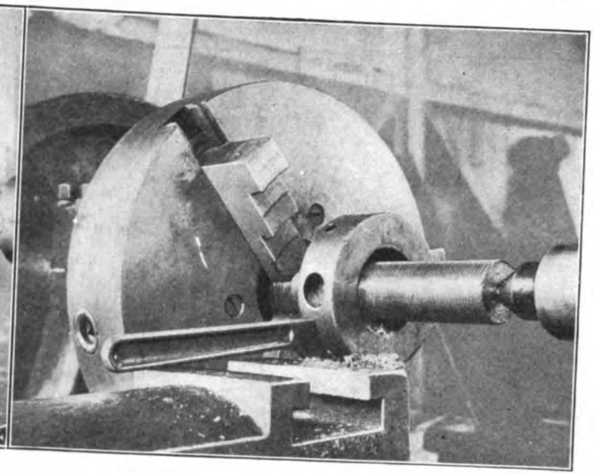


FIG. 108. MACHINING THE ADAPTER BOTTOMS

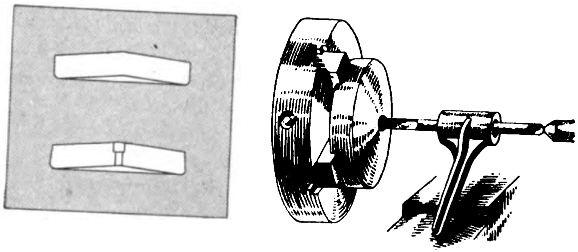


FIG. 106. MACHINING THE DIAPHRAGM

Machines Used—Boye & Emmes, Lodge & Shipley.
Special Fixtures—Standard chuck, drills and turning tools.
Gages—Radius, depth and form.
Production—One in 2 hr.
Lubricant—None.
Note—Between grindings of tools, 2 pieces; speed and feed of lathe, 42 r.p.m. with feed of $\frac{1}{16}$ in. per revolution.
References—Figs. 98, 99, 100, 101, 102 and 103.

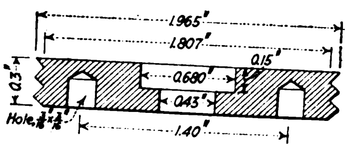


FIG. 107. ADAPTER BOTTOM

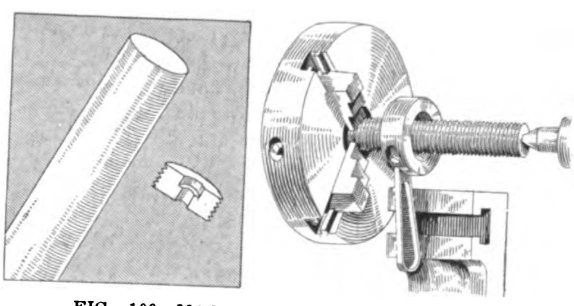
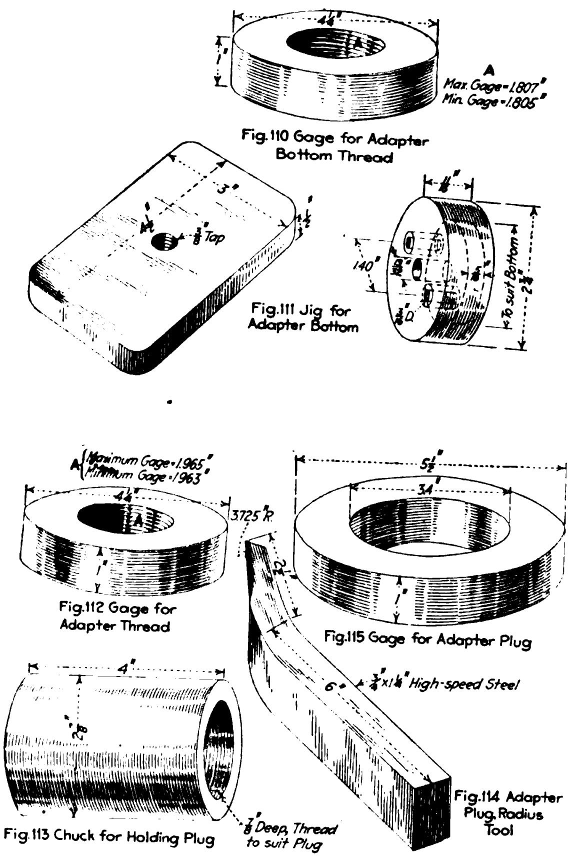


FIG. 109. MACHINING ADAPTER BOTTOM

Machines Used—Lodge & Shipley, Boye & Emmes.
Special Fixtures—Standard chuck and jig.
Production—Four per hour.
Lubricant—None.
Note—Between grindings of tool, 25 pieces; speed and feed of lathe, 110 r.p.m. with feed of $\frac{1}{16}$ in. per revolution.
References—Figs. 108 and 109.



FIGS. 110 TO 115. GAGES AND TOOLS

threaded to suit the adapter, testing with the gage in Fig. 112. The plug is then cut off by a parting tool in the lathe carriage, the width of stock on the large diameter being ½ in. The head of the plug is formed to shape, being screwed in the chuck, Fig. 113. This chuck is held in a standard three-jawed chuck secured to the lathe spindle. The form tool, Fig. 114, is held in the lathe carriage and fed against the revolving plug until the desired contour is obtained.

The ring gage, Fig. 115, tests the 3.4-in. diameter of the head. In Fig. 116 is the lathe set-up for performing the machining operation, which is also shown in diagrammatical form by Fig. 117.

The plug is held in the chuck, Fig. 113, and the slot machined on a miller. A detail of the finish-machined adapter plug is given in Fig. 118. In Fig. 119 is illus-

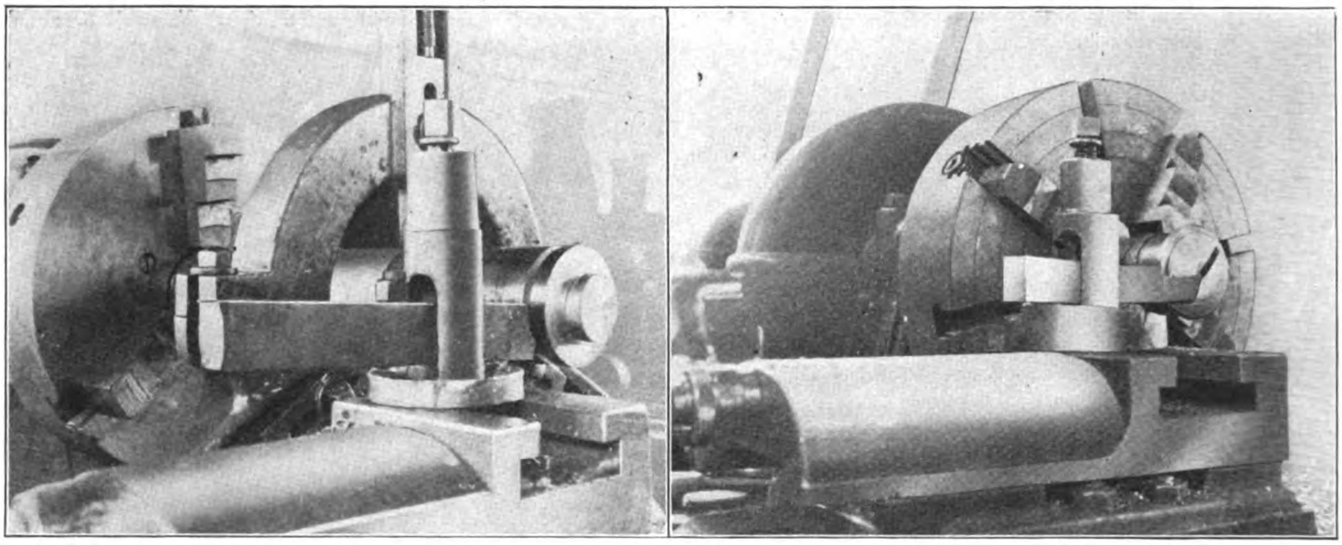


FIG. 116. TWO OPERATIONS FOLLOWED WHEN MACHINING THE PLUG

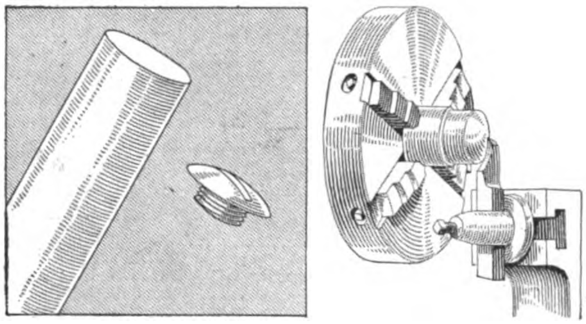


FIG. 117. MACHINING ADAPTER PLUG

Machines Used—Lodge & Shipley, Boye & Emmes.
Special Fixtures—Chucks and turning tools.
Gages—Ring and thread.
Lubricant—None.
Note—Between grindings of tool, 5 pieces; speed and feed of lathe, 110 r.p.m. with feed of $\frac{1}{16}$ in. per revolution.
References—Figs. 110, 111, 112, 113 and 114.

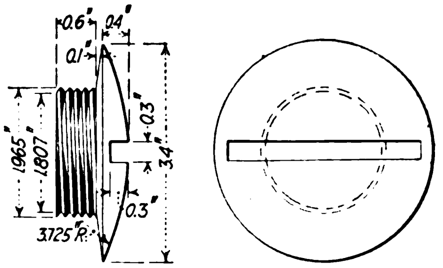


FIG. 118. ADAPTER PLUG

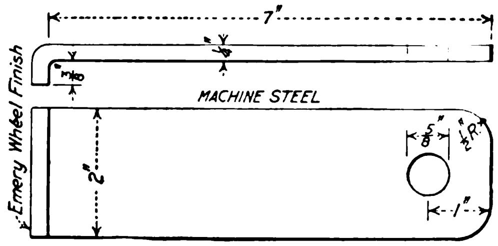


FIG. 119. PLUG KEY

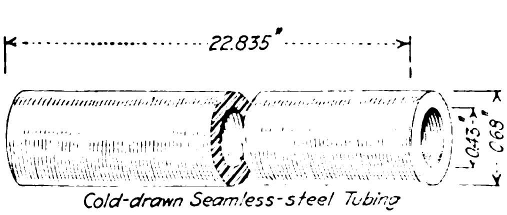


FIG. 120. POWDER TUBE FOR 12-IN. SHRAPNEL

trated the key used to insert the adapter plug in the adapter.

The powder tube, Fig. 120, is made from seamless tubing and is cut to length with a hacksaw. The elements are finally carried to the assembling department, ready to be placed in the shell.

Light Coloring for Large Machine Tools

By J. C. Austin

I recently visited the pressroom of a large concern manufacturing sheet-metal parts. The presses and shearing machines were painted with very light-colored paint. It was indeed surprising to observe the effect and the absence of the depressing and rather awesome feeling one usually gets from heavy blackened machines ordinarily found in big pressrooms. If this is so noticeable and relieving to a passerby spending only a few moments in the factory, what must it mean to the operators and other persons working there eight or nine hours of the day?

One's surroundings and the things handled and worked with have so much to do with one's spirits and feelings and resultant efficiency that even a trifling item such as the color of paint on a machine tool is well worthy of attention in these days when much effort is being put forth to conserve all energies for useful work. It is not uncommon, of course, to see the inner walls of a shop painted white, so why not carry the idea a little farther and include at least some parts of the machines?

An additional effect, other than psychological, is of the "safety first" order, for it is not true that the light reflected from a white surface and the resulting shades and shadows render objects more discernible, so that operators are less likely to misjudge distances and get their fingers or hands in the way of moving parts?

Without some study I am not prepared to state jus[illegible] much more effort is required to keep clean [illegible]e light-colored machines than the darkly [illegible]s, but venture the statement that it is not [illegible]ight at first be supposed.

Automatic Machine for Making Radiator Cells

By Ethan Viall

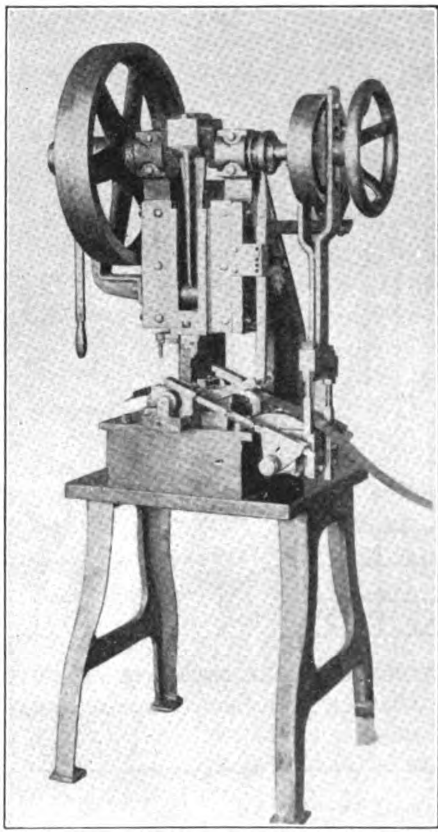
SYNOPSIS—The machine here described takes a flat strip of metal and automatically forms it into the complicated shape used in automobile radiators. Once set, the machine requires little attention on the part of the operator, the strip feeding in at one side and the formed cells coming out at the other. The low power consumption of a battery of these machines is remarkable.

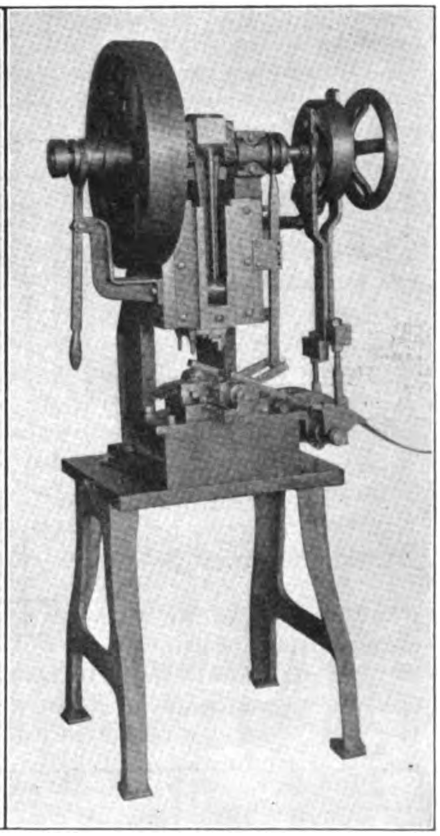
When one stops to consider the enormous number of automobiles produced in a year and the fact that each one, with the exception of the air-cooled type, has a radiator on it through which circulates the water that cools the motor, the question naturally occurs, How are these radiators made? That the copper cells are formed by automatic machinery is almost a foregone conclusion, since in no other way could such enormous quantities be produced cheap enough and good enough for commercial purposes. Several of the different machines employed have been described in these columns from time to time as they were perfected. The machine described in this article is remarkable, not only for the comparative simplicity of the mechanism used to produce a rather complicated form, but also for its ease of operation and low cost of upkeep. Moreover, it is in no wise an experiment, as two of the largest automobile factories have installed large batteries of these machine and some of them have been in use for over four years. It is enough to say that the first machine made is, in all points of essential construction, the same as those being made in the shop today.

Two views of one of these automatic cell-forming machines are shown in Figs. 1 and 2. This particular machine is set up for the production of a double row of copper cells each $\frac{5}{16}$ in. square, but by using different set-ups various sizes and shapes may be produced. The machines are made in pairs, to feed right and left, so that the formed cells will feed onto the same table. One operator runs two machines, and an electric-bell alarm gives notice as soon as the strip stock on a reel is run off.

On various kinds of work, copper strips 0.005 to 0.0055 in. thick and from 2 to $4\frac{1}{2}$ in. wide are used. The average speed of a machine is 70 r.p.m., and one will produce 2 ft. of formed cells per minute, using 14 ft. of strip stock. As the stock is almost as easily bent as so much paper, very little power is required; for instance, a 3-hp. motor runs 24 machines under working conditions. Each machine weighs complete about 850 lb. The City Machine and Tool Co., Toledo, Ohio, is the maker, and both the machines and the radiator cells were originally designed by K. M. Boblett, who has been radiator expert for several of the largest automobile factories in the country.

In order to be certain that the reader has a clear idea of the type of work produced, some of the cells will be shown and described before proceeding with a description of the working mechanism. At *A*, Fig. 3, is shown a section of a plain strip and a section of formed cells, just as they were removed from the machine. *B* gives an end view of the cells, and at *C* are some partly pulled apart, to show the arrangement. Another view is shown at *D*. From these illustrations it will be seen that the





FIGS. 1 AND 2. DIFFERENT ANGLE VIEWS OF AUTOMATIC RADIATOR-CELL FORMING MACHINE

cell groups are shaped somewhat like a figure 8, formed from the strip and repeatedly folded back against the cells ahead. Depressions are formed lengthwise on the outside of each pair of cells for the circulation of the cooling water.

The cell strips or groups are cut the proper length to fit the size of the radiator to be made and are then assembled into the radiator frame and soldered, a finished radiator in actual use being shown in Fig. 4 Several drawings of the different types of cells are seen in Fig. 5, and they will give a good idea of the arrangement of the various-shaped cells and also of the placing and shape of the water spaces.

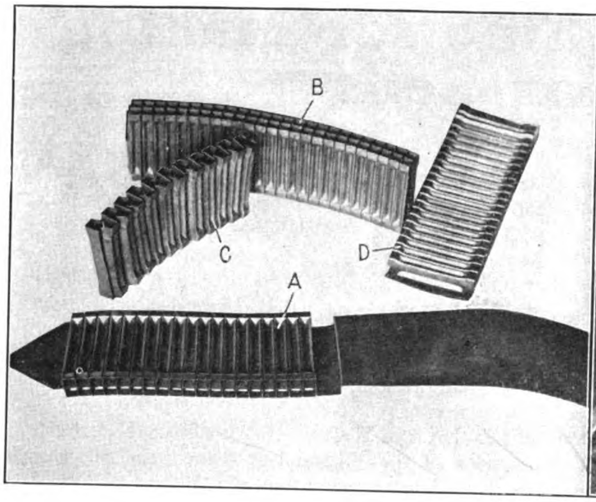


FIG. 3. EXAMPLES OF SQUARE-CELL WORK

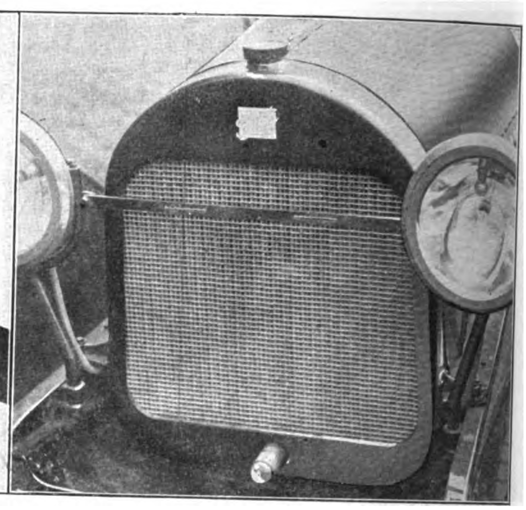


FIG. 4. A RADIATOR IN PLACE ON AN AUTOMOBILE

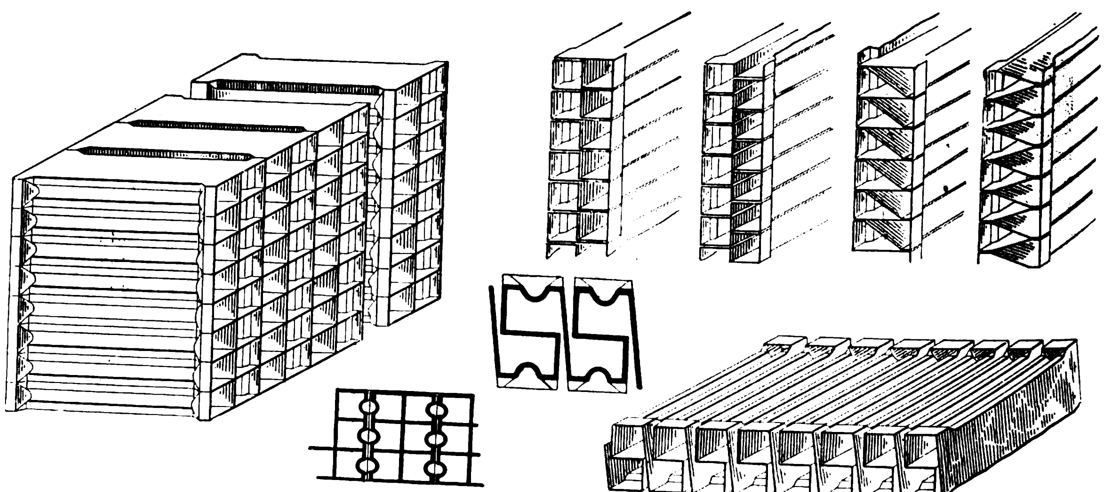


FIG. 5. DETAIL DRAWINGS OF VARIOUS TYPES OF AUTOMOBILE RADIATOR CELLS

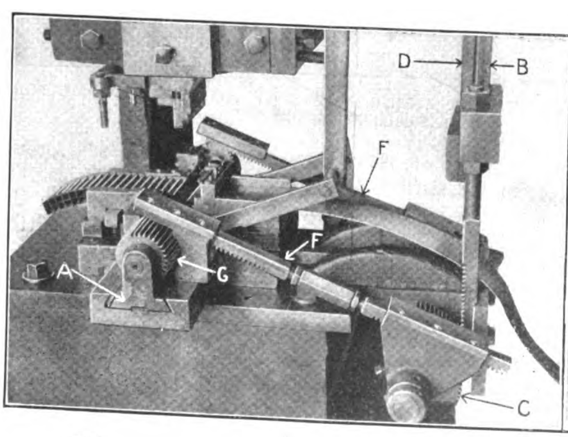


FIG. 6. POSITION OF PARTS WITH RAM UP

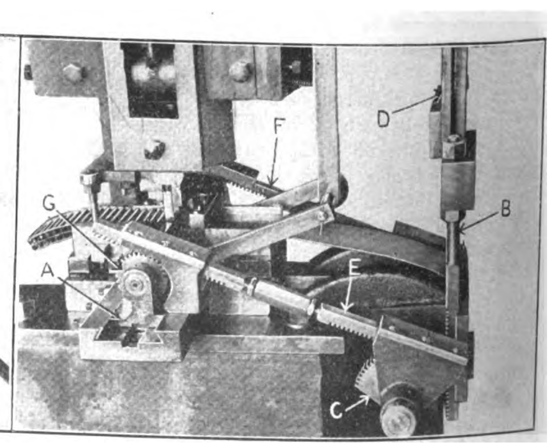


FIG. 7. CROSS-SLIDES IN, FINGERS PARTLY ROTATED

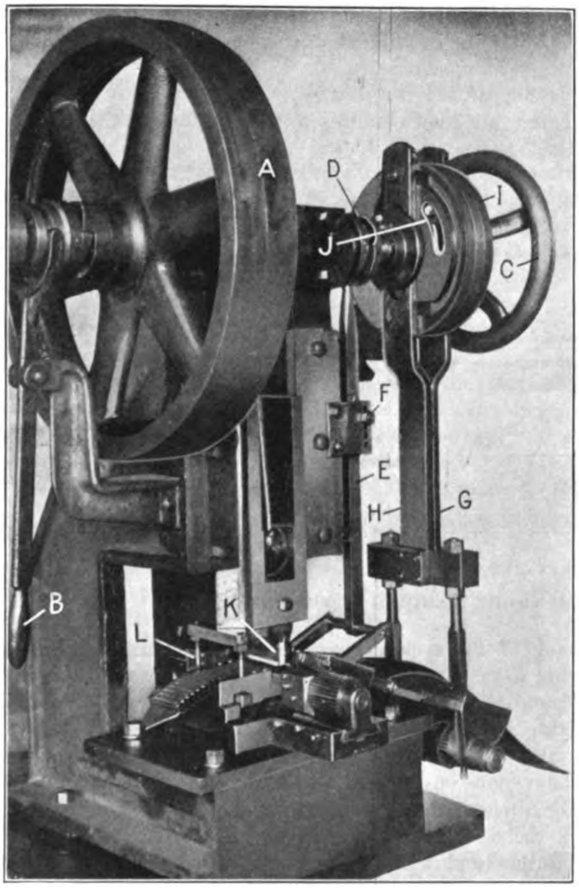


FIG. 8. CLOSE VIEW OF MAIN WORKING PARTS

A close-up view of one of the machines, Fig. 8, will serve to point out the main working parts. The combined drive pulley and flywheel, common to machines of this type, is shown at *A*. The clutch lever at *B* is in a convenient place to be reached easily by the operator. The handwheel *C* is used in setting or adjusting only. The cam *D* operates the feed-movement lever *E*. It will be noticed that this lever is fulcrumed in a block *F*, which has several holes in it in a vertical line. By placing the swiveling bolt in different holes the stroke of the lever may be varied to give several lengths of feed strokes.

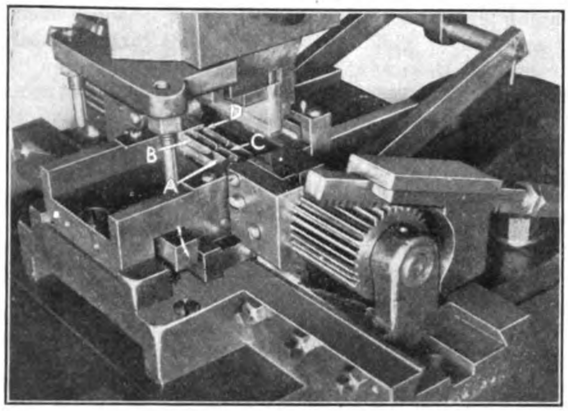


FIG. 11. MANDRELS IN AND CLOSE TOGETHER

The two slides *G* and *H* operate the in-and-out movement and the turning or folding movement of the forming mandrels. These slides are actuated by cams at *I*. Here a disk is keyed solidly to the drive shaft. On each side of this disk a cam disk is placed, being locked to the middle disk by screws through slots, as shown at *J*. By this means the cam disks can be accurately set and properly timed with the rest of the mechanism. The method of placing the slides themselves will be plainly seen by inspection. The press ram carries a forming punch *K* and the two die-raising pins *L*.

Proceeding now with further details of the forming mechanism, Fig. 6 shows the ram just starting down and the other parts in a corresponding position. The cell-forming is done by two sets of mandrels of four fingers each, run in from opposite sides and working simultaneously. Two fingers of each set are placed one above the other and have an out or an in movement only. The other two fingers of the set have an out or an in movement and also a rotary movement through an arc of 90 deg. The first two fingers are used simply to hold the work while the others form or fold the work against them.

Each set of mandrels is carried on the inner end of a slide *A*. These two slides are operated by a sliding plate working at right angles to them. This plate has two diagonal slots in it, in which rollers on the ends of the cross-slides work, so that as the plate is moved one way or the other the cross-slides are fed out or in. This

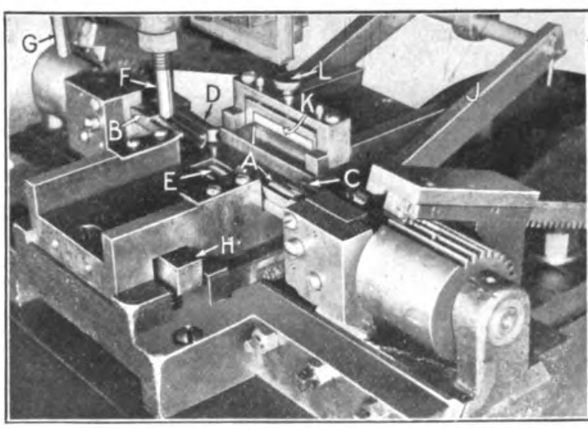


FIG. 9. MECHANISM WITH WORK REMOVED

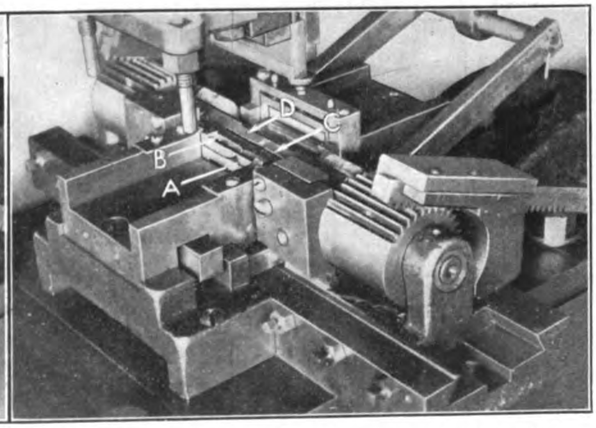


FIG. 10. MANDRELS IN AND PARTLY ROTATED

sliding plate, which works parallel to the stock movement, is operated by slide B from the outside cam previously described. Downward movement of this slide draws the two cross-slides inward. Movement is transmitted from the vertical slide by a rack on the lower end, which meshes with a gear segment on a cross-sleeve. A crank movement connects the sleeve and the sliding plate.

This action will be better understood by reference to Fig. 8. Here cross-slide A is shown drawn inward to the working position, and slide and rack B are moved downward. Care should be taken at this point not to confuse the gear segment C with the one operated by the rack referred to. As soon as the cross-slides are fed in, the vertical slide D commences to rise, which causes gear segments C on each end of the shaft to turn and move the racks E and F, so that the pinion segments G rotate through an arc of 90 deg., carrying the folding fingers through their rotary movement. It will be noticed that the long pinion segments allow the cross-slides to work freely out or in without interfering in any way with the rotary movement.

Some of the working parts, with the strip stock removed, are shown in Fig. 9, which illustrates the beginning of the cycle of movements. The mandrel fingers that have an out or an in movement only are shown at A and B in their respective slides. The others are shown lying on their sides at C and D. While the stock is being fed along, the lower form E, which makes the depressions on the under side of the cells, remains below the surface of the guiding channel, so as not to catch in the work. As the mandrels are moved into working position and the ram descends, however, this form is raised to contact with the work by means of the pins F and G, which strike both ends of the crossbar H and tilt the form upward.

The feeding of the stock is done by a small slide that works back and forth at I, being operated from the cam previously mentioned, through the yoke lever J. A roller K, tensioned by the thumb-screw L, presses the stock to the slide. Unless some means were provided to lock the stock as it was fed forward, the reciprocating movement of the feed slide would simply move the stock back and forth with it. This condition, however, is provided for by having the mandrels fed partly into the cells before the feed slide starts back.

The mandrel fingers, fed in to meet, and the fingers C and D, partly rotated, are shown in Fig. 10. The movement completed and all fingers together are shown in Fig. 11. The entire cycle of bending and forming

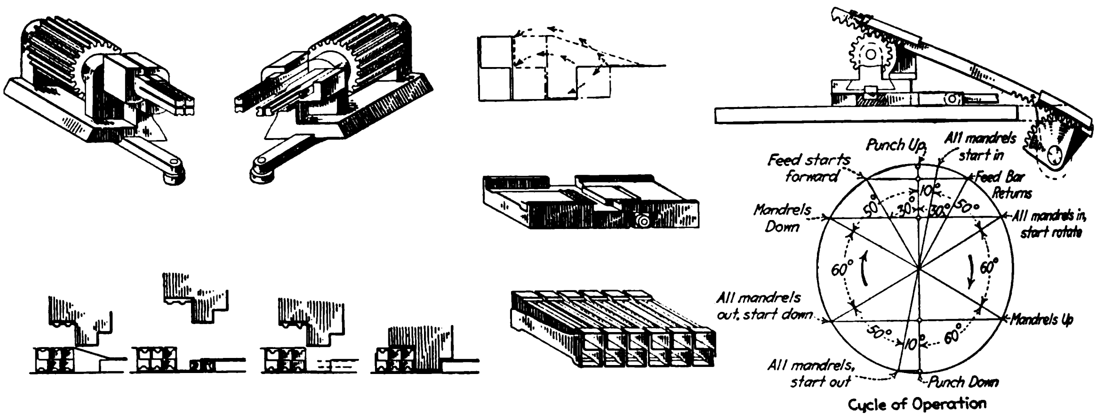


FIG. 12. DETAILS OF PUNCH AND MANDREL BENDING MOVEMENTS

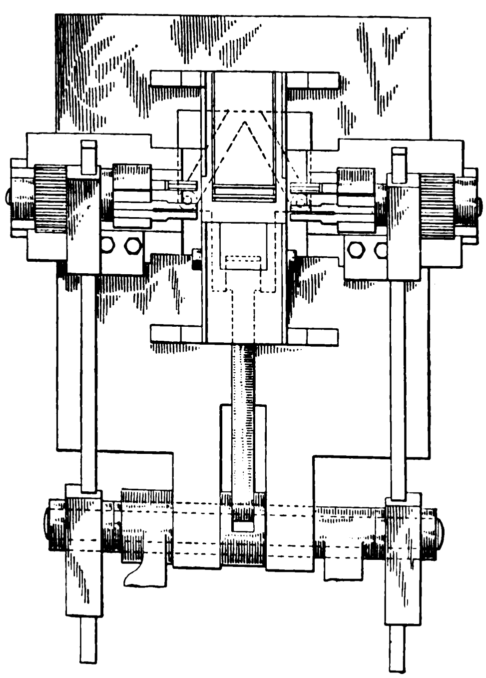


FIG. 13. DETAILS OF SLIDE POSITION AND ACTION

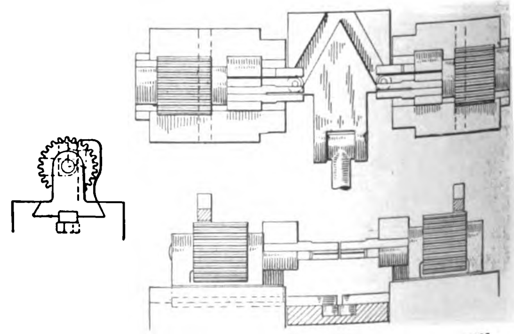


FIG. 14. DETAILS OF CROSS-SLIDE OPERATION

operations, the action of the punch carried in the ram and the mandrel-finger movements will be easily understood by reference to Fig. 12, which needs little explanation other than that afforded by the illustration itself.

Interesting Cross-Slide Movements

A plan view of the various slides is given in Fig. 13, and the method of moving the cross-slides out or in is plainly shown in Fig. 14. These drawings, taken together with the photographs and description, will give a clear idea of the entire mechanical action and formation of the radiator cells.

The precision with which the machine works will be appreciated when one considers that stock 0.005 in. in thickness is very thin material to be formed into such an intricate shape without tearing or buckling in any way. The finished product must be water-tight at 20 lb. pressure. These machines have handled stock only 0.003 in. thick, when making aëroplane radiators. It does not draw or stretch the metal in any way, but simply wraps it into the desired shape. Soap water is used as a lubricant and is applied to both sides of the stock as it is fed between two felt rolls.

Turning the Inside Edge of a Scale Case

By E. V. Thomas

An awkward piece to hold is shown in Fig. 1. It is a case for an automatic scale. The operation is turning of the inside edge or flange, which is done on a vertical turret lathe in the shop of the Caille Perfection Motor Co., Detroit, Mich. The method of holding the casting is illustrated in Fig. 2. The jaws *A*, *B* and *C* are stationary, and the casting fits over the specially shaped ends. The rubber-covered post *D* is used as a driver only, to prevent slippage during the cut. The casting is held down on the jaws by the spider *E*, which is tightened down by the screw *F*, the ends of the spider arms catching the inside bottom flange of the casting, as shown in Fig. 1. The turning is done after the case has been enameled, so that any method of outside holding is out of the question. In addition, by this method of holding it on the inside, centering is greatly simplified.

Precision Gage-Making Work

By Gustave A. Remacle

One of the commonest forms of gage is the snap gage. In spite of its simple construction, care and skill are necessary in its making. There are a number of different methods of making a snap gage, differing according to the dimensions of the measuring points and toolroom facilities.

In making a gage such as is shown in Fig. 1, the slots may be milled, leaving 0.003 or 0.004 in. for grinding on either side of the slot. Lately we have been annealing the stock after roughing the slots and stamping on all the required figures or names, for the gages have a tendency to warp, owing to the stamping. After hardening, the gage is ground on both faces and on all the edges.

If the familiar Brown & Sharpe surface grinder is to be used for grinding the slot or opening to size, the gage should be clamped to an angle plate and set in position so that the face of the gage is square with the face of the wheel. When being ground, the gage should be in a position directly under the center of the wheel. If the grinder is equipped with a magnetic chuck, parallels should be placed around the angle plate so that there will be little opportunity for the set-up to shift during the operation.

The wheel used should be thin enough to enter the slot without touching the sides, and it must be dressed so that it grinds only at the corner. One side of the slot is then ground until a smooth, clean surface is obtained. If a wheel of the saucer type is used, it must be reversed on the spindle for the second side and redressed enough to have it running true at the cutting edge. If a straight wheel is dressed as shown in Fig. 3, it will do the job without reversing. It can readily be seen that, after one side of the slot has been ground to a finish, the gage must not be shifted from its position on either the angle plate or the table of the machine.

The grinding operation is performed by entering the wheel into the slot, feeding the work against the wheel and then raising and lowering the wheel. The table of the machine may be moved so that the gage is removed from the wheel when the operator wishes to measure the slot. As lapping is a very slow process, a minimum amount of stock should be left for removal in this

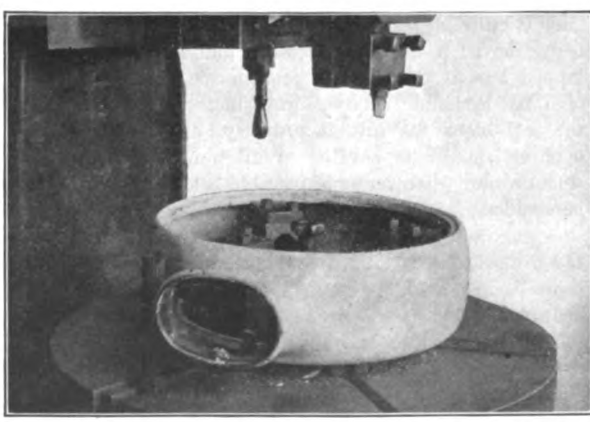


FIG. 1. TURNING INSIDE EDGE OR FLANGE OF AN AUTOMATIC SCALE CASE

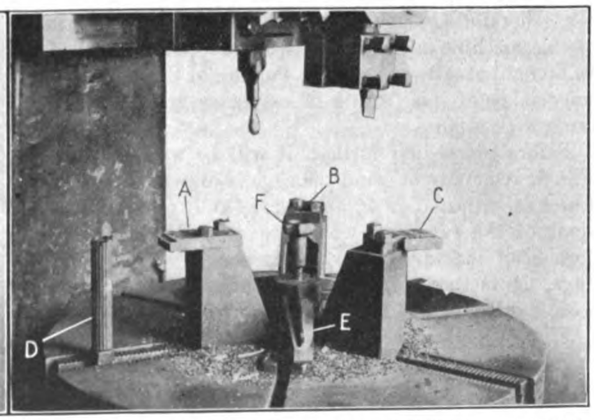


FIG. 2. DETAILS OF THE HOLDING FIXTURE FOR THE VERTICAL TURRET LATHE

manner. Therefore, all end play in the spindle of the machine should be removed, to facilitate a good grinding job. This is accomplished by clamping a spring against the end of the spindle, as shown in Fig. 5.

If the operator wishes to play safe when grinding out the gage, he should determine just how much stock remains to be removed, by measuring the slot with a smaller test block and feeler gages. When the gage is almost to size, a test block, Fig. 2, is used to give accuracy. As may be seen, there are two sizes on this piece, one being 0.002 smaller than the other. All the measuring surfaces of this test block are carefully lapped to size, as the accuracy of the finished snap gage will depend upon the accuracy of the test block. If the gage has been ground as described, a good grinding job will be the result, and the 0.0002 in. allowed for lapping will be sufficient to finish-lap the opening to the correct size.

Most cutter-grinding machines are well adapted for grinding gages such as the snap gage of Fig. 1. In fact, if the spindle is in good condition and the other parts are in fair shape, a machine of this type is the best suited for general snap-gage grinding. The one best feature of this machine is that the line of travel of the table can be brought exactly in line with the face of the wheel. The importance of this feature in snap-gage grinding will be dealt with later.

Before proceeding farther, it will be well to describe Fig. 6. One way to grind the gage is to move the gage or wheel as indicated at *A*; another, as at *B*. If the dimensions of the gage and wheel are such that the cutting corners of the wheel clear the corners *A*, Fig. 7, of the gage, the method *A*, Fig. 6, should be preferred. Otherwise, method *B* will have to be resorted to.

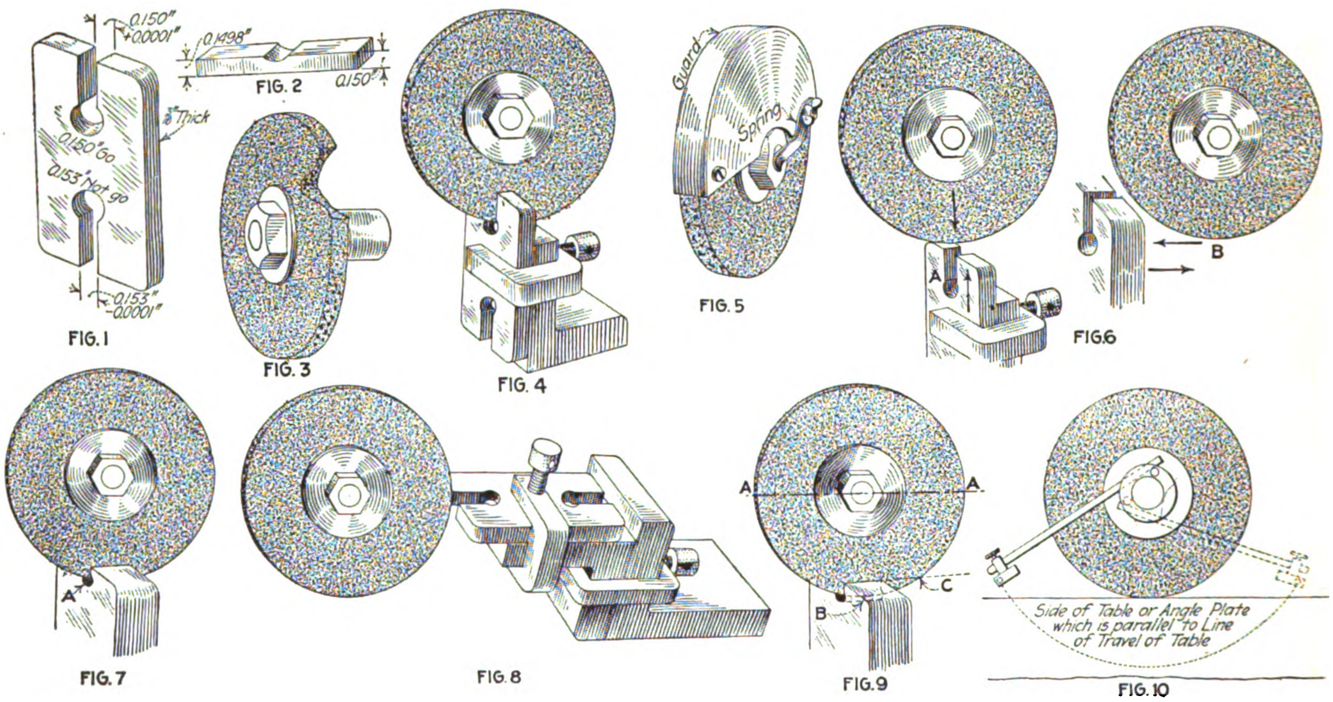
Fig. 8 shows a set-up for grinding gages on a cutter grinder. This is the most convenient manner of grinding small slots I have ever used, with the exception of a machine constructed especially for the purpose.

When it is imperative to grind the gage in the manner shown at *B*, Fig. 6, it should be ascertained whether the face of the wheel is in line with the line of travel of the table of the machine. If the wheel is not in line, the greatest error will be found at point *A*, Fig. 9, the error gradually decreasing to zero at point *B*. Hence, as the top of the gage comes in contact with the wheel at point *C* while the bottom of the slot in the gage comes in contact with the wheel only at point *B*, the top of the slot will be ground larger than the bottom. If a cutter-grinding machine is used for such grinding, the table may be adjusted with an indicator, as shown in Fig. 10.

If good grinding results have been obtained, 0.0001 in. on either side of the slot will be sufficient for lapping. If poor results have been obtained in the grinding—that is, if the sides of the slot are rough or not parallel—a correspondingly greater amount of lapping will have to be done. As lapping is slow work, the very best grinding results should be aimed at.

The gages, after grinding, are lapped to fit the test block, by means of small steel or cast-iron lapping blocks that have been ground somewhat smaller than the slot and charged with fine diamond dust. If the opening in the gage is quite large, a lap may be held in the vise, the gage being moved to and fro by hand; but most gages can be lapped best if the gage is held in the vise and the lap operated by hand. The opening should be lapped so that the test block fits into it properly. Both sides of the opening should be parallel at all points, very flat and smooth, and wherever it is possible round corners should be avoided.

A gage with an opening only $\frac{1}{16}$ in. in width requires the utmost skill if lapped by hand, and any slots smaller than $\frac{1}{16}$ in. should be lapped in a machine. At present we are making some snap gages with an opening of only 0.0325 in. in width and are doing the work on a special grinding device. After grinding with a small, fine wheel, the [illegible] replaced by a copper disk charged with [illegible] gage occupying an undisturbed position [illegible] at there is no opportunity for the slight-[illegible]



METHODS AND DETAILS FOR GRINDING SHOP GAGES

Chart for Ratios for Speeds in Geometric Progression

By A. Lewis Jenkins*

SYNOPSIS—An analysis of the problem of obtaining geometric progression for the speeds of cone-type machine tools. Ratios found in practice are given. An alignment chart provides an easy means for determining the ratios of any common type of cone drive.

It is generally conceded that the spindle speeds on machine tools should be in geometric series, and at the present time it would be unwise for a builder of machine tools to advertise his machines as having speeds in arithmetical, harmonic or cubic parabola series or in a geometric series that overlapped.

An investigation of the speeds of over 500 machine tools shows that the machines having speeds in geometric series are decidedly in the minority. If the speeds on these machines were presented to a mathematician having no knowledge of machine tools, with the request that he determine the series in which they are supposed to be, he would undoubtedly report that there is no law or series that expresses their arrangement even approximately and that they may be arranged in almost any way within certain limits. This peculiar condition has undoubtedly been brought about through attempts to introduce other considerations, such as large back-gear ratios, high belt speeds, large ranges of speeds and large steps on the cones.

In most cases a compromise of these considerations may be effected in such a way as to give a geometric series without greatly affecting the speed values. In order to do this, however, it is necessary to know how the speeds are related to the geometric series.

Considering a perfectly general case of speeds in geometrical progression, obtained by mechanisms consisting of a pair of stepped cones, back gears and one or more countershaft speeds such as are used on machine tools, let

p = Number of steps on cone pulley;
b = Number of back-gear changes;
c = Number of countershaft speeds;
A = First or slowest spindle speed, in revolutions per minute;
L = Last or fastest spindle speed, in revolutions per minute;

$N_1, N_2 \ldots N_c - 1, N_c$ = Countershaft speeds (N_1 the slowest and N_c the fastest);

$W_1, W_2, W_3 \ldots W_b - 1, W_b$ = Back-gear ratios affecting a decrease in spindle speeds by being in gear (W_1 the smallest and W_b the largest, their values being greater than unity);

r = Constant multiplier in the geometric series of spindle speeds, or the geometric ratio;

$U_1, U_2, U_3 \ldots U_p - 1, U_p$ = Cone-pulley ratios (U_1 the greatest and affecting the highest spindle speed);

*Associate professor of mechanical engineering, University of Cincinnati.

$A, B, C \ldots$ = Diameters of steps of the counter shaft or driving cone (A the largest);

$Z, X, Y \ldots$ = Diameters of the steps of the follower or cone on the machine (Z the largest);

T = Total number of spindle speeds.

Spindle and Countershaft Speeds; Geometric Ratio

The total number of spindle speeds is given by the equation

$$T = pc\,(b + 1)$$

As a matter of fact, a perfectly general formula for the number of spindle speeds would naturally consider a machine that has no back gear, or "drives direct," as having a back gear equal to unity, such a consideration being applicable to gear boxes and geared heads. In this case the expression for the total number of speeds is written $T = pcb$. But since a back gear is commonly considered as a combination of gears for decreasing the spindle speeds and since the terms first, second and third are used to designate the relative reductions they produce, it is considered desirable to follow the well-established practice of calling the one giving the least reduction and highest spindle speed the "first back-gear ratio."

The value of the geometric ratio for any number of countershaft speeds, steps on the cone and back-gear ratios may be found by the equation

$$r = \left(\frac{L}{A}\right)^{\frac{1}{pc\,(b+1)-1}}$$

On the assumption that the consecutive spindle speeds are obtained by employing all the countershaft speeds before shifting the belt or changing the back-gear ratio, the countershaft speeds are in the following geometric series:

$$\begin{aligned} N_1 &= N_1 & N_c - 3 &= N_1 r^{(c-4)} \\ N_2 &= N_1 r & N_c - 2 &= N_1 r^{(c-3)} \\ N_3 &= N_1 r^2 & N_c - 1 &= N_1 r^{(c-2)} \\ N_4 &= N_1 r & N_c &= N_1 r^{(c-1)} \end{aligned}$$

The ratio of any two successive countershaft speeds must be equal to the constant multiplier, in order to have the spindle speeds in geometrical progression.

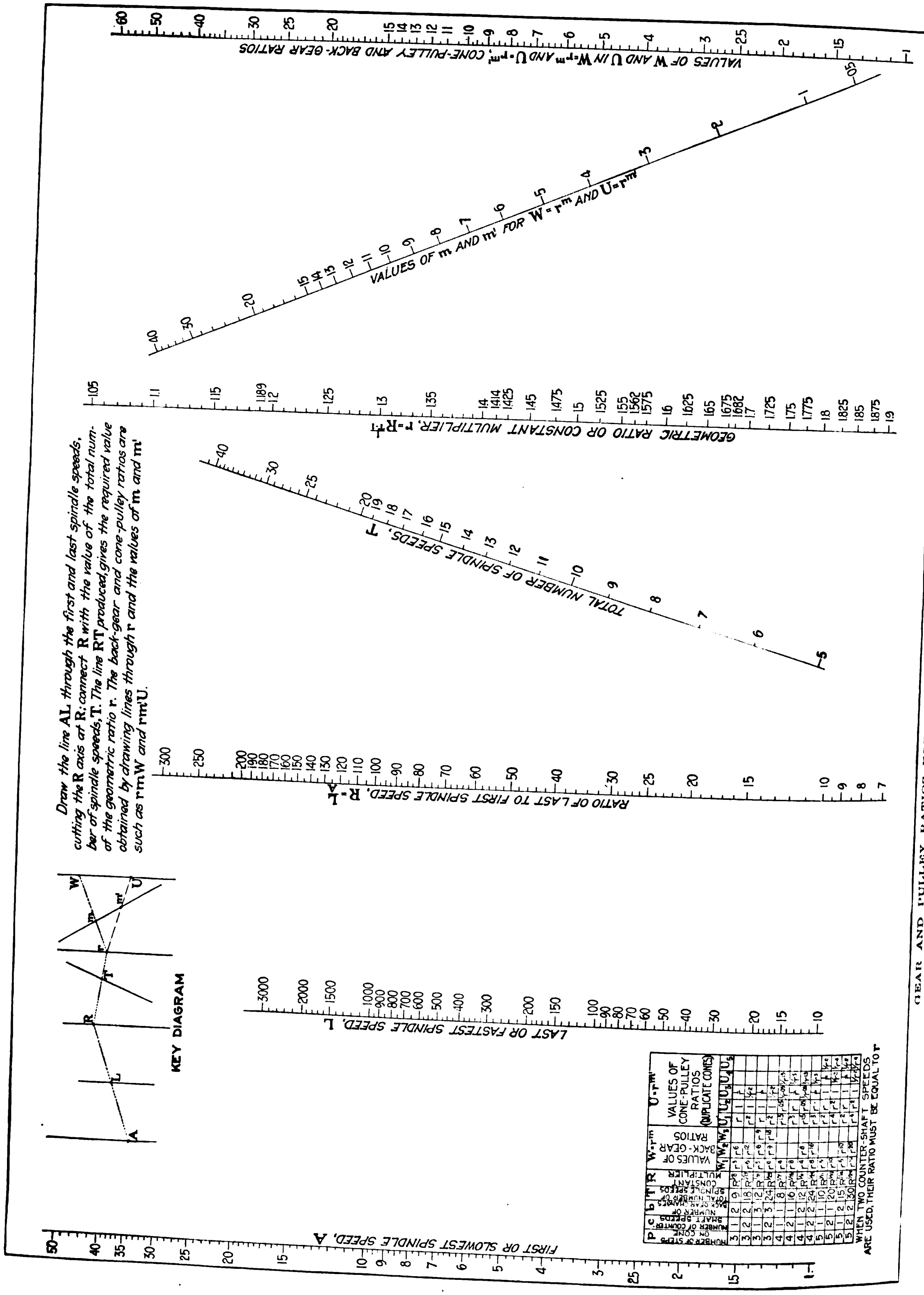
Taking the values of the back-gear ratios that reduce the spindle speeds as being greater than unity gives

$$\begin{aligned} W_1 &= r^{pc} & W_b - 2 &= r^{pc\,(b-2)} \\ W_2 &= r^{2pc} & W_b - 1 &= r^{pc\,(b-1)} \\ W_3 &= r^{3pc} & W_b &= r^{pcb} \end{aligned}$$

$a, b, c, d \ldots$ denote the diameters of the steps on the driver, a being the largest.

$z, y, x, w \ldots$ denote the diameters of the steps on the follower, z being the largest.

$U_1, U_2, U_3 \ldots U_p$ are the ratios of the cone-pulley diameters and are equal to $\frac{a}{v}, \frac{b}{w}, \frac{c}{x} \ldots$, U_1 being the largest and U_p the smallest.



GEAR AND PULLEY RATIOS FOR SPINDLE SPEEDS IN GEOMETRIC PROGRESSION

If N denotes the highest speed of a five-step cone pulley, regardless of the relative sizes of the cones, the lowest speed of the follower is

$$A = NU_5 = NU_p$$

and the highest speed of the follower is

$$L = NU_1 = NU_p r^{p-1} \qquad \text{or } U_1 = U_p r^{p-1}$$

which is true for any number of steps. If there are c countershaft speeds,

$$U_1 = U_p r^{c(p-1)}$$

This equation may be written

$$U_1 \div U_p = r^{c(p-1)}$$

and similarly, the other ratios are

$$U_2 \div U_{p-1} = r^{c(p-3)} \qquad U_3 \div U_{p-2} = r^{c(p-5)}$$

$$U_p \div U_1 = r^{c[p-(2p-1)]}$$

These equations represent ratios of the cone-pulley ratios, and in order to determine the value of any one cone-pulley ratio it is necessary to make some such assumption as

$$U_p U_1 = t^2$$

where $t = N \div N_1$ in the equation for the highest speed,

$$L = NU_1 = U_1 t N_1$$

or that value by which all the cone-pulley ratios must be divided when the countershaft speed is changed without changing the spindle speeds. It is easily seen that, if the countershaft speed on an ordinary lathe be doubled, the diameters of the countershaft cones must be reduced to half their size, if the spindle speeds remain unchanged. It is an important fact that the cone pulleys do not necessarily have to be duplicates in order to give the desired ratios or to maintain a constant length of belt; hence, from the foregoing equations

$$\frac{U_1}{U_p} = \frac{U_1}{\frac{t^2}{U_1}} = \frac{U_1^2}{t^2}$$

and

$$\frac{U_2}{U_{p-1}} = \frac{U_2}{t^2} = \frac{U_2^2}{t^2} \qquad \frac{U_3}{U_{p-2}} = \frac{U_3^2}{t^2}$$

By substituting,

$$\frac{U_1^2}{t^2} = \frac{U_1}{U_p} = r^{c(p-1)} \qquad \text{or } U_1 = tr^{c\frac{(p-1)}{2}}$$

and similarly,

$$U_2 = tr^{c\frac{(p-3)}{2}} \qquad U_{p-2} = tr^{c\frac{(5-p)}{2}}$$

$$U_3 = tr^{c\frac{(p-5)}{2}} \qquad U_{p-1} = tr^{c\frac{(3-p)}{2}}$$

$$U_4 = tr^{c\frac{(p-7)}{2}} \qquad U_p = tr^{c\frac{(1-p)}{2}}$$

In the equation for the slowest spindle speed

$$A = NU_p = Nt = r^{c(1-p)}$$

the actual countershaft speed, $N_1 = Nt$, may be given any desired value by selecting the proper value of t. By making $t = 1$, $N_1 = N$, and the cone pulleys practically become duplicates.

In connection with this last statement it should be remembered that duplicate cones have their diameters in arithmetical progression, and they will not give speeds in an exact geometrical progression; the error, however, is so small that it may be neglected except in very unusual cases.

The table on the alignment chart shows the number of spindle speeds; values of r in terms of the fastest and slowest spindle speeds; the back-gear ratios and the cone-pulley ratios in terms of r for all cases usually met in the construction of machine tools.

An investigation of about 400 lathes shows that it is average American practice to have a constant geometric ratio, based on the ratio of the highest-lowest speed, for each type of lathe, whereas it is English practice (Nicolson and Smith) not to have the geometric ratio the same for any two machines, unless by mere accident.

The average values of r, based on the ratios of the highest and lowest speeds, for lathes built in America are as follows:

Type of Machine	Average Value of r
Three-step cone, double back gear, 9 speeds	1.5
Three-step cone, double back gear, 18 speeds	1.22
Four-step cone, single back gear, 8 speeds	1.69
Four-step cone, single back gear, 16 speeds	1.3
Five-step cone, single back gear, 10 speeds	1.58
Five-step cone, single back gear, 20 speeds	1.26
All-geared head, 8 speeds	1.58
All-geared head, 12 speeds	1.36
All-geared head, 16 speeds	1.26
All-geared head, 18 speeds	1.23

Taking the average of these values of r for 8, 9 and 10 speeds gives 1.58, and for 16, 18 and 20 speeds gives 1.25.

For radial drilling machines having 20 spindle speeds the values of r vary from 1.27 to 1.35, the average being about 1.3. The value of r for vertical drilling machines having 8 spindle speeds varies with the size of the machine and is equal to $r = 0.9675S^{1/7}$ where S = size of machine which gives 1.49 for a 20-in. machine and 1.61 for a 36-in. machine. A constant ratio of 1.44 has been proposed for vertical drilling machines having 10 spindle speeds.

The result of having a constant geometric ratio for all machines would be an ideal condition from the standpoint of time setters who make special slide-rules and charts for machines. Carl G. Barth proposed the ratios of $\sqrt{2} = (2)^{1/2} = 1.414$ and $\sqrt[4]{2} = (2)^{1/4} = 1.189$ for all machines. These are considerably less than the values of 1.58 and 1.25 obtained by taking an average of average values used in the various types of lathes. Values of 1.25 and $(1.25)^2 = 1.56$ are easily remembered and come nearer to representing the present practice on lathes than the values suggested by Mr. Barth.

It would be in accord with Mr. Barth's idea to use $(2)^{3/4} = 1.682$ when $\sqrt{2}$ is not large enough to cover the required range and $\sqrt[8]{2} = (2)^{1/8} = 1.0905$ when $\sqrt[4]{2}$ is too large. There is apparently no very good reason why one of the values 1.0905, 1.189, 1.414 and 1.682 should not be used in designing any machine tool.

It should be observed that the values of the ratios of the countershaft speeds, cone pulleys and back gears depend only upon the value of r, which varies with the ratio of the highest and lowest spindle speeds for a given mechanism and is independent of the values of the countershaft speeds. Hence, if a machine is designed with speeds in a geometric series having a constant multiplier equal to r, its speeds will always be in a geometric series having that same value of r, regardless of the countershaft speed, provided the ratio of the countershaft speeds is kept equal to r.

The alignment chart, together with the table shown in Fig. 1, offers a very easy means of determining the values

of the geometric ratio and the gear and pulley ratios of practically any cone-type machine tool and may also be applied to some mechanisms used in the all-geared types. The method of using the chart is shown in the solutions of the following problems which are taken from lathe practice. The first gives the limiting speeds for a machine having a four-step cone and single back gear. The values for the various ratios are the quantities to be found. The second gives the highest spindle speed on a five-step cone single back-gear machine, having two countershaft speeds and asks for the pulley ratios and the value of the lowest spindle speeds.

Two Illustrative Problems

Problem 1—The highest and lowest speeds on a four-step cone single back-geared lathe having two countershaft speeds are 260 and 7; what should be the values of the cone-pulley and back-gear ratios and the ratio of the countershaft speeds? From the table on the chart it is seen that the back-gear ratio for this machine is $W = r^8$, the cone-pulley ratios are r^3, r, $\frac{1}{r}$ and $\frac{1}{r^3}$, and the total number of spindle speeds is $T = 16$. To use the chart, draw a line connecting 7 on the A axis with 360 on the L axis, cutting the R axis at 51.4. Then through this value of R draw a line through $T = 16$, and this will cut the r axis at 1.3, giving the geometric ratio. A line produced through $r = 1.3$ and $m = 8$ gives $W = 8.15$, which is the back-gear ratio; through $m = 3$ gives 2.2 for the first cone-pulley ratio, and through $m = 1$ gives 1.3 for the second cone-pulley ratio. Hence, the cone-pulley ratios are 2.2, 1.3, $\frac{1}{1.3}$ and $\frac{1}{2.2}$. The ratio of the two countershaft speeds is $r = 1.3$.

Problem 2—The highest spindle speed on a five-step cone single back-geared machine having two countershaft speeds is 430, and the back-geared ratio is 10.1; what are the pulley ratios and the value of the lowest spindle speed? From the table it is seen that the back-gear ratio is r^{10}, the cone-pulley ratios are r^4, r^2, 1, $\frac{1}{r^2}$ and $\frac{1}{r^4}$, and $T = 20$. Through $W = 10.1$ draw a line through $m = 10$, giving $r = 1.26$. Then through this value of r draw lines through $m = 4$ and $m = 2$, giving values of $U = 2.52$ and 1.59; or the cone-pulley ratios are 2.252, 1.59, 1, $\frac{1}{1.59}$ and $\frac{1}{2.52}$. Then through this value of $r = 1.26$ draw a line through $T = 20$, cutting the R axis at 81. A line through this value of R and $L = 430$ cuts the A axis at 5.3, the desired value for the slowest spindle speed.

Problem 3—On a three-step cone double back-geared machine having two countershaft speeds the first cone-pulley ratio is 1.49 and the highest spindle speed is 313; what are the lowest spindle speed and the back-gear ratios? It is seen from the table that the first cone-pulley ratio for this machine is r^2, the back gear ratios are r^6 and r^{12}, and $T = 18$. Through $U = 1.49$ and $m = 2$ draw a line cutting the r axis at 1.22. Then through this value of r and $m = 6$ and $m = 12$ draw lines cutting the W axis, giving 3.29 and 10.9 for the back-gear ratios. Through $r = 1.22$ and $T = 18$ draw a line cutting the R axis at 29.5; then through this point and $L = 313$ draw a line cutting at $A = 10.6$, which is the desired value of the slowest spindle speed.

The Best Way To Make Cores and Prints

By J. J. Eyre.

One of the necessary evils of the pattern shop when the hole to be cored is below parting line of mold is the making of tail prints and core boxes.

Pattern makers should appreciate the necessity of allowing plenty of taper to the face as well as the sides of the tail prints, which insures better work in the core room and foundry, and consequently a better casting. It allows the core to drop freely into place without scraping the sand into the bottom of the mold, and also does away with the "fin" back of the hole, caused by clearance being allowed or by the molder filing the teat of the core, as is frequently done.

It is common practice to make the core box as shown in Figs. 1 and 2. Both methods are costly and have their faults. Fig. 1 illustrates the core parted through the

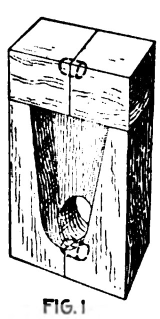


FIG. 1

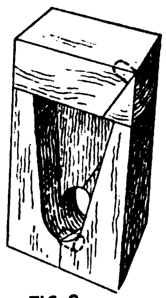


FIG. 2

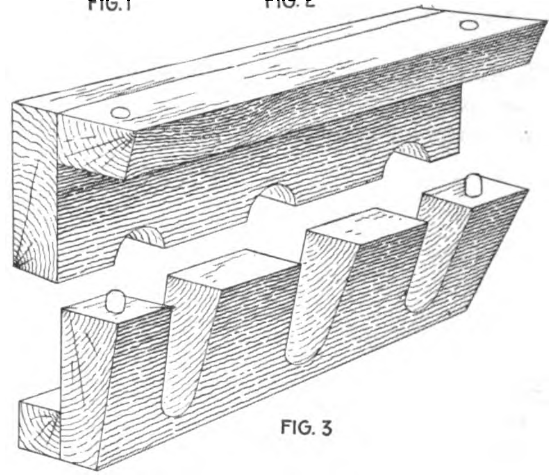


FIG. 3

METHOD OF MAKING CORE PRINTS

center, when it is apt to break down unless the greatest care is used by the core maker. The method of making the joint shown in Fig. 2 exacts more care and time in the pattern shop, and unless special attention is given, it is likely to stick in the square or closed corner of the box. With both methods the core box is choked with sand in the joint of the box, making the core oversize, which is likely to crush the mold when placing the core in position.

In Fig. 3 is shown a much simpler form of construction. I have used this type of box for wood and metal molds for a good many years and find it gives better satisfaction in the core room, besides being much cheaper to make.

It has a further advantage over the methods illustrated in Figs. 1 and 2 in that it can be made up for multiple cores, as shown in the illustration, for any number of cores.

Dies for Making a Pressed-Brass Hame Ball

BY ERNEST A. WALTERS

SYNOPSIS—The work described herewith includes blanking, cupping, drawing and bulging dies used in turning out a regular standard product—a hame ball for draft-horse harness. The details of the bulging die, or "fluid punch," are particularly interesting, as they show how bulging dies can be worked rapidly and maintain a supply of the bulging liquid.

The production of a pressed-brass hame ball, as shown, necessitates four press operations, including both drawing and bulging. The drawing dies produce a brass shell, 1$\frac{3}{16}$ in. in diameter by 4 in. deep, which goes through an annealing furnace and is then put through the bulging operation of the "fluid punch" type, which is not commonly known, producing a finished brass hame ball, as shown.

A set of first-class dies is also shown. They are so designed that it is possible to replace parts quickly and without much cost. In the first operation a cup *A*, Fig. 1, is blanked and drawn on a double-action press, which gives greater satisfaction than a single-action press. The

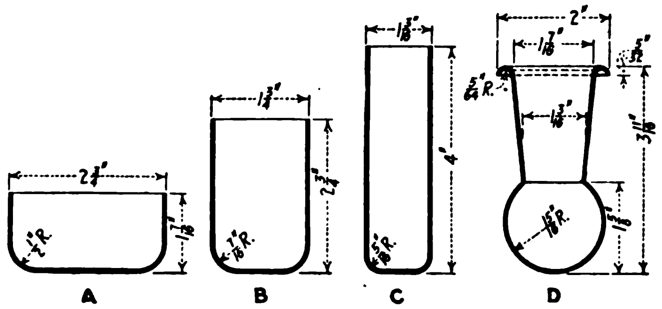


FIG. 1. HAME BALL, 16 GAGE BRASS

double-action press makes it possible to run continuously on the sheet, the shells being pushed through the draw die and dropping into a receptacle beneath, whence they are automatically conveyed to the belt press. Here they are drawn to 1¾-in. diameter as *B* drops through, and are again automatically conveyed to the following operation, where they are reduced to 1$\frac{3}{16}$-in. diameter, as *C*. They are then annealed, to prevent the shells from breaking or splitting while being bulged on the fluid die, which is supplied with lard oil automatically through a pump and the proper supply gaged by an overflow pipe, shown at *H*, Fig. 5.

In Fig. 2 are shown the blanking and cupping dies and the punches. The blanking punch *A*, made of hardened tool steel, is screwed to the cast-iron punch holder *B* by screws *C*.

The blanking die *D* is made of hardened tool steel, the cupping die *F* of high-speed steel, highly polished. The dies *D* and *F* are seated in the cast-iron bolster plate *E* and held in place by the stripper and side gages *G*, which in turn are held securely by fillister-head screws *H*.

The stripper plates *I* release the shell from the punch *K*. They have a horizontal motion of $\frac{3}{16}$ in. and receive the proper tension by small springs *S*. A small pin gage *J* spaces the blanks.

The drawing-punch point *K* is made of high-speed steel and screwed to the machine-steel punch *L*. A small hole drilled in the center continues through the punch,

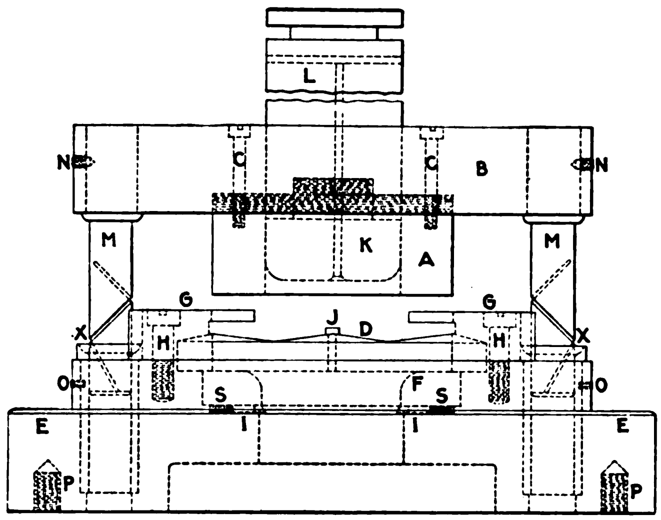


FIG. 2. BLANKING AND CUPPING DIES

to prevent a vacuum and allow the shell to strip easily.

Guide pins *MM* are made of hardened tool steel and secured by headless screws *N*. The guide pins are 0.002 in. smaller in diameter than the bronze bushings *X* and are lubricated with machine oil mixed with white lead, which is placed in a recess at *X*.

The bushing *X* is secured by headless screws *OO*. The holes *PP* are tapped underneath the bolster plate. This

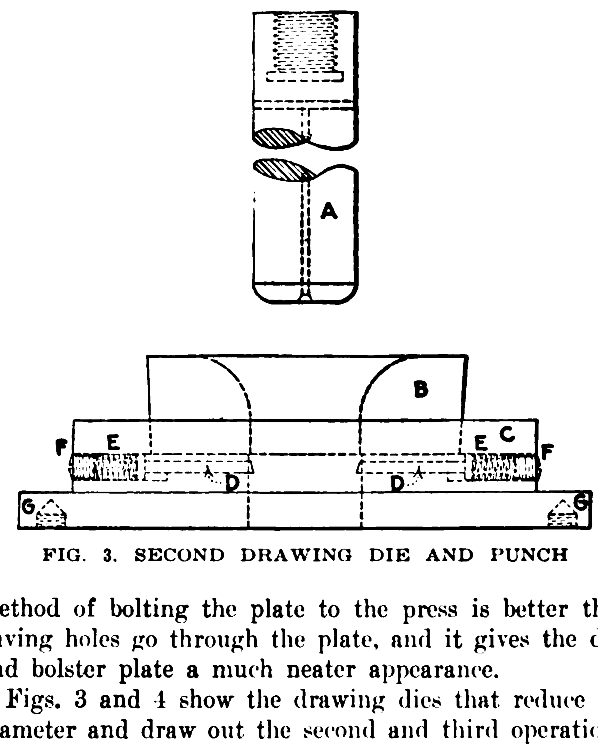


FIG. 3. SECOND DRAWING DIE AND PUNCH

method of bolting the plate to the press is better than having holes go through the plate, and it gives the dies and bolster plate a much neater appearance.

Figs. 3 and 4 show the drawing dies that reduce the diameter and draw out the second and third operations. The punch *A* and the dies *B* are made of high-speed steel

highly polished and very durable, as compared with ordinary tool steel.

The inserted die *B*, Figs. 3 and 4, are cheap and lasting, as compared with a large solid die, because it can be shrunk and brought back to size a number of times. It can also be replaced in a few seconds when necessary and does not hold up production on the succeeding operations while making a change.

The ring dies *B* are set in the bolster plate *C* and do not require to be held, as the stripper pins *DD* strip the shell from punch *A* on its return, making it impossible for the shell to unseat the die.

The stripper pins *DD* are made of tool steel and hardened at the ends *X*. They receive the proper tension from springs *E*. The setscrews *F* hold springs *E* in position and regulate the necessary tension. The holes *G* are tapped to secure the bolster plate to the press bed.

Fig. 5 shows the bulging die and punch with shell in position and reservoir filled with oil ready for the descent of the punch to bulge the taper and finish the ball. The punch *A* is made of hardened tool steel, while *B* is the bolster plate which seats the dies. These are

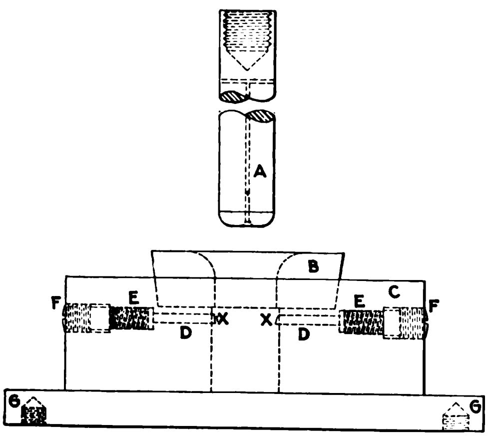


FIG. 4. THIRD DRAWING DIE AND PUNCH

made of hardened tool steel, consisting of two halves *CC*, which in operation are opened and closed by handle and screw *DD*. Both halves are counterbored to receive four springs *E* that spread the dies and keep them open while removing and placing the shell *F*, shown in place to be opened and bulged.

The oil is supplied by an automatic pump and enters through the pipe at *G*. The overflow pipe *H* expels the surplus oil and acts as a gage in keeping the reservoir from overflowing. It is important that the overflow pipe be ½ in. above the shell level, in order to keep enough oil in the reservoir instantly to fill the shell *F* when it is dropped into position.

The punch *A* has a ¾-in. threaded hole through the center to allow pressure adjustment by the threaded plugs *JJ* and rubber washer *K*. This must be 0.005 in. smaller than the inside of the shells. This operation opens and wires over the flange and at the same time bulges out a perfect ball on the end.

Good judgment and care must be exercised in both adjusting the press and in the oil-displacement space in the punch. This space is secured by adjusting the plugs *JJ* in order to get the proper effect on the ball. The pressure is equally distributed on the dies *CC* by the hardened block *I* when closed by screw and handle *DD*.

When the shell is in place, it will be noticed that the hollows of the dies are full of oil. As this must be expelled, the oil channels *XX* are provided and must be as small as possible in order not to leave any depres-

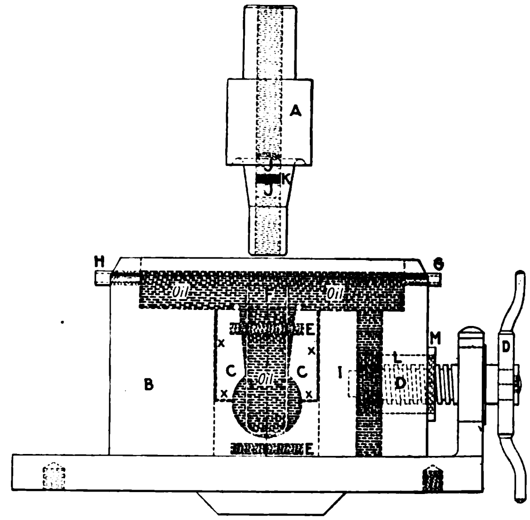


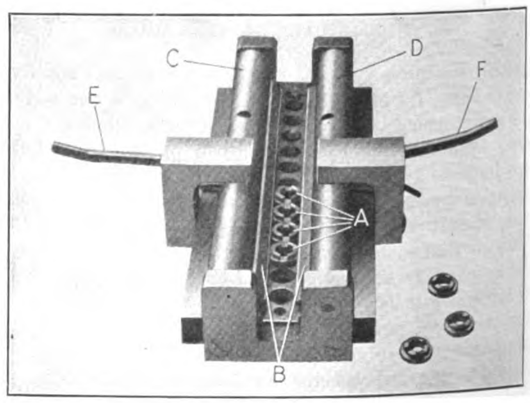
FIG. 5. BULGING AND OPENING DIE AND PUNCH

sion on the finished ball. The bronze bushings *L* and *M* and the nut can quickly be replaced when it becomes necessary. The tapped holes *OO* are to secure the bolster plate to the press.

Multiple Milling Jig

By E. A. Thanton

The idler stud washers on Henderson motorcycles are first drilled and turned; then they have a ⅛-in. slot milled across the top. Some of the slotted washers may



A MULTIPLE MILLING JIG

be seen at the right in the accompanying illustration. They are slotted in lots of 12 in the jig shown.

The washers are slipped into the channel, as at *A*. The clamping jaws *B* just catch the shoulders of the washers. These jaws are operated by eccentric rolls *C* and *D*, which are turned by the handles *E* and *F*. As soon as the lot is slotted, the washers are pushed out and the jig refilled by shoving washers in from one end.

Furnace and Oil Burner Plans

By Louis D. Peik

A large furnace equipped with oil burners and with the proper combustion and draft for annealing steel castings economically was for some time a problem with us in several ways. A large positive blower furnishing the air for the burners caused no end of repair expenses, and the steel stack was usually red hot and a smoke nuisance.

The furnace was 20 ft. long, 13 ft. wide and 9 ft. high from the car to the roof arch. Remodeling was carried out with good results, as in Fig. 1, which shows a cross-section of the annealing furnace after it was changed, and equipped with new home-made burners.

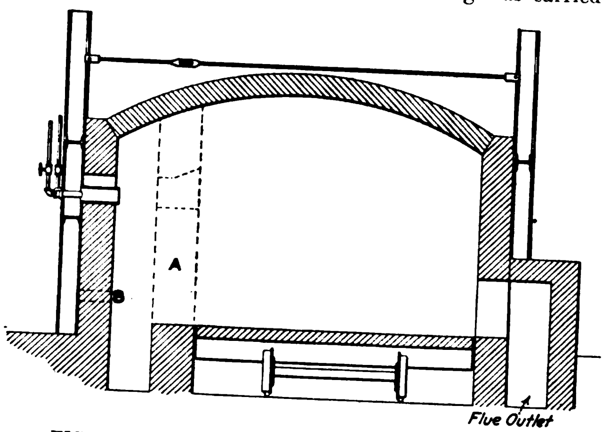


FIG. 1. ANNEALING FURNACE AS REMODELED

The original construction included the wall *A* and air-take holes *B*, comprising the combustion chamber.

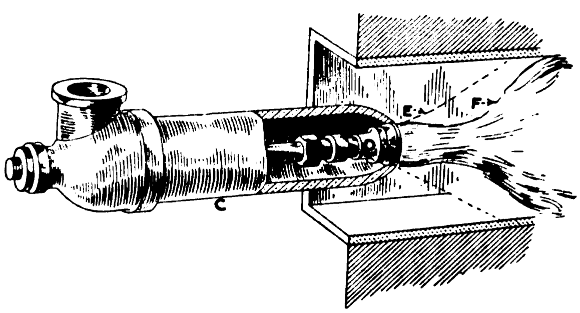


FIG. 2. ACTION OF THE BURNER

A burner was devised, as is shown in Fig. 2, made up almost entirely of standard fittings and gas pipe. The pipe *C* was heated and drawn somewhat to a point, leaving a hole just large enough to pass through it the nozzle *D*. The nozzle is a water-hose garden sprayer and can be bought for 20c.; the rest of the parts are standard fittings. The complete burner, fitted with valves and oil strainer, is shown in Fig. 3.

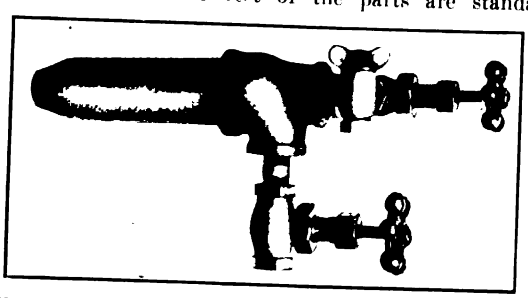


FIG. 3. BURNER WITH VALVES AND OIL STRAINER

Fig. 2 gives a good idea of the spray. Before the steam is turned on, the oil sprays in the direction *E*, shown in dotted lines. The steam passes out over the nozzle, mixes with the oil and in a very fine vapor or gas takes the course shown by *F*. The injector effect draws in enough air to produce perfect combustion in the furnace without any additional air supply.

It might appear that the burner side of the furnace will be colder than the outlet side, owing to the travel of the heat, but our experience with a furnace of this size does not find this to be the case. Conditions would be more nearly ideal, however, if the flue outlets were placed on both sides of the furnace. Under their changed condition our stack barely gets warm, and the smoke is hardly perceptible. In addition to this the blower was shut down and steam used instead. There is also a marked saving in fuel oil. Fig. 4 shows a cross-section of a proposed heating furnace for melting alloys with fuel oil. It is built in tunnel shape, so as to give a coiling motion to the flames.

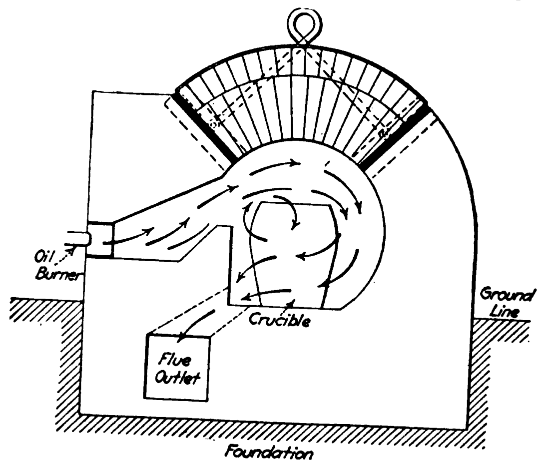


FIG. 4. FURNACE FOR MELTING ALLOYS

It might be of interest to many who have furnace problems to know something in regard to the proper size of flue outlets. After considerable experimenting with three different kinds of furnaces, I find that 1 per cent. of the volume in cubic feet of the furnace expressed in square feet gives the proper total area of flue outlet. For example, take a furnace 5x6x2 ft., to have two flue outlets: $5 \times 6 \times 2 = 60$ cu.ft.; 1 per cent. of $60 = 0.6$ sq.ft.; $0.6 \times 144 = 86.4$; $86.4 \div 2 = 43.2$ sq.in. Therefore the size of each opening is 6x7 in., nearly.

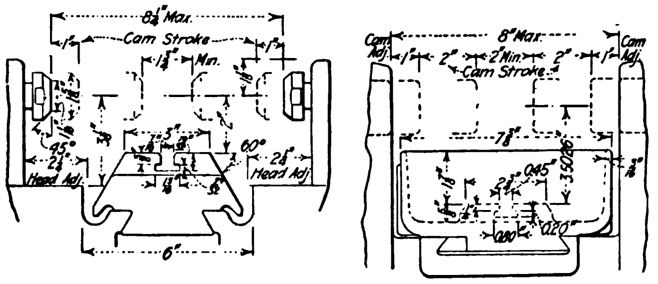
Spline-Milling Fixtures

By W. S. Wright

The spline miller has been used quite extensively in the past to spline keyways, to hog away metal to be finished later by another operation and for cutting through slots. With the rush of gun work a new field of usefulness has been opened up for this type of machine. It will do a vast amount of work with practically no attention, for one man of the unskilled class can handle several machines without inconvenience, as a machine once started will run until its operation is completed and then stop. Each

cutter may not remove as much stock as an end mill; but as each machine is two spindled, the results of a day's run are quite satisfactory. The cutter used is called a fish-tail cutter, being made with two, three or four teeth.

The table moves as any miller table, only it is accelerated by different means and passes back and forth



FIGS. 1 AND 2. DIAGRAMS OF STROKES OF TWO SPLINE MILLERS

between the two spindles. The distance from the center line of the cutters and the top of the table is constant and cannot be changed.

Capacity diagrams of these machines, of Pratt & Whitney make, are shown in Figs. 1 and 2. Fig. 1 is for the smaller machine, in which the standard collet takes a straight-shanked cutter $\frac{1}{4}$ in. in diameter, although $\frac{5}{16}$-in. cutters may be used. The entire head of this machine is adjustable $2\frac{1}{4}$ in., and the table cam stroke is 1 in. for each spindle, making a total movement of 2 in. The table travel is 2 in.

The larger machine, shown in diagram in Fig. 2, has an adjustment of 1 in., by means of moving the cam on its shaft, and has a 2-in. cam stroke for each spindle. This machine takes straight-shank cutters $\frac{1}{4}$ and $\frac{7}{16}$ in. in diameter. The table travel is 4 in.

In Figs. 3 and 5 are shown two styles of spline-milling fixtures, which are typical designs for these machines. Considering Fig. 3, the base *A* is of cast iron. Upon it is mounted a stationary jaw *B*, which is screwed, doweled and tongued to the base. Under this jaw and in a slot in the base is a machine-steel slide *D*, upon which is mounted a swivel jaw *C* held on the slide by means of a shoulder screw *H*. All these parts, except the base, are made of machinery steel and are carbonized, hardened and ground. With the high cost of tool steel it would be out of the question to make these parts of that material.

The jaws are closed by means of a cam *E*, mounted on a stud *F* in the iron base *A*. The long end of the slide is held down by passing under the stationary jaw *B*, and the head end of the slide is forced downward as well as forward by the action of the cam in closing.

On the side of the slide is screwed a plate *G*, in which is a rectangular opening. Driven into the side of the cam handle *E* is a pin *K*. As it is desired to open the jaws to remove the work, this pin bears against the back side of the opening in the plate *G* and pulls the slide back or toward the operator, thus allowing the work to be removed. In the bottom of the base is planed a slot of the same width as the slot in the miller table, and two keys *J* are screwed in place.

Fig. 4 shows the part upon which the cuts for both slots are made. The slot cut in the fixture, Fig. 3, is the small one marked *X*, while the cut marked *Y* is the one taken in the fixture of Fig. 5. The work in each case is positioned by the lug at the right of the cut *Y*.

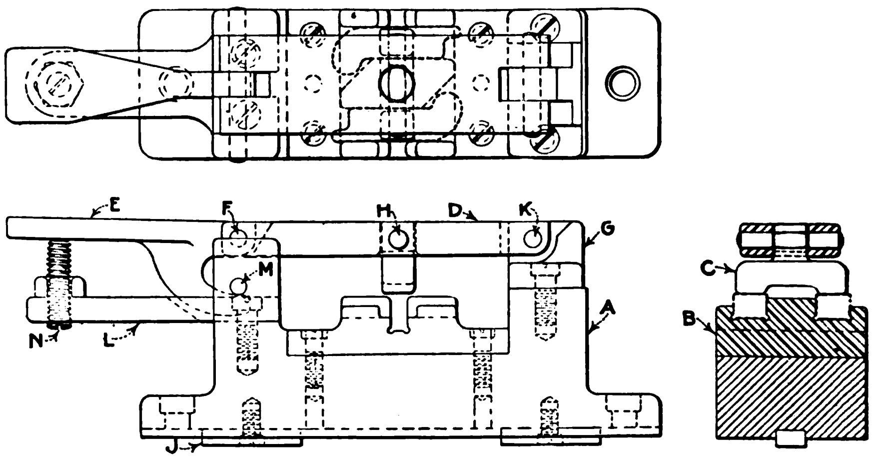


FIG. 5. ANOTHER SPLINE-MILLING FIXTURE

When work can be held in a horizontal position and not vertical, as in Fig. 3, a fixture of the type shown in Fig. 5 may be used. In this fixture upon the base *A* is screwed and doweled the machine-steel block *B*, which is a bedding and locating block for the work.

The work is held down on this plate by means of a swivel clamp *C*, hung in the leaf *D*. The leaf is swiveled on the pin *K* on a machine-steel block *G*, which is screwed to *A*. Clamping the work is done by a binder handle *E*, which is hung on the pin *F* in the leaf and binds under the pin *M* in the base. The block *G* is cut at a 45-deg. angle, as shown, to prevent the leaf from being thrown back on the table of the machine. The binder *E* is a forging. The casting is planed from $\frac{1}{32}$ to $\frac{1}{64}$ in. below the bottom of the leaf, when in the position to hold a piece of maximum size and to allow the leaf to close tight on a piece of minimum size. As considerable pressure may be put on the handle *E*, a stop handle *L* is provided with screw and nut *N*. This fixture is keyed to the machine table in the same manner as the one of Fig. 3, and each is held in place by T-nuts and fillister-head screws. While conditions may require fixtures of different construction, these convey the general idea.

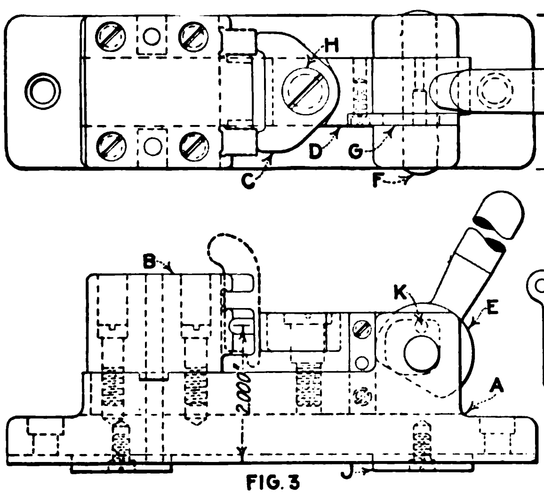


FIG. 3

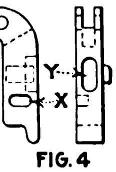


FIG. 4

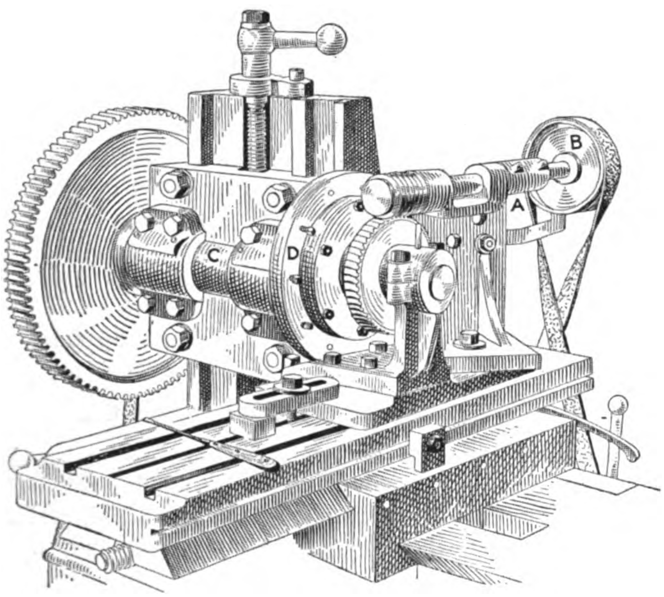
FIGS. 3 AND 4. A SPLINE-MILLING JOB AND ITS FIXTURE

Letters from Practical Men

A Continuous Milling Fixture

The continuous milling rig shown herewith was set upon a Brainerd miller to help out on a rush order. The work to be done was the surfacing of irregular-shaped cast-iron pieces that were already ground on one side. The two faces had to be parallel within ± 0.0005 in.

There was at hand a fixture that, with a little changing, was well adapted to the work. A pair of heavy bearings, mounted on a base, carried a 1½-in. worm-driven shaft, on which a faceplate was swung. This faceplate was provided with a locating stop for the work and a screw



A CONTINUOUS MILLING FIXTURE

to draw each piece flat against the faceplate, a tapped hole already in the pieces being convenient for this operation. Removing the worm shaft from its former position, it was fastened to an angle plate as at *A*, so that a belt drive could be obtained from the regular feed. To do this a pulley was screwed to the worm gear on the back of the machine in line with the pulley *B* in the upper worm shaft. The usual feed changes were thus obtained and applied to the faceplate. Removal of the pinion on the screw allowed the table feed worm gear to revolve without moving the table.

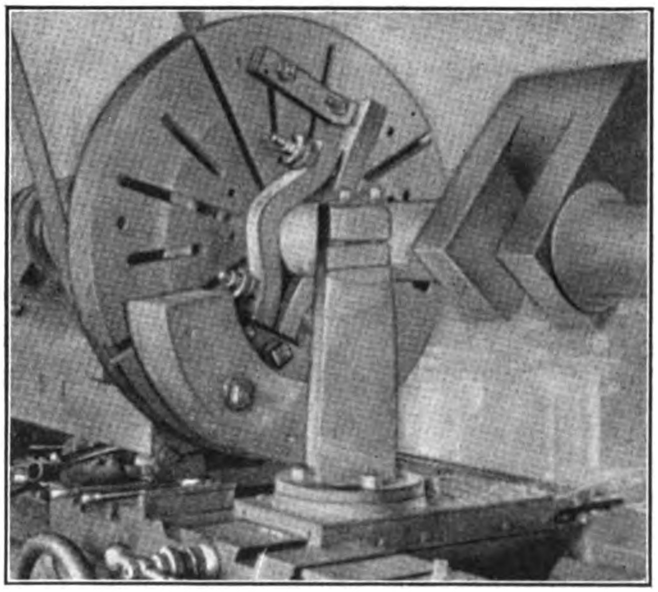
An end mill carried in the spindle *C* completed the outfit. The production was 450 pieces per day—all within the prescribed limits. To insure perfect work, the saddle was moved up, the feed put on and the working surface of the faceplate *D* dressed off lightly by the end mill before any pieces were run. A screwdriver was the only tool the operator needed to attach the pieces to the faceplate. The screws used to hold them may be seen on the outer ring.

Incidentally, the illustration shows a source of danger—guarded in this instance—which to the writer's belief the safety inspectors have overlooked. There are any number of this type of miller in use, all powerfully geared and all made with a big driving gear in the spindle. The gear has six arms, the spaces between which when revolving forming as dangerous a trap as could be found. If by any chance an arm were thrust through one of the openings, the mildest possible result would be a broken limb. The writer has protected the machine shown and others by disks of ⅜-in. boards cut out on the bandsaw and held on the gear by wood screws passing through the boards themselves, one disk being on each side of the arm. DONALD A. HAMPSON.

Middletown, N. Y.

Extended Tool Post for Crankshaft Turning

For turning large crankshafts the extended tool holder shown in the illustration has proved very suitable. The regular tool slide has been removed and the upright, which is a steel casting, bolted in its place. This, of



TOOL POST FOR CRANKSHAFT TURNING

course, may be swiveled so as to use it with either the right or the left hand. Near the upper end a slot has been planed, and a hardened-steel circular piece has been provided beneath the tool, enabling it to be set at any angle necessary. Two setscrews are used for clamping.

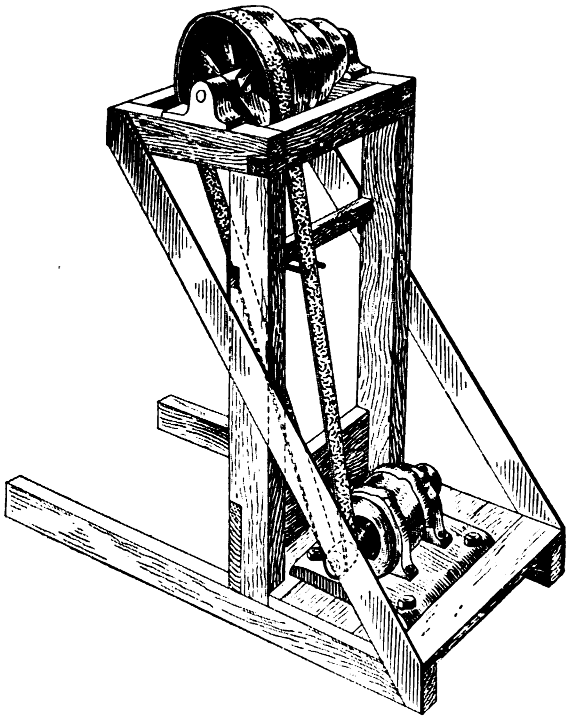
Lima, Ohio. D. S. MANN.

Portable Power Plant and Countershaft

The illustration shows a portable countershaft built for use in the finishing operations on hand screw machines. The base is of the same width and height as the standard elevating truck platform, with extensions of sufficient length to straddle the leg of the lathe at the spindle end and take the belt pull. A 3-hp. motor is mounted

on the base and belted to a countershaft, with tight and loose pulleys and cone on the upper framework. The power wires are supported over the erecting floor by small ropes and weights and are long enough to allow the machine to be moved anywhere on the floor. They are attached to the frame, with a double-throw switch on the side nearest the operator.

The machines were assembled by the progressive system, in rows of ten each. When the end one was completed, the countershaft was moved up to it, the belt attached, sliding the countershaft back until the requisite belt pull was applied. The screw machine was run in the reverse direction while the spindle nose was ground to the correct taper, owing to the fact that our internal grinder ran anticlockwise. The turret holes were then drilled, bored with a single-point tool and reamed. The tools


THE PORTABLE COUNTERSHAFT AND POWER PLANT

for this operation were held in the automatic chuck collet, thus insuring absolute alignment of the turret holes with the spindle. The belt was then taken off and the countershaft moved to the next machine in line.

The countershaft was easily handled by one man and saved a great deal of time and confusion that would otherwise have been required in moving machines to the line shaft and back again. H. B. McCray.

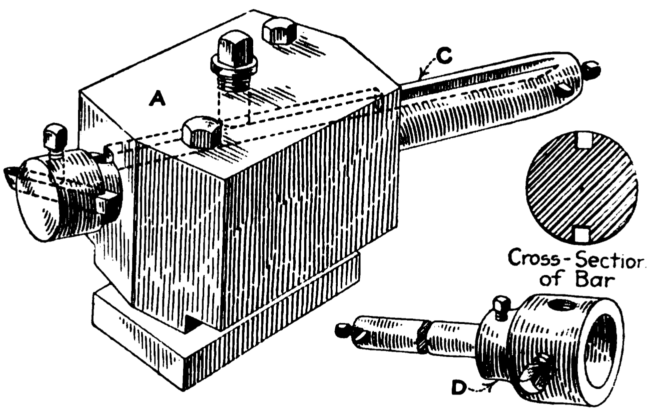
Charles City, Iowa.

A Boring Bar

The accompanying drawing shows a boring bar that has been found very useful for short heavy engine-lathe work. While it is a bar, its construction permits it to be used for numerous turning and facing jobs as well.

The cast-iron block *A* is bolted to the carriage after being planed to fit the tool-post slot and is bored in place. A keyway is cut in the top of the bore and a hardened key fitted to it. The key is made slightly loose, so that it may be removed easily. When in use, i... held in place by a substantial setscrew in the b...

The bar has a keyway in each side, which permits it to be turned over for inside or outside work. The tool slot is cut at an angle of about 45 deg., for the purpose of getting into corners. Forged bits of ¾-in. steel are used, and the bar is about 3 in. in diameter or may be heavier, if required. Braces may also be provided for



A BORING BAR ADAPTED FOR HEAVY LATHE WORK

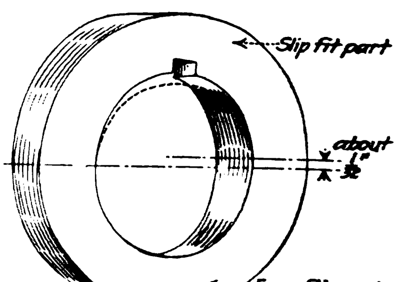
the back end of the bar and attached to the rear end of the carriage to prevent springing.

A socket *D*, which slips over the end of the bar and is held in place by a setscrew, makes it unnecessary to remove the bar for boring small holes. Bars of various lengths to suit the work being done may be used in the small end of the socket. Other sockets or caps may be made to slip over the end of the bar, for holding thread chasers and forming tools of different kinds.

Los Angeles, Calif. F. L. Bowler.

Fitting Tube-Mill Gears

The tube mills in a certain portland-cement works are gear driven. The gear and pinion on the intermediate shaft are subjected to tremendous stresses and vibration. To be sure that they would not come loose, we used to bore them out a force fit and press them on the shaft in the shop. When the gear was worn out or broken, the whole shaft, which weighed over 3,000 lb., had to be taken out and moved to the shop, the gear pressed off and a new one pressed on, which took considerable time. We tried to hold them on with a slip fit, but in time they always worked loose, no matter how well the key was fitted, spoiling not only the gear, but sometimes the shaft as well. So we tried a system which, because we did not know any other name for it, we called the two-diameter fit. The gear was bored out a force fit as usual, but allowing more for the fit. The shafts were 6 in. in diameter and we allowed eight thousandths. Then the gear was moved over in the chuck about $\frac{1}{32}$ in. and another cut taken. We allowed the tool to touch just half of the diameter of the first hole. This second bore was ...y slip fit on the 6-in. shaft. The keyway was then ...he middle of the larger-sized bore. To assemble,



FITTING TUBE-MILL GEARS

the gear was slipped on the shaft to the required point and the taper key driven, drawing the force-fit bore against the shaft.

When the gear was to be changed, the key was drifted out. A few blows from a sledge were sufficient to knock the gear down onto the slip-fit part of the bore, and it was easily slipped off the shaft and a new one put on.

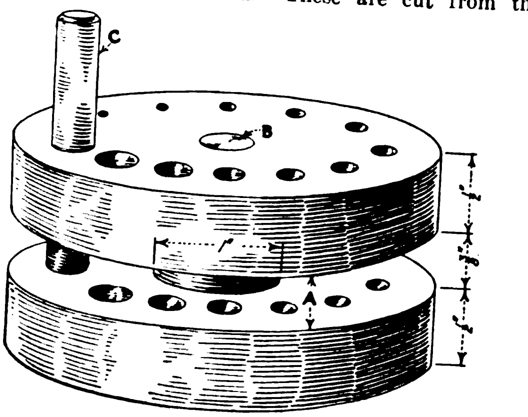
Although these drives are subjected to great stresses and vibration, we never had one come loose. As far as we could judge, this method of holding was just as secure as the force fits.

Seattle, Wash. E. W. WRIGLEY.

Handy Punch and Die Block

Herewith is shown a sketch of a very handy punch and die for a mechanic's tool kit. It may be used to punch sheet metal of any kind.

The series of holes is drilled straight through both flanges and is made to take the punches *C*, made from standard sizes of drill rod. These are cut from the



A HANDY PUNCH AND DIE BLOCK

rods and the ends hardened. Either of the surfaces *A* may be used as the die. When both are dull, they may easily be renewed by grinding on an arbor inserted in the hole *B*.

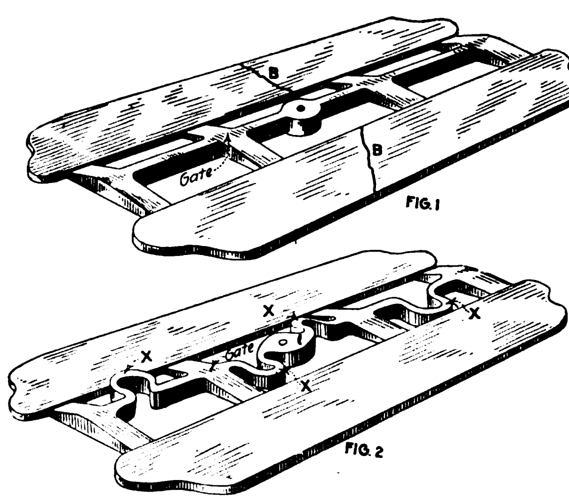
It is understood of course that the whole die block is to be hardened. HAROLD E. GREENE.

Ilion, N. Y.

Preventing Shrinkage Cracks

Considerable difficulty was experienced by a malleable-iron foundry in producing long thin castings such as shown in Fig. 1. The difficulty was to prevent them from cracking through the points indicated by *B*, while cooling in the mold. The trouble was overcome by employing an extra man during the pouring period, to dump the molds immediately after being shifted and to break the castings off the gate before cooling. After several years of production by this method the foundry head took the matter of making alterations on the gating, to overcome the extra expense involved.

The pattern department came to the conclusion that the cracking was due to the castings being much lighter in cross-section than the gate, causing unequal contraction, which was successfully overcome by the use of a bent gate, Fig. 2. The contraction breaks this at the points marked *X* and saves the castings.



PREVENTING SHRINKAGE CRACKS

The foundry is now producing the castings in large quantities at moderate cost and doing away with the expense of the extra man. STEPHEN BONA.

Union City, Conn.

Relation Between Drafting Room and Factory

Issuing drawings to the factory and keeping the factory supplied with uptodate prints are matters of no little importance. It often happens that, after blueprints have been sent to the shops and even after apparatus has been manufactured from them, the engineer will change the design, so that the prints in the factory become obsolete.

In some large factories, when changed prints are sent to the manufacturing departments daily, a bulletin is also issued and sent along, giving the drawing numbers affected, describing the changes, stating the requisition and job numbers and giving the disposition of material in process of manufacture. Where patterns and tools are involved, this bulletin will state, "Patterns changed" or "Tools changed." The production man, seeing this, will at once issue orders to change the patterns or tools and will state whether production is to be held up on present apparatus or whether it may go on and the change work in automatically.

This bulletin is sent to all manufacturing departments and should accompany the blueprints of that issue. Pattern shop, foundry, screw-machine, tool and machine-assembly departments are automatically notified at once. Each and every foreman is thus acquainted with the situation and is watching for his new or changed orders from the production department.

The clerk in the factory, on receiving these new prints and bulletins, will call in all the old prints of the previous issue, which should be scrapped. He should keep a record of all prints charged out and make sure that each man in the department holding an old print is supplied with a new one covering the latest changes. Some factory foremen in trying to cut down their "overhead" will neglect to have their blueprint files properly looked after, although this is a big mistake. It may happen that hundreds of dollars will be thrown away by making

up, according to an old drawing, parts that will be useless for the new construction.

The bulletin issued on new and changed drawings should be kept on record for at least five years, for possible reference. It is the chart on which the whole manufacturing work hinges. By living up to it and doing strictly what it states the factory foreman or superintendent will eliminate all his troubles with the engineering and drafting departments. It may happen that the bulletin is wrong, but this is the fault of the engineer and not of the factory man.

It may be found sometimes that the bulletin may not have as many drawings recorded as there actually are on change. The factory clerk is in a good position to discover this, as he is the checker. By notifying the drafting department a supplementary sheet is sent through, covering the missing numbers.

To sum up the whole situation: The drafting-department daily bulletin notifies the factory of new and changed drawings, calls attention to pattern and tool changes, tells of disposition of material in course of construction, notifies the production and cost departments of all changes on apparatus being built and, lastly, is a silent superintendent of the whole manufacturing department.

Pittsfield, Mass. JOHN INKERMAN.

Chuck Wrench Provided With Renewable End

Having had much trouble with chuck wrenches which operate screws with female openings, I devised a wrench that successfully does away with the annoyance caused by twisting off the square end that enters the chuck screw.

The body of the wrench is made as large as practical, to give the necessary metal around a square broached hole in the end. A small hole is drilled entirely through the shank. The wrench ends are made of standard cold-drawn square stock driven in the broached hole. In case the end is twisted off, the cross-handle is removed, and the broken end is driven out with a drift through the small hole in the wrench body. A new piece is driven in, and the wrench is as good as new.

Brazil, Ind. FRANK G. SENTER.

Inspection of Castings

The inspection of castings is a subject on which very little has been written and at the same time one which should interest all mechanics. A casting is something more than a lump of metal taken out of the sand. It is oftentimes the foundation for a lot of expensive work. If defective, the further expense of machining it should be stopped, if possible.

The inspection of large castings is interesting, as each casting, even if off the same pattern, will check differently. To decide whether or not to use a defective casting, before any machine work has been done, will often tax the judgment of the most experienced of inspectors. To facilitate the inspection of castings and to standardize it, I have worked out the following specification and find it very satisfactory:

All castings must check reasonably close to the dimensions on the drawings, all variations to be noted and reported when necessary, an allowance being made for the required amount of material for finishing all parts that require machining.

Castings should be free from all defects—such as shrinkage cracks, sand-, shrink- or blow-holes, warped or twisted surfaces, lumps, fins or burnt sand—that affect the strength or appearance.

All castings must be cleaned thoroughly. This means that no extra work will be necessary in order to use the castings, that all lumps and fins must be chipped off flush with the surface of the castings and that all sand, chaplet plates, cleaning jacks, nails and core rods must be removed from fillets and cored pockets or holes. Exceptions will be made from these rules, in the following cases:

Castings used for a rough class of work will pass as O.K. with a foundry finish suitable for this particular class of work. Minor defects, unless present in large numbers, that do not affect the strength or appearance of the castings will pass as O.K. Castings that have shrinkage cracks, shrink-, sand- or blow-holes located at such points that they will not affect the strength of the casting will pass as O.K., provided that the filling of the defective spot or spots is done at the expense of the foundry. Castings that have had defective spots filled or welded without first having obtained permission of the inspector will be subject to rejection. Permission to patch a defect will only be given after inquiry has been made regarding the extent of the defect.

Castings that have been welded or burned on at points that are to be finished must be soft enough at such points to be readily machined. If too hard, the castings will be subject to rejection.

Castings that develop defects after machine work has been done will be subject to rejection or will be filled or welded at the expense of the foundry.

Castings that have warped or twisted surfaces that do not affect the use of the casting or cause extra work in machining will pass as O.K. W. H. NOURSE.

Portland, Ore.

Wanted--Data on Shell Practice

There seems to be such a variety of methods used when machining the shells that the practice followed by our readers is worth recording.

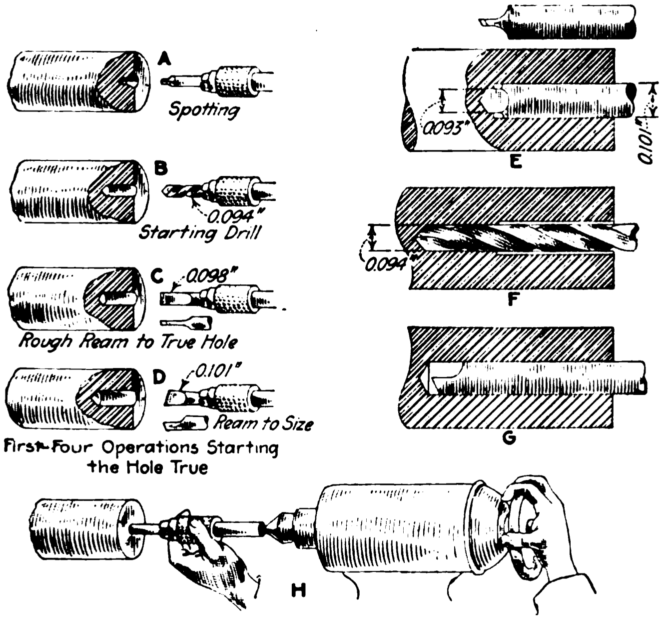
In some firms we find that low-carbon steel is used for the machining tools, some using them dry, others with a cutting lubricant. Other concerns are utilizing high-speed tools, either dry or with cutting fluid. Will our readers engaged on this class of work kindly send us what is their practice, which to be of value should contain the following data: Chemical analysis of steel being machined, surface speed at which it is machined, feed and depth of cut being taken, nature of steel used for the machining tool, whether dry, or if using a cutting fluid, its nature. A compilation of such information would be of great value, as it deals with an interesting, live subject.

Also of value would be the following information: Operation and machine tool used, physical properties of steel machined. If heat-treated, what is the treatment? Is steel from bar or forged? Of what type is the cutting tool? Information on threading is especially wanted.

Discussion of Previous Question

Drilling Long, Small Holes

The article by A. R. Robertson on page 241 of the *American Machinist* proved of interest to me, as I have several times faced the same problem. Just a few months ago a number of spindles were required that called for a long, small hole of the kind referred to. These spindles are used on a special machine, and six are required for each set. The outside diameter is a little less than $\frac{1}{2}$ in. and the length is 6 in. A 0.101-in. hole is drilled and reamed from end to end and is required to run true with



DRILLING LONG, SMALL HOLES

the outside and to be as near straight as it can reasonably be made. The hole size limits are 0.001 in. over and nothing under. The specifications called for machinery steel, and the pieces were to be cyanided on each end when completed.

The steel had already been cut off, but on taking up the job I returned it to the stockroom and had cold-rolled steel furnished instead, allowing about $\frac{1}{8}$ in. to turn off. The pieces were then rough-turned to within $\frac{1}{32}$ in. of size and well annealed. The reason for using the cold-rolled steel is that machinery steel is often stringy and uneven in grain, while cold-rolled is smooth and easy to work. This is a material aid in keeping the hole going straight. The roughing off and careful annealing are for the purpose of disposing of the rolling or drawing stresses in the steel, which would otherwise be likely to make the piece crooked later on.

The hole is drilled in a bench lathe. First, one end of each piece is trued off on the diameter for $\frac{3}{8}$ in. back, making the size uniform for the lot. Then this end is back-rested, the other end being held in the draw-in chuck. The illustrations from *A* to *D* show how the work is spotted with a center drill, drilled about $\frac{5}{16}$ with a 0.094 twist drill and rough-reamed with a short two-lip tool made of drill rod. These tools are all caught short in the chuck, which is held in the tail spindle, thus insuring a true start. The finish-reaming should not be done with too short a reamer, for a slight lack of alignment will give a large hole at the start, which will not help matters. We are now ready to proceed.

Three different tools are used, shown from *E* to *G*—a spotter, a drill and a cannon reamer—and two lengths of each, $3\frac{1}{2}$ and $6\frac{1}{2}$ in. All are made from drill rod, with the exception of the drill. These tools are used in rotation, as the hole is put through by stages.

The chuck, however, is no longer held in the tail spindle, but the center hole in the shank is placed against the tail center. Therefore, the operator, lightly holding the chuck as shown at *H*, is quickly aware of any undue resistance encountered by the tools and lets the chuck run around, thus avoiding breaking a drill in the hole.

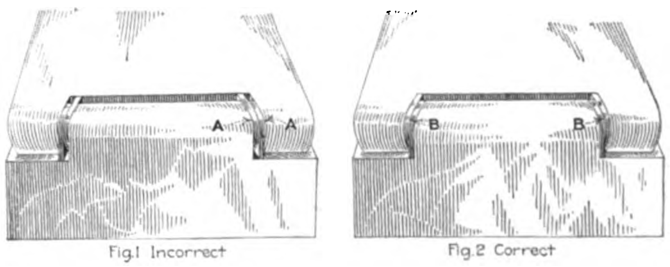
The first tool is the spotter. Its body fits the hole just reamed, and the point, ground the same as the drill, spots the bottom just enough to give the drill a true start. Then comes the drill, which is a regular twist drill sweated in a drill-rod shank. It is cleaned and oiled by withdrawing and dipping in an oil cup wherever it pulls hard. After about $\frac{3}{8}$ in. or a little more has been drilled, the hole is reamed with a cannon reamer, and so on through the piece. This follow-up method will keep the hole going nice and straight. On these pieces 6 in. long, drilled from the one end, there were none running out more than four or five thousandths at the back end.

The correspondent mentions grinding the drill out of center. I have used this plan for getting through hard bronze or high-speed steel, but it does not seem that a very straight job would result. ARTHUR W. SUITER.

Woonsocket, R. I.

Wearing Plates for Jigs

The wear plates for jigs, described by B. Maxim on page 200, are excellent, but the illustration is rather misleading. It is no doubt an error in draftsmanship, but the hardened wear plates are shown anchored in such



WEARING PLATES FOR JIGS

a fashion as to lose their usefulness, as the plates and casting rub at *A*, Fig. 1.

No doubt, Mr. Maxim's idea is, as in Fig. 2, to have the wear come on the plates at *B*. A comparison of the two sketches will show the difference.

Luton, England. P. J. TOMPKINS.

Heavy Projectile Turret Lathes

SYNOPSIS—The heavy turret lathes described in this article were made expressly for work on the smaller sizes of projectiles. The range of speeds and feeds is ample for this class of work, yet care has been taken to avoid complication.

In designing and making the turret lathes here shown the Hill Pump Co., Anderson, Ind., first intended building them for its own use only, but later decided to place them on the open market. The nature of the company's factory work and the ownership of an ample foundry gave it especial facilities for manufacturing these machines. Two sizes are made at present, known as No. 3 and No. 6.

The main idea has been to produce strong, accurate and easily operated lathes for machining the smaller sizes of explosive shells. The comparative simplicity of design and the absence of complications add to the security from breakage under severe working conditions. The use of a large number of these machines in its own shops has enabled the company to test out the various features.

The bed is of the box-pattern type, wide, deep and reinforced with cross-ribs. It rests on a large oil pan supported on pedestal legs that form large oil chambers. The headstock totally incloses the spindle and the main gears. It contains a large oil reservoir for chain lubrication to the spindle and back-gear shaft bearings. The latter are all fitted with heavy renewable bronze bushings. A glass gage on the front of the headstock enables the operator to see that sufficient oil is kept in the reservoir at all times.

The spindle is of high-carbon steel, hollow and accurately ground to size. All gears are accurately cut and are made of steel, with the exception of a bronze worm-wheel in the apron. The flat turret is of large diameter, gibbed at the outer edge and very heavy. All its parts are carefully fitted and scraped into position. It is arranged for six tool holders, which are tongued and fitted to slots in the turret and are held firmly in their respective positions by a pin set under the cutting tool and by hardened and ground bushings into which the pin fits The turret apron is of the shrouded box style, arranged for longitudinal power feed, with a single automatic stop. The oil pump is of the gear type and supplies oil or other lubricant to the cutting tool through an automatic distributor only when the tool is in working position.

Except in certain dimensions and in the method of operating the chucks, the No. 3 and the No. 6 lathes

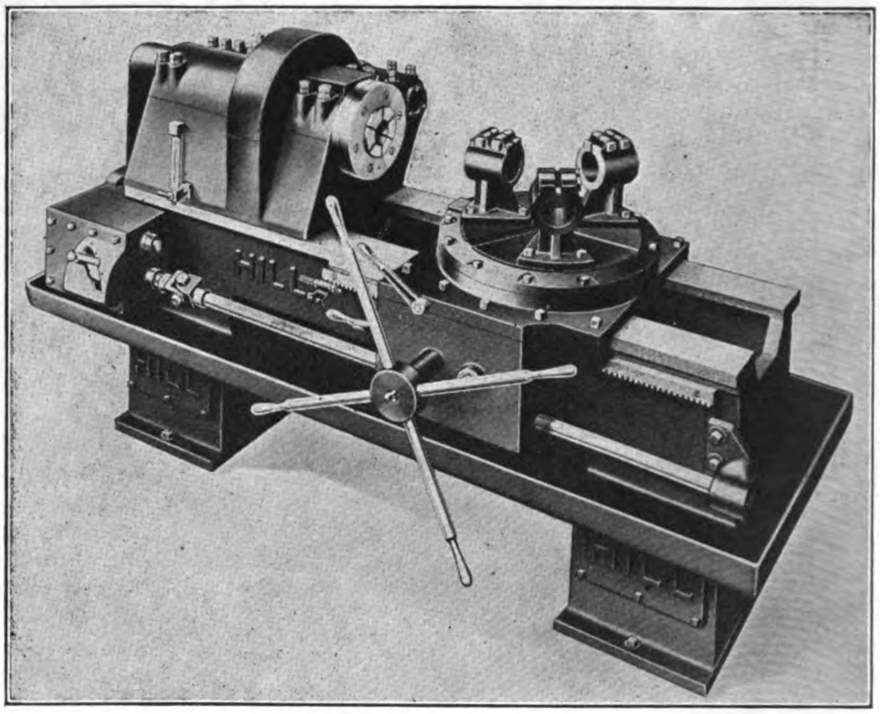
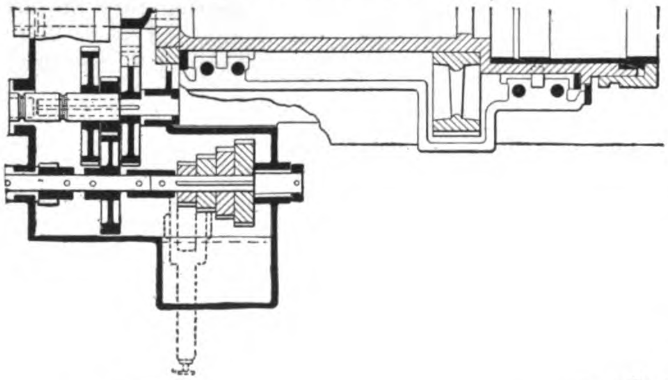


FIG. 1. EXTRA-HEAVY PROJECTILE TURRET LATHE



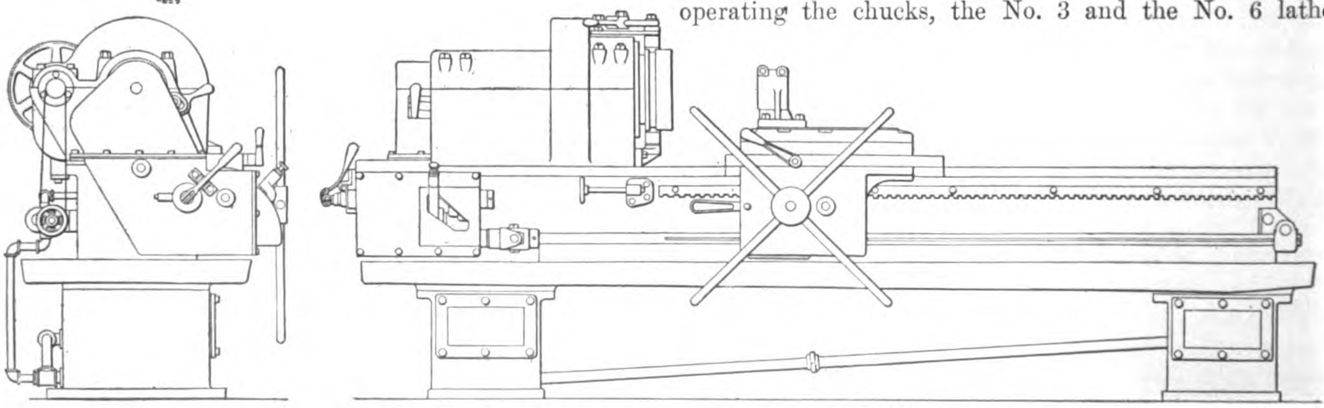


FIG. 2. DETAILS OF NO. 6 HEAVY PROJECTILE TURRET LATHE

closely resemble each other. The No. 3 may be seen in Fig. 1 and in detail in Fig. 3. These two illustrations show how the self-centering draw-in chuck is operated by a handwheel at the back. Fig. 2 gives details of the No. 6 machine. Here the handwheel is dispensed with, and the chuck is operated by means of a toggle-lever action mounted over the front bearing within easy reach of the operator.

The driving power is supplied to each machine through a single pulley on the back-gear shaft, which is 12 in. in diameter and has an 8-in. face. Eight changes of feed are available through quick-change gears, which are 0.015, 0.020, 0.025, 0.030, 0.045, 0.060, 0.075 and 0.090 in. per revolution. The regular equipment includes self-centering draw-in chuck with hardened jaws. Special tools or holding fixtures are supplied on order. The following are important dimensions of the two sizes of machines:

For the No. 3 machine—swing over bed, 22 in.; from face of chuck to turret tool socket, 27 in.; longitudinal movement of carriage, 25 in.; height from floor to center of spindle, 40 in.; length of bed, 6 ft.; ratio of driving gear from back-gear shaft to spindle, 4.13; face of gears, 3 in.; bore of spindle, 3½ to 4½ in.; overall length of spindle in bearings, 25 in.; front spindle bearing, 5¾ in. in diameter by 6 in. long; rear spindle bearing, 5½ in. in diameter by 5 in. long; diameter of turret, 18 in.; floor space for machine, 2 ft. 6 in. by 7 ft. 6 in.; cubic measure boxed, 8 ft. 6 in. by 5 ft. 6 in. by 4 ft. 6 in.; net crated weight, about 6,000 lb.; net boxed weight, about 6,500 lb.

For the No. 6 size—swing over bed, 22 in.; from face of chuck to tool socket, 48 in.; longitudinal movement of carriage, 48 in.; height from floor to center of spindle, 40 in.; length of bed, 9 ft.; back-gear ratio, 4.13; face of gears, 3 in.; bore of spindle, 3½ to 4½ in.; overall length of spindle in bearings, 25 in.; front spindle bearing, 9⅜ in. in diameter by 6 in. long; rear spindle bearing, 5½ in. in diameter by 5 in. long; floor space, 10 ft. 6 in. by 2 ft. 6 in.; cubic measure boxed, 11 ft. 6 in. by 5 ft. 6 in. by 4 ft. 6 in.; net weight crated, about 8,000 lb.; net weight boxed, about 8,500 lb.

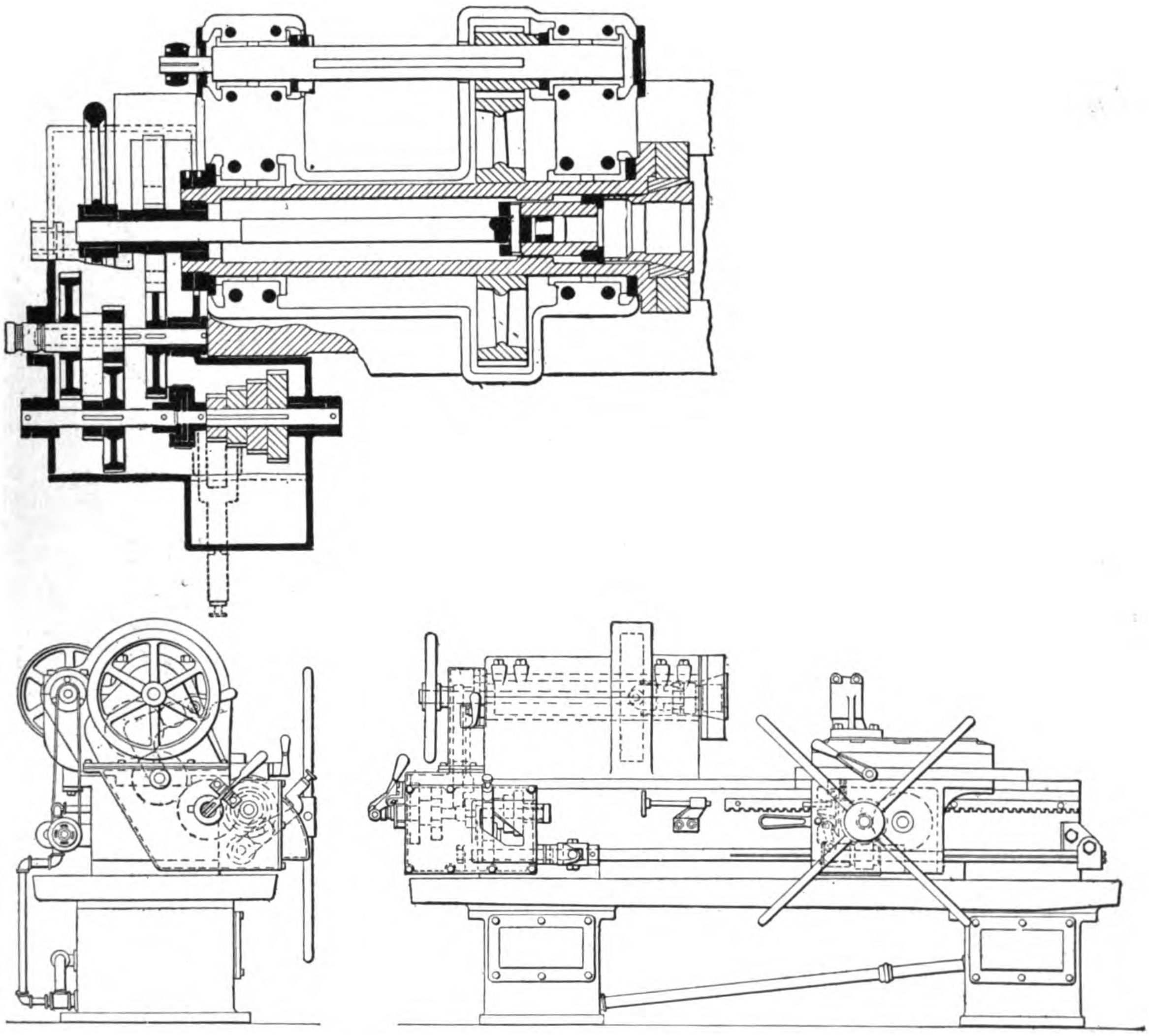


FIG. 3. DETAILS OF NO. 3 HEAVY PROJECTILE TURRET LATHE

Whale Oil for Cheap Cutting Compound

A Canadian concern manufacturing 18-pounder high-explosive shells makes inquiry for a recipe for a good cutting compound that could be made from whale oil.

The extensive use of lard oil in this plant has led to what is considered excessive cost for cutting compound, and the plentiful supply of whale oil has suggested the possibilities of economy through the utilization of this grade of oil.

DISTRIBUTION OF MACHINE SHOPS IN SOUTH AMERICA IS SHOWN BY THE DOTS

Editorials

Last Call for Index

A supply of indexes for Vol. 43, July-December, 1915, is still available.

Those desiring copies should make prompt application.

Machine Shops in South America

Comments on South American business conditions in general have appeared in these columns during the past few weeks. This discussion is the first of several that will give accurate statistics and facts in regard to the machine shops of that great southern continent—their equipment, workmen and executives. The information is drawn from records prepared on the spot by Duncan N. Hood, the special representative of the *American Machinist* who has just returned from an 18 months' journey, going down the west and returning along the east coast.

The reason for referring to this as a coast journey is realized at once by glancing at the map on page 652. On that map are plotted the machine shops of South America. It will be observed that they are strung along the coast line, with the exception of a cross-continent belt stretching from Chile across the upper part of Argentina.

The total number of machine shops indicated on the map is 461, divided among the various countries as follows: Panama, 3; Colombia, 12; Ecuador, 21; Peru, 45; Bolivia, 21; Chile, 69; Argentina, 95; Paraguay, 5; Uruguay, 15; Brazil, 147; the Guianas, 9; Venezuela, 19. During Mr. Hood's recent trip he visited 70 per cent. by number of all these shops and obtained detailed information in regard to their work, equipment and personnel. In this group are included all the large shops of South America. Those not visited are the smaller ones in remote or inaccessible locations.

A familiar way to estimate the importance of the machinery building and repairing in a given locality is to tabulate the shops according to the number of men employed. Grouping the South American shops in this way gives the following classification: Number of shops employing up to 20 men each, 368; from 21 to 50 men each, 52; from 51 to 150 men each, 18; from 151 men up, 23.

Another classification that is of interest is one that arranges the shops according to the kind of work done. As will be expected, the two important items in such a grouping of South American machine shops are general repairs and railroad repairs. The complete classification is as follows: Railroad repairs, 88; shipbuilding and ship repairs 31; general repairing, 225; light-machinery building, including engines, 26; street-railroad repairs, 57; mining-machinery repairs, 34.

What these figures mean in terms of possible increase in the number of machine shops in South America can be gathered by a comparison with United States statistics. In South America there is in round numbers one machine shop for every 100,000 persons. In the United States there is one shop for every 5,000 persons. The ratio is 20:1. Hundreds of shops will be built and equipped as the great southern continent follows the path of development that this country has traversed during the last 75 years. What a tremendous prospect!

Protest Against Committing U. S. to Metric System

The leading editorial on page 563 in the issue of two weeks ago pointed out an attempt to commit the United States to the metric system in the conference for uniform laws recently held at Buenos Aires, Argentina. On page 609 of last week's issue a copy of the cablegram of protest sent by the National Association of Manufacturers was printed. Other protests were sent, and the *American Machinist* can now state definitely that at least eight such cablegrams were forwarded to Secretary of the Treasury McAdoo prior to the opening of the sessions of the conference in South America.

At this writing we do not know what action, if any, was taken. It is inconceivable, however, that anything detrimental to the great manufacturing and commercial interests of the United States could have been done in view of the standing and importance of the associations and firms that registered their protests.

Manufacture of Munitions in Navy Yards

The impression one receives in going through a United States navy yard is that it is greatly overequipped. The appearance of some of the yards is worse than others in this respect, but they all look lonesome in spots. The reasons for this condition are many and involved; but whatever the reasons, there is this justification—in wartime there would be work for every machine and every square foot of space.

The new idea in cost keeping—that the cost of work should not be assessed for idle equipment—has led those who have thoroughly apprehended it to make changes in their business and manufacturing policies so as to take on work that can be handled in connection with their regular work and that will employ equipment which would otherwise be idle. This policy tends to stabilize the working force and permit general economies of practice, as well as to increase revenue.

Applying this reasoning to the navy yards, it would appear to be profitable for the yards to take up manufacturing work to keep busy this idle equipment, and what more appropriate side line is there than munitions? Why, for example, would it not be well for a forging press to be busy making shells when it is not occupied by its regular jobbing employment? Moreover, the introduction of work of this kind generally in the yards

would go a long way toward solving the problem that has for years been before the Navy Department—of developing a sort of "coal and ice business." The yards are always very short of work when the fleet is in southern waters, and the workmen and general organizations suffer thereby.

There is another and more important factor to be considered in this connection. Manufacturers who went in for war orders are pretty generally agreed that their great difficulty in getting started lay in finding men who knew how to make munitions. Optimistic persons took contracts and then looked to see how to make the goods. Not but what we had plenty of men who could find out how. When an emergency turns up, we want plenty of men who know what to do. Also, we want to know just what equipment is needed for each line of goods—machines, jigs and fixtures, gages, etc.

Through the engineers of the country the Government is seeking to make preparations for the prompt mobilization of industry, in case of war, for the production of war material in immense quantities. Let the Government start now to manufacture men, in the navy yards and arsenals, who will know how to make this material, with the view of distributing them among the producing units of mobilized industry when the occasion arrives. They should take with them detailed plans and specifications for the material necessary to the production of munitions and for the details of the manufacturing processes and of inspection. These men should be of the kind that can explain matters clearly and show other men how to do things; they should be high-grade, intelligent machinists, of the sort that makes good inspectors.

The navy yards would then stop munition manufacture and turn to the work for which they are intended, tackling it with large, well-trained forces, excellent equipment in working order and complete, well-oiled organizations.

This proposition is sensible and practicable. It will cost nothing, it will undoubtedly lead to substantial economies, and the Navy Department has the power to adopt it, right now.

The Broad View in Adjusting Complaints

A proper sense of proportion is essential to success in any field of endeavor. Lengthy correspondence resulting from deficiency in this faculty is one of the most prolific wastes of energy in the industrial establishment, particularly as it takes up the time of the better-paid members of the organization. Not that the written word can be dispensed with—it is the very life of modern business—but it should be confined to essentials. Too frequently correspondence concerns itself with the elaboration of the obvious, on the one hand, or the discussion of that which is relatively of no importance, on the other hand.

Wastes of time and energy in the latter direction are especially prolific in connection with adjusting complaints made by customers concerning their purchases. An example came to our attention recently, which is typical of this failing. A purchaser found a fitting misplaced on a new lathe and made a claim on the manufacturer for the cost of shifting it, as the machine could not be operated satisfactorily otherwise. The manufacturer replied at considerable length, to the effect that such a mistake could not have been made at his factory; it must have been the result of faulty assembling. The customer pointed out that the fitting was secured by dowels and was found in place when the machine arrived. This ruled out the possibility of error in erecting. The manufacturer in reply questioned the extent of the misplacement. The customer, to satisfy the manufacturer, submitted further proof of his contention. After several more letters the manufacturer grudgingly gave his consent to a deduction of $5 from the bill, to correct the error.

The correspondence probably cost the purchaser more than $5 in loss of time and temper. However, as he felt that he was in the right, he naturally would not drop the matter until he had obtained satisfaction from the manufacturer. To be sure, he had nothing much to gain by making his point, but that purchaser can never be expected to accept an unsatisfactory delivery without a protest.

The case of the manufacturer was quite different and showed considerably greater lack of vision in extending the controversy. No matter what the merits of the purchaser's complaint may have been, the manufacturer had nothing to gain by carrying on a lengthy argument with his customer. His sense of proportion was deficient. When a customer reports in a $1,000 machine a defect that can be corrected for $5, it is, in the first place, a certainty that the customer is honest in his complaint, even if he is mistaken. This consideration alone should lead the manufacturer to accede to requests for minor adjustments. The manufacturer who does not quibble over complaints at once acquires merit in the eyes of his customer. But even when the manufacturer feels that a complaint is unwarranted as to fact and questionable as to intention his sense of proportion should still show him that the expense of lengthy correspondence will be more than the cost of a trivial correction.

Wanted--A Lighting Gage

When we begin to have state laws or commission rules in regard to the lighting of factories, there will be specifications for the minimum amount of both day lighting and artificial lighting that must be provided. How is the foreman in charge of a room or a department to know when the daylight is insufficient and it is time to snap the switch and put on the artificial light? It is evident that some sort of lighting gage must be provided.

This matter has already been made a subject of discussion among illuminating engineers, with the suggestion that there must be developed either a simple, portable and inexpensive stationary lighting gage or, as they call it, a photometer. It should be so arranged that a glance at a dial or some other part would indicate to the foreman whether or not the intensity of illumination is equal to the minimum requirement. The use of such an instrument would put the matter of illumination on the basis of knowledge and not in the swamp of guesswork.

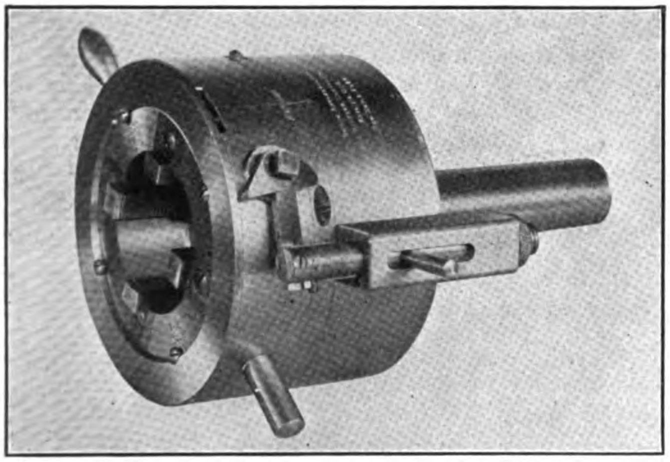
Here is possibly a fruitful field for the use of some mechanical ingenuity in developing a successful, inexpensive photometer. If it can be made cheaply enough, one should be provided for every department of every shop.

Shop Equipment News

Self-Opening Die Head with Floating Die

In the design of the die head shown, known as the Boehm automatic die, the Rickert-Shafer Co., Erie, Penn., has aimed to provide a die head that will cut a truly parallel thread and that will possess a positive opening mechanism.

The chasers have a radial movement and are directly backed up by the cam ring throughout their entire length and width. They slide between hardened and ground chaser guides and are carried by hardened and ground carriers. The chaser carriers have a groove milled in the outer end to take the positive-opening cam, which is a face cam milled on the under side of the cam ring. The cam ring is locked in the closed position by two hardened locking pins, which slide in hardened bushings and lock against hardened plugs. These locking pins are



SELF-OPENING DIE HEAD
Made in eight sizes ranging from $\frac{3}{8}$-in. to $2\frac{1}{2}$-in. capacity, either with or without float

entirely independent in action from the rest of the die, thus allowing the die head to come to the back position before closing. The die head is driven by three hardened rollers, which are located at the extreme outside of the shank head, in order to eliminate as much torsional strain as possible.

The floating die has a lateral float of from $\frac{1}{8}$ to $\frac{1}{4}$ in., according to the size of the die, and is provided with an adjusting ring by means of which all the float may be taken up and the die made to cut the threads as short as $\frac{3}{32}$ in. By means of this float any error in the camming of automatic or screw automatic machines is taken up by the die head. When it is used in hand machines, the operator by watching the float can tell whether he is forcing the die or letting it drag. This will prevent his spoiling work and also opening the die before the proper length of thread is cut.

The taper attachment is adjustable, so that one set of cams is able to handle all practical tapers. The swivel cam is graduated for tapers from $\frac{1}{4}$ to $1\frac{1}{2}$ in.

Oxyacetylene Welding and Cutting Torches

The Oxyacetylene Torch Co., Greenfield, Mass., has recently placed on the market a line of welding and cutting torches, two views of which are shown in Fig. 1. The upper torch is of the plain type, and the lower illustration a roller attachment. This device is useful to guide the torch over metal in performing cutting operations, so as to retain the correct distance of the torch from the plate. The lower design also shows a loop connection by which the operation may be performed with only a single tank of oxygen.

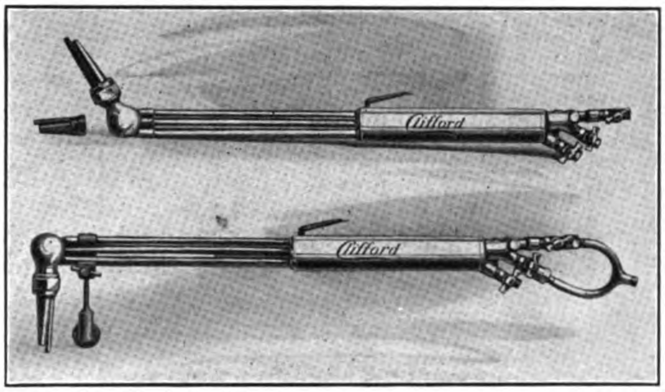


FIG. 1. TWO TYPES OF CUTTING TORCH

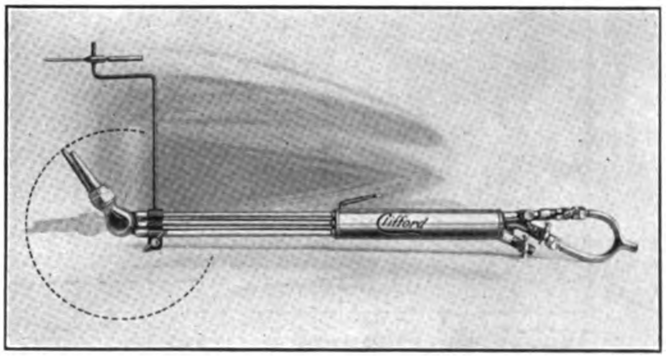


FIG. 2. CUTTING TORCH EQUIPPED WITH RADIUS ATTACHMENT

Another view of the cutting torch is given in Fig. 2. This illustration shows a radius attachment for use in cutting circles of various diameters.

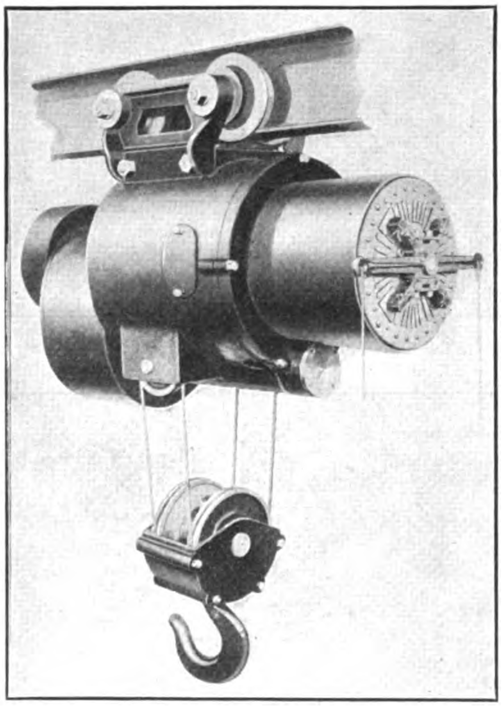
The novel and interesting feature of the welding and cutting torches here described is the universal head, by which the head and thus the flame may be swung on an arc up to 270 deg. while the flame is burning. The advantage of this feature is apparent, as it allows the welder to swing around the flame to suit various positions as desired, such as up, down, straight or round a corner. In this way difficult welding operations are made simple. The various welding tips have self-contained mixing chambers, thus enabling the proper gas mixture to be obtained for each size.

Electric Shop Hoist

The frame of the electric hoist shown is made of cast iron, cylindrical in form and so constructed as entirely to inclose the operating units. Easy access for inspection is provided through a number of openings with easily removable covers.

The portion of the frame containing the gearing and mechanical brake is operated from the drum and motor by a cast partition and is packed with transmission grease. The drum is provided with suspension lugs for attaching to a trolley or other type of mounting.

The hoist is equipped with roller bearings, and owing to the comparatively slow movement, the drum bearings are bronze bushed. Cut spur gearing is used throughout. The drum is of cast iron, grooved to receive the full amount of rope for the given lift without overlapping. The drum gear is fastened to the end of the drum and not to its shaft. The drum replaces the motor frame and revolves around the motor armature, by which construction a more compact hoist is secured and a higher lift made possible. In replacing the motor frame, the drum is of unusually large diameter, being 40 to 45 times the diameter of the hoisting rope used.



ELECTRIC SHOP HOIST

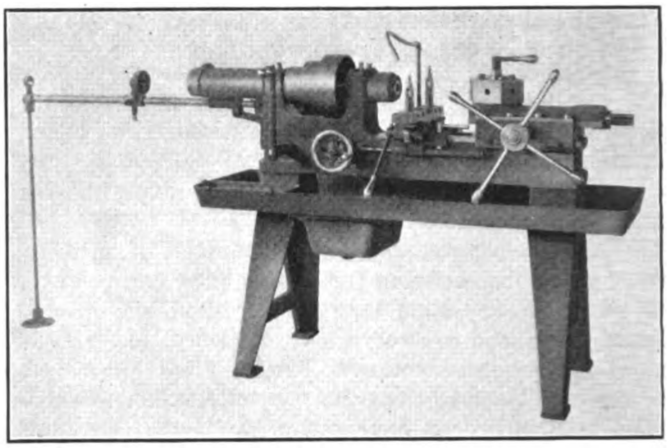
The hoist is equipped with a mechanical-load brake, which automatically stops and holds the load when the motor is stopped and is released only by revolving the motor in the lowering direction. It is of the friction disk type and is contained in the same inclosure as the gearing. A solenoid-operated brake capable of holding the full load attached to the hoist armature shaft is provided. It will instantly stop the motor when the current is cut off. The hoist can be equipped with standard series wound motor for direct current and standard motor for alternating current. Either rheostatic or single-speed control can be furnished.

This type of hoist is a recent product of the Economy Engineeri[illegible] Co., Willoughby, Ohio, and is made in capaci[illegible] from 1,000 to 10,000 lb.

Hand Screw Machine

The illustration shows a plain-head hand screw machine recently developed by the Charles Stecher Co., Chicago, Ill.

The machine is similar to that shown on page 700, Vol. 43, with the addition of power feed to the turret.



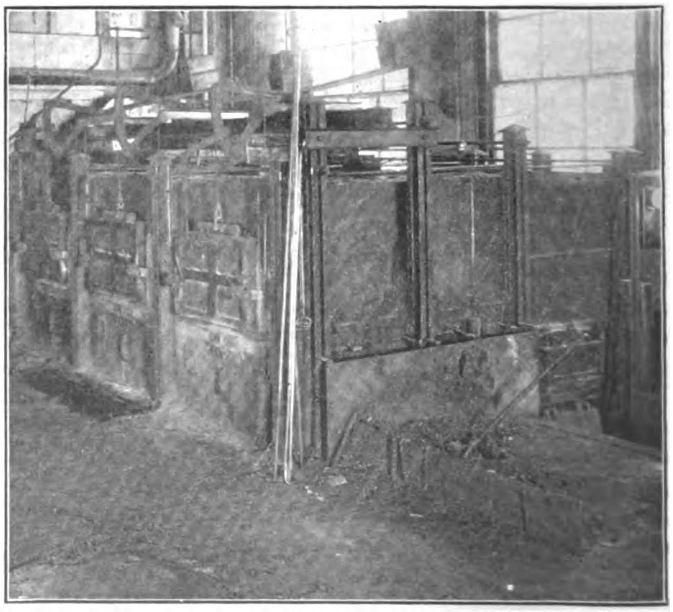
PLAIN-HEAD HAND SCREW MACHINE

Wire-feed capacity, $1\frac{5}{16}$-in. round, $\frac{15}{16}$-in. square and $1\frac{1}{8}$-in. hexagon bars; hole in spindle, $1\frac{5}{8}$ in.; swing over bed, 14 in.; diameter of holes in turret, $1\frac{1}{4}$ in.; length that can be turned, 7 in.; greatest distance from end of spindle to turret, 17 in.; width of belt, 3 in.

The arrangement of the power feed is such that the tools are fed positively the same distance each time. This is accomplished by an arrangement of the friction in the power-feed rod. The friction permits the rod to slip when the tools have reached the positive stop and can be easily seen by the operator, who trips the feed. The gears are entirely inclosed and run in oil.

Combined Three-Oven Furnace

The design of the heat-treating furnace shown is based on the research work of Alfred Smallwood, Birmingham, England. The American rights for the manufacture of this furnace have been secured by the American Incandescent Heat Co., Delta Building, Boston, Mass.



COMBINED THREE-OVEN FURNACE

In the design and construction of this type of furnace it is claimed radical departures have been introduced to take care of the often neglected factors of the purity of the gases generated by the burning material and the action of these gases on the metal.

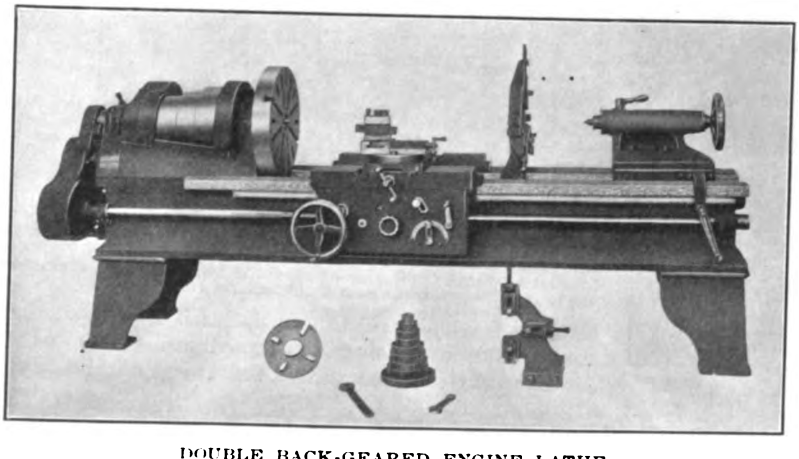
The furnace is planned for the scientific heat-treatment of steel, copper and alloys. It is made to use coal, oil or gas as fuel, ordinary bituminous coal, either hand fired or fired by mechanical stokers, with natural draft, commanding the maker's preference. A system of controlling dampers is said to provide a high degree of uniformity of temperature in the heating chambers, and in addition an extended secondary combustion is maintained to a length considered sufficient to insure a pure reducing flame at the point at which the gas enters the heating chamber.

With the construction employed it is possible to operate from one to five independent heating chambers on one firebox, with a different temperature in each chamber, if desired. The claim for low maintenance cost is based on the existence of low gas temperatures in this type of furnace, the use of standard-size brick, and large heat-storage area. The heating chamber is completely surrounded by canals through which the gas passes before leaving the furnace, providing a rapid and even heat absorption.

Heavy-Duty Engine Lathe

The dominant aim in the design of the lathe shown was a sufficiently heavy proportioning of parts to enable the rapid removal of stock.

The machine is double back geared and is built along conventional lines. To maintain alignment of the lead screw, the pads of the lead-screw bearings have grooves, into which the bearings fit. The lead screw is $3/4$ in. in diameter, Acme thread, four threads per inch, splined to provide for driving the feed mechanism. The threads of the lead screw are engaged only when cutting threads. The tailstock is of the cutaway type and can be set over $1\frac{1}{4}$ in. for taper turning.



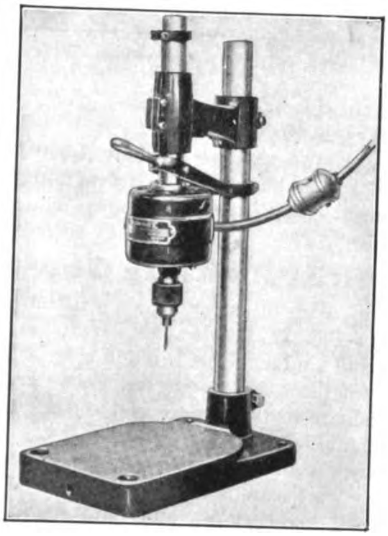
DOUBLE BACK-GEARED ENGINE LATHE

Swing over bed, $22\frac{1}{4}$ in.; swing overcarriage, $14\frac{3}{4}$ in.; hole in spindle, $1\frac{3}{8}$ in.; diameters of driving cones, 14, 12 and 10 in.; width of belt, 4 in.; distance between centers, 8 ft.; bed, 36 in.

The machine is made in a variety of bed sizes, ranging from 8 to 14 ft., by the Davenport Locomotive Works, Davenport, Iowa.

High-Speed Electric Sensitive Drilling Machine

The motor-driven sensitive drilling machine shown is equipped with ball bearings and is rendered sensitive by the use of a special coil-spring mechanism located in the column. The simple construction is apparent.



MOTOR-DRIVEN SENSITIVE DRILLING MACHINE

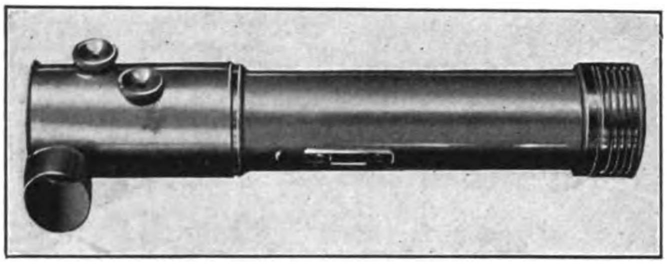
Capacity in steel, 0 to $\frac{3}{32}$ in.; in brass, aluminum and wood 0 to $13/64$ in.; vertical adjustment of spindle, 2 in.; height over all, 18 in.

The motor and bracket can be readily raised or lowered on the main column. The motor overhangs sufficiently to permit drilling in the center of a 6-in. circle. This machine is a recent product of the Wisconsin Electric Co., Racine, Wis.

Eye Color-Pyrometer

The instrument shown is designed to measure directly the temperature of a piece under heat-treatment. With this instrument the color of the heated body is exactly duplicated, and at the same time the temperature is indicated on an accurately calibrated scale. The operation of the instrument is extremely simple. It is focused on the piece in the furnace and is then adjusted until the color of the work is duplicated in the instrument, when the temperature can be read on the calibrated scale. It is claimed that the temperature readings with this instrument are within 1 to 2 per cent., regardless of the furnace temperature, and that an operator who is color blind can utilize it; for although he cannot distinguish color as red, orange, blue, etc., he can still duplicate the intensity, on which principle the instrument operates.

While this form of pyrometer was designed for the more precise temperature measurement of high-grade steels under treatment, it can also be used for taking the temperatures of heated bodies either within or without a furnace, so that it is adapted to measuring the



EYE COLOR-PYROMETER

temperatures of ingots, billets, rails, plate, structural shapes, forgings, castings, etc.

It is made in two ranges—1,000 to 1,800 and 1,800 to 2,300 deg. F.—and represents a recent product of the Gibb Instrument Co., Pittsburgh, Penn.

Mechanical Pickling Conveyors

The accompanying illustrations show a conveyor made by the Chain Belt Co., Milwaukee, Wis., carrying cartridge cases and similar goods through a series of rinsing and pickling baths for removing all grease and oily deposits that adhere to the surface of the work during the process of manufacture.

The conveyor consists of two strands of roller chain belt, between which are attached steel bars whose ends are bent up at right angles and have semicircular recesses punched in them to suit the diameter of the work to be handled. The recesses in the bars are so disposed that the tubes lie slightly on an incline and automatically drain off the water or pickling fluid as the work leaves the bath and thereby saves time in draining off.

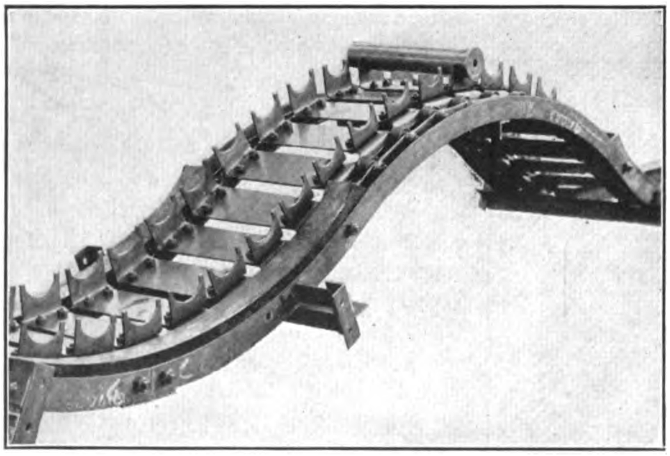


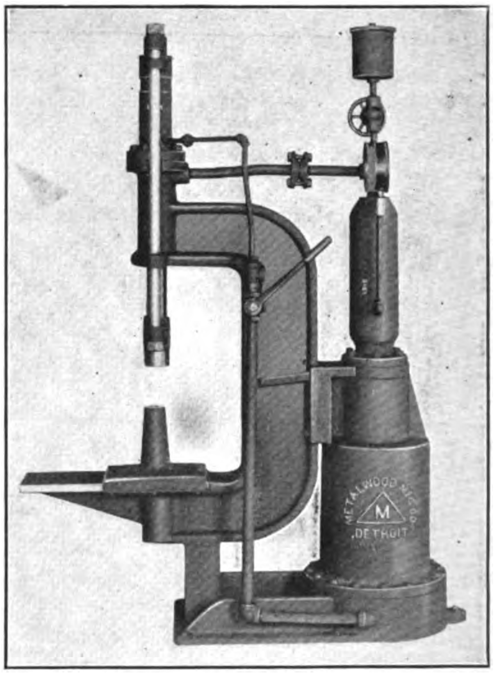
FIG. 1. CONVEYOR REMOVED FROM TANKS

The upper trackage consists of steel angle irons bent into a series of curves to suit the length and depth of the tank and the time which it may be desired to hold the work in the various baths. Hold-down guides are provided at the curves. The trackage is entirely a self-contained unit and is constructed so that it can be removed, as in Fig. 1, or placed without disturbing the tanks or their fittings. The return run of the conveyor is carried on straight angle-iron tracks below the tanks.

The conveyor, shown in Fig. 2, is 34 ft. from center of head shaft to center of take-up shaft and is motor driven by spur gearing connected to the head shaft. The apparatus was designed to receive the work at one end and automatically discharge it at the delivery end after passing through the baths at the rate of 1,200 cases per hour when traveling at a speed of 10 ft. per minute.

Quick-Acting Press

The special feature of the hydro-pneumatic press shown is its quick action, 10 full strokes per minute being possi-



QUICK-ACTING HYDRO-PNEUMATIC PRESS
Capacity, 10 tons; diameter of ram, 3 in.; stroke, 6 in.; distance from ram to platen, 20 in.

ble while developing the full rated capacity. With shorter strokes and less tonnage the speed can of course be correspondingly increased to take advantage of conditions.

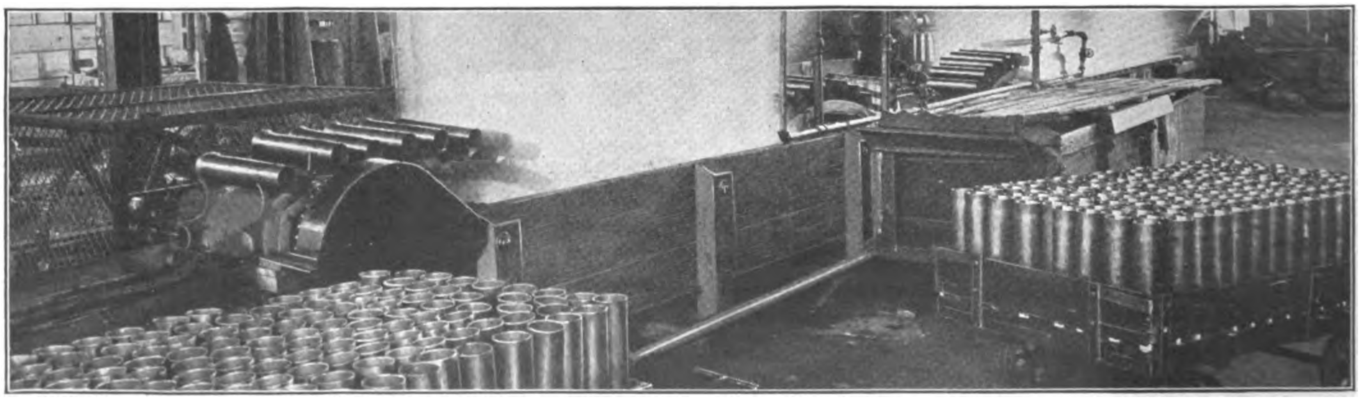


FIG. 2. CONVEYOR IN OPERATION IN SHELL PICKLING BATH

While intended primarily for flanging or upsetting in the assembly of parts, modifications in the design of the sliding fixture or the interchange of several fixtures makes it adapted for a wide variety of operations.

This press is a recent addition to the line made by the Metalwood Manufacturing Co., Detroit, Mich.

PERSONALS

Thomas K. Egan, for several years superintendent of manufacturing of the Dexter Folder Co., Pearl River, N. Y., has accepted the position of plant superintendent of the Brown Cotton Gin Co., New London, Conn.

J. C. Drumm, for a number of years associated with the Carnegie Steel Co. in engineering work, has joined the Scientific Materials Co., Pittsburgh, Penn., where he will be in charge of the efficiency-instrument department.

Wilmot Fleming, of the Fleming Engineering Co., Philadelphia, Penn., has been retained as the superintendent of the machine shop of the Pennsylvania Forge Co. which recently took over the equipment and business of the Fleming company.

J. B. Doan, for many years vice-president and general manager of the American Tool Works Co., Cincinnati, Ohio, has been elected president to fill the vacancy caused by the death of Franklin Alter. Robert S. Alter has become vice-president and foreign manager and Henry Luers, treasurer.

BUSINESS ITEMS

The offices of J. J. McCabe will be moved on Apr. 16 from 30 Church St. to the 18th floor Singer Bldg., 149 Broadway, N. Y. City. The warehouses remain in the same location, 10th and Brunswick Sts., Jersey City, N. J.

The Steel Products Engineering Co., Springfield, Ohio, has taken over the business of the Springfield branch of the Gem City Machine Co., and in addition to doubling the toolroom equipment has added a department for manufacturing.

Owing to rapid expansion in its special and contract machine business the C. H. Cowdrey Machine Works, Fitchburg, Mass., have completed a new addition three stories high and 235 ft. long by 85 ft. wide. The building is of the latest approved mill construction and with the additional equipment now in the course of installation greatly increased facilities will be available.

INQUIRY FOR MUNITION MACHINERY

A communication received from F. R. Ratcliffe, acting manager, Small Arms Factory, Department of Defense, Lithgow, Australia, indicates that the Australian military authorities will soon be in the market for additional machines and special equipment for small-arms and other munition factories.

TRADE CATALOGS

Wilmarth & Morman Co., Grand Rapids, Mich. Catalog No. 106. Drill grinding machines, universal grinders, etc. Illustrated, 40 pp., 6x9 in.

The Moore Oil Co., Cincinnati, Ohio. Catalog. Cutting compounds and oils, drawing compounds, quenching oils. 12 pp., 6x9 in.

National Tube Co., Pittsburgh, Penn. Bulletin No. 26. Autogenous Welding of National Pipe. Illustrated, 52 pp., 8x11 in.

FORTHCOMING MEETINGS

American Society of Mechanical Engineers. Spring meeting, April 11-14, New Orleans, La., Calvin W. Rice, secretary, 29 West 39th St., New York, N. Y.

National Metal Trades Association. Annual meeting, Apr. 27-28, New York, N. Y., Hotel Astor. H. D. Sayre, secretary, Peoples Gas Building, Chicago, Ill.

American Society for Testing Materials. Annual meeting June 27 to July 1, 1916, Hotel Traymore, Atlantic City, N. J. Edgar Warburg, secretary, University of Pennsylvania, Philadelphia, Penn.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Wednesday each month. J. A. Brooks, secretary, Brown University, Providence, R. I.

New England Foundrymen's Association. Regular meeting second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. J. H. Warder, secretary, 1735 Monadnock Block, Chicago, Ill.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Technical League of America. Regular meeting second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York, N. Y.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

of American Machinist, published weekly at New York, N. Y., for April 1, 1916.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the State and County aforesaid, personally appeared Chester W. Dibble, who, having been duly sworn according to law, deposes and says that he is the Vice-President of Hill Publishing Co., publisher of American Machinist, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are:

Publisher, Hill Publishing Company, 10th Ave. at 36th St., New York, N. Y.
Editor, Leon P. Alford, 10th Ave. at 36th St., New York, N. Y.
Managing Editor, Fred H. Colvin, 10th Ave. at 36th St., New York, N. Y.
Business Manager, Mason Britton, 10th Ave. at 36th St., New York, N. Y.

2. That the owners are:

Hill Publishing Company, 10th Ave. at 36th St., New York, N. Y.
Owners of 1% or more of Stock Issued.
Estate of John A. Hill, 10th Ave. at 36th St., New York.
Arthur J. Baldwin, 10th Ave. at 36th St., New York.
Fred R. Low, 10th Ave. at 36th St., New York, N. Y.
John McGhie, 10th Ave. at 36th St., New York, N. Y.
Fred S. Weatherby, 1600 Beacon St., Brookline, Mass.
Frederick A. Halsey, 356 W. 120th St., New York, N. Y.
G. Eugene Sly, 50 Union Sq., New York, N. Y.
Frederick W. Gross, 215 E. 11th St., Erie, Pa.
Alfred E. Kornfeld, 10th Ave. at 36th St., New York, N. Y.
Emma B. Hill, 80 Munn Ave., East Orange, N. J.

The balance of the stock issued (less than 1% each) is owned by 68 employees, 3 ex-employees, and 13 others who are wives, daughters or relatives of employees.

3. That the known bondholders, mortgagees and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages or other securities are: Mortgage on building, Dime Savings Bank, Brooklyn, N. Y.

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association or corporation has any interest direct or indirect in the said stock, bonds or other securities than as so stated by him.

CHESTER W. DIBBLE,
Vice-President Hill Publishing Co.

Sworn to and subscribed before me this 31st day of March, 1916.

[Seal.] RICHARD L. MURPHY.
(My commission expires March 30, 1917.)

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points indicated:

	Apr. 7, 1916	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$15.00	$15.00	$9.00
No. 2 X Northern foundry, New York	20.50	19.75	14.25
No. 2 Northern foundry, Chicago	19.00	18.50	13.00
Bessemer, Pittsburgh	21.95	21.45	14.55
Basic, Pittsburgh	19.20	19.20	13.45
No. 2 X, Philadelphia	20.50	20.00	14.25
No. 2, Valley	18.50	18.50	12.75
No. 2, Southern Cincinnati	17.90	17.90	12.15
Basic, Eastern Penn	21.00	19.50	13.50
Gray forge, Pittsburgh	18.70	18.45	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger from jobbers' warehouse at the places named:

	New York				
	Apr. 7, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Steel angles, base	3.10	2.95	1.85	3.25	3.10
Steel T's, base	3.15	2.95	1.90	3.25	3.10
Machinery steel (bessemer)	3.10	2.95	1.80	3.25	3.10

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse at the places named:

	New York				
	Apr. 7, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
No. 28 black	3.50	3.50	2.60	2.95	3.20
No. 26 black	3.40	3.40	2.50	2.85	3.10
Nos. 22 and 24 black	3.35	3.35	2.45	2.80	3.05
Nos. 18 and 20 black	3.30	3.30	2.40	2.75	3.00
No. 16 blue annealed	4.30	3.75	2.35	3.00	3.45
No. 14 blue annealed	4.20	3.70	2.25	3.60	3.35
No. 12 blue annealed	4.15	3.65	2.20	3.55	3.30
No. 28 galvanized	5.65	5.65	4.00	5.50	5.50
No. 26 galvanized	5.35	5.35	3.75	5.20	5.20
No. 24 galvanized	5.20	5.20	3.55	5.05	5.05

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot:

	Black		Galvanized	
	Apr. 7, 1916	One Yr. Ago	Apr. 7, 1916	One Yr. Ago
¾ to 2 in. steel butt welded	72%	80%	53½%	69½%
2½ to 6 in. steel lap welded	71%	79%	52½%	68½%
Diameter, In.				
¾	3.12	2.30	5.35	3.51
1	3.91	3.40	7.91	5.19
1¼	6.44	4.60	10.70	7.02
1½	7.70	5.50	12.79	8.39
2	10.36	7.40	17.21	11.29
2½	16.97	12.29	27.79	18.43
3	22.19	16.07	36.34	24.10
4	31.61	22.89	51.78	34.34
5	43.12	31.08	68.30	46.62
6	55.68	40.32	91.20	60.48

Bar Iron—Prices are as follows in cents per pound at the places named:

	Apr. 7, 1916	One Month Ago
Pittsburgh, mill	2.45	2.40
New York	2.70	2.60
Warehouse, New York	3.10	2.90
Warehouse, Cleveland	3.25	2.25@2.50
Warehouse, Chicago	3.10	2.90

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-size lots, the following quotations hold:

New York	15% above list price
Cleveland	20% above list price
Chicago	List price

Boiler Tubes—From Pittsburgh, the following are the less-carload basing discounts for lap-welded boiler tubes:

1¾ and 2 in.	51%	3½ to 4½ in.	60%
2¼ in.	48%	5 and 6 in.	53%
2½ and 2¾	54%	7 to 13 in.	50%
3 and 3¼	59%		

These discounts apply to standard gages and to even gages not more than 4 gages heavier than standard. For long tubes charge 10% net extra as follows: 1¾ in. size over 18 ft. and not exceeding 22 ft.; 2 to 3 in. sizes over 22 ft. and not exceeding 24 ft.; 3¼ to 13 in. sizes over 22 ft. and not exceeding 25 ft.

High Speed Tool Steel containing from 10 to 18% tungsten sells as follows per pound in New York:

Billets .... $2.35 Bars $3.00

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York			
Today	One Year Ago	Cleveland	Chicago
$4.75	$3.25	$5.05	$4.10

In coils an advance of 50c. is usually charged.

METALS

Miscellaneous Metals—The present quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	New York		
	Apr. 7, 1916	One Month Ago	One Year Ago
Copper, electrolytic (carload lots)	27.50	27.25	16.50
Tin	53.00	55.00	53.00
Lead	8.50	6.75	4.25
Spelter	18.50	19.50	11.00
ST. LOUIS			
Lead	8.50	6.75	....
Spelter	18.50	18.00	....

At the places named, the following prices in cents per pound prevail:

	New York				
	Apr. 7, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Copper sheets, base	35.50	35.00	21.00	34.50	34.50
Copper wire (carload lots)	35.50	35.00	16.60	34.50	37.00
Brass rods, base	41.50	37.00	16.35	36.00	37.00
Brass pipe, base	44.50	41.00	19.10	43.00	45.00
Brass sheets	40.50	37.00	16.25	36.00	37.00
Solder ½ and ½ (case lots)	32.25	31.00	33.50	35.50	31.25

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York		
	Apr. 7, 1916	One Year Ago	Cleveland
Copper, heavy and crucible	23.00	23.00	22.00
Copper, heavy and wire	22.00	22.00	21.00
Copper, light and bottoms	19.00	19.00	18.00
Lead, heavy	6.50	5.25	6.50
Lead, tea	6.00	4.75	5.50
Brass, heavy	14.00	14.00	18.00
Brass, light	12.00	12.00	12.00
No. 1 yellow rod brass turnings	15.00	14.00	16.25
Zinc	13.00	14.00	14.50

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	31.50	32.00	32.50	33.00	36.00
¼ to 5/16	31.25	31.75	32.25	32.75	35.75
⅜ to 1⅞	31.00	31.50	32.00	32.50	35.50
1 15/16 to 2⅞	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3 7/16	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3½ to 3 15/16	32.25	32.75	33.25	35.75	36.75
Squares					
3 1/16 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4 15/16	33.00	33.50	36.00	36.50	37.50
5 to 6 15/16	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Aluminum—Quotations in cents per pound are as follows for ton lots:

No. 1 virgin 98-99%	59.00@61.00
Pure 98-99% remelt	58.00@60.00
No. 12 alloy remelt	48.00@50.00

Jobbers usually charge 2c. per pound over these figures.

Antimony—Chinese and Japanese brands are quoted in cents per pound for spot delivery, duty paid:

New York.. 45.00 Cleveland.. 50.00@55.00 Chicago.. 45.50

Copper Bars from warehouse sell as follows in cents per pound:

New York.... 40.00 Cleveland.... 33.50 Chicago.... 38.00

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places named:

	New York	Cleveland	Chicago
Best grade	55.00@60.00	59.00	60.00
Commercial	25.00@30.00	22.50	28.00@30.00

Copper Sheets—In New York hot rolled 16 oz. (large lots) base per lb. is 35.50c.; cold rolled 14 oz. and heavier add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

SHOP SUPPLIES

Nuts—From warehouses at the prices named, on fair sized orders the following amount is deducted from list:

	New York	Cleveland	Chicago
Hot pressed square..........	$2.75	$3.50	$3.70
Hot pressed hexagon	2.75	3.75	3.80
Cold punched square	2.50	3.00	3.25
Cold punched hexagon	3.00	3.75	4.00

Semifinished nuts sell at the following discounts from list price:

New York.... 65% Cleveland....70-10% Chicago.... 70%

Carriage Bolts—From warehouses at the places named the following discounts from list price are in effect:

	New York	Cleveland	Chicago
⅜ by 6 in.................	50 and 5%	65%	65%
Larger and longer........	40 and 5%	50 and 5%	50 and 15%

At this rate the net prices are as follows:

Length, In.	New York ¼	New York ½	New York ¾	Cleveland ¼	Cleveland ½	Cleveland ¾	Chicago ¼	Chicago ½	Chicago ¾
1½	$0.48	...	...	$0.35	...	...	$0.35	...	...
2	.53	...	...	.38	...	...	.38	...	...
2½	.57	$1.85	$4.85	.42	$1.55	$4.04	.42	$1.38	$3.61
3	.62	1.41	5.16	.45	1.68	4.27	.45	1.50	3.82
3½	.67	2.17	5.42	.49	1.81	4.51	.49	1.62	4.04

Machine Bolts—From warehouses at the places named the following discounts hold:

	New York	Cleveland	Chicago
⅜ by 4 in. and smaller....	50 and 10%	65 and 10%	65 and 5%
Larger and longer up to 1 in. 1 in. by 30 in...............	45%	50 and 15%	50 and 20%

Length In.	New York ¼	New York ½	New York 1	Cleveland ¼	Cleveland ½	Cleveland 1	Chicago ¼	Chicago ⅝	Chicago 1
2 ...	$0.81	$2.13	$8.80	$0.57	$1.22	$5.04	$0.59	$1.55	$6.40
2½ ...	.84	2.27	9.30	.60	1.30	5.32	.62	1.65	6.76
3 ...	.88	2.41	9.79	.63	1.38	5.61	.65	1.75	7.12
3½ ...	.91	2.55	10.29	.67	1.46	5.89	.68	1.85	7.48

Wrought Washers—From warehouses at the places named the following amount is deducted from list price:

New York.... $4.25 Cleveland.... $6.00 Chicago.... $6.30

At this rate, the net prices follows:

Diameter, In.	New York	Cleveland	Chicago
9/16	$9.25	$8.00	$7.70
¾	7.45	6.20	5.90
⅞	6.65	5.40	5.10
1	5.75	4.50	4.20
1¼	4.95	3.80	3.50
1⅜	4.45	3.40	3.10
1½	4.35	3.30	3.00
1¾	4.25	3.20	2.90
2, 2¼, 2½, 2¾..................	4.05	3.10	2.80
3, 3¼	4.25	3.20	2.70
3½, 3¾	4.25	3.20	2.90
4, 4¼, 4½	4.75	3.50	3.20

For cast-iron washers the base price per 100 lb. is as follows:

New York.... $2.50 Cleveland.... $1.75 Chicago.... $1.90

Rivets—The following quotations are allowed for fair sized orders from warehouse:

	New York	Cleveland	Chicago
Steel 7/16 and smaller...........	60%	60—10%	60%
Tinned	60%	60—10%	60 7/16

Button heads ¾, ⅞, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.:

New York.... $4.75 Cleveland.... $3.40 Chicago.... $3.50

Cone heads, same sizes:

New York.... $4.85 Cleveland.... $3.50 Chicago.... $3.60

For the following sizes, the extras over the above prices in cents per 100 lb. are as follows:

1⅛ to 1⅞ in. long, all diameters..................	$0.25
⅝ in. diameter	0.15
½ in. diameter	0.50
1 in. long and shorter............................	0.50
Longer than 5 in..................................	0.25
Less than kegs....................................	0.50
Countersunk heads	0.50

Nails—Wire nails f.o.b. Pittsburgh sell at $2.40; galvanized, 1 in. and longer, $4.40, and shorter, $4.90. These prices are to regular customers and delivery is made at the mill's convenience. From warehouse wire and cut nails sell as follows:

	New York	Cleveland	Chicago
Wire	2.90	2.95	2.70
Cut	2.90	2.85	2.70

Bolt Ends—Fair-sized orders of bolt ends with hot-pressed nuts, from warehouses at the places named sell at the following discount from list price:

New York... 45% Cleveland... 60% Chicago..50 and 20%

Copper Rivets and Burs sell at the following rate:

	Rivets	Burs
Cleveland	List price	List price
Chicago	List price	List price
New York 20%	from list price	10% above list price

MISCELLANEOUS

Seamless Drawn Tubing—The base price in cents per pound from warehouse is as follows:

	New York	Cleveland	Chicago
Brass	41.50	44.50	42.50
Copper	42.50	45.50	39.50

For immediate stock shipment the following quotations prevail:

Diameter, In.	Copper: New York Apr. 7, 1916	Copper: New York One Year Ago	Copper: Cleveland	Brass: New York Apr. 7, 1916	Brass: New York One Year Ago	Brass: Cleveland
¾ to 2½.....	45.50	22.50	44.50	43.50	19.50	45.50
3	45.50	22.50	44.50	43.50	19.50	45.50
3½	46.50	23.50	44.50	45.00	20.50	45.50
4	47.50	24.50	45.50	46.00	21.50	46.50
4½	49.50	26.50	47.50	48.00	23.50	48.50
5	51.50	28.50	49.50	50.00	25.50	50.50
6	52.50	29.50	51.50	51.00	26.50	52.50
7	54.50	31.50	51.50	53.00	28.50	52.50
8	56.50	33.50	55.50	55.10	30.50	56.50

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire

⅜, 11/32, 5/16, ¼, 7/32, 3/16....	8.50
No. 8, 5/32 and No. 10....	9.25
⅛	10.00
No. 12	11.00
3/32, No. 14 and 1/16......	12.00
No. 18	14.00
No. 20	16.00

Special Welding Steel

⅛	33.00
5/32	30.00
3/16	28.00

Cast-Iron Welding Rods

¼ by 19 in. long.......	22.00
3/16 by 12 in. long.......	26.00
⅜ by 19 in. long.......	20.00
½ by 21 in. long.......	20.00

Vanadium Wire in Coils or Sticks

1/16	15.50
3/32	15.00
⅛	14.00
5/32	12.00
3/16 and larger..........	11.00

Tin Plates—The following prices are in effect from warehouses at the places named:

			New York	Cleveland	Chicago
Coke tin plate, 14x20:					
100 lb.			$5.00	$5.00	$5.00
I. C. 107 lb.			5.15	5.15	5.15
Terne plate, 20x28:					
Base Weight	Net Weight	Coating			
100 lb.	200	8.........	$9.50	$9.10	$8.50
I. C.	214	8.........	8.90	9.35	9.10
I. X.	270	8.........	11.80	11.60	11.15
I. C.	218	12.........	12.00	10.25	11.25
I. C.	221	15.........	13.00	10.50	11.50
I. C.	226	20.........	13.50	12.50	12.20
I. C.	231	25.........	14.25	13.50	13.50
I. C.	236	30.........	15.50	14.50	14.50
I. C.	241	35.........	17.00	15.75	16.00
I. C.	246	40.........	19.00	16.75	16.75

Cotton Waste—The following prices are in cents per pound:

	New York Apr. 7, 1916	New York One Year Ago	Cleveland	Chicago
White	11.00@13.00	6.25@8.00	9.50@13.00	11.00@12.50
Colored mixed	8.00@10.00	4.50@6.50	7.50@10.00	8.50@10.50

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Mar. 18	Mar. 25	Apr. 1	Apr. 8
Prompt furnace	$3.50@3.75	$3.50@3.75	$3.25@3.75	$2.75@3.00
Prompt foundry	3.75@4.00	3.75@4.00	3.75@4.00	3.75

Sal Soda sells as follows per 100 lb.:

New York............. $1.25 Cleveland.............. $2.25 Chicago..............$1.90

Roll Sulphur in 360-lb. bbl. sells as follows per 100 lb.

New York.... $2.25 Cleveland.... $2.60 Chicago.... $2.85

Zinc Sheets—The following prices in cents per pound prevail:

Carload lots, f.o.b. mill................................ 25.00

	New York	Cleveland	Chicago
In casks	26.00	26.00	27.00
Broken lots	26.50	26.50	27.50

Swedish Steel Sheets—To consumers requiring fair-sized quantities tool steel sheets sell at 16c. base and spring steel sheets at 12c. base. These prices are f.o.b. warehouse, New York.

Linseed Oil—These prices are per gallon:

	New York	Cleveland	Chicago
Raw in barrels	$0.81	$0.80	$0.83
5-gal. cans	.91	.90	.91

Boiled, it is 1c. per gal. higher.

White Lead, dry and in oil, in cents per pound sells as follows:

100-lb. keg	10.50
25- and 50-lb. kegs..................................	10.75
12½-lb. keg	11.00
1- to 5-lb. cans	12.50

Red Lead in cents per pound sells as follows:

	Dry	In Oil
100-lb. keg	10.50	11.00
25- and 50-lb. kegs.........................	10.75	11.25
12½-lb. keg	11.00	11.50

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

Bids will soon be received for the construction of a 2-story garage at Auburndale, Mass., for F. W. Norris, 582 Massachusetts Ave., Auburndale. Estimated cost, $35,000. Noted Feb. 24.

The Killon Rubber Co., 26 A Clayton St., Dorchester, Boston, Mass., will construct a garage at Dorchester.

The contract has been awarded for the construction of a garage and manufacturing building for Isadore Sonnabend, 440 Commercial St., Boston, Mass. Estimated cost, $45,000.

Plans are being prepared for the construction of a 1-story, 20x70-ft. garage at New Bedford, Mass., for D. J. Sullivan, 660 Cottage St., New Bedford. Estimated cost, $10,000.

A. D. Moore and W. L. Shaw have leased the Belchertown Shoe Shop at Palmer, Mass., and will equip it for the manufacture of automobile bodies.

The contract has been awarded for the construction of a garage on Maplewood Terrace, Springfield, Mass., for L. Kinsman.

Bids will soon be received for the construction of a 1-story, 50x140-ft. garage at Winchendon, Mass., by W. H. Hunt & Son, Arch., Federal Bldg., Salem, Mass. Estimated cost, $12,000 Noted Mar. 23.

Plans are being prepared for the construction of a 1-story, 57x60-ft. garage for A. Berkowitz, 5 Chapin St., Worcester, Mass. Estimated cost, $20,000.

The Hi-Lo Jack Co., recently incorporated, plans to establish a factory at 140 Green St., Worcester, Mass.

The Bridgeport Screw Co. has awarded the contract for the construction of a 2-story, 100x150-ft. addition to its plant on Union Ave., Bridgeport, Conn.

The Ball and Rubber Bearing Co. plans to construct a factory at Danbury, Conn.

The Birmingham Iron Foundry Co. plans to construct an addition to its plant at Derby, Conn.

The contract has been awarded for the construction of a garage at Forestville, Conn., for F. N. Manross.

The contract has been awarded for the construction of a garage on Crown St., New Haven, Conn., for the Blue Ribbon Co., Bridgeport.

The contract has been awarded for the construction of a garage on Worth St., Stamford, Conn., for George Bliss.

Plans have been prepared for the construction of an addition to the casting shop of the Plume & Atwood Manufacturing Co. at Thomaston, Conn.

Frank F. Garrity has awarded the contract for the construction of a 2-story, 30x40-ft. garage on Willow St., Waterbury, Conn.

Plans are being prepared for the construction of a 2-story, 18x36-ft. garage on Hawlins St., Waterbury, Conn., for John O'Brien.

Plans are being prepared for the construction of a 1-story, 38x40-ft. and 38x140-ft. addition to the plant of the Connecticut Brass Co. at West Cheshire, Conn Estimated cost, $10,000.

MIDDLE ATLANTIC STATES

Plans have been prepared by Henry L. Behlert, Arch., 653 40th St., New York, N. Y. (Borough of Brooklyn), for a garage at 10th St. and Prospect Park W., for J. S. Corrigan, 316 6th Ave., Brooklyn. Estimated cost, $15,000.

The Franklin Machine and Boiler Works, 13 Franklin St., New York, N. Y. (Borough of Brooklyn), will rebuild its plant which was recently destroyed by fire.

Plans are being prepared by Thomas Bennett, Arch., 3rd Ave. and 52nd St., New York, N. Y. (Borough of Brooklyn), for garage on 83rd St. near 5th Ave. for R. McDornald, 68th St. near 2nd Ave., Brooklyn. Estimated cost, $12,000.

The De Mant Tool and Machine Co., 79 East 130th St., New York, N. Y. (Borough of Manhattan), recently incorporated, is in the market for grinding, milling and shaping machines and lathes. Sidney Diamant is Pres.

The contract has been awarded for the construction of an addition to the plant of the R. E. Dietz Co., manufacturer of lanterns, 431 Greenwich St., New York, N. Y. (Borough of Manhattan). Noted Jan. 27 and Apr. 6.

Charles Steele, 83 East 61st St., New York, N. Y. (Borough of Manhattan), is having plans prepared by George E. Wood, Arch., 103 Park Ave., for a 3-story garage at 107 East 61st St. Estimated cost, $20,000.

The Niagara Searchlight Co., Niagara Falls, N. Y., has awarded the contract for an addition to its plant. Estimated cost, $8,000. Noted Mar. 23.

The Ingersoll-Rand Co., 11 Broadway, New York, N. Y., has awarded the contract for an addition to its machine shop at Painted Post, N. Y.

The Iriquois Foundries, 474 Genesee St., Utica, N. Y., recently incorporated with $25,000 capital stock, will build a plant for the [illegible]facture of Rath white metal and brass and bronze cas[illegible]

The A. W. Wheaton Brass Works, Newark, N. J., is in the market for about 50 turret lathes.

Plans are being prepared for 3 manufacturing buildings at 14th St. and Economy Belt Line, Ambridge, Penn., for the Asbestos Protected Metal Co., Pittsburgh. Noted Mar. 16.

The American Brake Shoe and Foundry Co., Erie, Penn., has awarded the contract for an addition to its plant. Estimated cost, $5,000.

The Carnegie Steel Co. will build an addition to its plant at Farrell, Penn. Estimated cost, $1,000,000.

Plans are being prepared for an addition to the plant of the Bronze Metal Co., Meadville, Penn. Estimated cost, $15,000. Noted Feb. 24.

The Wicaco Screw and Machine Works, Inc., 623 Wood St., Philadelphia, Penn., has awarded the contract for the construction of a 2-story addition to its factory. Noted Mar. 16.

Bids are being received by J. E. Keim, Arch., Brighton Rd., N. S., Pittsburgh, Penn., for 2-story manufacturing plant for F. A. Hunter Saw and Machine Co., Pittsburgh. F. A. Hunter, Gen. Mgr

C. R. Kammerer, Pres., Pittsburgh Galvanizing Co., 26th and Railroad St., Pittsburgh, Penn., would like to communicate with manufacturers of machinery for drawing seamless brass and copper tubing and machines for manufacturing brass cartridge shells.

The Kelly & Jones Co., Pittsburgh, Penn., plans to construct converter steel foundry at its plant at Greensburg, Penn.

The Standard Seamless Tube Co., Pittsburgh, Penn., is in the market for one 15-ton, one 30-ton, one 10-ton and one 50-ton electric traveling crane.

The contract has been awarded for the construction of a 2-story, 60x100-ft. garage at Williamsport, Penn., for the La France Garage Co., Elmira, N. Y. Estimated cost, $25,000. Noted Feb. 24.

SOUTHERN STATES

The Atlas Steel Casting Co., 1963 Elmwood Ave., Buffalo, N. Y., plans to construct an addition to its plant.

The J. P. Devine Co., Buffalo, N. Y., manufacturer of vacuum and drying apparatus will construct additions to its plant at Clinton St. and Erie R.R.

The Covert Motor Vehicle Co., Lockport, N. Y., has awarded the contract for an addition to its plant. Estimated cost, $70,000. Noted Feb. 3.

Plans are being prepared by R. J. Reidpath & Son, Arch., Buffalo, N. Y., for an auto factory at Syracuse, N. Y., for the H. H. Franklin Manufacturing Co., West Marcellus St., Syracuse.

MIDDLE WEST

The Republic Stove and Manufacturing Co. contemplates constructing a 4-story, 60x120-ft. factory at Cleveland, Ohio. Estimated cost, $50,000. A. S. Keifer, 1802 East 40th St., Cleveland, Pres.

The contract has been awarded for the construction of a 2-story garage at 596 North High St., Frederickstown, Ohio, for R. Y. Strubel. Estimated cost, $20,000

Plans are being prepared by J. M. Bostick, Arch., Leader-News Bldg., Cleveland, Ohio, for the construction of a garage at Greenspring, Ohio, for H. C. Gammeter, 2337 Bellfield Ave., Cleveland Heights (Warrensville post office). Estimated cost, $25,000.

Plans are being prepared for the construction of a 2-story, 30x70-ft. garage at Mason, Ohio, for Wayne Shurt. Estimated cost, $15,000.

C. L. Baugh, Clarksville, Ohio, contemplates constructing a 3-story, 36x70-ft. canning factory at New Vienna, Ohio. Estimated cost, $10,000.

Jacob F. Waddell contemplates constructing a sheet steel plant at Niles, Ohio.

The Portsmouth Steel Co. plans to improve its plant at Portsmouth, Ohio, at an estimated cost of $1,000,000.

The contract has been awarded for the construction of a 3-story, 100x100-ft. garage and service station at Adams and 14th St., Toledo, Ohio, for the Willys-Overland Co. Estimated cost, $100,000. Noted Dec. 23.

The Oglesby Furnace-Stove Co. plans to construct a factory at Clinton, Ind.

The contract has been awarded for the construction of an addition to the foundry of the Indianapolis Malleable Iron Co., 546 Holmes Ave., Indianapolis, Ind. Estimated cost, $10,000.

Bids will soon be received for the construction of a 2-story, 60x140-ft. garage for John J. Steele, 909 Main St., Richmond, Ind. Estimated cost, $25,000.

Charles F. Lembke will build a 3-story, 66x132-ft. garage at Valparaiso, Ind. Estimated cost, $15,000.

Plans are being prepared for the construction of a 3-story, 125x150-ft. addition to the plant of the Standard Motor Truck Co. at Detroit, Mich. Estimated cost, $100,000. Noted Feb. 23.

Plans are being prepared for the construction of an addition to the factory of Wilmarth & Norman Co. at 1175 Monroe Ave., Grand Rapids, Mich. Noted Oct. 7.

The Sheffield Car Co. has awarded the contract for the construction of a 1-story, 60x200-ft. factory at Three Rivers, Mich. Noted Feb. 3 and 24.

The Roesch Stove Co. plans to build a factory at Belleville, Ill.

The contract has been awarded for the construction of an addition to the plant of the United States Radiator Corporation at Edwardsville, Ill. Estimated cost, $10,000.

The contract has been awarded for the construction of factory buildings at Waukegan, Ill., for the Ogren Motor Co. Estimated cost, $300,000. Noted Mar. 16.

E. F. Krueger plans to construct a 2-story, 50x70-ft. machine shop at Glenwood City, Wis.

The Wood County Cooperage Co. will build a 2-story, 40x120-ft. shop at Grand Rapids, Wis.

We have been advised that the Chalmers Motor Co., Jefferson St. and New Belt Line, Detroit, Mich., does not plan to construct a 4-story, 60x400-ft. plant with a 50x60-ft. wing at La Crosse, Wis., as was stated in our issue of Mar. 30. The company has under construction a plant at Detroit, Mich. Estimated cost, $150,000.

The contract has been awarded for the construction of a 77x114-ft. machine shop and foundry at Manitowoc, Wis., for the Wisconsin Aluminum Foundry Co., 16th and Franklin St., Manitowoc. B. Dalwid is Gen. Mgr. Noted Mar. 16.

The contract has been awarded for the construction of an addition to the plant of the W. Toepfer & Sons Iron Works, 193 Broadway, Milwaukee, Wis.

The Wisconsin Foundry Co., 1138 32nd St., Milwaukee, Wis., has awarded the contract for the construction of a pattern shop at Milwaukee.

WEST OF THE MISSISSIPPI

Press reports state that H. W. Graham and associates, Chillicothe, Mo., plan to equip a plant for the manufacture of tractors. Estimated cost, $100,000.

Press reports state that a garage and machine shop will be established at Kansas City, Mo., by L. L. Brown. About $4,000 worth of machinery will be required.

Plans are being prepared by J. C. Braecklein, Arch., Massachusetts Bldg., Kansas City, Mo., for a machine shop for Henry Lappe, Corliss, Kan. Estimated cost, $3,000.

The Panama Rubber Co., St. Louis, Mo., will install equipment in its plant for the manufacture of motor accessories.

The Robinson Fire Apparatus Manufacturing Co., St. Louis, Mo., will install equipment in its plant for the manufacture of heavy duty trucks and tractors.

Plans are being prepared for a 1-story boiler factory for the McCayne Investment Co., 15th and Dodge St., Omaha, Neb. Estimated cost, $4,000. R. Everett, 106 North 15th St., Arch.

Press reports state that the Studebaker Corporation New York, N. Y., plans to install about $50,000 worth of machinery in its proposed assembling plant at Dallas, Tex. Noted Feb. 10 and Mar. 2.

The Phoenix Iron and Steel Co., Galveston, Tex., recently incorporated, plans to construct a plant.

Ford & Roberts, Ada, Okla., will construct a machine shop.

WESTERN STATES

Charles Snyder and I. C. Thompson plans to construct a garage and machine shop at Buhl, Idaho.

The Beaver State Motor Co. is constructing the second unit to its plant at Gresham, Ore. Noted Jan. 6.

The S. Lowengart Estate has been granted a permit for the construction of a 2-story garage at Park and Couch St., Portland, Ore. Estimated cost, $28,000.

The contract has been awarded for an addition to the plant of the Globe Iron Works, Tacoma, Wash., which will be occupied by Pacific Boiler Co., Seattle.

Bausch & Founch plans to construct a 75x180-ft. garage and machine shop on E St., San Bernardino, Calif. Estimated cost, $20,000.

The Ford Motor Co. has awarded the contract for the construction of a 5-story addition to its assembling plant at Treat Ave. and 21st St., San Francisco, Calif. J. B. Lund is Mgr. Noted Dec. 23.

Plans are being prepared for the construction of a 1-story addition to the automobile repair shop of I. C. Noble on Bush St., San Francisco, Calif.

CANADA

Plans are being prepared by W. C. Cowan, 200 Victoria St., Berlin, Ont., for the construction of a factory at Berlin for the Canadian Regal Motor Co., Ltd., 433 King St. Estimated cost, $18,000.

Plans are being prepared for the construction of a garage at Brantford, Ont., for C. J. Mitchell, 55 Darling St., Brantford. Estimated cost, $20,000.

The Steel Co. of Canada, Hamilton, Ont., will construct an addition to its plant at Hamilton. Estimated cost, $24,000. Robert Hobson is Mgr.

Fire recently damaged the munition plant of B. Bell & Son Co., Ltd., at St. George, Ont. Loss, $10,000.

The National Equipment Co., Ltd., manufacturer of gasoline engines, pumps, etc., is constructing a tank shop at Toronto, Ont., and will install new machinery.

The Canadian Brush Machinery Co., Ltd., plans to establish a plant at Walkerville, Ont.

The Ford Motor Co. of Canada will build a 4-story assembling plant at 5th Ave. and Fir St., Vancouver, B. C. W. G. Patrick is Local Mgr.

GENERAL MANUFACTURING

NEW ENGLAND STATES

Bids are being received for the construction of a 3-story woolen mill for the Troy Blanket Co., Troy, N. H.

The United Fruit Co., Board of Trade Bldg., Boston, Mass., plans to construct a sugar refinery at (Charleston), Boston, Mass.

The contract has been awarded for the construction of a 2-story, 45x45-ft. addition to the factory of the Carpenter Manufacturing Co., manufacturer of braided and twisted cords, at Norwich, Conn.

MIDDLE ATLANTIC STATES

The contract has been awarded for the construction of an addition to the plant of the Schoellkopf Aniline and Chemical Works, Inc., Buffalo, N. Y. Estimated cost, $16,000. Noted Mar. 30.

Plans are being prepared for an addition to the plant of the American Sugar Refining Co., South 3rd St., New York, N. Y. (Borough of Brooklyn). Estimated cost, $1,000,000. Noted Mar. 30.

Plans have been prepared for 2 agitator buildings at New York, N. Y. (Borough of Manhattan). Estimated cost, $8,000.

The General Chemical Co., 25 Broad St., New York, N. Y. (Borough of Manhattan), has awarded the contract for the construction of a factory at Laurel Hill (Flushing post office), New York, N Y. (Borough of Queens).

The Isco Chemical Co., Niagara Falls, N. Y., has awarded the contract for a plant at Royal and Union St. Estimated cost, $300,000. Noted Mar. 16 and Apr. 6.

Bids are being received by the Sodus Packing Co., Sodus, N. Y., for a 2-story addition to its plant.

The Figuerao Cut Glass Co., Hammonton, N. J., will construct a 7-story factory at Hammonton.

The American Lead Pencil Co., Hoboken, N. J., has purchased a site at Willow Ave. and 5th St., Hoboken, and will construct a 10-story building.

The Vacuum Oil Co., 61 Broadway, New York, N. Y., is having plans prepared for an oil refinery at Lincoln Park, N. J. Estimated cost, $2,000,000.

Berkowitz, Goldsmith & Spiegel Co., Newark, N. J., will build an addition to its leather factory on Garden St.

The Central Dyestuff and Chemical Co., Newark, N. J., has awarded the contract for the construction of an addition to its plant on Plum Point Lane. Noted Apr. 6.

Fire, Mar. 25 destroyed the plants of the Lister Agricultural Chemical Co., Lister Ave., Newark, N. J. Loss, $100,000. The plant will be rebuilt.

The contract has been awarded for the construction of 2 additions to the plant of the Seton Leather Co., Verona Ave., Newark, N. J. Estimated cost, $25,000. Noted Mar. 30.

The Yatman Rubber Co., Newark, N. J., will improve and enlarge its plant on Mt. Pleasant Ave.

The Cedartown Cotton and Export Co., Cedartown, Penn., will build 3 additions to its plant. Estimated cost, $225,000.

The Lee Tire and Rubber Co., Conshohocken, Penn., has awarded the contract for the construction of a 2-story fireproof mill construction building. Noted Mar. 30.

Plans are being prepared by E. Cornelius, Arch., House Bldg., Pittsburgh, Penn., for a 2-story addition to the plant of the Consolidated Lamp and Glass Co., Coraopolis, Penn. Estimated cost, $15,000. Noted Mar. 23.

We have been informed that the Northampton Silk Co., Easton, Penn., will not construct factory buildings at Ann and St. Joseph St., Easton, as stated in our issue of Mar. 2. H. J. Haytoel is Treas.

The Jenkins Kirby Co., Kingston, Penn., has awarded the contract for the construction of a 1- and 3-story packing plant. Estimated cost, $25,000.

The Benzol Products Co., Marcus Hook, Penn., has awarded the contract for the construction of a 2-story factory. Estimated cost, $55,000.

The Caledonian Dye Works, Philadelphia, Penn., has awarded the contract for the construction of a 2-story factory at Emerald and Westmoreland St., Philadelphia. Estimated cost, $11,000.

The L. H. Gilmer Co., manufacturer of webbing, belting and tape, has awarded the contract for the construction of an addition to its plant at Tacony, Philadelphia, Penn. Estimated cost, $12,000. Noted Feb. 3.

The Hardwick & Magee Co., 7th St. and Lehigh Ave., Philadelphia, Penn., manufacturer of rugs and carpets, plans to build an addition to its plant.

The contract has been awarded for the construction of a rug factory at Philadelphia, Penn., for Archibald Holmes & Sons, Allegheny Ave and A St. Estimated cost, $15,000.

Plans are being prepared by Frank E. Hahn, Arch., 1112 Chestnut St., Philadelphia, Penn., for the construction of 5 factory buildings for the Mifflin Chemical Co., Philadelphia. Noted Mar. 30.

Bids are being received by the Philipsburg Beef Co., Pine St., Philipsburg, Penn., for 2-story packing plant. Estimated cost, $10,000.

The St. Louis Independent Packing Co., 6349 Station St., Pittsburgh, Penn., plans to construct a packing plant. Estimated cost, $55,000.

The Quincy Engine Co., Quincy, Penn., has purchased the plant of the T. B. Woods Sons Co., Chambersburg, Penn., and will equip it for its own use.

Seldon & Leach, Wilkes-Barre, Penn., has awarded the contract for a silk mill at New Grove and Gilligan St., Wilkes-Barre. Andrew K. Leach, Pres. Noted Apr. 6.

The Baltimore Paper Box Co., 1201 South Howard St., Baltimore, Md., plans to enlarge its plant.

The F. X. Ganter Co. will rebuild its showcase manufacturing plant at Baltimore, Md., which was recently destroyed by fire.

William E. Hooper & Sons Co., Baltimore, Md., manufacturer of cotton duck has awarded the contract for the construction of a plant.

Plans are being prepared for an addition to the plant of the International Wood and Paper Products Corporation, 112 North Calverton Rd., Baltimore, Md. Estimated cost, $50,000. Noted Mar. 9.

The Mutual Chemical Co., 1348 Block St., Baltimore, Md., has awarded the contract for a 2-story addition to its plant. Estimated cost, $6,000. Noted Mar. 16.

An addition will be built to the plant of the Lansconing Glass Co., Lansconing, Md. A. Anderson, Mgr.

The Central Market Co., Washington, D. C., has awarded the contract for the construction of an 8-story cold-storage building at 12th and E st. Estimated cost, $70,000.

The Washington Market Co., Washington, D. C., has awarded the contract for an addition to its cold-storage plant. Estimated cost, $75,000.

SOUTHERN STATES

The United States Leather Co. plans to build a plant at Narrows, Va. Estimated cost, $250,000.

Swift & Co., Chicago, Ill., has awarded the contract for the construction of a plant at St. Paul, Va., for the manufacture of wood extracts. Estimated cost, $40,000. Noted Feb. 10.

The Hazel-Atlas Glass Co., Grafton, W. Va., is enlarging its plant.

The Toledo Glass Co., Toledo, Ohio, plans to construct a factory at Kanawha City, W. Va.

The Grasselli Chemical Co., Cleveland, Ohio, contemplates building a plant at Meadow Brook, W. Va.

The Cerro Gordo Warehouse Co., Cerro Gordo, N. C., plans to establish a knitting mill.

The Durham Knitting Mills, Durham, N. C., will build an addition to its factory and install new machinery.

The Durham Hosiery Mills, Goldsboro, N. C., has awarded the contract for the construction of a 3-story factory. Noted Mar. 16.

W. Y. Frazier and D. B. Mull, Connelly Springs, N. C., will build a knitting mill at Icard, N. C.

The Linn Mills Co., Landis, N. C., manufacturer of cotton yarn, has awarded the contract for several additions to its plant. Noted Feb. 3.

The Carolina Hosiery Mills Co., Marion, N. C., plans to build additions to its plant and install new machinery.

The Crescent Hosiery Co., Scotland, N. C., plans to build a 2-story mill to replace present one.

Fire recently destroyed the plant of the Union Compress Co. at Augusta, Ga. Loss, $100,000.

The Penfield Hosiery Mill, Greensboro, Ga., recently destroyed by fire with a loss of $20,000, will be rebuilt.

John Greer, Moultrie, Ga., is interested in the construction of a packing plant at Lake City, Fla. Estimated cost, $150,000.

The Fulton Cotton Mill Co., Athens, Ala., plans to increase the capacity of its plant.

Montgomery Cotton Mills, will build 2 brick buildings at Montgomery, Ala., for the manufacture of cotton goods.

Fire recently destroyed the plant of the Swift Packing Co., Alexandria, La. Loss, $90,000.

The Busch Box Co., New Orleans, La., plans to rebuild its plant recently destroyed by fire with a loss of $30,000.

W. B. Davis & Co., Chattanooga, Tenn., will build a knitting mill at Attalia, Ala.

Fire recently destroyed the plant of the Carcolite Chemical Co. at Copper Hill, Tenn.

The Federal Dyestuff and Chemical Co. plans to build a 1-story, 200x300-ft. addition to its plant at Kingsport, Tenn.

Cock & Howard plans to construct additions to its plant at Cocksville, Ky., and install new machinery.

MIDDLE WEST

Preliminary plans are being prepared for the reconstruction of a 2-story, 75x110-ft. packing plant at Akron, Ohio, for Zimmerly Bros. Estimated cost, $25,000. Jacob Zimmerly, 215 South Main St., Akron, is Pres. Noted Mar. 9.

The contract has been awarded for the construction of the Frederick Silk mill at Canton, Ohio.

Plans have been prepared for the construction of a 4-story, 26x150-ft. factory at Cincinnati, Ohio, for the Starr Piano Co., 139 West 4th St., Cincinnati.

The Aetna Rubber Co., Perkins Ave., Cleveland, Ohio, plans to build a factory on East 79th St., Cleveland.

The Grasselli Chemical Co., The Arcade, Cleveland, Ohio, has purchased a site at Terre Haute, Ind., and plans to construct a plant. Estimated cost, $1,000,000. W. T. Cashman is Asst. Secy.

The contract has been awarded for rebuilding the plant of the Capac Paper Co. at Capac, Mich. Estimated cost, $90,000.

Plans are being prepared for the construction of a factory at Pere Marquette Crossing and Madison Ave., S. E., Grand Rapids, Mich., for the Grand Rapids Leather Novelty Co.

The contract has been awarded for the construction of a plant at Kalamazoo, Mich., for the Riverview Coated Paper Co. Estimated cost, $150,000. Noted Feb. 17.

The Western Knitting Mills is constructing an addition to its factory at Rochester, Mich.

Plans are being prepared for the construction of a 49x155-tannery at Rockford, Mich., for the Hirth-Krause Co.

The Converse Shoe Co., Malden, Mass., plans to construct a factory at 618 West Jackson Blvd., Chicago, Ill. Estimated cost, $110,000.

Plans are being prepared for the construction of a 1- and 2-story factory for the Fulton Saw Works, 52nd Ave. and 22nd St., Chicago, Ill.

The Western Thread Co. has awarded the contract for the construction of an addition to its plant at Elgin, Ill. Estimated cost, $11,000. W. R. Swartwout is Mgr. Noted Mar. 23.

WEST OF THE MISSISSIPPI

The contract will soon be awarded for a 2-story addition to the plant of the Coleman Lamp Co., North St. and Francis Ave., Wichita, Kan. Estimated cost, $20,000. Noted Mar. 2.

A. D. Kennedy and associates, Greenville, Tex., plan to construct a cotton seed oil mill at Dallas, Tex. Estimated cost, $750,000.

R. B. White and associates, Ennis, Tex, plan to construct a cotton mill at Ennis. Estimated cost, $200,000.

WESTERN STATES

Irving Canning Co. plans to rebuild its plant at LaConner, Wash., recently destroyed by fire with a loss of $15,000. G. W. Irving is Pres.

The Inland Empire Paper Co. plans an expenditure of $250,-000 for additions to its plant at Millwood, Wash.

R. S. Clark, Seattle, Wash., plans to construct a fruit canning plant at North Yakima, Wash. Estimated cost, $65,-000.

G. C. Huber, Spokane, Wash., is promoting the construction of a packing plant at Palouse, Wash.

Thomas Carsten and Charles Frye, Seattle, Wash., contemplates constructing a packing plant at Pasco, Wash.

Carl Feller plans to construct a cold-storage plant at Marshfield, Ore.

R. H. Schwartz, E. J. Martin and H. T. Snufler, Bakersfield, Calif., plan to construct a canning plant at Armona, Calif.

A. M. Allen, Point Lobos, Calif., plans to build cannery at Cayucas, Calif.

CANADA

The Belding-Paul-Corticelli, Ltd., manufacturer of sewing silk, plans to construct an addition to its factory at Coaticook, Que., and will install machinery.

Fire, Mar. 27 destroyed the factory of the Canadian Rubber Co., Montreal, Que. Estimated cost, $50,000.

The D. H. Langlois & Co. will rebuild its furniture factory at St. John's, Que., recently destroyed by fire with a loss of $16,000.

The Chatham Shoe Co. plans to construct a factory at Chatham, Ont.

The Peerless Weaving and Belting Co., recently incorporated, will construct a factory at Hamilton, Ont.

The Bonner Worth Co., manufacturer of spinners worsted yarns, will construct an addition to its plant at Petersborough, Ont. Estimated cost, $8,000.

Classified Advertising

The Classified Advertising section appears on pages 151, 152, 153, *of this issue and will in future appear in the same relative position in the paper.*

American Machinist

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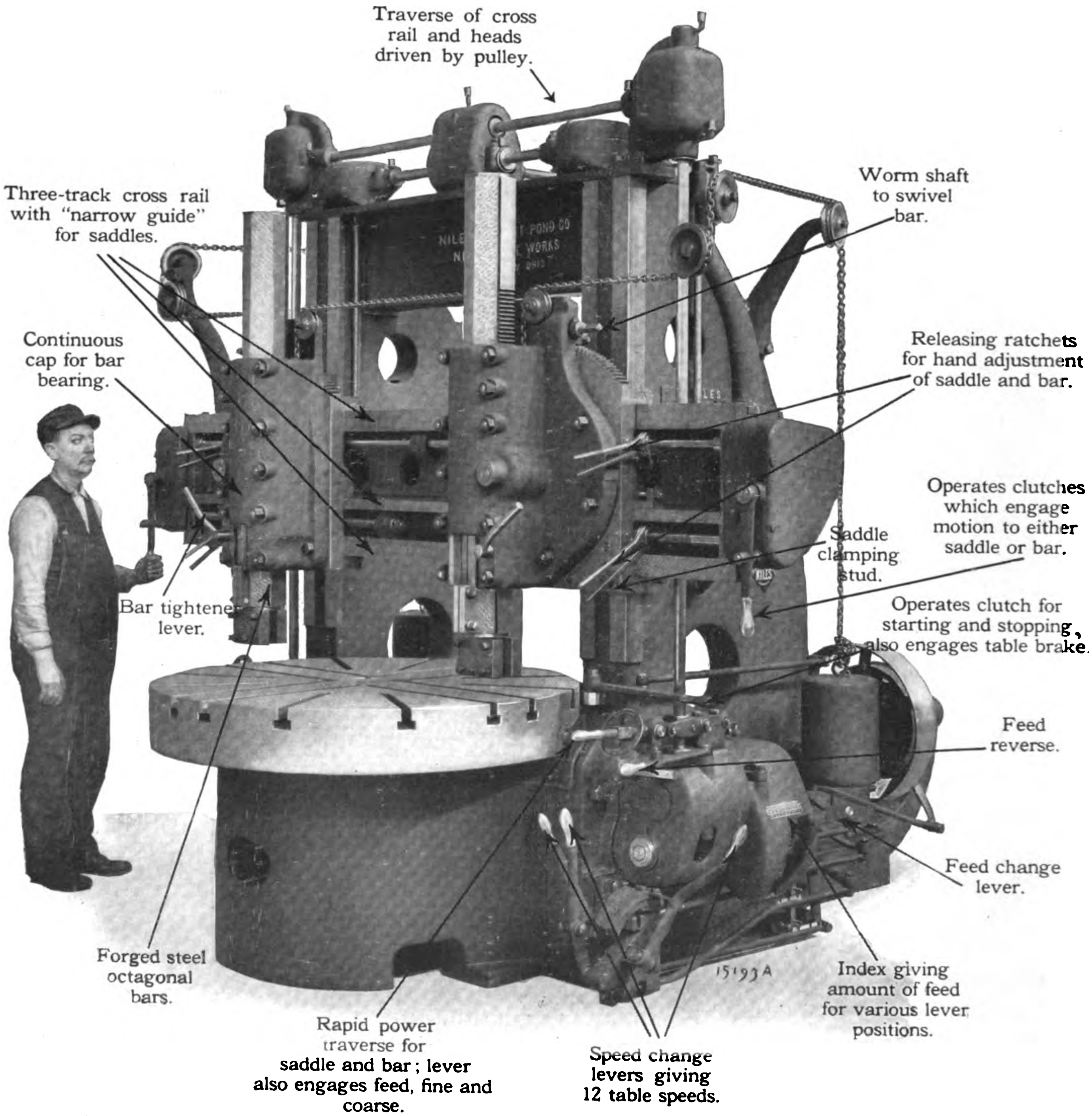
Advertising Index, Last Page

FOLLOW THE ARROWS

To the Superior Points of Our

All-Improved-Feature Boring Mills



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VOLUME 44 — APRIL 20, 1916 — NUMBER 16

CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormay processes, protected by United States patent issued June 22, 1915, and another pending

NUMBER OF COPIES PRINTED THIS ISSUE, 23,250
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Talks With Our Readers

By the Publisher

DON'T get the idea that the Buyers Cyclopedia is a cure-all for any trouble you may have found in the search for advertised products.

But it *is a specific* cure for one great defect that up to now has existed in all technical papers.

You have learned the value of reading the advertising pages in the American Machinist. By so doing you keep yourself well acquainted with the points of superiority of, and the differences between various makes of machines intended to do the same work. But when you came to buy a machine for a particular job, you found that all was not so easy. Only a machine of a certain size, weight, capacity, price, etc., could qualify. When you looked under the heading of the article you wanted, all you got was a list of manufacturers, without addresses—provided you found even the right heading. There was no detailed information about the articles made by the various manufacturers; you didn't know whether the machine Jones & Co. made was small or large; or whether you would have to write to Philadelphia, Salt Lake, or what not. In other words, when it came to the actual point of buying something that you had seen advertised in the American Machinist, the exact information that you wanted to enable you to make the right purchase was NOT THERE.

The Buyers Cyclopedia, page 188 will provide that.

It should give you all that information about everything that you use at the instant you want it.

No looking through dusty directories.

No searching through out-of-date card files.

Fresh, up-to-the-week — it enables you at any instant with full knowledge and no delay, to buy advertised products— which are the most reliable.

The Buyers Cyclopedia is designed and maintained for your use and convenience.

The advertising pages keep you informed.

The Cyclopedia gives you the detailed data about the products you need and tells you where to get them.

Get acquainted with it. Use it.

Making Flexible-Back Metal-Cutting Saws

By Ethan Viall

SYNOPSIS—This article not only gives data on the kind of saws, the number of teeth and the thickness to use on various metals, but it also tells how the saws are made.

A mere description of how a certain thing is made does not insure, by any means, that a man can take that description and produce articles equal to those described. Experience, trained men and a certain "know-how" obtained only from actual mechanical production will give the desired results. Long experience and good mechanical methods in the production of both wood- and metal-cutting saws of every description enable the James Ohlen & Sons Saw Manufacturing Co., Columbus, Ohio, which has been in business since 1852, to make saws that give satisfaction.

This article, however, will deal only with saws intended for metal cutting. Aside from the various sizes and number of teeth, two classes of metal-cutting saws are made here. One is known as a bright, high-tempered metal bandsaw, which is hard from tooth to back and is used for cutting the softer metals, such as manganese bronze, aluminum and others of that class. It closely resembles a wood-cutting bandsaw, except that it has a harder temper and finer teeth. The metal bands from which these saws are made come already properly tempered previous to the cutting of the teeth. The teeth, while hard, are not too hard to be filed.

The other class consists of saws made for the harder metals. These saws are flexible—that is, the teeth are hard, but the backs are not—and they are made in both the bandsaw and the hacksaw shapes and of all the widths, thicknesses and with all the numbers of teeth required for different uses. It is with this class of flexible-back saws that this article will deal especially, though incidentally some data will be given on the all-hard class.

For convenience in assisting customers in selecting the proper saws for their particular needs, the Ohlen company has divided its output into the following classes, which are typical of those in general use in shops throughout the country:

Class A—14 teeth to inch; for cutting soft steel, castings and rails.

Class B—16, 18 or 20 teeth to inch; for cutting tool steel, iron pipe, angle iron or other hard metals.

Class C—20 or 22 teeth to inch; for cutting brass, copper, drill rod, sheet metals or medium thin tubing.

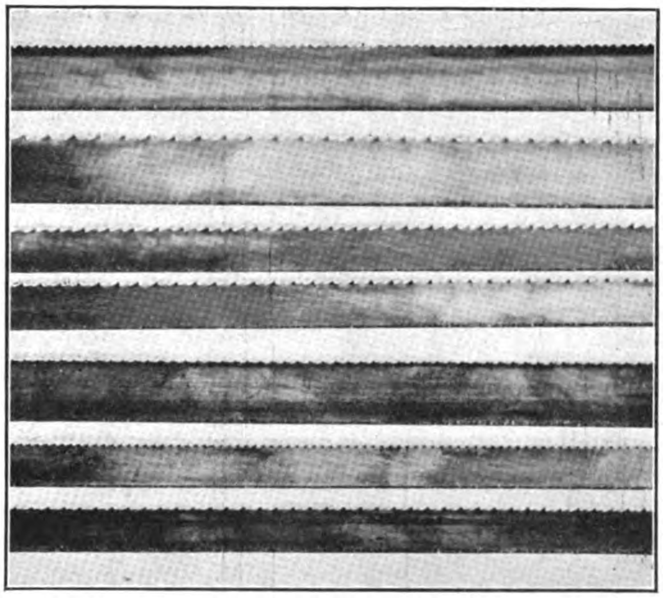


FIG. 1. SAMPLE SECTIONS OF METAL-CUTTING SAWS

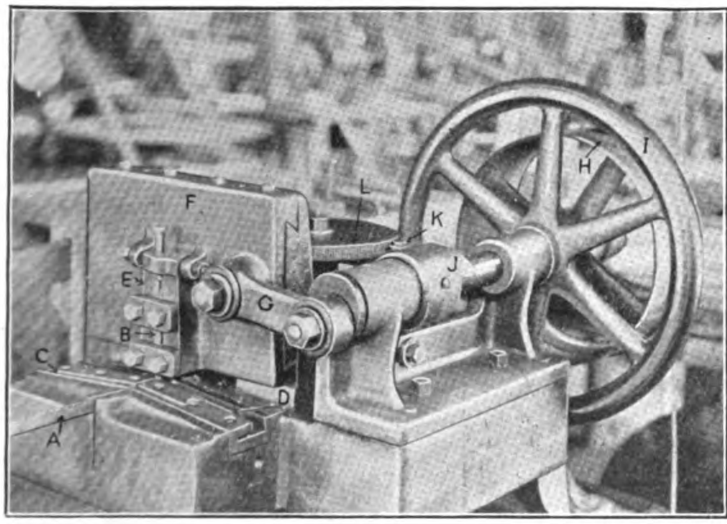


FIG. 2. A TOOTH-CUTTING AND SETTING MACHINE

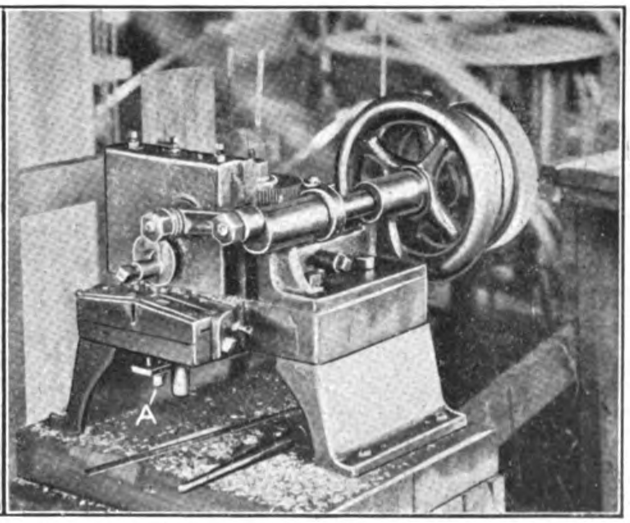


FIG. 3. ADJUSTMENT FOR STOCK WIDTHS

Class D—20 or 22 teeth to inch; for cutting manganese bronze.

Class E—28, 30 or 32 teeth to inch; for cutting tubing or thin sheet metal.

These saws are regularly ½ in. wide, 23 gage (0.026) thick and from 6 to 20 in. long. They are of the flexible-back type and ordinarily intended for use in hand frames.

For power, light gravity-feed machines the blades are 5/8 in. wide, run from 9 to 18 in. in length, are of 22 gage and cut with 14 teeth. For heavy gravity or power-feed machines the blades are from 12 to 24 in. long, 3/4 to 1 in. wide, 18, 19 or 21 gage and cut with from 10 to 18 teeth. For special purposes saws with teeth from 8 to 32 and of any required length, width or thickness are made. The foregoing classes, however, represent general practice.

Flexible-back metal-cutting bandsaws are made regularly from 3/8 to 1 in. wide, of different gages, and with any number of teeth up to 32 per inch. The all-hard bandsaws average 1/2, 5/8 or 3/4 in. in width and from 8 to 14 teeth. More of the 5/8-wide 23-gage 14-toothed saws are probably used than of any other size. As previously stated, they are suitable for the softer metals. All metal-cutting saws, whether of the hack or band type, flexible back or all hard, are made with a straight-faced tooth: that is, the cutting face of the teeth is at exact right angles to the back of the saw. This straight face is obtained by filing after the tooth has been cut and set.

Some of the blades, of various widths and different numbers of teeth, are shown in Fig. 1, though it is hard to give a clear idea by an illustration of this kind. Fortunately, every reader of this paper knows what hack-saw teeth look like and how they are set. The steel for these saws comes from the steel mills in big rolls that are placed on special holding tables, from which they are fed into the tooth-cutting and settling machines. Passing through the machines, the steel bands are again rolled up ready for the next operation.

One of the tooth-cutting and setting machines is seen in Fig. 2. The steel strip to be toothed feeds in from the back and out between the dies, as at *A*. The teeth, or "points," are cut by a reciprocating cutter, or punch, *B* working alternately against the cutting edges of two dies placed in slots at *C* and *D*. The cutter is carried in an adjustable tool block *E* bolted to the slide *F*, which is connected to the crankshaft by the rod *G*. The crankshaft is run by a belt on the pulley *H*, or for adjusting purposes it may be operated by the handwheel *I*. From this explanation it will be seen that two teeth are cut at each revolution of the crankshaft.

The steel strip is fed forward between each cut, which is accomplished by placing a double cam *J* on the crankshaft. These cams operate a pawl *K* every time they pass, or twice per revolution of the shaft. Thus two impulses are given to the notched disk *L*, which operates feed rolls so timed as to move the stock forward the right amount between the strokes of the cutting tool. By changing the notched disk or by varying the stroke of the pawl various leads per inch are obtained, so as to form the required number of points per inch.

Another machine, differing only in minor details, is illustrated in Fig. 3. This view shows better, however, how the machine is adjusted for different widths of stock. Adjusting screws at *A* move a guide up or down, as desired. The top of this guide rests between the dies, and the stock feeds over it; so that if the guide is raised, the stock is also raised up between the dies and vice versa.

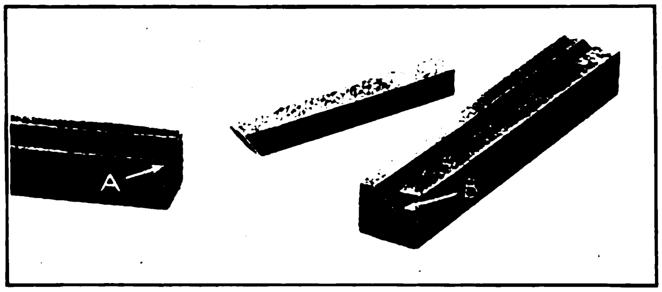


FIG. 4. TOOTH CUTTER AND DIES

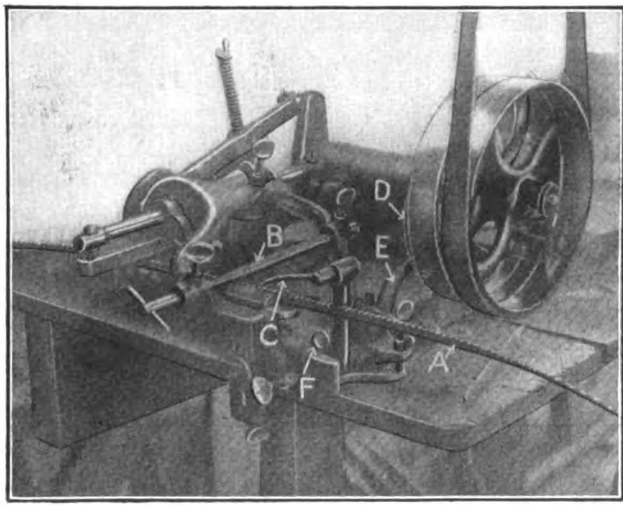


FIG. 5. AUTOMATIC TOOTH-FILING MACHINE

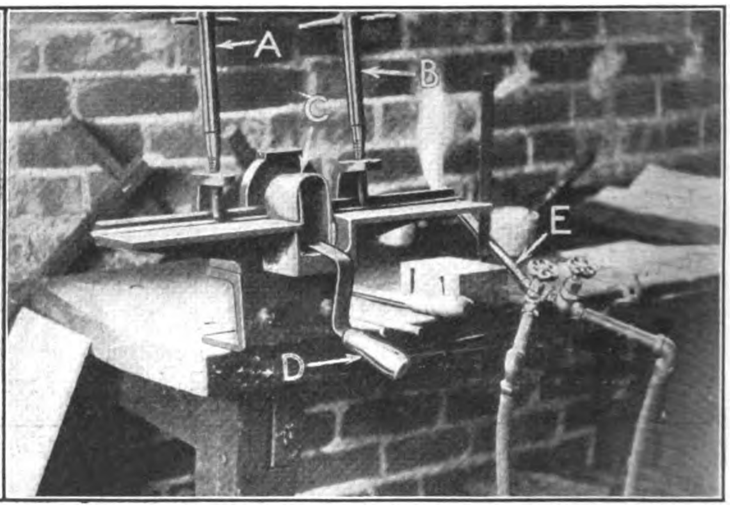


FIG. 6. A BRAZING FIXTURE

The method of setting the teeth as they are cut will be understood by referring to Fig. 4. Here two of the dies and a cutter may be seen. It will be observed that the ends of the dies are first ground off almost square and then have an angle ground at *A* and *B*. This angle and corresponding angles ground on the front edges of the cutter are what do the setting work. The additional clearance beyond the angled cutting edge of the die affords room for the set teeth to feed along. These dies and the way they are ground will show that the saws feed out "backward." The method of setting the dies in the machines makes it easy to remove and grind them, as they are practically made like straight forming tools.

By carefully observing the way the dies are ground and keeping in mind the way the strip feeds, it will be seen that the shearing action of the cutter tends to cut the back or slope of the tooth in line with the strip itself, but shoves the front or cutting edge outward to the angle at which the die is ground. This method gives an ideal

set to the teeth, as it does not distort or weaken the metal in the wrong place.

As previously stated, all metal-cutting saws are filed with a straight face to the teeth, so there is no hook whatever. This filing is done in automatic machines like the one in Fig. 5. The toothed bands are fed into the machine from the right, as at *A*. As they pass through guides, the file *B* strokes straight across. The feeding of the saw is done by the dog *C*, which engages the teeth one at a time in succession. This dog is operated from the cam *D*, which strikes the lever *E* at each revolution of the pulley. The cam action pushes the dog ahead, but it is returned by the spring *F*. As the spring forces the dog back against an adjustable stop; the regulation of the stop determines the length of the stroke of the dog. In this way the feed may be easily regulated for various numbers of teeth per inch. The file carriage is so made as to accurately guide the file and automatically lift free of the work on the return stroke. A number of these machines are kept constantly at work on both metal- and wood-cutting saws.

For bandsaws the ends, of the required length, are carefully beveled and fitted and are then placed in the fixture seen in Fig. 6, for brazing. In using this fixture the dressed ends of the saw are placed together and held by means of the clamp screws *A* and *B*. The removable "hood" *C* is placed over the saw ends, to confine the heat close to the place to be brazed. This hood is fitted with a handle *D* for convenient setting. The heating is done with a blow torch *E*. After brazing, the place is dressed up in the usual way, so that the joints are scarcely discernible.

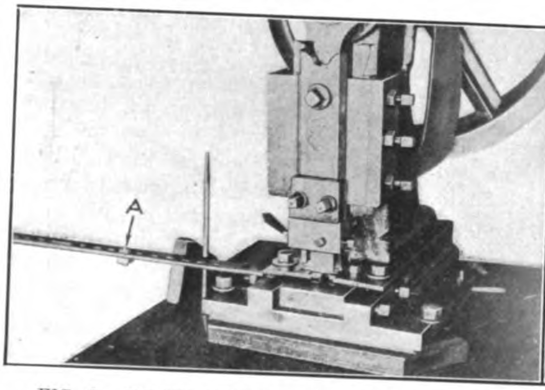


FIG. 7. PUNCH PRESS FOR HACKSAW ENDS

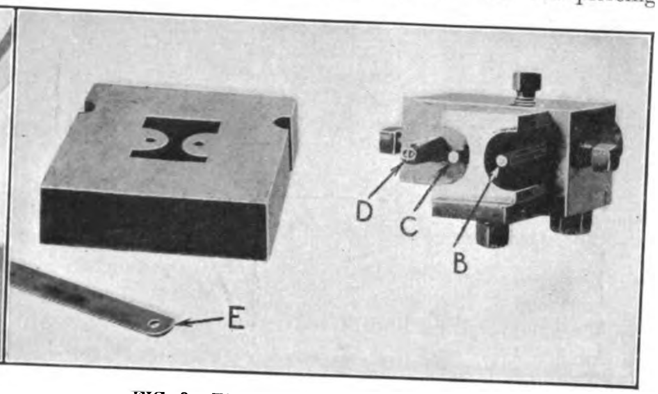


FIG. 8. THE PUNCHES AND DIE USED

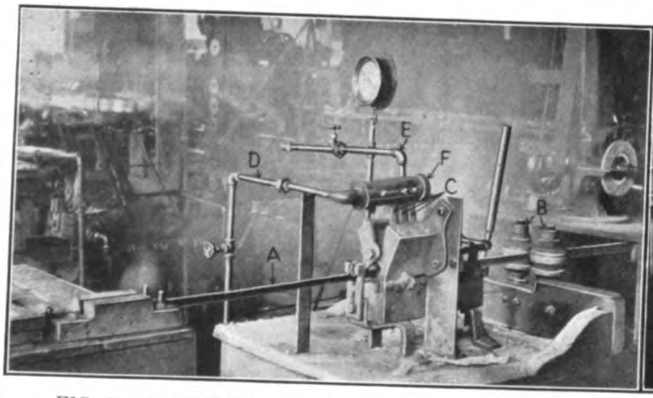


FIG. 9. AUTOMATIC TOOTH-HARDENING FURNACE

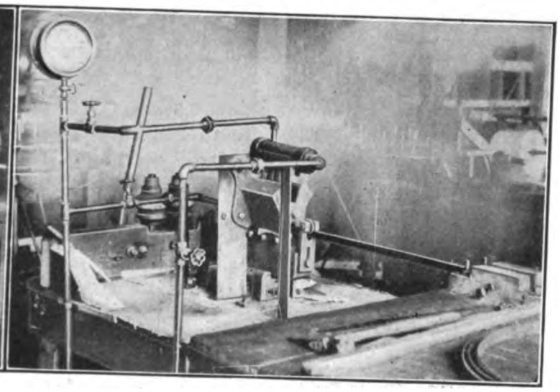


FIG. 10. ANOTHER VIEW OF HARDENING FURNACE

For cutting long bands into hacksaw lengths a punch press fitted as in Fig. 7 is employed. The band to be cut is fed in from the right against the stop *A*. The press is then tripped, cutting the piece to length and both forming and piercing the ends. As can be seen, the stop is adjustable for various lengths. The punches and dies for this work are shown in Fig. 8, from which it will be seen that two ends and two holes are pierced at each stroke, so that, once started, a saw blade is completed at each stroke of the press. The two piercing punches are illustrated at *B* and *C*. The punch *D* is a lettering punch for impressing the firm trade-mark on the blade. A sample of a finished saw end is given at *E*.

The method of hardening flexible-back saws leaves the extreme cutting points the hardest and does not harden the body of the blade or band at all. This treatment gives an almost unbreakable saw with fully as good cutting qualities as can be produced by an all-hard saw, but without the latter's brittleness. For hardening the teeth, special furnaces have been made that are practically automatic in action after being regulated for a certain class of work. One of these furnaces is shown in Fig. 9. The band to be hardened feeds into the furnace from a holding table, as at *A*, and is drawn through the furnace, teeth upward, by the power-driven rolls *B* at the back. As the band is slowly drawn along between asbestos-packed guides, gas jets *C* heat the points to the proper temperature. As they leave the heating flames, the points are cooled by a compressed-air blast, and the band then feeds on through the rolls to a holding reel. The pipe *D* is a gas pipe, *E* is an air pipe, and *F* is a mixing chamber from which the heating jets lead.

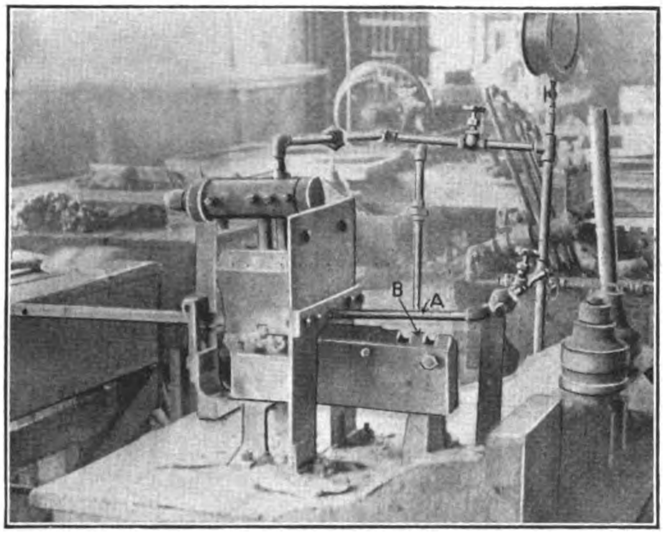


FIG. 11. REAR VIEW, SHOWING COOLING PIPE

Of course, the operator has first to blow all the moisture possible out of the compressed-air pipes and then carefully regulate both the heating and cooling jets to the work in hand. After that it is merely a case of watching to see that the product comes uniformly tempered. About 900 ft. of saw band may be hardened in one of these furnaces in 9 hr., taking a 5/8-wide 18-point band as an example. Other sizes and points will vary the amount one way or the other. About 140 lb. of air pressure is carried in the system.

Another view of this same furnace is given in Fig. 10 and shows the piping to better advantage. Fig. 11 is a rear view, and the cooling-air pipe is seen at *A*. This is simply a small pipe with holes drilled in the under side so as to throw the air directly on the teeth as they pass under. The guiding jaws through which the saw feeds are shown at *B*. Teeth properly hardened in this way cut freely, do not shell off and last unusually long on account of their soft backing.

Design and Construction of Textile-Machinery Cams

By Sumner B. Sargent

In this article I will take up and design a set of loom cams, commonly called harness cams. Their work is to raise and depress the warp threads. Then the shuttle containing the filling yarn is shot across. Such cams are made in sets of two, three, four, five, six, seven or eight and are commonly locked together on the same camshaft. The outer end of the cam lever is attached by straps to the bottom of the harness frames. The tops of these harness frames are attached by straps to rolls overhead. These rolls are each proportioned in size to the stroke of a corresponding cam lever, and they wind up or unwind the straps (thus raising or lowering the harnesses) as the cam lever moves up or down.

In Fig. 1, *M* represents the "fell" of the cloth, where each successive thread of filling is beaten in and tied in place by the warp threads *MAP* and *MAR* as they pass each other in rising or falling. The raised front harness is represented by *BC*, and *DE* represents the back harness depressed. At *P* and *R* is represented the eye of the harness wire, or needle, through which each warp thread passes. The line *MAP* represents the warp threads raised and *MAR* the warp threads depressed. Between these threads the shuttle lays the filling. At *H* is represented the boss of the roll, around which the front-harness strap winds as the harness rises. At *L* is represented another boss of the same roll, around which the back-harness strap winds.

The opening between the warp threads caused by cams is called the "shed." All the cams must have such a stroke as will make a uniform shed for the shuttle to shoot through. This means that the back-harness cams must have a longer stroke than the front ones.

In the case of a two-harness set such as I am now designing the back-harness roll should be of such proportion as to wind up the longer length of strap due to the longer stroke of the back harness; the conditions are the same in reference to the front-harness roll. In other words, one cam lever and top roll take up the slack delivered by the other. So the cams, levers and rolls must be proportioned; otherwise the shed opening will not be uniform and some of the threads will not show in their proper place in the woven cloth. The strain on the warp threads is generally greatest when the shed is open and lessens as

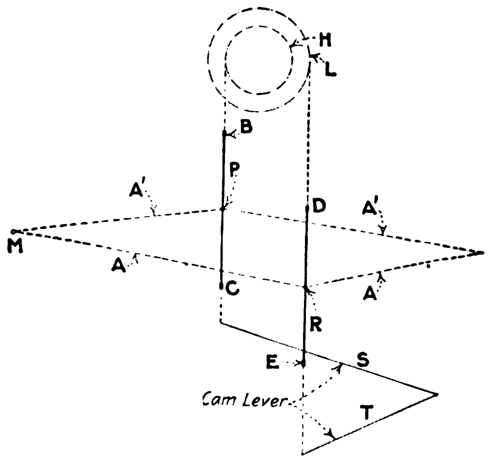


FIG. 1. ARRANGEMENT OF LOOM HAMMERS

the threads depart from this open position. Too severe or sudden straining of the threads causes frequent and undesirable breaking, with consequent imperfections in the finished cloth and loss of production while repairing break.

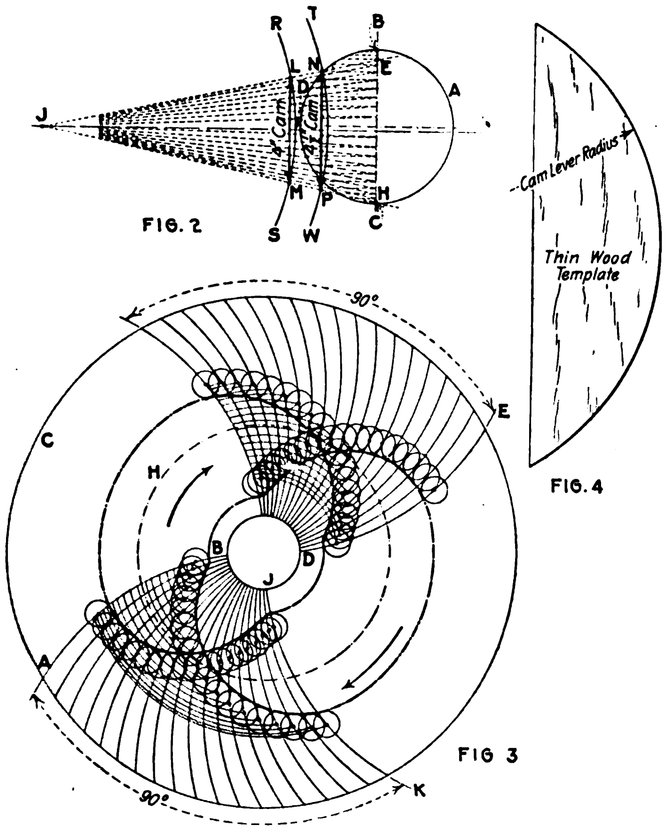
As the warp threads get tighter and the shed approaches the open position, more power is used in operating the cams. For these reasons I generally decide that the cam movement shall be uniformly retarded as the shed approaches the open position and correspondingly accelerated as it departs from that position. This result is accomplished by reversing the order in which the cam-stroke graduations are plotted on the cam.

If the graduations are numbered from 1 to 16, they are applied in that order to the stroke side and in reverse order—16 to 1—on the follow side of the cam. Therefore, to operate with the minimum breakage of warp threads and to consume the least power in operation I generally use a modification of the crank-motion principle in designing this class of cams (see Fig. 2).

To lay out such a cam, first strike the circle *A*, having a diameter somewhat longer than the largest cam stroke, in this case 6 in. Divide the semicircle *BDC* into 24 equal parts and square the division points across to the line *BC*. Of these 24 divisions representing a crank-motion stroke I arbitrarily select the 18 divisions from *E*

to H. The spaces at H are shorter than the spaces at E; therefore use the H-end of the divisions for the cam stroke as it approaches the open-shed position.

Now, in order to locate the center of the stroke for both cams, bisect the line EH with the line JK. Using the proportional method to determine the graduation for the 4-in. and 4½-in. cams, extend the lines EJ and HJ and erect the two lines LM and NP, representing the strokes. Now extend radiating lines from J to each of the division points on the line EH. Then with a radius equal to the distance from the center of the cam ball to the lever fulcrum strike the arcs RS and TW, representing the arcs described by the cam balls. When the radial



FIGS. 2 TO 4. LAYOUT OF TWO-HAMMER LOOM CAMS

lines cut the arcs RS and TW, the division points are indicated for the cam-stroke graduations.

I now decide that the cams shall complete their stroke in 90 deg., as in Fig. 3. The circle C is struck with a radius representing the distance between the cam-ball center and the lever fulcrum. Ninety degrees of the circle is divided into 18 equal parts, and radial arcs swing from each division point to the center of the circle.

In actual practice I rarely use the large circle and swing the radial lines as described. I find it too inconvenient; and after many radial arcs are swung through the center, I lose its location. But I obtain the same result in the following manner:

I make a thin templet of wood representing the radial arc, Fig. 4. Then I draw the circle C as large or as small as I find most convenient and divide it into spaces as desired. Then I drive a thin needle through the center of the circle into the drawing board, and with one end of the arc side of the wooden templet against the needle and the other end resting at the division points on the circumference of the circle, I use the templet to scribe the radial arcs.

Turning back to Fig. 2, transfer graduations of the stroke from the arc RS to the arc AB, Fig. 3. Next swing these graduation points onto the proper radial arcs and with the cam-ball radius strike the points of contact for the working side, or stroke side, of the cam. For the follow side, transfer the same graduation in reversed order to the radial arc DE, then swing these graduation points on to the proper radial arc and with the cam-ball radius describe the points of contact for the follow side of the cam.

The circle H represents the center of the stroke of cam ball and corresponds with the line JK, in Fig. 2. Now using the circle H to locate the center of the stroke for the 4½-in. cam, transfer to the arc JK the graduation for this cam.

The arrow in Fig. 3 indicates the direction of movement of the cams and therefore plainly shows the stroke side. For reasons already given, the finer graduations on the stroke side should be toward the outer periphery, and the coarser graduations nearest the center or hub.

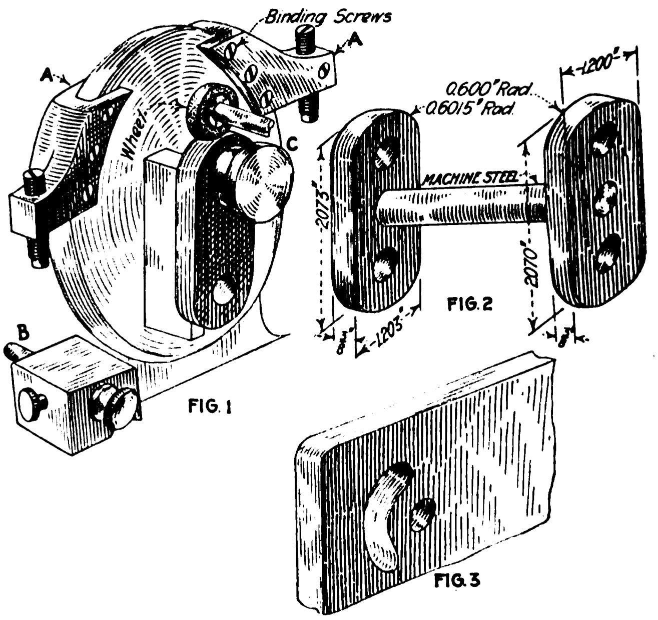
In cams thus designed an arrow should be cut into the periphery of the pattern to indicate the *direction in which the cam should operate.*

Precision-Gage Manufacture

By Gustave A. Remacle

When constructing gages that contain radii such as those shown at Fig. 2, the bench lathe is used for grinding the radii. Fig. 3 shows another form of gage that is ground in a similar manner.

The adjustable stops A, Fig. 1, enable the operator to grind any desired radius without grinding into other parts of the gage. The stop pin B, Fig. 1, may be withdrawn, thus permitting the gage to swing on the faceplate with-



PRECISION-GAGE MANUFACTURING METHODS

out interruption. This is a valuable feature of this method of grinding a radius, as the operator, after withdrawing the stop pin B, may grind the disk C following each adjustment of the wheel while grinding the radius. By grinding the disk and measuring with the micrometer the radius is accurately determined. The manner in which the stops are fastened to the faceplate is shown at D, Fig. 1.

The gaging parts of Fig. 2 were machined to shape, allowance being left for grinding after hardening. The two holes were bored so that the centers were 0.870 in. apart. After hardening, the faces of the parts were ground. The holes were ground, care being exercised to have them both of exactly the same diameter and 0.870 in. from center to center. The two remaining sides were ground in relation to the holes, the same methods being pursued as described in preceding articles on similar operations. The parts were swung on the faceplate of the bench lathe and ground as shown.

The plug, which is firmly located in the faceplate, is a good fit for the holes in the gage parts and disk. The object of the disk may be readily seen. After each advance of the wheel toward the work, the disk is ground and then measured.

Motor-Truck Repair Shop with the Army in Mexico

By Hi Sibley

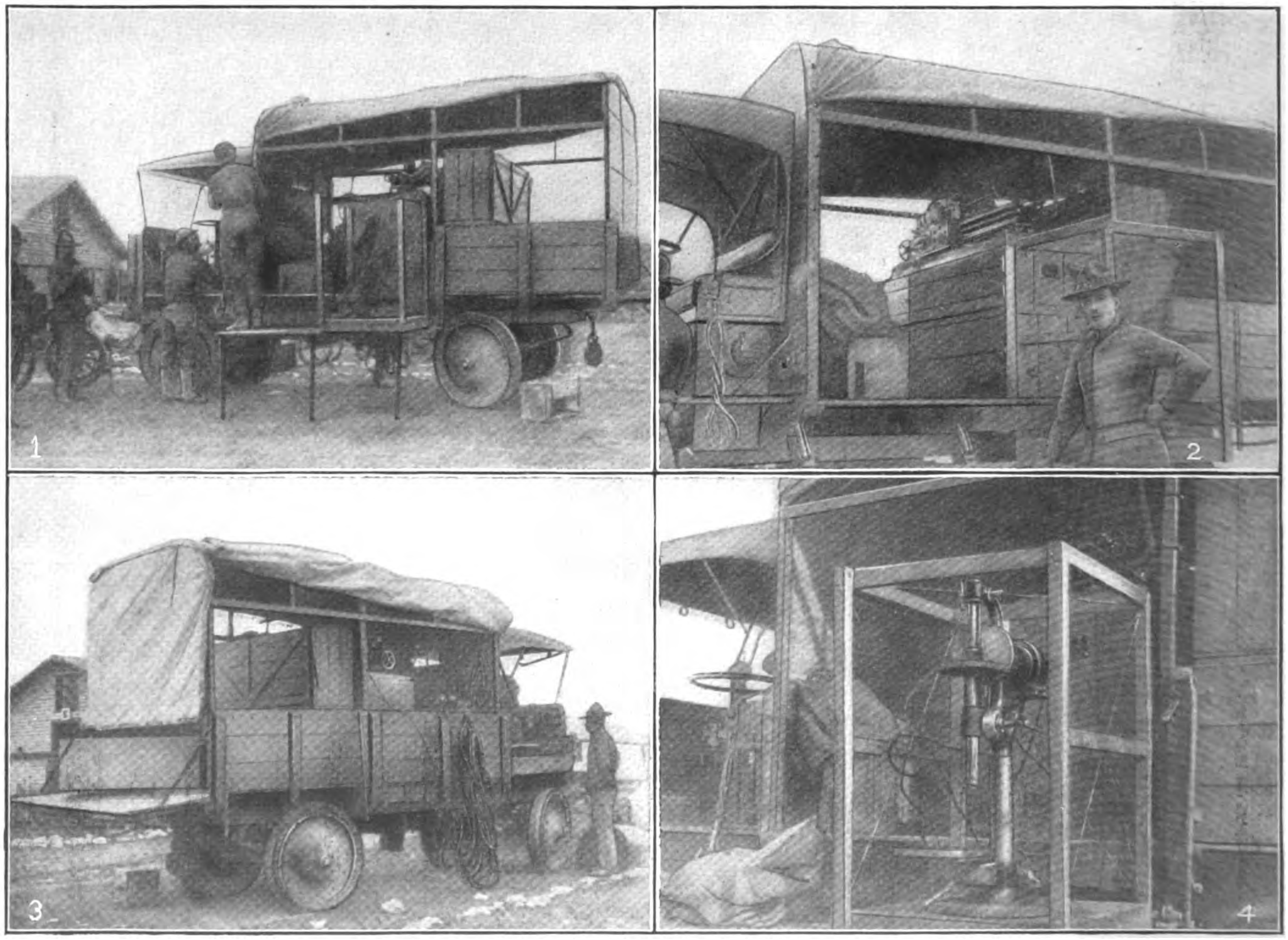
So much dependence is placed in the motor-truck service between the base of supplies in the Mexican camp and the army of the punitive expedition, over 150 miles (at this writing) across the Mexican border, that new squads of trucks in lots of from 25 to 50 are being added every few days to take care of the extended line of communication. It is said that without motor trucks to transport supplies the expedition would have been impossible.

A repair shop, completely equipped with tools and machinery to take care of aëroplanes as well as motor cars, has been set up in camp and it is an extremely serious breakdown that cannot be handled efficiently here. An interesting feature of this department is the field repair truck. A Jeffery four-wheel-drive "quad" truck is equipped with a Seneca Falls 9-in. lathe and Hisey-Wolf friction drill press (about 16-in.), both motor driven with current supplied by a generator belt driven from the truck motor. The lathe is stationary, just behind the driver's seat, and the canopy top is high to give the operator sufficient headroom while at work.

The drill press is demountable for traveling, but when in use is set upon a drop platform, which is folded up against the side of the car during a trip. The rear half of the truck is fitted up as a combined stock and tool room, and here, systematically arranged in neat drawers and lockers, is a large assortment of tools and parts.

Thanks to the high quality of the American trucks in daily service between camp and the front, to date there has been no call for the repair truck to do any work on the road, but such contingency might arise.

The pictures show, in Fig. 1, the field repair car, with folding platform for drill press, this being covered with canvas to protect it from rain and dust storms frequent in this section. Fig. 2 shows the lathe and lockers with rheostat at side of driver's seat. Fig. 3 gives a right-side view of the field repair car, while Fig. 4 shows how the drilling machine is mounted on the platform.



MODERN MOTOR MACHINE SHOP ON THE MEXICAN BORDER
Fig. 1—Motor-truck repair shop. Fig. 2—Showing the lathe in the front end. Fig. 3—The other side of the outfit. Fig. 4—The sensitive drilling machine ready for business.

Making Patterns and Castings for the Small Shop

By John H. Van Deventer

SYNOPSIS—What to avoid is even more important to know than what to do. This article throws cold water on the ambition of the small-shop owner who is thinking of operating his own foundry. Patterns also come in for their share of rapping.

A foundry is a handy thing to have in connection with a big shop—you can blame most mistakes upon it. This abode of the sand rammer has always been a convenient "goat," and many a shop foreman would lose his job if deprived of its unconscious support when it comes to excuses for spoiled work.

When the time clerk trots down the line with a job that took an hour and a half longer than it should, what is more easy and soothing than to tell him that the cast-

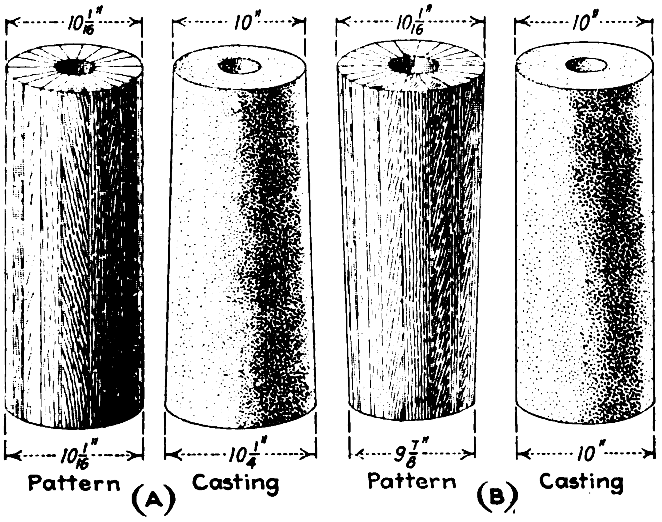


FIG. 1. TOM COOPER'S EXPERIENCE WITH ROLLS

ing was hard and sandy and that you think some cuss over in the foundry must have slipped a couple of files into the cupola? When the old man sits on your neck because a machine is three days overdue, what will change a disorderly rout into a glorious retreat more quickly than to tell him that the frame pattern was rapped so large that it required three cuts to get it down to finishing size? When a pulley or gear arm has cracks in it, how is it possible for these to have occurred in the casting anywhere but in the foundry where it was made? In one large shop with which I am familiar there is a saying as follows: "A slight error in the designing department, a mistake in the machine shop, a d—— big blunder in the foundry."

While a foundry is so convenient in this respect, aside from its capacity to deliver castings, it is usually an expensive luxury when attached to a small shop. When castings can be bought on contract as cheaply as is possible nowadays, it is foolish to assume a new burden of responsibility with the prospect of such a slight saving as that between the cost to make and the cost to buy, especially where the castings that are bought need not be paid for unless good, while those that are made must be paid for whether good or bad.

One of the supposed advantages of having your own foundry is in being able to get castings on time, but those who have foundries have come to believe that this advantage is not inseparably affixed to them. If the small-shop man is really looking for trouble, let him add the duty of a foundry superintendent and metal mixer to his already numerous and diversified duties and learn the 39 reasons why a casting can come out bad, starting with too high a barometric pressure and ending with too hard sand ramming, and he will feel as if he had his hands full.

There are of course exceptions to this even in the small shop. Some isolated cases exist where a foundry that can take no more than one heat a week will make a profit. But this is due to unusual conditions, such as the absence of competition; and since the majority of our small shops are in fairly close touch with competition, it does not apply in general.

There are some small-shop owners who think to add to their volume of business by adding to the number of

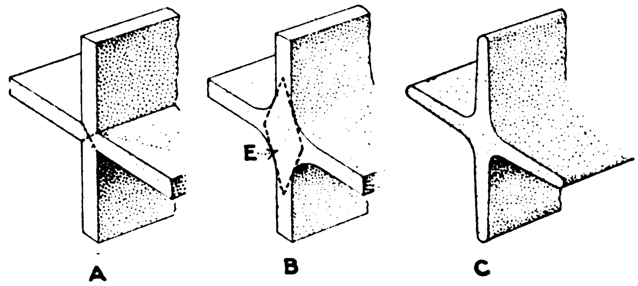


FIG. 2. TROUBLE WITH NOT ENOUGH AND TOO MUCH FILLER

departments in their plant. Not satisfied with an ordinary machine shop, they must have a foundry, blacksmith shop, pattern shop, nickel-plating department and what not. One shop owner of my acquaintance was doing a total volume of business of less than $12,000 a year and yet kept adding one department after another. Most people find it hard to support simply a machine shop on this amount of annual business, let alone extending it over a blacksmith shop, foundry and pattern shop. In addition to spreading the money very thin, the capacity of an ordinary human being must be stretched to the breaking point when he has to look after such a great variety of things. You will find the most successful shops are those that find out what they can do to best advantage and then cut out everything else as much as possible.

The same reasoning applies to making patterns. It is hard to get some men to realize that this is a special trade in itself. Unless a man is in daily touch with foundry conditions, knows foundry problems and has had years of experience with them as well as with his own trade, he is not fitted to make a real pattern. What I mean by a real pattern is one for a piece of work that counts for something, not the ordinary odds and ends of junk required about the shop from time to time, which may be made from whatever is at hand.

Old Bill Higgins, of Vermont, knew these facts as well as anyone and yet insisted on making his own patterns. But then he was a man who ran in unusually good luck. He said that to get a good casting you must have a good pattern; to get a good pattern you must have a good design; to get a good design you must have a good designer; and to get such a man you must have a lot of luck, so the whole casting business resolves itself into a matter of luck anyway, whichever way you look at it. Whereupon he would proceed to make a pattern that violated all the laws of nature. He would put the draft upside down and the cores inside out, mold it in too small a flask in the wrong kind of sand, ram it too hard and pour it too cold—and get a good casting!

Sometimes the carpenter finds that it falls to his part to make the small-shop patterns. They tell of one such wood butcher, newly hired by a small-shop owner, who, when told to put a little more draft on the pattern he was making, opened the window in front of the bench a bit wider!

Tom Cooper thought he knew enough to make a pattern for a plain cylindrical roll. He botched together a pattern such as shown at *A*, Fig. 1, allowing $\frac{1}{16}$-in. diameter for shrinkage. He sent this over to the nearest foundry with instruction to cast it on end, so as to get the surface clean all around. He was quite surprised on receiving the casting to find that one end of it was larger than the pattern. He jumped on the foundryman for rapping the pattern on this job with a sledge hammer, but got a quick come-back combined with the information that he should have made allowance for the pressure due to the head of liquid iron, which had expanded the mold at the bottom. After some experimenting he found the way to get a straight casting by making the pattern tapered, as shown at *B*. But he used up several hundred feet of good pattern lumber and a lot of time finding this out.

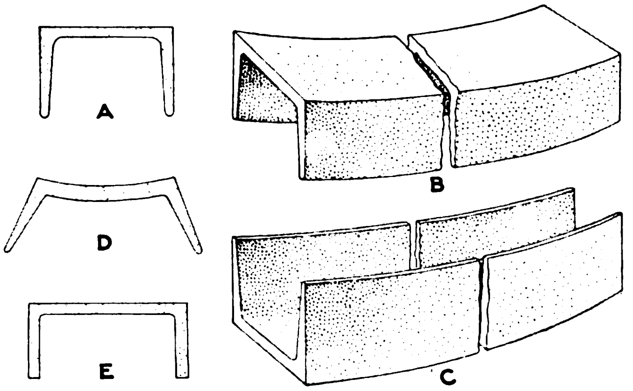


FIG. 3. CAM CUT DIFFERENT EVERY TIME IT WAS MADE

A JOB THAT BOTHERED TOM COOPER

Another little job that bothered him some was a pattern of which there were several + sections. Tom first made these as illustrated at *A* in Fig. 2 and got his pattern back in short order with a request to put fillets in the corners. He did so in the way seen at *B* and was shocked to find that too much fillet is as bad as too little, for the central portion was so heavy in comparison with the ribs that the unequal cooling set up heavy strains that resulted in cracks. Finally, the foundry owner took pity on him and told him to make it as shown at *C*, so that there would be a gradual change in the width of sections from one part to another. But while fussing around with these things, he overlooked a bad error in a machine for his best customer, and it was shipped without remedying the defect.

Not yet having his fingers badly enough burned, Tom tackled a pattern which had a channel cross-section, like that at *A* in Fig. 3. This pattern was straight, to be sure, but the casting came to him as hollow as an empty stomach, looking quite like the illustration at *B*. He called up the foundry on the phone, but dropped the receiver in a hurry when the foundry boss told him that he did not pay his men to furnish brains for amateur pattern makers. He sent the pattern to another foundry and got back a casting bent in the opposite direction, like the one shown at *C*. Then he changed the pattern a bit, thinning the metal at the center and thickening it at the ends. The casting which resulted, shown at *D*, reminded him of a dog stretching after a nap. In desperation he gave the job to a pattern maker, who solved the problem by thickening the ribs as at *E*.

A mistaken belief is a hard thing to kill, and Tom's belief in his pattern-making ability was not yet dead.

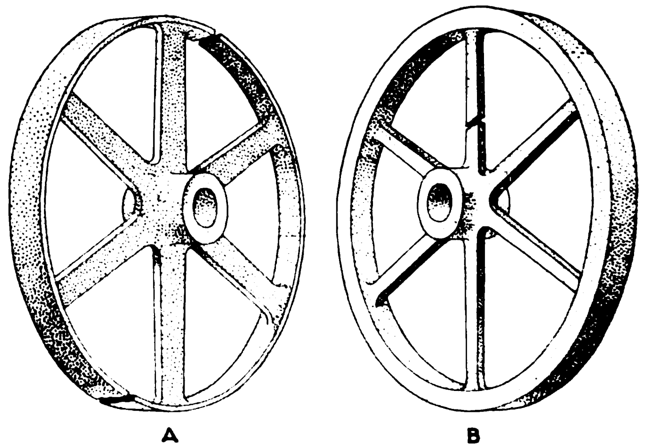


FIG. 4. CURING ONE DISEASE BROUGHT ON ANOTHER JUST AS BAD

even after such a severe shaking up, so he tackled a pulley.

A cast-iron pulley is one of the most innocent appearing objects, but beneath its honest sandy skin it contains a heart more full of stresses and strains to the square inch than anything else one can imagine. First, Tom made the rim light, as in Fig. 4 at *A*, so that it would not require a heavy cut for finishing. As a matter of fact it did not require any, meeting its finish while cooling in the sand. Then he made the rim heavy, so that this would not happen again, but unfortunately, with the results shown at *B*, the arms breaking this time instead of the rim. He lightened the rim a bit and made the arms a little heavier, but found that, although the casting looked good, the arms would snap under the slightest provocation, the hub thickness being much too great for equal cooling. Finally, it dawned upon Tom that he did not know much about pattern making and that it would be cheaper for him to have the few patterns he required made by someone who knew how.

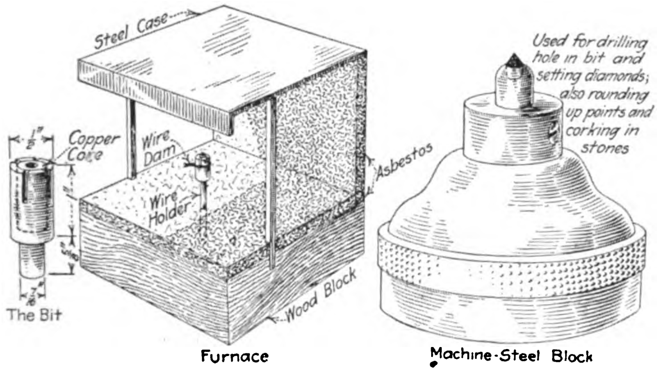
Not only with reference to making patterns and castings, but with almost everything else the following should be remembered: A man can know nearly all there is to know about one thing, he can know a great deal about a few things or he can know a little about a great many things. Take your choice, but remember that success will come only with the proper choosing.

Setting Diamonds

By O. F. Philler

For settings, or "bits," for small stones I use a piece of $\frac{5}{16}$-in. annealed copper wire about 1 in. long, driven into a hole in the end of a piece of $\frac{7}{16}$-in. cold rolled. For larger stones I use $\frac{1}{2}$-in. cold rolled with $\frac{3}{8}$-in. annealed copper wire about 1 in. long inserted in the end.

A hole is drilled in the copper to receive the diamond. Two saw slots, at right angles to each other, are put in to the bottom of the hole. The diamond is dropped in,



METHODS OF SETTING DIAMONDS

and by reaching in through the slots with a pick, the stone is turned over until the proper face is exposed. The stone is held in this position by pressing down on it with a small tube. With an automatic center punch the four copper walls are calked in around the diamond.

After the stone is anchored, the outside steel walls are pinched in with a pair of gas pliers. The stone and setting are placed in a coiled-wire holder and brazed, an ordinary 1-pt. gasoline blow-torch furnishing the heat. The slots act as vents and permit the solder to surround the stone completely. A coil of soft wire is wound around the setting just below the slots, to prevent the solder from running over the entire bit. Silver solder is used, with borax as a flux.

After the setting has cooled, the coil of wire is turned off in the lathe, and the end is faced off and rounded down so that the point of the stone is exposed a trifle. The setting is placed in the holder shown and the copper again calked with a set and light hammer. It is polished with a fine file. The reason for using the copper core in the setting is that it is easier to close for anchoring.

After the work is brazed, it is one solid mass. I generally use the same bit for resetting, by sawing it off just below the stone. I can center up and reset a stone ready for use in from 45 min. to 1 hr.

Boring and Planing Small-Car Bearing Brackets

The Standard Dry Kiln Co., Indianapolis, Ind., makes a great many brick and lumber trucks. The bearings for some of these are carried in cast-iron brackets as at *A* and *B*, Fig. 1. The bracket is placed in the fixture over the pin *C*. The fork *D* is run up, and the fork ends are thrust through the two side flange holes. The fork completely contacts with the rounded part of the bracket and holds it securely against the locating block while the hole is bored out with the piloted tool *E*.

The fork has a quick in-and-out action, making it unnecessary to turn the crank *F* more than a few times. The quick movement is accomplished by lifting up the hooked latch *G*, as shown, and moving the crank and fork

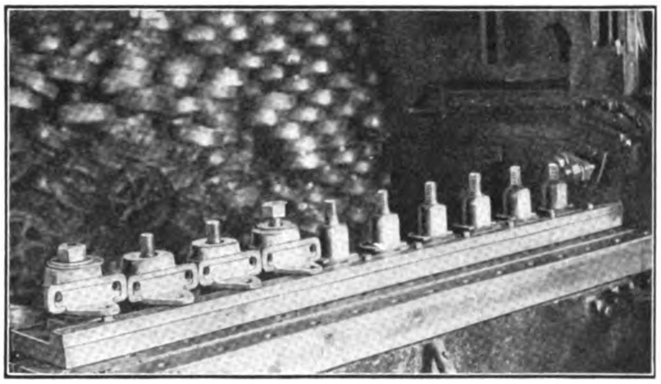


FIG. 3. GANG PLANING FIXTURE

in or out. The various parts are illustrated in working position in Fig. 2, but without the casting in place, in order to make clear the positions. The boring tool is set into its guide bushing at *H*; and the latch holding the fork and crank is shown down, as it is used while working.

The bolting flanges of these brackets are planed, as shown in Fig. 3. The fixture will hold ten brackets at a time. The bored bearing hole of the bracket fits over a holding plug, and it is located by means of a pin that fits into the hole in the triangular flange as shown.

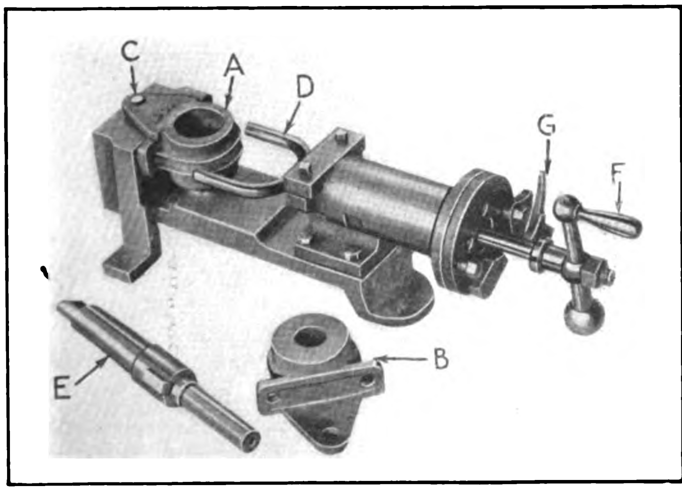


FIG. 1. CAR BEARING BRACKET-BORING FIXTURE

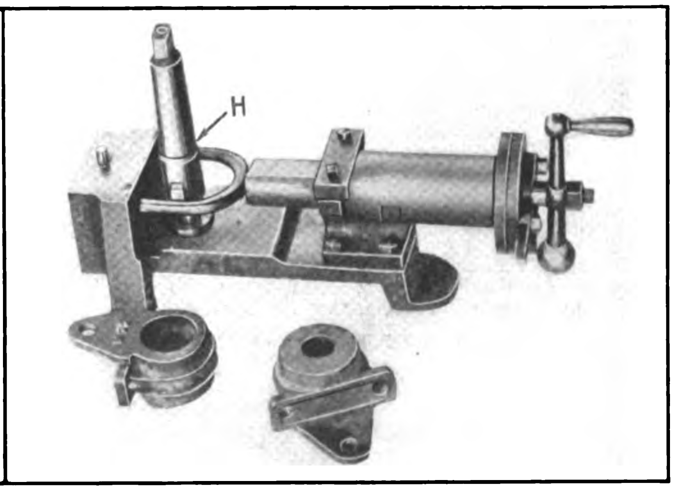


FIG 2. FIXTURE WITH PARTS IN WORKING POSITION

Punch, Die and Jigs Used in Machining Press Details

By Robert Mawson

SYNOPSIS—When making this printing press, not many punchings are required. In this article, however, one interesting element used and the tools employed are described. This punch and die pierces and blanks in one operation with a minimum amount of waste material. Three simple jigs are also shown which have, however, been found to be economical in operation, producing interchangeable parts. The castings are mostly rough when drilled, so that adjustable means must be employed in locating them.

The two-sheet rotary printing press illustrated on page 58 is manufactured by the United Printing Machinery Co., Woonsocket, R. I. Some of the jigs and fixtures used in making this press were shown and described on pages 138, 232, 458 and 492. In this article are illustrated and described a punch and die and jigs used in making and machining four other details used on the same press. These, like the ones previously shown, are examples of modern economical and small-tool design and construction.

The punch and die illustrated in Fig. 2 is a well-designed tool, as it locates one part while another is being blanked. The end of the punch rounds the end of the second part while simultaneously punching the first.

The jig used for the tumbler pin lever bracket employs a sliding bar to hold it after the casting has been located against a V-block. A screw that is tightened through the bar against the casting keeps it in position.

The jig seen in Fig. 6 is of the cover type. After the pieces have been placed in the jig, they are located by an adjustable setscrew. The cover is dropped down and fastened with a thumbscrew. A knurled-head screw through the cover holds the piece firmly.

The jig for the detector finger holder is of a simple type. The rough casting is placed on a plug, and a setscrew at the end holds the part securely in position.

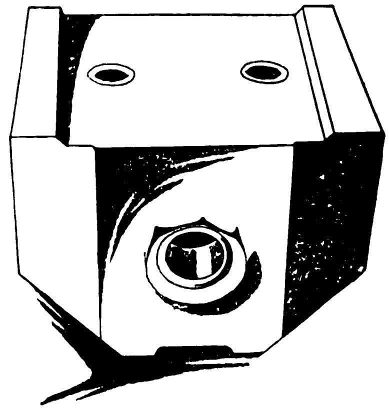


FIG. 4. DRILLING AND REAMING JIG

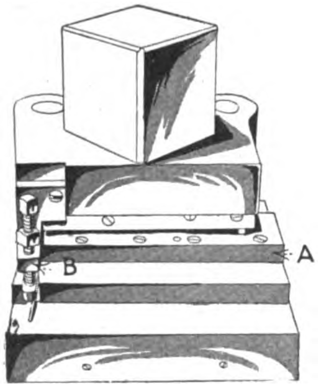


FIG. 2

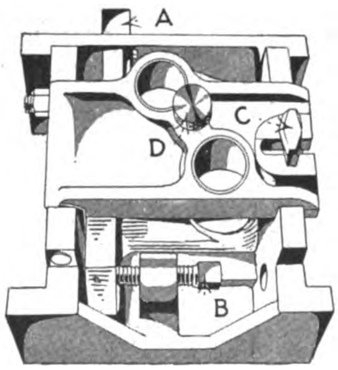


FIG. 6

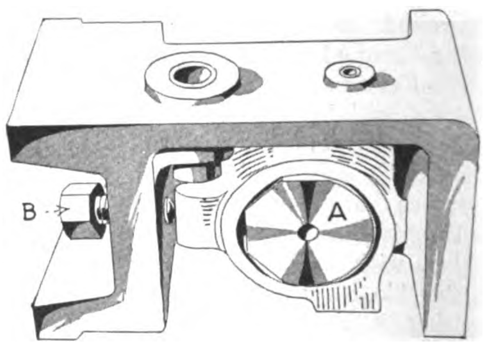


FIG. 8

PUNCH, DIE AND JIGS USED IN MACHINING PRINTING-PRESS DETAILS, WITH WORK IN POSITION

FIGS. 2 AND 2-A

Operations—Piercing and blanking feed gage rest blade, Fig. 1. The stock, which comes in a strip, is fed into the punch at A against the stop B. The punch is then made to descend, and the piece is pierced and blanked in one operation. It will be observed that the end of the punch when blanking also punches the rounded edges required on the slot. The punch is then raised and the part pushed along out of the die; and as the punch is made to descend, the strip is again located by the stop actuated by the spring shown.

FIGS. 4 AND 4-A

Operations—Drilling and reaming tumbler pin lever bracket, Fig. 3. The milled casting is placed in the jig, and the bar, shown in Fig. 4-A, is slid into position. The casting is located by a V-block inside of which the circular boss of the casting fits. A screw through the bar, when tightened, holds the piece securely.

Holes Machined—Two $\frac{25}{64}$-in. drilled, one $\frac{43}{64}$-in. drilled and reamed $\frac{11}{16}$ in.

FIGS. 6 AND 6-A

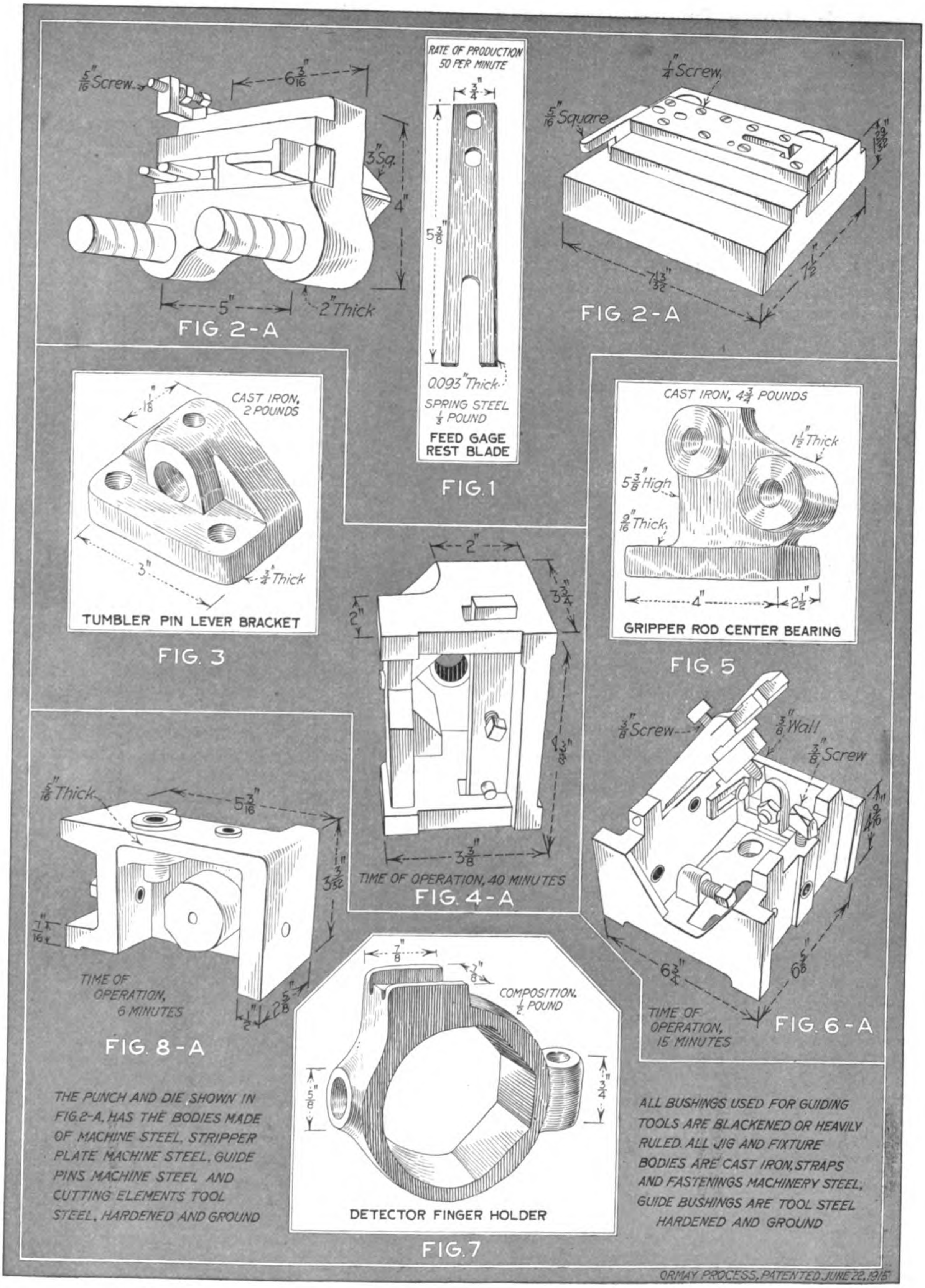
Operations—Drilling and reaming gripper-rod center bearing. The milled casting is placed in the jig and is located against an adjustable setscrew and forced against the side of the jig with the wedge A and setscrew B. The cover is then dropped down and fastened with the thumb-screw C. The knurled-head screw D when tightened holds the casting down in the jig.

Holes Machined—Two $\frac{33}{64}$-in. drilled, one $\frac{5}{8}$-in. spot drilled and reamed and two 1-in. holes are spot drilled and reamed.

FIGS. 8 AND 8-A

Operation—Drilling detector finger holder, Fig. 7. The rough casting is placed on the plug A, and the screw B bearing against the lug of the finger holder fastens it in position for the drilling operations.

Holes Machined—One hole drilled to suit No. 8-32 tap and one $\frac{5}{16}$-in. drilled for $\frac{3}{8}$-in. U.S.S. tap.



DETAILS OF PUNCH, DIE AND JIGS USED IN MANUFACTURING PRINTING-PRESS PARTS

Organizing for Industrial Preparedness*

By Spencer Miller†

The President of the United States, Woodrow Wilson, speaking from his intimate contact with foreign affairs, recently said, "There may come a time when I cannot preserve both the honor and the peace of the United States." He also urged that we should be "very adequately prepared, not for war, but for defense."

Both ex-Presidents Taft and Roosevelt have declared for the immediate and adequate preparedness of our army and navy. Our highly trained army and navy experts, whose life work entitles them to speak with authority, have been most earnest for far more effective military defenses. The public press, reflecting largely public opinion, is overwhelmingly in favor of adequate preparedness.

With so formidable an array of authoritatve opinion engineers patriotically, quietly and earnestly ask the question, "What may we do to serve our country?" Engineers are for peace with honor and will make personal sacrifices to insure it.

The United States Naval Consulting Board

It was a proud day for the engineers and scientists when Secretary Daniels of the United States Navy Department invited Thomas A. Edison, our own society and 10 other engineering and scientific societies to form a civilian advisory board of 23 members to aid in mobilizing the engineering and industrial world for preparedness. This invitation was eagerly accepted, and the United States Naval Consulting Board is now fully organized with Mr. Edison as chairman. Ten members of our society are members of this board, two representing it officially.[1] This board serves without monetary compensation, even paying its own expenses.

The Naval Consulting Board has resolved itself into committees, one of which, headed by Howard E. Coffin, member of this society, is the Committee on Production, Organization, Manufacture and Standardization. This committee formulated a plan for aiding in organizing the industries for preparedness. This plan, laid before the President of the United States, prompted him to invite the five leading engineering societies, whose combined membership is about 35,000, to effect such an organization. This he did by writing identical letters to each of the following societies: The American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Electrical Engineers, the American Institute of Mining Engineers and the American Chemical Society.

The President's letter to our society, dated White House, Jan. 13, 1916, reads as follows:

> The work which the American Society of Mechanical Engineers has done, through its members on the Naval Consulting Board, is a public service which is deeply appreciated. It has been so valuable that I am tempted to ask that you will request the society to enlarge its usefulness to the Government still further by nominating, for the approval of the Secretary of the Navy, a representative from its membership for each state in the Union to act in conjunction with representatives from the American Institute of Mining Engineers, the American Society of Civil Engineers, the American Institute of Electrical Engineers and the American Chemical Society, for the purpose of assisting the Naval Consulting Board in the work of collecting data for use in organizing the manufacturing resources of the country for the public service in case of emergency. I am sure that I may count upon your cordial coöperation.
>
> (Signed) WOODROW WILSON.

This letter appeared everywhere in the public press and was received with a glow of patriotism in the hearts of engineers generally.

The President's Invitation Accepted

Each society named has accepted the President's invitation. Each has selected one director from every state of the Union, for the approval of the Secretary of the Navy. The five directors in each state will constitute a Committee of State Directors for Industrial Preparedness. These State Directors will report to the Naval Consulting Board through the committee of which Mr. Coffin is chairman.

The immediate work of these State Directors will be to obtain an accurate inventory of all the facts necessary to be known to the army and navy of the resources of our nation to supply munitions of war in case of need.

To obtain this census the State Directors will be assisted by the members of each of the five representative societies residing within the state. In many states there are more members than industries in which the army and navy may be interested. This indicates that this census will be rapidly completed.

The importance of such a census can scarcely be overstated. It has been estimated that for every million of soldiers and sailors at the front at least three million of workers will be needed to maintain them efficiently with the necessary implements and supplies of warfare.

Major General Leonard Wood, U. S. A., estimates that a serious war would require at least 2,000,000 men. Under such circumstances 6,000,000 men would be required for producing munitions of war. Some statistics about wars in the United States follow:

War of the Revolution (1775-83)—Number of troops	309.791
War of 1812 (1812-15)—Number of troops (including navy)	576,622
Civil War (1861-65)—Number of troops (including navy)	2,778,302
Cost of Civil War to date, including pensions (about)	$16,000,000,000
Present estimated wealth of the United States	$200,000,000,000
Present estimated population of the United States	100,000,000
Present estimated wealth per capita	$2,000
Public debt (less cash in treasury)	$1,027,000,000
Public debt per capita	$10
Appropriation in 1915, navy (about)	$145,000,000
Appropriation in 1915, army and forts (about)	$108,000,000
Cost of navy per capita	$1.45
Cost of army per capita	$1.08

David Starr Jordan, the eminent pacifist, recently said, "In all ages war costs all that it can." Benjamin Franklin observed, "War is not paid for in war time; the bill comes later." The Civil War cost about 16 billion dollars, or about as much as the whole estimated wealth of the nation at that time.

Have we any right to assume that a war with one or more first-class powers finding us unprepared would cost less than one-quarter of our national wealth—namely, 50 billions of dollars? Such a cost represents one-quarter of the wealth of each of our hundred million population on an average, to say nothing of lives lost and personal property destroyed.

To insure this country against successful invasion, a much greater navy is generally demanded. In fact, a

*Presented at New Orleans meeting of the American Society of Mechanical Engineers.

†Member of United States Naval Consulting Board.

[1] W. L. R. Emmet and the author.

navy superior to that of any nation save only England. Some declare even that our navy should exceed that of England, on the ground that we may have to fight two great nations at once. Today our navy costs about $1.50 per capita per annum, average. Even though our navy be doubled, we would only pay $3 per capita, average. Our per capita wealth is about $2,000. Is $3 per year a heavy tax on $2,000 worth of property, if such a tax would provide a navy adequate to defend us against successful invasion?

Schedule for Industrial Inventory

The term munitions of war covers the whole field of army and navy requirements—guns and ammunition, rifles and uniforms, food and blankets, tents and cooking equipment, automobiles and aëroplanes, battleships and submarines, coal and oil, medical supplies and hospital equipment, even mules and horses. Thus it will be apparent that this volunteer army of engineer census takers must needs visit woolen mills as well as machine shops, boot and shoe factories as well as foundries, coal mines as well as shipyards.

An elaborate printed form has been prepared for taking the industrial inventory. It will be "a strictly confidential, nonpartisan, nonpolitical and wholly patriotic inventory of our country's manufacturing and producing resources. The information given upon this form will be used by the United States Naval Consulting Board in aiding in effecting an industrial organization necessary to the plans for national defense. The information contained in these blanks is not to be used in any way to affect the business of the concern reporting or for comparison with any other report of any kind previously filed by it. The value of this patriotic work can best be insured by making this report complete in every detail. We must deal with the problems of an adequate national defense as we deal with the problems of our everyday business life. We must face facts—not theories. We must do now, in time of peace, quietly, efficiently and thoroughly, those things which all know must be done to achieve true industrial preparedness, and which, if postponed until an outbreak of hostilities, must result in tremendous losses in lives and money. The form properly filled out will give:

1. The names, post-office address, age and nationality of the officers and directors.
2. Capitalization, commercial rating and banking connection.
3. Description and location of plant, its possibilities for expansion, its fire protection.
4. The telephone and telegraph facilities of the plant.
5. Sources of raw material and its character.
6. Character of products, volume or tonnage and its value per annum—proportion shipped abroad.
7. If munitions of war have ever been manufactured, the quantity produced and ultimate possible capacity.
8. Character of labor—union, nonunion or open shop—number and nationality of employees.
9. If women are employed, and the possibility for further employment of women.
10. Transportation facilities—rail and water.
11. Under the heading "Agreements" appears the following, which is quoted in full:

AGREEMENTS

Will bid upon United States Army and Navy contracts in time of peace........

Will accept United States Army and Navy contracts in time of war........

Will accept minimum annual order (see Clause A)........

Clause A. Minimum order for annual production will be accepted with the understanding that such order will be restricted to that product for which the manufacturer's equipment is best fitted. Also, that such order shall be for only such small quantity of product as will insure familiarity with the work upon the part of the manufacturer's organization. The manufacturer agrees that this minimum annual order shall be put through the factory in regular course and in such manner that foremen and those holding positions of responsibility shall become familiar with the peculiarities incident to the manufacture of these goods. In time of war the manufacturer will be expected to concentrate upon this same product, and it is essential, therefore, that his entire organization, including purchasing, manufacturing, inspection, shipping, engineering, cost-keeping and administrative departments, be made familiar with the work. Minimum orders will not be of sufficient quantities to interfere with manufacturer's regular production.

Will accept payment in accordance Clause B........ (Wording of Clause B not fully determined at time of going to press.)

Will construct jigs and tools in accordance Clause C.......

Clause C. The manufacturer will agree to make and preserve one set of special jigs, tools, gages or fittings necessary for the production of these goods, and corrected drawings shall be kept on file in the engineering department of the plant covering such special jigs, tools, gages or fittings. In short, the engineering or designing department shall maintain at all times corrected drawings from which the shop may, upon short notice, construct the necessary equipment for quantity production.

Will enroll skilled labor in "Industrial Reserve" (see Clause D).

Clause D. In war as now waged the industrial force has become quite as important as the fighting army. Skilled mechanics in all lines of production work must be kept from enlistment in the regular army and must be retained in the factories, mills and mines for the production of munitions. It is essential, therefore, that the names of these skilled workmen be listed and that the men themselves be enrolled in the industrial reserve. Explanations and instructions as to the detail of such organization will be submitted at a later date. A button or other distinguishing mark will be supplied by the Government in the event of war to skilled workmen enrolled in the industrial reserve, and such enrollment will be considered to carry with it honors equal to enrollment in the fighting army. A Government card will be issued to each man enlisted.

Will agree to limit profits in time of war in accordance with governmental regulations (basis cost plus........).

Will insert clause in all civil contracts making them contingent upon governmental needs in time of war........

Will agree to restore existing labor agreements at close of war........

List any and all agreements now in force........

12. An inventory in detail of tools, furnaces, etc., and their capacity.

With the facts in this census properly collated we shall learn where the nation is weak and where strong. Not only will the Government be instantly enabled to determine where munitions can be obtained, but how rapidly. We shall also know from this inventory:

1. Whether America is independent of foreign countries for raw or manufactured war material and if not, wherein we are lacking and to what degree.
2. In what kind of munitions we have ample manufacturing facilities and wherein we must provide means for making up the deficiency.
3. Whether it is prudent for the Government to build new arsenals and other works in the central part of the United States.

Tools, Gages, Jigs and Templets

This inventory will probably show that many shops well equipped to manufacture ammunition will not employ the skilled machinist to make the required tools, jigs, gages and templets. Possibly then it will transpire that the most efficient plan would be for a government

factory to make standard gages, jigs and templets and lend or sell them to certain shops for use in the manufacture of shells, rifles, etc.

This work of industrial preparedness should serve to inspire our machine-tool builders to perfect and improve their product and perhaps to standardize their machine tools to the end that those who must needs purchase them would find an adequate and immediate supply available in case of emergency.

The various engineering societies contain in their membership men who could prepare most valuable papers on the subject of ammunition manufacture. For the present there may be many secret processes which for the time being may not be forthcoming in the way of books and papers, which, however, might be prepared in advance and held until the hour of need, when, through patriotic motives, they could naturally be published for the benefit of the nation at large. The old saying that "Necessity is the mother of invention" is now applicable to the nations at war, and it is reasonable to assume that they have discovered superior methods, processes and tools for the rapid and economical manufacture of shells, etc. The best method of overtaking such a lead would be by a combination of talent and experience such as might be brought about by a congress of ammunition manufacturers, assembled for the purpose of exchanging experiences, etc. The best way for the manufacture of each element should then be arrived at, and the widest publicity should be given to descriptions of such methods.

Fuels for Internal-Combustion Engines

Wholly aside from the needs of war, there is a growing demand for liquid fuels for automobile and aëroplane motors. An interesting and profitable inquiry might be directed toward securing other fuels than gasoline, such as grain alcohol from sawdust and other wood wastes, sugar-house waste and cornstalks. Here the chemist will find ample fields for investigation.

These State Directors will be an influence in every state by urging the military value of good roads, especially along and near tidewater, and they should not forget that the bridges be made strong enough for heavy automobile trucks and extra-heavy cannon.

Such an army of engineers census takers actively at work cannot fail to breed a better spirit of citizenship. Working without compensation, they will set an example of patriotism which is bound to be felt. This spirit of patriotism will be transmitted to the workingman producing war supplies. These workers are surely a part of the defensive force of the country and should receive adequate recognition as such.

Ex-Senator Elihu Root recently said: "Eternal vigilance is the price of liberty. The principles of American liberty today stand in need of a renewed devotion on the part of the American people. . . . I want to see in my country the spirit that beat in the breasts of the men at Concord Bridge—who were just and God-fearing people, but who were ready to fight for their liberty; and if the hundred million people of America have the spirit and it is made manifest, they won't have to fight."

Time Necessary for Cutting Off Shell Forgings

By A. H. Anger

Since the manufacture of shrapnel and other shells has lately become such an important industry in this country, a table conveniently arranged for determining the cutting-off time of shell forgings will no doubt find extensive use in the plants at present engaged in this class of work.

The accompanying table covers a wide range of speeds and feeds for cutting off shell forgings, and the constants given in the table are such that the product of the thickness of shell and the constant in the table will give the cutting-off time in minutes. The constants in the table are tabulated with respect to the revolutions per minute and the feed of tool per revolution. These constants give the time in minutes required for cutting off a shell forging 1 in. thick. So, if it is desired to find the time required for cutting off a shell forging of a given thickness at a certain speed and feed, it is only necessary to multiply the constant found in the table under the given speed and feed by the given thickness.

Thus, if we wish to find the cutting-off time for a shell forging 1½ in. thick at a speed of 40 r.p.m. and a feed of 0.03 in. per revolution, we multiply the value 0.833, given in the table, by 1½, which gives us 1.25 min. for the cutting-off time. It is an easy matter then to form an accurate estimate of the output of a cutting-off machine after allowance is made for handling the work into and out of the machine.

TABLE OF CUTTING-OFF TIME IN MINUTES FOR SHELL FORGINGS

Feed per Revolution	Revolutions per Minute 10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
0.005	20.000	13.333	10.000	8.000	6.666	5.714	5.000	4.444	4.000	3.636	3.333	3.077	2.857	2.666	2.500	2.353	2.222	2.105	2.000
0.006	16.666	11.111	8.333	6.666	5.555	4.762	4.166	3.703	3.333	3.030	2.777	2.564	2.381	2.222	2.083	1.961	1.852	1.754	1.666
0.008	12.500	8.333	6.250	5.000	4.166	3.571	3.125	2.777	2.500	2.273	2.083	1.923	1.786	1.666	1.563	1.471	1.389	1.316	1.250
0.010	10.000	6.666	5.000	4.000	3.333	2.857	2.500	2.222	2.000	1.868	1.666	1.539	1.428	1.333	1.250	1.176	1.111	1.052	1.000
0.012	8.333	5.555	4.166	3.333	2.777	2.381	2.083	1.851	1.666	1.515	1.389	1.282	1.191	1.111	1.041	0.981	0.926	0.877	0.833
0.014	7.143	4.762	3.571	2.857	2.381	2.041	1.785	1.587	1.428	1.299	1.191	1.099	1.020	0.952	0.892	0.840	0.793	0.752	0.714
0.015	6.666	4.444	3.333	2.666	2.222	1.905	1.666	1.481	1.333	1.212	1.111	1.026	0.952	0.889	0.833	0.784	0.741	0.702	0.666
0.016	6.250	4.166	3.125	2.500	2.083	1.785	1.562	1.389	1.250	1.136	1.042	0.961	0.893	0.833	0.781	0.735	0.695	0.658	0.625
0.018	5.555	3.704	2.778	2.222	1.852	1.587	1.389	1.234	1.111	1.010	0.926	0.855	0.793	0.741	0.695	0.654	0.617	0.585	0.555
0.020	5.000	3.333	2.500	2.000	1.666	1.428	1.250	1.111	1.000	0.934	0.833	0.769	0.714	0.666	0.625	0.588	0.555	0.526	0.500
0.022	4.545	3.030	2.273	1.818	1.515	1.298	1.136	1.010	0.909	0.826	0.757	0.699	0.649	0.606	0.568	0.535	0.505	0.479	0.455
0.024	4.166	2.778	2.083	1.666	1.389	1.191	1.042	0.925	0.833	0.757	0.694	0.641	0.595	0.555	0.521	0.491	0.463	0.438	0.417
0.025	4.000	2.666	2.000	1.600	1.333	1.143	1.000	0.889	0.800	0.727	0.666	0.615	0.571	0.533	0.500	0.471	0.444	0.421	0.400
0.026	3.846	2.564	1.923	1.538	1.282	1.099	0.962	0.855	0.769	0.699	0.641	0.592	0.549	0.513	0.481	0.452	0.427	0.405	0.385
0.028	3.572	2.381	1.785	1.428	1.190	1.021	0.893	0.793	0.714	0.649	0.595	0.549	0.510	0.476	0.446	0.420	0.396	0.376	0.357
0.030	3.333	2.222	1.666	1.333	1.111	0.952	0.833	0.741	0.666	0.606	0.555	0.513	0.476	0.445	0.417	0.392	0.371	0.351	0.333
0.032	3.125	2.083	1.625	1.250	1.042	0.892	0.781	0.694	0.625	0.568	0.521	0.481	0.446	0.417	0.391	0.367	0.347	0.329	0.313
0.034	2.941	1.961	1.471	1.176	0.980	0.840	0.735	0.653	0.588	0.535	0.490	0.453	0.420	0.392	0.367	0.346	0.327	0.310	0.294
0.035	2.857	1.905	1.428	1.143	0.952	0.816	0.714	0.635	0.571	0.519	0.476	0.424	0.408	0.381	0.357	0.336	0.317	0.301	0.285
0.036	2.777	1.852	1.389	1.111	0.926	0.794	0.695	0.617	0.555	0.505	0.463	0.427	0.397	0.371	0.347	0.327	0.308	0.292	0.277
0.038	2.632	1.754	1.316	1.053	0.877	0.752	0.658	0.585	0.526	0.478	0.438	0.405	0.376	0.351	0.329	0.310	0.292	0.277	0.263
0.040	2.500	1.666	1.250	1.000	0.833	0.714	0.625	0.555	0.500	0.467	0.417	0.384	0.357	0.333	0.313	0.294	0.277	0.263	0.250
0.042	2.381	1.587	1.191	0.952	0.793	0.680	0.595	0.529	0.476	0.433	0.396	0.365	0.340	0.317	0.297	0.280	0.265	0.251	0.238
0.044	2.272	1.515	1.136	0.909	0.757	0.649	0.568	0.505	0.454	0.413	0.379	0.350	0.325	0.303	0.284	0.267	0.252	0.240	0.227
0.045	2.222	1.481	1.111	0.889	0.741	0.635	0.555	0.493	0.444	0.404	0.370	0.342	0.317	0.296	0.278	0.261	0.247	0.234	0.222
0.046	2.174	1.449	1.087	0.870	0.725	0.621	0.543	0.483	0.435	0.395	0.363	0.334	0.310	0.290	0.272	0.256	0.242	0.228	0.217
0.048	2.083	1.389	1.042	0.833	0.694	0.595	0.521	0.463	0.417	0.378	0.347	0.320	0.297	0.277	0.261	0.245	0.232	0.219	0.208
0.050	2.000	1.333	1.000	0.800	0.667	0.572	0.500	0.445	0.400	0.364	0.333	0.308	0.286	0.267	0.250	0.236	0.222	0.211	0.200

Manufacturing 12-In. Shrapnel--IV*

By Robert Mawson

SYNOPSIS—The shells now receive the finishing operations. The balls, resin, powder and pellets are put in, and the manner in which this is done is here described. The adapter bottom, adapter and plug are also inserted and the shell finally weighed and passed. The shells are packed in individual packing cases after being covered with grease to prevent rust. A target is shown similar to that employed in testing some of the shells to determine the covering capacity of the balls when the shells were fired and exploded.

After the shell has been finally inspected and passed, the powder tube, adapter, adapter bottom and plug are inserted. The shell is then transferred to the loading department. The plug, adapter bottom and adapter are there removed. The spider, Fig. 121, is screwed into the thread at the open end of the shell. It will be observed that the spider is made with an $1\frac{1}{8}$-in. hole, which the powder tube fits, thus holding it central.

The shell receives ½-in. diameter balls, composed of lead and antimony, for about 4 in. of its height. Melted resin is then poured over the balls until they are entirely covered. On top of this is placed about 6 oz. of smoke compound. Another 4-in. layer of balls and resin is then added in a similar manner. This operation is repeated until the balls and resin come to approximately ½ in. from the top of the open end of the shell. The balls are fed into the shell through the funnel, as in Fig. 122. The resin is poured in as shown in Fig. 123.

*Previous installments appeared on pages 537, 581 and 625.

The reason for placing the balls and resin in the shell in layer form is to insure their cementing into a solid mass. As the shell is so large, if the balls were all inserted and then the resin poured in, the probability is that the resin would not reach between all the balls before solidifying. Under such conditions the mass would not be homogeneously held together; and when the shell was fired, it would act in a biased manner and its "flight" would not be true.

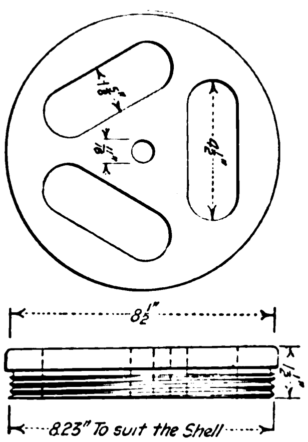


FIG. 121. SPIDER FOR HOLDING THE POWDER TUBE

Further, as all air is expelled from the shell by the resin filling the gaps between the balls, the explosive charge has less room to expand and the shell, besides being fired with a truer aim, also bursts with greater force. To insure the best results, it is found that the melted resin should be at a temperature of from 365 to 400 deg. F. Then the crevices between the balls are properly filled.

In Fig. 124 is shown the spider screwed into position in a shell ready for receiving the resin. Attention should be directed to the boss in the center of the spider, through which the powder tube fits, thus holding it in position while the resin is being poured. The spider is then removed, and the threads on the inside of the shell and adapter are covered with red-lead paint. The adapter

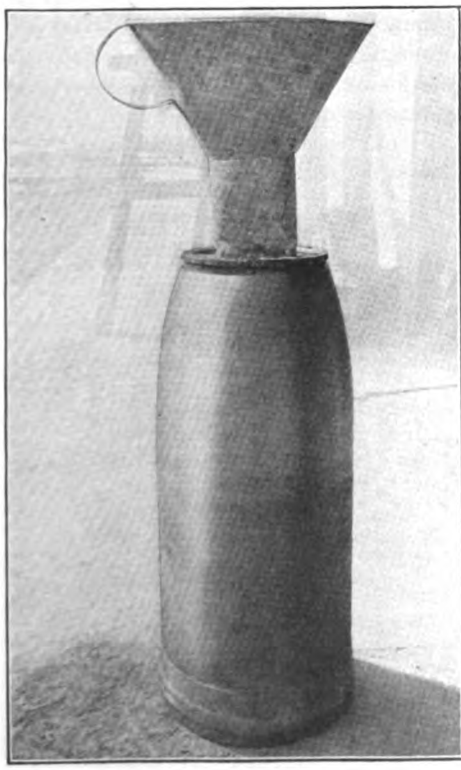


FIG. 122. FILLING SHELL WITH BALLS

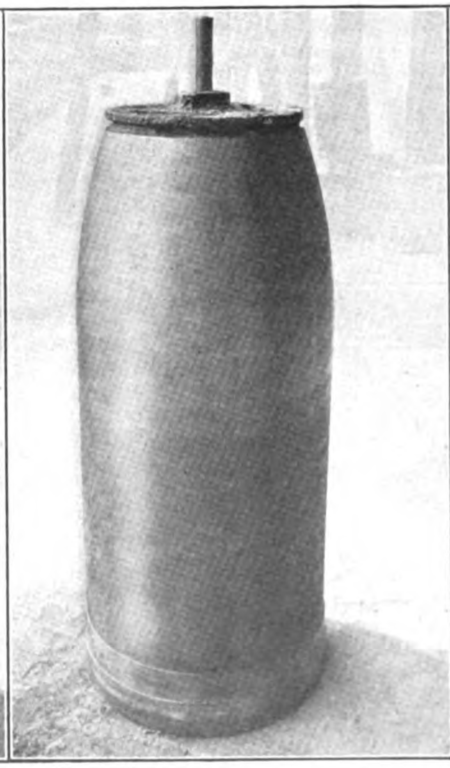


FIG. 124. SPIDER IN POSITION READY FOR POURING RESIN

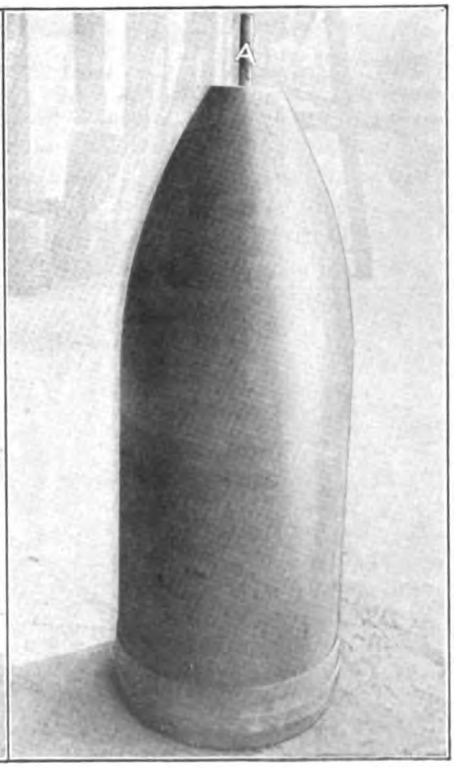


FIG. 125. FILLING UP ADAPTER WITH BALLS AND RESIN

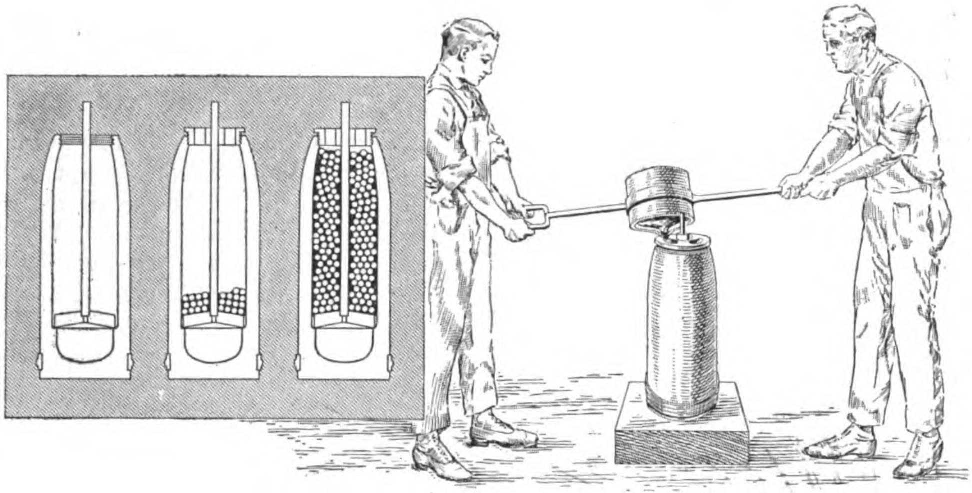


FIG. 123. OPERATION 19: FILL WITH BALLS AND RESIN
Equipment—Spider, funnel and resin-pouring pan. Production—Two men, 2 per hr. References—Figs. 121 and 122.

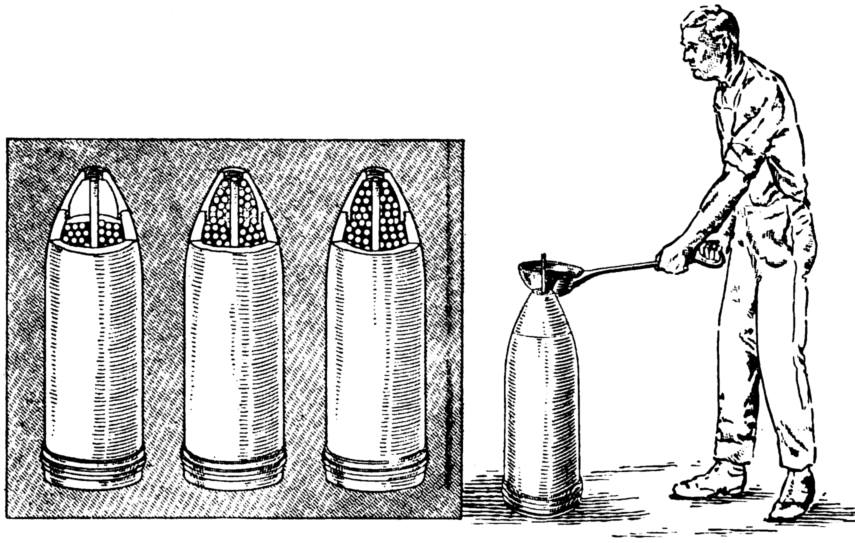


FIG. 126. OPERATION 20: FILLING ADAPTER WITH BALLS AND RESIN
Equipment—Plug to fit in top of powder tube and resin-pouring scoop. Production—Two men, 6 per hr. Reference—Fig. 125.

is screwed down, using the clamp, Fig. 34. More balls and melted resin are added until the shell weighs 729 lb.

In Fig. 125 is shown the shell set up ready for this loading. It will be observed that a plug A is placed in the top of the powder tube to prevent the melted resin from entering it. A view of the operation of pouring in the resin is given in Fig. 126.

The adapter bottom is placed in the adapter by the aid of the wrench, Fig. 127. It will be noticed that this tool is provided with a "tit" that enters the powder tube. The purpose of this is to hold the tube central while the bottom is being screwed down. The shell is left for about 4 hr., so that the resin will properly solidify and cool.

The funnel, Fig. 128, is then screwed into the end of the adapter. Powder fed into the funnel passes through the powder tube into the powder chamber. The funnel is afterward removed, and powder pellets are put into the tube. One purpose of the pellets is to prevent the powder grains from coming back against the fuse threads if the shell should be turned over. This precaution eliminates accidents that would result when the fuse is inserted, if powder grains were resting on the threads and the fuse was screwed down against them. The primary purpose of the pellet is, however, to convey the spark from the fuse to the powder chamber. Fig. 129 illustrates the funnel in position ready for pouring in the powder. This operation is shown in diagrammatical form by Fig. 130.

The plug is next screwed into the shell, which is then ready for the final weighing. In Fig. 131 one of the shells may be seen on the scales being weighed. This operation is also shown in diagrammatical form by Fig. 132. A number of shells being loaded with balls and resin are illustrated in Fig. 133.

The shells are covered with axle grease, to prevent rust, and are packed in individual cases, as in Fig. 134. The cover of the box is securely fastened down; and after the case has been properly marked, it is ready for its journey across the water. This operation is shown in diagrammatical form by Fig. 135. A detail of the packing case is given in Fig. 136.

It will be understood that the shell industry is new to most shops, and on a shell of such large size as described

FIG. 129. POURING POWDER INTO SHELL

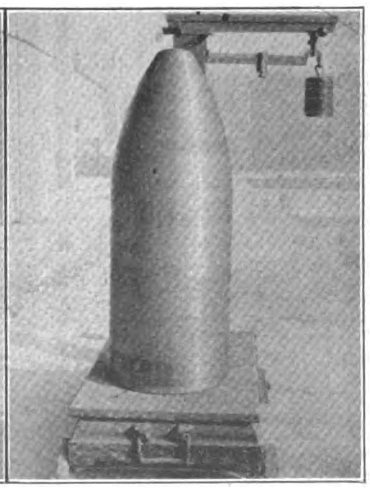


FIG. 131. FINAL WEIGHING OF THE SHELL

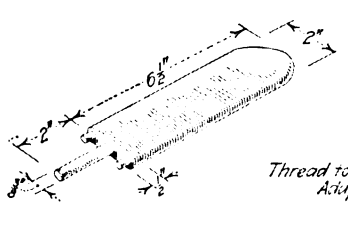


FIG. 127. SPANNER WRENCH FOR ADAPTER

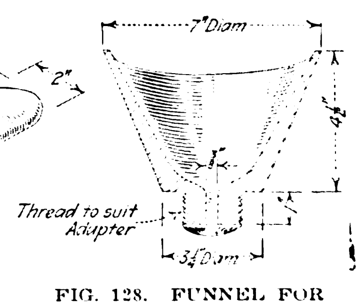


FIG. 128. FUNNEL FOR LOADING THE POWDER

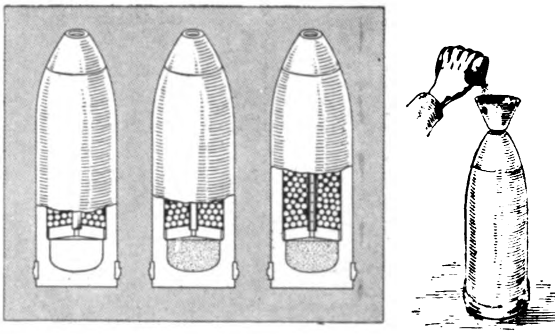


FIG. 130. OPERATIONS 22 AND 23: LOADING WITH POWDER
Equipment—Funnel to suit adapter end of shell.
Production—One man, 3 per hr.
References—Figs. 127, 128 and 129.

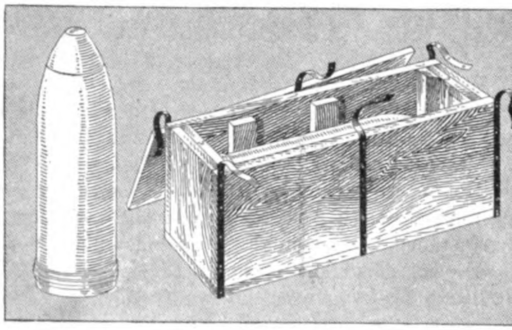


FIG. 135. OPERATION 25: BOXING THE SHELL
Equipment—Crane, truck and packing case.
References—Figs. 134 and 136.

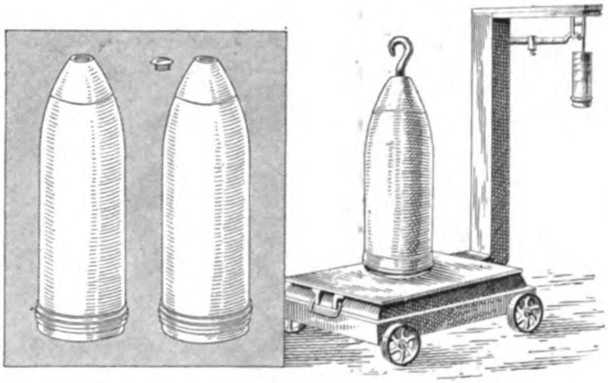


FIG. 132. OPERATION 24: FINAL WEIGHING
Equipment—Hook in shell nose; crane and scales
Reference—Fig. 131.

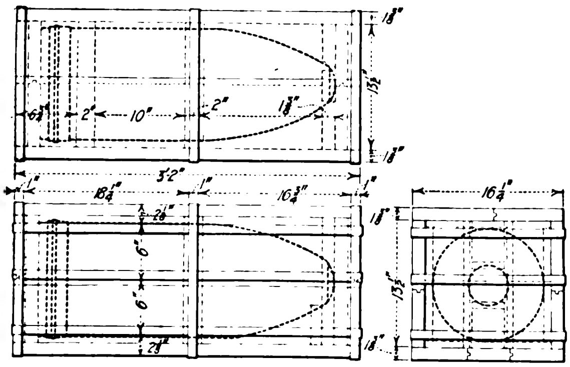


FIG. 136. DETAILS OF PACKING CASE SPECIFIED FOR THE 12-IN. SHRAPNEL

in this series some slight modifications in the machining operations will occur. However, the methods outlined enable the manufacturer to turn out shells in increasing quantity week by week and also meet the highly accurate requirements.

In the series of articles of which this installment is the concluding one it has been the aim to show the methods used in sufficient detail to act as a guide for any shop not already accustomed to shell-work requirements. It will be seen how the methods employed in making the 12-in. shrapnel differ in many respects from those previously described covering the smaller sizes. It is thought quite likely that the practice illustrated in the present instance will undergo changes as the large-shell work reaches a more abundant stage, notably in case hollow forgings become generally available in the 12-in.

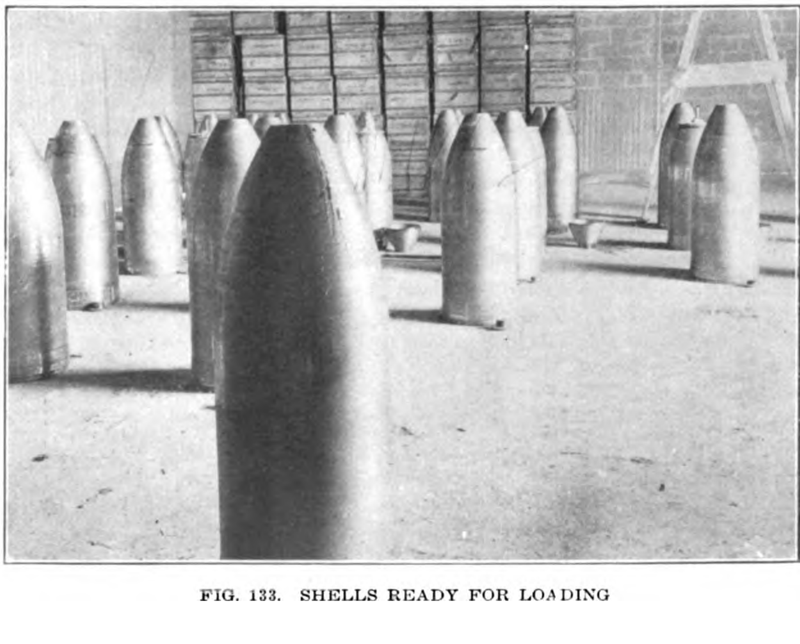


FIG. 133. SHELLS READY FOR LOADING

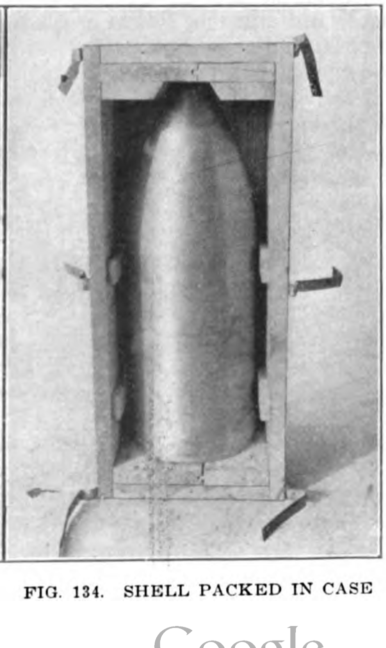


FIG. 134. SHELL PACKED IN CASE

Making Copper Rifling Rings

By Fred H. Colvin

Although the copper rifling ring used on the base of a shell to make it follow the rifling grooves in the gun barrel and secure the necessary rotation seems like a comparatively trifling part, it must be remembered that one of these rings is forced on every shell of every size. This fact makes their total number mount up to large proportions. The American Steam Gauge and Valve Manufacturing Co., Boston, Mass., was fortunate enough to secure a large quantity of copper tubes early in the war and is supplying bands to many who are making shells. Making rings is a comparatively simple operation, as it consists merely of cutting off the tubing into rings of the proper width; but when the product must be turned out by thousands, it becomes something of a problem to cut off the rings quickly and economically.

Two ways of cutting off are shown in Figs. 1 and 2. The first method uses a semispecial machine having a hollow spindle and a quick-closing chuck, together with a substantial cross-slide and a tailstock for stopping the tube in the proper position.

There is a power feed for the tube, which is fed against the stop at the right and then clamped by the forward lever. The tools in the cross-slide are then fed in to the work, the one at the right cutting a little in advance of the others. Each in turn is set somewhat behind its right-hand neighbor, as is usual in this kind of cutting-off work.

Each cutting-off tool is substantially held in a separate block, as shown, these tools being made of Dreadnaught high-speed steel, forged and ground on the face, as shown in Fig. 4. The groove has been found to prevent an excessive burr at the cut-off; the cutting edge is $\frac{5}{32}$ in. wide.

The cutting speed is set at 225 ft. per min., the lubricant being mineral lard oil charged with fire sulphur. On the small sizes the production is 250 rings per hour, while on some of the larger rings 110 per hour have been secured. The largest rings, as shown in Fig. 2, are cut on an engine lathe especially equipped for this work. To begin with, the tube is held in special chuck jaws, which are set out so as to first grip the tube on the inside, and then the setscrew in each jaw is screwed down against the outside of the tube. The end of the tube is supported in a substantial follow rest, which is bolted to the lathe carriage. The stop C is bolted to the other side of the

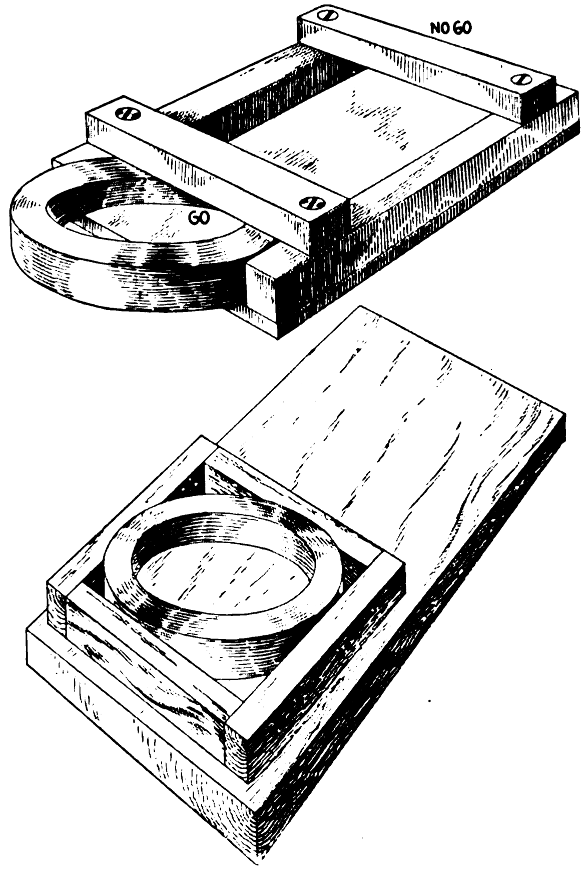
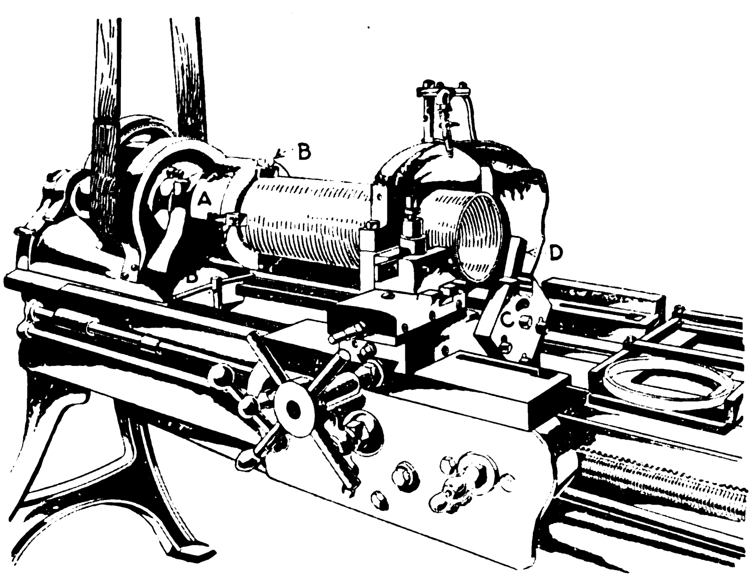
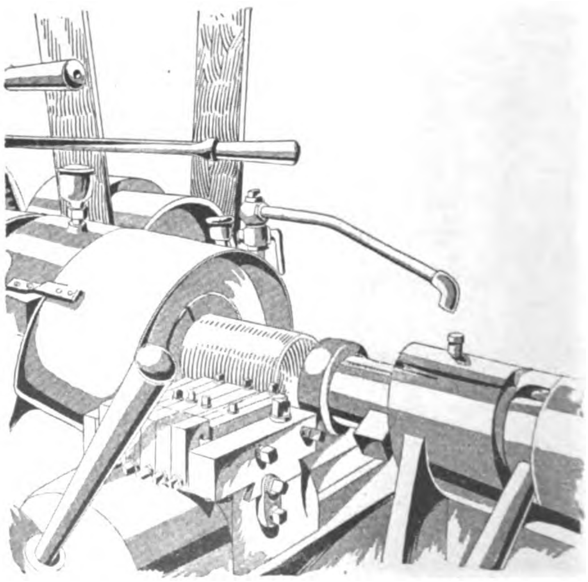


FIG. 3. GAGING COPPER RIFLING RINGS

carriage and carries the distant finger D, which forms the actual stop.

The lathe carriage is moved until D comes against the end of the pipe, the cutting-off tool then being in position to make the ring of the proper width. The stop is swung down out of the way, and the cutting-off tool is fed in





FIGS. 1 AND 2. TWO METHODS OF CUTTING OFF COPPER RIFLING RINGS IN THE LATHE

by means of the large cross-handle, shown. The same lubricant and cutting speed are used on this lathe as on the simispecial machine, and the results are extremely satisfactory. Those who have had experience in cutting copper and know its peculiarly disagreeable cutting

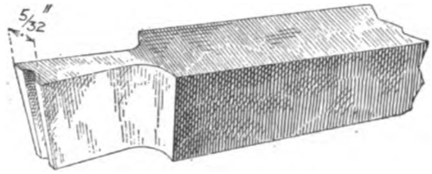


FIG. 4. THE CUTTING-OFF TOOL

qualities will appreciate the results obtained by the tools, feed and lubricants employed.

The rings are gaged by the simple device shown in Fig. 3, consisting of a steel plate with built-up sides and two crossbars of hardened steel, one forming the "go" and the other the "no-go" end of the thickness gage. In case a ring is a trifle too thick, it is placed in the shallow box built on the end of the board, shown below and the sides are taken down with a smooth file. It takes only a few judicious strokes of the file to bring almost any oversized ring to its proper thickness. While this method may seem somewhat crude, it obtains the desired results in remarkably quick time and prevents the necessity of moving the rings to a grinder or other machine.

Future of American Machine Tools in Belgian Market

By One Who Knows Belgium

Although it is early to forecast what the machine-tool business in Belgium will be after the war, it is generally admitted that immediately peace has been declared there will be considerable activity in all industries appertaining to railway material, building material, etc., in Belgium. The fact that a large number of machine tools have been taken out of the leading factories to Germany will undoubtedly create immediately a tremendous demand, and consequently there will be a very great opening for American and English manufacturers.

It is interesting, however, at first to consider what were the industrial conditions before the war. The majority of the metal-working factories in the country devoted their activities to the semifinished product; this was the dominating industry of Belgium. The fact has been confirmed in a speech made by Minister Francotte at the opening of the new factory of the Minerva Motor Co. in Antwerp a few years ago, in which he congratulated the promoters of the business on trying to extend the manufacturing capacities of Belgium in the finished article. He stated that, while Belgium was holding a considerable position in the world market for semifinished products, she was hardly recognized as an exporter of the finished article, and he urged Belgian manufacturers to devote more of their time and energy to the production of finished goods.

This situation was quite natural in view of the small area of Belgium. The home consumption was comparatively small, and in the world market Belgian manufacturers had to compete with big competitors such as America, England and Germany, all with considerable home consumption and able to reduce the cost of producing the various articles needed for their own countries by enlarging their capacities and exporting the surplus.

This situation may change after the war. As Belgium possesses a considerable number of skilled metal workers and a vast number of enterprising men, it is quite certain that many industries which have so far not flourished very greatly in Belgium will make great extensions, because in the allied countries preference will be given to the Belgian articles, provided they are produced at the same cost as in Germany and Austria.

Before the war the price of living in Belgium was rather moderate. Hence, wages were lower than in any other industrial country. It is to be assumed that after peace is concluded these conditions will still prevail proportionately and will be better than in England, France or Germany. Consequently, the lack of a home market will be compensated by the advantages arising from better labor conditions.

Steel Making an Important Industry

The manufacture of steel is one of the principal industries in Belgium, and machine tools in steel works are mostly of the heavy type. A great number of these machines formerly came from Germany, and among them are the punching and shearing machines with plate-steel frames. These were in great demand, and it might be advantageous for some of the American manufacturers to take up this line. I understand that one manufacturer has already started; it remains to be seen whether the freight conditions will allow these heavy machines to be imported from America.

Locomotive and car manufacturers also used machines imported from Germany. Lately, however, the heavier radial drills have been imported from England. The boiler and engine manufacturers, while having many machines made in America, used a considerable number of a heavier type made in Germany. The larger rifle factories, electric-motor manufacturers, automobile manufacturers, etc., had in their equipment a large proportion of American machines.

However, the vast community of manufacturers doing a medium or small amount of business formed the largest buyers of the cheaper grade of German and English machines. They did not give enough attention to the improvements of modern American and English machines and were mostly influenced by the first cost of the tools. Such manufacturers require the special attention of the American machine-tool manufacturer. They must be educated to the advantages of the labor-saving devices in American machines. After the war, while labor may be abundant in Belgium, it will be dearer than before. Consequently, much more attention will be paid to equipment that will enable the saving of this labor. This is one of the essential points of the campaign which American manufacturers will have to open as soon as conditions permit, and their arrangements should be such as to have one of their practical men on the spot, to demonstrate all the advantages of modern American tools.

As the greater part of the manufacturing plants in Belgium are owned by Belgians, it is certain that preference will be given to any machines or goods not of German make; and undoubtedly a great outburst of patriotism will take place after peace has been declared.

Before the war the Belgian manufacturers in general were not particular as to the origin of the goods they

were buying; but this situation no longer exists, and the users of machine tools will avoid as much as possible all buying from Germany or from German firms. Also, there were established in Belgium besides the German firms a certain number of other foreign dealers in machine tools. These firms were holding the agencies of renowned American and English manufacturers. It is a fact hereafter preference will be given by Belgian manufacturers to the Belgian dealers. As it is the duty of the builders of machines to please the buyer as much as possible, it stands to reason that the best policy for the American or English machine-tool manufacturers to adopt is to intrust their Belgian agency to Belgian firms of good standing.

Previous to the war the Belgian firms were not able to develop their capacity to the fullest extent, being hampered by foreign firms established in Belgium and holding agencies for several countries at the same time. Among original Belgian firms several were hard working and deserving of every assistance. They sometimes had strenuous struggles against the foreign competitors in Belgium, and it was not always the house that deserved the business that obtained it.

It is quite natural that the Belgian merchants know their market better than anyone else. They know how to deal with the consumer; they know his ways, his character and his peculiarities; they deal with him in his own language. Moreover, in the future all genuine Belgian houses will certainly not, if they can possibly help it, sell any machines made by the enemies of the country. In the case, however, of firms from neutral countries there will be no reason why they should not try to sell machines made in enemy countries, and they will consequently bring upon themselves the mistrust of the Belgian manufacturers.

Belgian Representatives Preferable

It is generally admitted that Belgium will be overrun by firms from neutral countries after the war is over, and they will try to swamp the market with any kinds of machines they can get hold of, whatever the origin. It would therefore be against the interests of American and English manufacturers to intrust their Belgian agencies to any such foreign firms.

Several large organizations seem to be formed in America for obtaining the agency of the leading American manufacturers for the European countries. Is it in the interest of American manufacturers to patronize such organizations? Some of them seem to have immense capital at their disposal, and manufacturers are of course the best judges whether it is to their advantage to place their agencies in the hands of such very powerful concerns. Aside from this, the selling organization of such firms is rather complicated, and the overhead expenses run up to a considerable percentage of the value of the machines. I believe that one large firm with a branch in Belgium had something like 17½ per cent. selling expense.

Now, is it right for the prospective buyers to pay such an extremely high margin for expense that could certainly be reduced if the concerns representing manufacturers did not handle so many different lines? It is quite natural that foreign firms having only a branch office in Belgium should have these heavy overhead charges, as they have to pay double office expenses.

If the American manufacturers arrange for the Belgian market with a firm whose head office is in New York, Paris or London, they will hardly be in direct touch with the Belgian market and consequently will not know so well the conditions there as if they were directly represented.

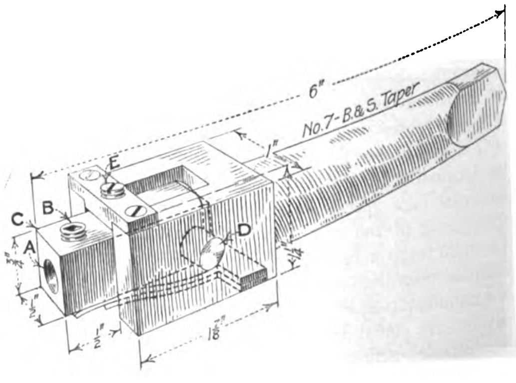
The direct representation by Americans is not to be advised, as the Belgian consumer has quite a different character and tendency from the average American salesman; as already stated, however, the latter may be of very great assistance as technical adviser to the Belgian firm, which is better able to smooth out differences arising from opposed views. Some American tool makers of repute have in late years kept a good technical man in Europe. This practice should be general, as the Belgian manufacturers doing a small business need a good deal of sound technical advice and are certainly not familiar with all the merits of American tools. In past years they have given preference to the cheaper German machines, simply on account of the price, and this attitude should and can be overcome more easily now than ever before. The opportunity should not be lost.

In conclusion it would be well for American and English manufacturers not to settle their agencies for Belgium without first completely investigating the aspirations and tendencies of the firms that solicit them. They should intrust their representation exclusively to good Belgian firms that will agree to sell nothing but American and English machines, as any other policy adopted by their agents would certainly ruin the business for the tool manufacturers.

Boring Head for Miller

By H. M. Darling

The accompanying illustration shows a boring head for use in the miller. Boring tools for this head are made of ⅜-in. drill rod and are inserted in the ⅜-in. hole *A*, being securely clamped by the screw *B*. The



BORING HEAD FOR THE MILLER

block *C* swings on a ¼-in. pin *D* and is adjusted by the ¼-in. 40 screw *E*. The swinging block is held against its adjusting screw by a strong double-leaf spring made from two pieces of $\frac{1}{16}$-in. spring steel. The two screws *B* and *E* are hollow and are adjusted by the wrench shown.

This head has a large range. I have bored holes with it all the way from $\frac{3}{16}$ to 2 in. in diameter.

Special Truck Wheel and Axle Lathe

SYNOPSIS—This lathe was built expressly for handling large numbers of small truck wheels and axles. Details of the operating mechanism show considerable ingenuity and will interest mechanics generally.

A company building large numbers of lumber-, coal-, brick- and stone-handling trucks or small cars and in consequence using very many cast-iron truck wheels decided to build a big machine capable of adequately handling both the wheels and the axles. The machine shown and described in this article was the result. This double-end lathe is in use in the shop of the Standard Dry Kiln Co., Indianapolis, Ind.

Some of the cast-iron truck wheels are illustrated in Fig. 1 and, together with the axle, will give a good idea of the work to be handled. The axles will average about 1¼ in. in diameter, and the holes bored in the wheels will run from 1¼ in. to 2 in. or more, according to the size and type of truck on which they are to be placed. The holes in the wheels are cored out, so that the operation is boring only. A two-cutter bar of the usual pattern is employed. The ends of the axles are machined with box tools that feed on both ends at once.

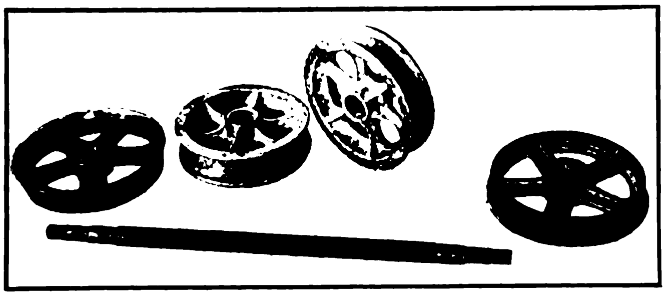


FIG. 1. SMALL TRUCK WHEELS AND AXLE

A front view of the lathe is given in Fig. 2. Here, two wheels are shown at *A* and *B*. It will be seen that the work is held in chucks of the steadyrest type, with two stationary jaws and one adjustable jaw each. Of course, the two lower jaws are adjustable for setting in the first place; but after the work has been centered, they are supposed to be let alone. The upper jaw of each chuck is carried in a swinging yoke in exactly the same way as on a regular lathe steadyrest. A handwheel on top, as at *C* and *D*, enables the operator to lock the wheels tightly in place after the yokes have been swung down and clamped by handwheels *E* and *F*. Boring bars feed into the cored holes of the wheels from each end of the lathe in opposite directions, so that both wheels are finished simultaneously. In machining axles the chuck jaws shown are replaced by longer ones, and an axle is held in them with the ends projecting far enough to allow box tools to be fed on and both ends finished at once.

In Fig. 3 is a rear view of the machine. It measures 14 ft. in length, 3 ft. in width and is about 5 ft. 6 in. to the top of the upper handwheels. It will weigh approximately 5 tons. About 700 wheels per day are bored out, or about 70 per hr. This makes 35 per hr. for each spindle. The axle output averages about the same.

The main drive of the machine is by a five-step cone *A* driven by the belt *B* from a countershaft above. This five-step cone is placed directly on the end of the shaft *C*, which runs the entire length of the machine and is geared to the large gears *D* that drive the boring spindles at each end. A pulley *E* is placed on the shaft *C*, and from it a crossed belt runs to a jackshaft above. Pulleys on each end of the jackshaft are belted to pulleys like *F*, which drive the feeding mechanism at each end. The handwheels *G* on the front of the machine enable the operator to run the boring spindle in or out when the feed clutch is not engaged. The entire feed mechanism is thrown in or out on the end shown, by the lever *H*. However, this action will not start the feed unless another intermediate clutch is also thrown in. As the clutch is thrown in by the lever *H*, the worm *I* turns and causes the worm gear *J* to rotate, revolving the shaft *K*. Now if the feeding of the boring spindle is desired, the clutch operated by the lever *L* must be engaged. The clutch jaws are shown at *M*; and as these engage, the feed bar is fed along through a rack and chain of gears *N*.

A similar mechanism, which operates on the opposite end of the lathe, may be seen with the same lettering in Fig. 4; but some other parts are shown more plainly. The feeding of the boring spindle *S* is controlled by a sliding rack *O* yoked to the spindle by the bracket *P*.

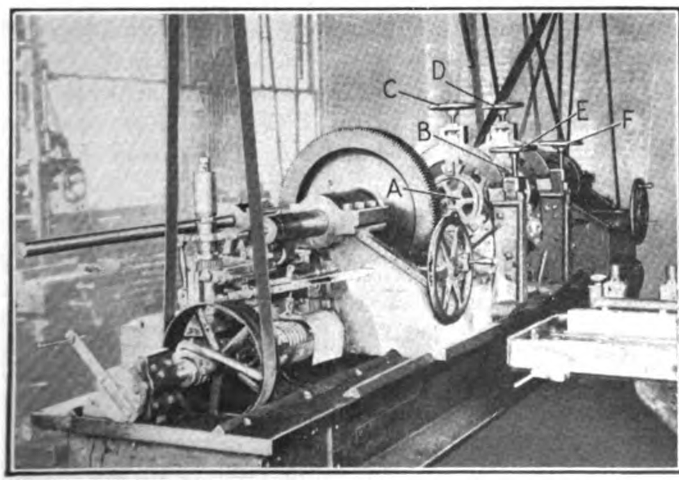


FIG. 2. FRONT VIEW OF WHEEL AND AXLE LATHE

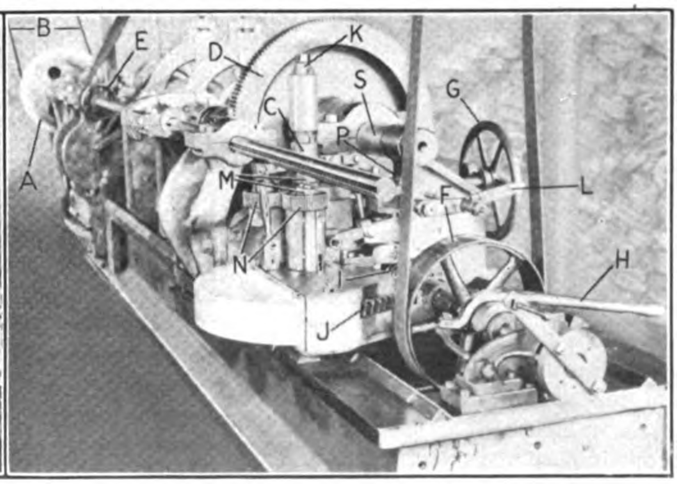


FIG. 3. REAR VIEW OF LATHE WITH WORK IN PLACE

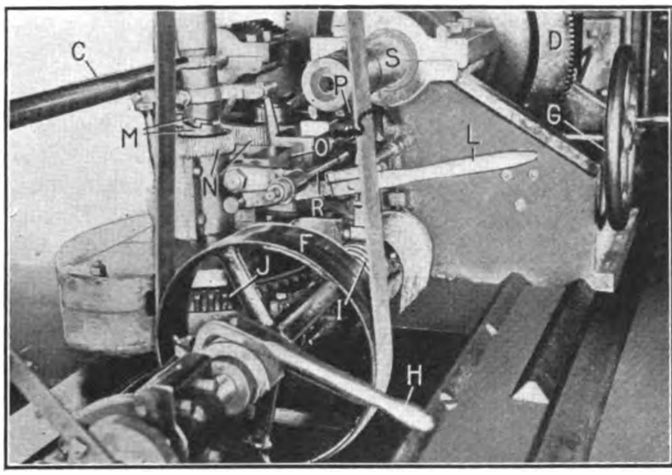


FIG. 4. CLOSE VIEW OF FEED MECHANISM

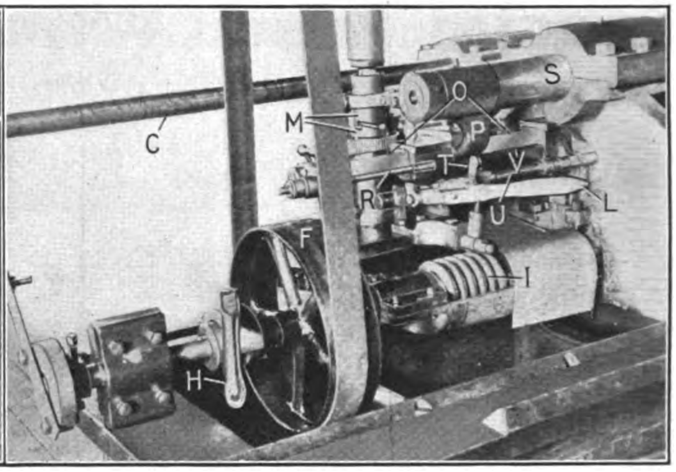


FIG. 5. ANOTHER VIEW OF FEED MECHANISM

The rod *R* is an adjustable stop for knocking off the feed clutch *M*. As the chain of gears operates, the feed-bar rack *O* moves along and carries the boring spindle *S* with it. This is more clearly shown in Fig. 5, which is also lettered in the same way as the two previous views. This illustration shows the clutch not engaged; but when it is engaged, the lever *L* is held down by a hooked piece *T* that is held secure by the spring *U*. The bar *O*, the spindle *S* and the stop *R* move along together until the

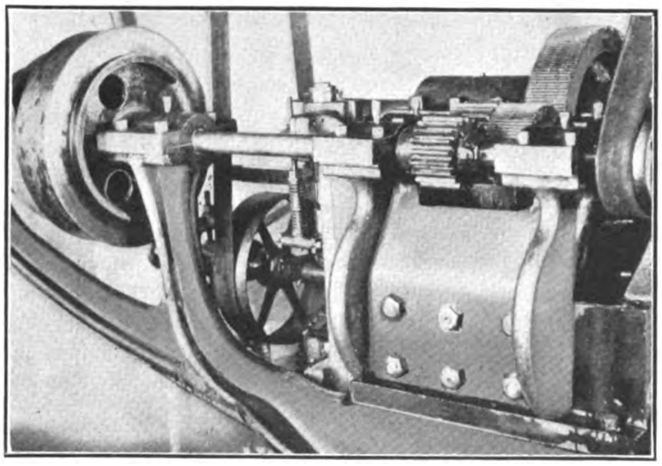


FIG. 6. CLOSE VIEW OF DRIVING END

end of the stop *R* hits the end of the hooked latch *T*, when the clutch level is released and flies up, throwing out the clutch and stopping the feed movement. Rack teeth are the ones with which a pinion operated by the handwheel *G* meshes. This relation will explain how the boring spindle is moved out or in when the feed clutch is out of engagement.

Fig. 6 is a close view of the opposite end of the machine. The driving and feeding mechanism is practically the same, except that it is placed more under the head and carries the cone-pulley bracket in addition.

The 60-Deg. Screw Thread

It was anticipated that there would be some difficulty in duplicating European sizes and fits on munitions, but that this trouble should lead to the adoption of United States standard proportions was not expected. However, in one important particular the unexpected has happened.

In the Mark-VII British fuse, as recently modified in design from the former Mark-V fuse, all of the screw threads, with a single exception, are 60 deg., three being A.S.M.E. standard, eight U.S.S. and the one exception Whitworth standard. The latter is used for the thread where the fuse screws into the nose of the shell and could not be changed because of the necessity of having any fuse assemble with any shell. The list of threads of the new Mark-VII is as follows:

Part	Pitch	Diameters in Inches Maximum	Minimum
A.S.M.E. Standard			
Setscrew for cap	32	0.164	0.1593
Needle plug	24	0.216	0.2108
Screw plug in base plug	24	0.190	0.1848
U.S. Standard			
Time-pellet plug	24	0.299	0.296
Time pellet	24	0.303	0.300
Percussion pellet	24	0.303	0.300
Percussion-pellet plug	24	0.299	0.296
Thread on stem of body	14	0.866	0.858
Thread in cap	14	0.872	0.867
Thread on base plug	24	1.378	1.374
Thread in body for base plug	24	1.383	1.379
Whitworth Standard			
Base of body	14	1.996	1.990

This change of standards proves the difficulty of overturning settled shop practice, for the modification was made to facilitate production in the United States and Canada and for no other reason. The question is also raised whether or not the American 60-deg. thread is a form that possesses inherent advantages that make it easier to cut with small tolerances than the Whitworth shape. A definite answer to this query would be instructive.

Properties of Steel

A review of the work done in correlating the magnetic and mechanical properties of steel has been published by the Bureau of Standards, Department of Commerce, in its Scientific Paper No. 272. Special attention is paid to the commercial application of the magnetic data as criteria of the mechanical fitness of a given steel and of magnetic changes of steel under stress as indications of the state of strain. The evidence presented shows that the interrelation of the magnetic characteristics and the mechanical behavior of steel is so close that the magnetic examination in conjunction with the mechanical tests may be expected to add considerably to our knowledge of the material.

The magnetic method tests the whole amount of material and not merely some surface phenomenon. It does not destroy the test piece, but leaves it unaltered. Thus it is possible to apply a magnetic test to the identical material that is to enter into a given structure.

Specifications for Purchase of Leather Belting

SPECIAL CORRESPONDENCE

SYNOPSIS—In general, present-day leather belting specifications are largely confined to describing minutely how belting should be made, without prescribing satisfactory tests to determine whether or not it has been so made. As a result, most buying has been done on price alone. The author points out the absurdity of this course and makes a plea for new specifications safeguarded by proper tests and prepared from the viewpoint, "What service will the belt give?"

Leather belting, one of the oldest means of power transmission, is still the best for general use on all but the heaviest machinery. Substitutes in great number have been developed, but more leather belting is used today than ever before. Repeated predictions of the failure of the raw-material supply have not materialized, nor will they as long as the human race continues to require an increased food supply. Confirmation of this statement may be found in the splendid response of the leather industry to the unprecedented demands created by the European War. Leather belting will continue to be widely used for many years to come.

Satisfactory belt service is an important factor in the production of nearly all manufactured goods, and in cases where competition is especially keen the success of the enterprise depends upon continuous maximum output. Yet little is known, even by large users, of the actual physical properties of leather belting, and most of it is purchased without any attempt to forecast its performance in service. Most buyers make no real attempt to determine which of the numerous brands offered at the same price are superior or, where prices differ, which offers the best value. Lowest cost per belt per year is seldom the governing consideration. Some large users invite competitive bids on uniform specifications, but only a small part of the total output is purchased on anything but a price basis.

Defects of Present Specifications

A careful survey of current specifications in use by Federal and municipal governments, railroads and large manufacturing corporations reveals many indefinite, useless and even misleading clauses, of which the following will serve as examples:

All butts used in the construction of this belting shall be of No. 1 selection, free from all defects and blemishes and of the native packer-steer hides class, tanned by the slow oak-bark process.

No solutions or bark or wood extracts shall be used, nor any chemical or electrical process used to force or hasten the process.

The leather shall be stretched in straight-edged clamps . . . Centers and sides must be stretched separately.

The scarfing, joining and cementing shall be done by expert and experienced workmen. . . .

. . . all sizes below 8 in. shall not be cut from any other section but the quality area, which extends not more than 15 in. each side of the backbone. . . .

. . . absolutely no shoulder or belly stock shall be used.

The finished leather shall be smooth to the touch on both sides. . . .

. . . the leather shall show no excessive amount of matter soluble in water nor of ash. . . .

Each piece shall be of fine close fiber, and all pieces shall be of uniform thickness.

Each piece shall be stretched by hand.

Dressing must be mixed hot in a double tank and applied with a brush.

Most of these requirements are such that the purchaser, or even an expert belt maker, cannot be sure that they have been carried out. Others do not represent best modern practice, and nearly all ignore the purpose for which the belt is to be used—the transmission of power. Such specifications discourage progress in the art, place the reliable belting manufacturer at the mercy of his unscrupulous competitors and make it impossible for the user to ascertain the merits of competing brands. Some of the most important characteristics of good belting, such as pliability and durability, are not even mentioned.

In general, present-day specifications are largely confined to describing minutely how belting should be made, without prescribing satisfactory tests to determine whether it has been so made. As a result, most buying is done on price alone, with no standards by which to judge relative values. Such is the situation at the beginning of 1916.

The Advent of More Intelligent Buying

Each year sees fewer advocates of price as the first consideration in the purchase of materials and a keener realization that the true basis is lowest ultimate cost. More and more frequently the purchasing officer is an engineer or makes excellent use of his company's engineering organization to determine true ultimate cost. The result is a gradual casting off of antiquated trade customs, the establishment of rational specifications based on the service expected and the development of fair and accurate tests. If the work is well done, both the buyer and the seller are greatly benefited. To the manufacturer is presented the opportunity to get away from unfair price competition by obtaining recognition for quality, while the user, provided with definite standards and means for testing, can be sure he is getting what he pays for.

The essential features of any specification are: (a) Explicit requirements based on the service expected; (b) definite tests to show whether the requirements are met or not. Present belting specifications do not even approach a fulfillment of these conditions, and much must be done to improve them before they will be fair to either maker or user. The task is difficult, because the raw material grows on the back of an animal and cannot be made to develop every desired characteristic. Furthermore, it is essential that means be provided to determine in advance, approximately at least, what kind of service the belting will give, so that if necessary it may be rejected. All tests laid down must be such that they may be performed quickly and cheaply, that they may be reproduced with concordant results at any time and, above all, that they do not discourage progress. All reference to the details of manufacture should be omitted and the way left clear for new and better methods. The

main issue is not, "How has this belt been made?" but, "What service will it give?"

Much careful study of these matters will be necessary on the part of both makers and users before real progress can be made toward better conditions. The following tentative suggestions are put forth to stimulate thought and research rather than as concrete proposals:

Strength—Ultimate tensile strength should be as high as possible without sacrificing other desirable qualities, in order to protect the belt from unusually severe strains to which most belts are occasionally subjected. This is now commonly specified in pounds per square inch—a thoroughly unsound practice. Two hides of the same thickness may be manipulated during tannage and the subsequent processes so as to produce finished leather of appreciably different thickness; yet they contain the same amount of fiber and show approximately the same strength for equal widths of belt. The power required to drive a given machine, its belt speeds and pulley widths are determined by the builder and can seldom be changed by the user. The latter is therefore not primarily interested in the strength per square inch of cross-section, but is vitally concerned in the strength per inch of width. To give the user what he really needs and still be fair to all makers of belting, tensile strength should be specified in pounds per inch of width.

Stretch—A belt that stretches unduly in service is a source of considerable trouble and expense, yet it must yield instead of breaking when subjected to severe strains. Even when operated far below its capacity, however, leather will permanently elongate in service for some time after installation. Manufacturers aim to remove as much of the natural stretch of the leather as may be done without damage to its other properties, but depend upon the judgment of the individual workman. If his judgment is faulty in either direction, the belt will be unsatisfactory. The best present method of testing this important property is by observing the elongation of a test specimen at rupture or some fixed strain, but we have no assurance that this bears any direct relation to elongation in service. Some way of predetermining this point would be of great value. Existing specifications allow 8 to 12½ per cent. elongation of the test specimen, but actual tests of the best brands show double this amount.

Pliability—The value of the power consumed in friction between the fibers during the life of a belt is probably many times the cost of the belt. Even a small gain in pliability would therefore be quite worth while. Greater pliability also means better pulley contact and less slip. Yet present specifications are wholly silent on this subject. An accurate method of testing for pliability should be worked out and belt makers given every inducement to develop this quality.

Thickness—As a general rule, the thinner the belt the less power required to bend it around the pulleys, the less wrinkling on the inside and the less stretching on the outside. This means better pulley contact and less internal friction, resulting in better service and longer life. Hence it would seem desirable, from the user's standpoint, to place a premium on the thin, strong belt. This should not be done, however, at the expense of more important properties. Whatever the thickness, it is of prime importance that it be uniform, especially on light, high-speed machines where vibration is serious. More attention to this point would result in decreased upkeep expense on the machine and better quality in its output. Most specifications ignore this feature entirely or require the thickness to be "uniform." It is obvious that some tolerance must be allowed, and $\frac{1}{32}$ in. is entirely feasible, although this degree of uniformity is seldom attained unless careful inspection is enforced.

Weight—This is now specified in ounces per square foot. This practice is a clumsy attempt to indicate, in connection with the prescribed tensile strength in pounds per square inch, the total strength of the belt. Prices are quoted per foot of length, but belting is really sold on the basis of weight—a custom that gives the dishonest manufacturer an opportunity to stuff his product with white lead or other heavy material, bringing light-weight stock up to standard weight. The users should have little or no interest in weight, if the other characteristics are right, and this premium on deception should be entirely removed. The self-interest of the maker would then lead to the lightest weight consistent with the required strength. Thus would be attained the nearest practicable approach to the zero weight of the ideal belt. With strength specified in pounds per inch of width, thickness and weight need not be mentioned.

Piping—When a belt passes over a pulley, the inner surface is compressed and forms corrugations. A certain amount of wrinkling is inevitable; but when it becomes very pronounced, the area in contact with the pulley is materially lessened. This condition is known in the trade as "piping." It is universally agreed that piping should be absent in first-quality belting, yet the borderland between permissible wrinkling and objectionable piping is still shrouded in mystery. At a meeting of belt manufacturers not long ago not one was able to put into words his idea of what constituted piping.

Cemented Joints—Poor workmanship or material at the joints will cause more trouble than any other defect. Great advances have been made in recent years along both these lines, and it is no longer necessary to resort to riveting or sewing. With reasonable care a cemented joint should be as strong as the remainder of the belt and should be so specified.

Injurious Blemishes—Current specifications as a rule do not discriminate against soft spots, knife cuts, grub holes and other injuries that weaken the belt and shorten its life. Healed barbed-wire scratches and similar surface defects are harmless. Such a thing as a perfect hide is unknown in the trade, but proper selection of the strips from which the belting is made should eliminate most of the injurious blemishes. Such selection should be insisted upon in first-quality belting.

All these matters and numerous others (such as the effect of varying humidity, dust, heat and fumes; the best methods of lacing; whether the points of laps should run toward or away from the pulley; and proper working tensions) offer fruitful fields for research. The ground to be covered is so great that no single commercial organization can afford to undertake it all. Lacking a Federal Department of Manufactures, much can be accomplished by hearty coöperation between manufacturers and consumers. An engineering bureau maintained jointly by all makers of belting and given every opportunity for study in the plants of their customers would be of great service to the manufacturing industries.

Making Small End Mills

EDITORIAL CORRESPONDENCE

SYNOPSIS—In making the tools and fixtures shown here great care was necessary in order to produce accurate work rapidly enough for commercial purposes. They are so designed that the output of one about balances that of another.

For making a large number of small end mills of various sizes special fixtures had to be designed and made in order to produce the pieces with sufficient precision and rapidity. These small end mills are being made by the Grayson Tool and Manufacturing Co., Indianapolis, Ind., which also made the fixtures. The mills are of the four-fluted type, and a number of them are shown in Fig. 5. Two sizes only are quoted in this article, but a number of other small sizes are also manufactured in this shop. The larger size is made from $\frac{1}{4}$-in. drill rod, cut into $1\frac{1}{4}$-in. lengths. The smaller size is from $\frac{3}{32}$-in. drill rod cut into $1\frac{1}{2}$-in. lengths. The cutter diameter of the former is 0.180 in. and of the latter 0.105 in., with 0.0015 limits in both cases.

The flutes are milled in a Brown & Sharpe miller, using four milling cutters on the arbor and a special indexing fixture to hold the work. Both the indexing fixture and the milling cutters are so made that by a slight shifting of the table and a movement of the work holder either the flutes or the ends of the small end mills may be machined. Fig. 1 shows the fixture set for milling the flutes. The blanks are held in the fixture by spring collets operated by crosshandles at the back. The holding spindles are indexed separately, each one being supplied with a disk notched quartering, into which a spring latch engages. Between each pair of holding spindles there is set a bevel-end locking-pin, which is pressed down by means of the strap and capscrew shown on top. In this way the tightening of the capscrew locks all four of the spindles. For milling the flutes the regular table feed is engaged in the manner shown in Fig. 1.

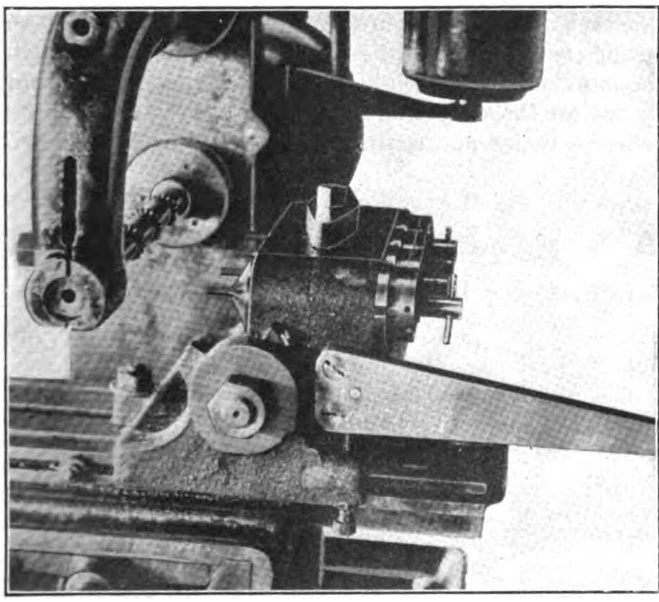


FIG. 1. MILLING THE FLUTES

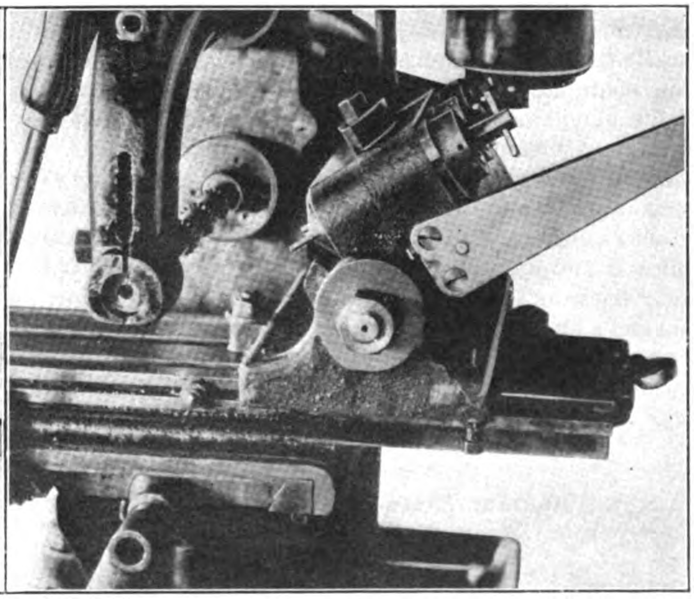


FIG. 2. MILLING THE ENDS

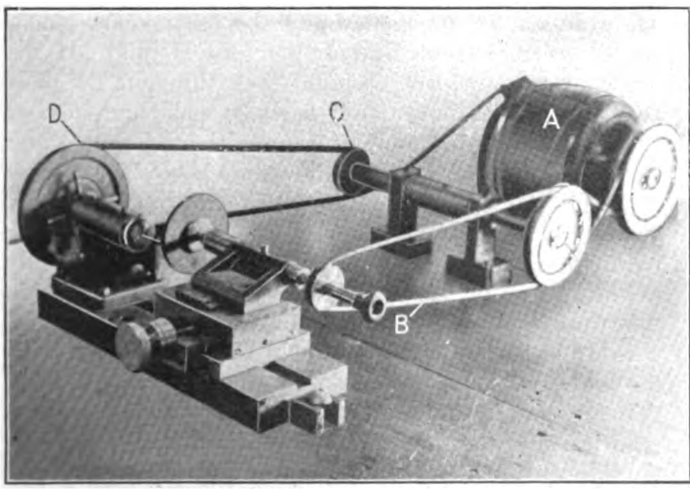


FIG. 3. SET FOR CIRCLE GRINDING

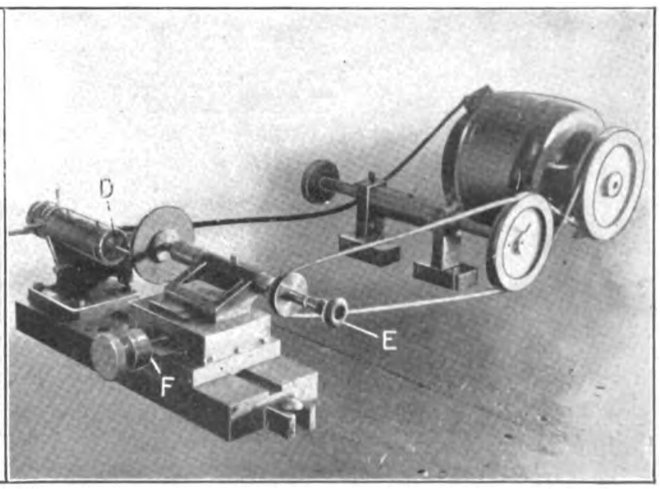


FIG. 4. SET FOR GRINDING THE RELIEF

The ends of the small cutters are milled by shifting the table over so that the opposite sides of the arbor mills will contact with the work. The table is also raised and the fixture tilted, as in Fig. 2. Adjustable stops are provided on the fixture, and the table is set by means of the graduated dials.

After being milled, the cutters are carefully hardened and drawn and are then ground. The grinder is made both to circle-grind and to relieve. The machine set for

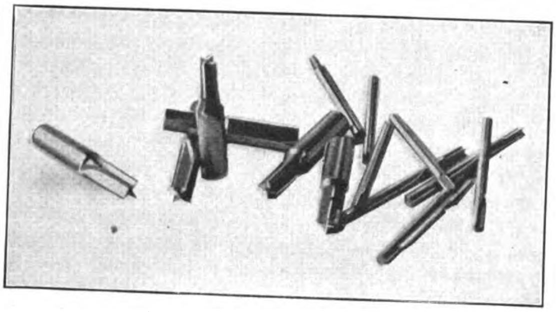


FIG. 5. SMALL END MILLS

circle-grinding is illustrated in Fig. 3. From this view it will be seen that the motor A runs the grinding spindle by means of the belt B, which is crossed so as to run a jackshaft carrying the small pulley C on the opposite end. This small pulley is belted to the pulley D on the outer end of the spindle holding the work, which is slowly revolved while the grinding wheel runs at a high rate of speed.

After the mills have been circle-ground, the pulley D is removed and the machine set for grinding the relief, as shown in Fig. 4. The indexing is done by a notched collar E and a spring stop. The grinding wheel is fed along the work by pushing on the knob E. A micrometer dial and a knurled knob F give an accurate means of cross-feed when needed. A 3-in. wheel is used, running at about 7,000 r.p.m., and the output is 500 end mills per 10-hr. day.

Adjustable Bushing and Center

By F. Fisher

The adjustable boring-bar bushing shown in Fig. 1 enables one to take up all the looseness and shake from the bar and at the same time allows perfect freedom for

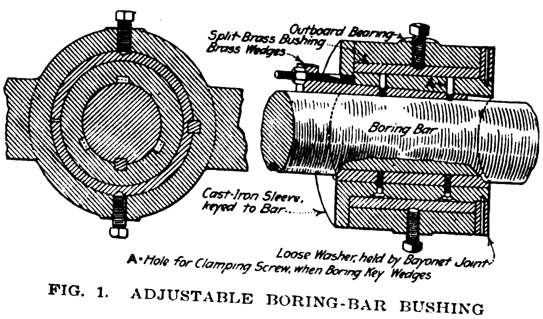


FIG. 1. ADJUSTABLE BORING-BAR BUSHING

its regular working movement. We have one of these bushings for each size of bar in use, the outside diameter of the cast-iron sleeve being made a standard size to fit the brass bushing in the outboard bearing or steadyrest. The latter bushing is keyed into the bearing, is split and is provided with adjustment screws to take care of wear and slight variation in size of the different bushings. The holes A are provided for clamping screws when boring key wedges.

The other detail, Fig. 2, is an adjustable bushing, or rather centering plug, for hollow shafting and similar jobs. We have a good many heavy drum shafts to make with a large hole through the center for a clutch-operating device. We find that, after the hole is bored, the shaft is apt to be out of true. We accordingly make

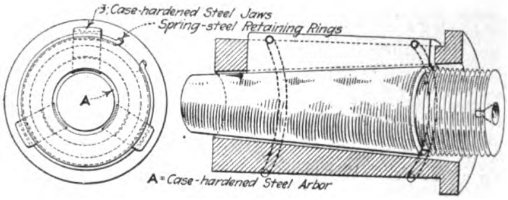


FIG. 2. ADJUSTABLE CENTER PLUG

the finishing cut and do the grinding after this hole has been made. The adjustable plugs are used to center up these shafts. They accommodate themselves nicely to any variation in the size of the rough-bored holes and are easily removed when the job is finished. The two spring-steel retaining rings, which are threaded through the movable jaws, not only tend to keep these jaws drawn in against the wedge, but also keep them from dropping into the center of the sleeve when the plug is removed.

A Suggestion on Preparedness

By Burton A. Prince

One of the problems that sometimes confronts the public-school machine shop is the matter of securing sufficient commercial work to keep everybody busy on it. Of course, there is generally enough of that variety to be obtained; but then, too, there is the danger of incurring the enmity of the local union, if too much commercial work is taken on.

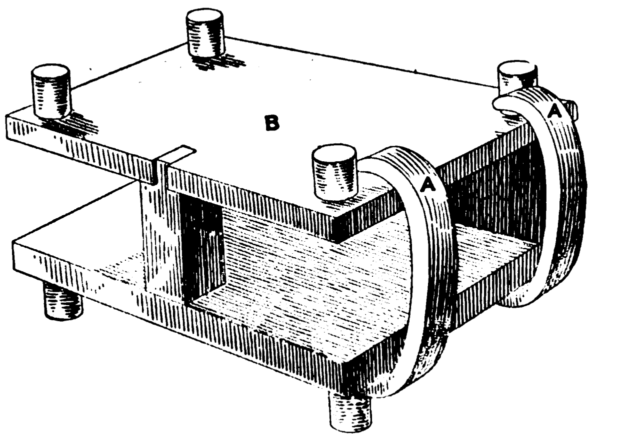
If the Federal Government is shortly to become a partner in the matter of educating boys for the trades, it seems only fair that it should get some return for its money; and I should like to offer the following scheme, which will be of benefit to both parties concerned, giving one a return on its money and the other some much-needed work. Briefly stated, the idea is this: If the proposed preparedness program goes through, the War Department will immediately begin to make and store at least another day's supply of ammunition—shrapnel and high-explosive shells. The different school shops are as well equipped for some parts of this work as were many of the commercial shops a year ago and would require no more changes to make shrapnel or parts thereof. It would be possible for the War Department so to divide this work that some of it could be done in the schools, possibly in such amounts as would be in proportion with the amount of money paid in aid to that particular school.

Before people land too heavily on this scheme, let them keep in mind the fact that a big percentage of the ammunition made today is being turned out by women and boys.

Letters from Practical Men

Rocker Arrangement on Jigs

In designing jigs it is often necessary to drill from the top and bottom of the jig. To drill from the bottom, feet must be put on the lid. After the holes are drilled from the top, the jig is turned over on the feet in the lid. If a jig is not equipped with the rockers shown at *A*



ROCKER ARRANGEMENT ON JIGS

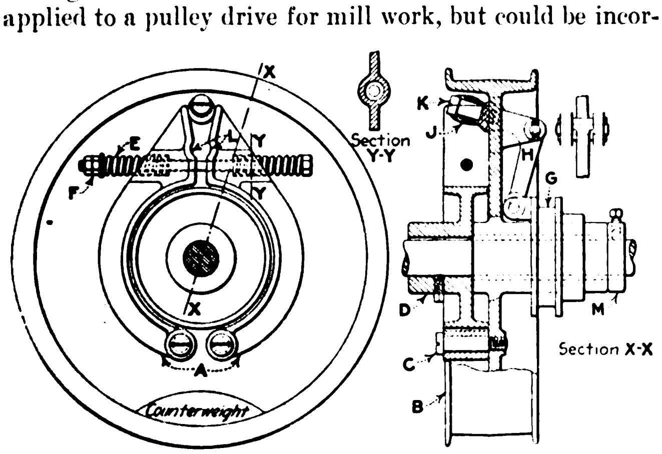
in the illustration, the edge of the lid *B* hits the drill-press table, and the lid may be injured or the jig thrown out of alignment.

The rockers do away with this trouble and also make easier the handling of the jig. These rockers are made of cold-rolled steel $\frac{5}{16}$ to ½ in. thick, to suit different sizes of jigs. B. Maxman.

Dayton, Ohio.

Design for a Friction Clutch

In the illustration is shown a design for a friction clutch having some unusual and desirable features. It is shown applied to a pulley drive for mill work, but could be incorporated in almost any design of clutch mechanism. Its favorable features are: (1) Few parts of rugged proportions; (2) it is free from end thrust, except a very small amount during engagement; (3) it is easily adjusted to any load; (4) the shifting sleeve revolves only when the clutch is engaged.



DESIGN FOR A FRICTION CLUTCH

Two clutch shoes *A* are hinged on the center web of the pulley *B* by a screw *C* and are drawn into contact on the drum *D* by the two helical compression springs *E*. These brake shoes are lined with a friction lining, preferably of the woven-wire asbestos-fabric type. The compression on the springs is regulated by the nuts *F*, and the loading of the spring determines the driving power of the clutch within the limits of the design. When the two clutch shoes are in the position illustrated, the clutch is engaged.

If the shifting sleeve is moved in the direction of the arrow, it will transmit a motion through the bell crank *H* such that the roller *J*, on the stud *K*, will be forced between the inclined or beveled jaws of the clutch shoes, thus separating the shoes and disengaging the clutch. The reverse of this operation will cause engagement. The clutch is held in the disengaged position by having the roller fit the depression *L* in the clutch shoes. The collar *M* is used to retain the whole assembly in place against the drum.

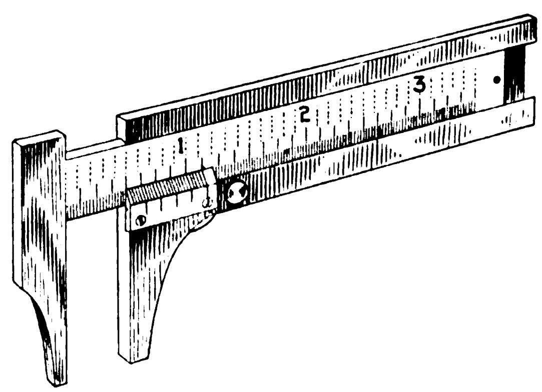
It is necessary in designing such a clutch to recognize the effect of centrifugal force and to proportion the compression springs accordingly. Also, a counterweight should be provided, as shown. W. Burr Bennett.

Bridgeport, Conn.

Button Gage with Vernier Reading to Thousandths

One of our surface-grinder operators had a lot of fairly accurate work that, because of its shape, could not be measured with a micrometer. He did not want to buy a vernier caliper, so to overcome the difficulty I fixed up a tool that was accurate enough.

He bought a Starrett button gage, graduated in fortieths of an inch, upon which I set a vernier plate.



BUTTON GAGE WITH VERNIER

I was surprised at the accuracy of the tool. In testing it out I made a large number of settings, checking them up with micrometers. None of these settings was out more than a scant half-thousandth, and most of them

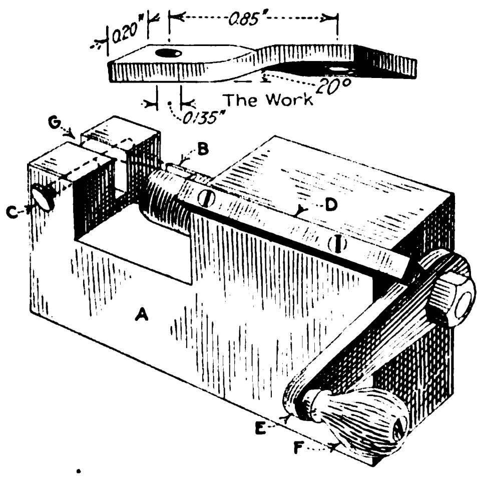
were much closer. I graduated the vernier scale by fastening it to an angle iron on a surface plate and marking the divisions with my Brown & Sharpe height gage. Every fifth graduation on the button gage was longer than the rest, to facilitate reading it. I extended every fourth graduation as shown by dotted lines in the illustration. H. M. DARLING.

Greenfield, Mass.

Hand Bending Fixture

The machine part illustrated is of $\frac{5}{16}$x0.083-in. oval-edge cold-rolled steel. The specifications require that it shall have a twist of 20 deg. at a certain part of its length. Just how to do this work in a power or hand press was a question, so a hand bending tool was designed.

The machinery-steel base *A* has a slot to receive the work. It is bored to take the locating pin *C* and a tool-steel stud *B* whose function is to bend or twist the part to be made. It will be seen that *B* is operated by the



HAND BENDING FIXTURE

crank *E*, which is fitted with a wooden handle *F*, the whole fastened to *B* by a hex nut. A steel piece *D* is fastened to *A* by screws and acts as a stop, allowing *B*, *E* and *F* to travel only a required distance.

The operation is as follows: The part is placed with one end in the slot *G* and with the locating pin *C* in the hole. The other end is in the slot in *B*. The operator grasps the handle *F* and rotates it until *E* comes in contact with the stop *D*, when the work is completed. GEORGE P. BREITSCHMID.

Arlington, R. I.

The Use of Stellite for Fine Brass-Turning Tools

I wish to contribute my mite to your columns in return for the many good things I have gained from the *American Machinist*. I have been trying out an alloy of chromium and cobalt (Stellite) for lathe tools in my laboratory and find it truly remarkable for holding its edge on unannealed steel at high speed. This quality, I believe, is of common knowledge.

Recently I have been using it for fine brasswork and find that it leaves the most beautiful finish—such as is found on the higher grades of optical and mathematical instruments. This surface is at present obtained only by skilled workmen and the use of carefully graded emery papers. Tools of this alloy leave the work finished perfectly, and the lacquer may be applied at once, thus saving much time and preserving the sharp edges and square shoulders so apt to be dulled by the use of emery paper. This feature may be new to some of your readers and may suggest applications of stellite for other brass work.

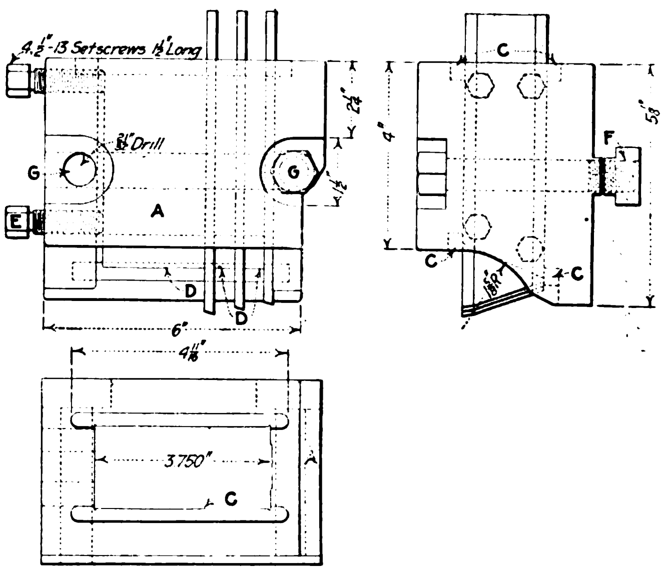
I am inclined to the opinion that this characteristic is not so much due to the property of the alloy to keep its edge as to the fact that its peculiar dense structure enables it to be given a more perfect edge than can be given to other alloys. FRANK D. SKEEL, M. D.

New York City.

Cutoff Block for Automatic Screw Machine

It is often profitable to form two or more pieces at once. For such jobs the block shown in the illustration was designed for holding a number of cutoff tools.

The body *A* is made from a solid machine-steel block, with the rectangular hole milled and planed in to take the cutoff tools. The dimension *B* is 0.005 to 0.012 in. larger than the cutoff tool. This clearance is provided so that the cutoff tool need not be a tight fit all the way across the block. In order to make the tools fit tight,



CUTOFF BLOCK FOR HOLDING MULTIPLE AUTOMATIC SCREW-MACHINE TOOLS

four strips are inserted at *C*. Slots are milled in so that the strips will press against the cutoff tools, thus insuring a tight fit at all times. The cutoff block is set on the front cross-slide. Shims *D* are made for each different width of piece to be cut off.

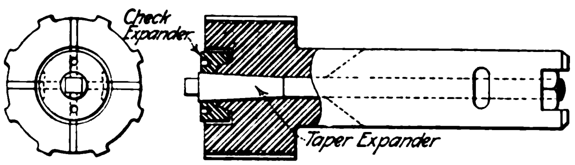
The tools are held by the four screws *E*, which squeeze the tools together. A clamp *F* is put in the tee slot of the cross-slide, and the block is tightened down with the two bolts *G*. The cutoff tools are set one ahead of the other, the pieces drop off very easily and are held to size.

This tool is used on all cold-rolled steel parts where there is no facing or counterboring operation.

Dayton, Ohio. RAYMOND W. BECKMAN.

Parallel Expanding Tap

The illustration shows an expanding tap that, I think, has improvements over others that I have seen. The expander regularly used will not expand a tap parallel; it makes the tap larger at the end. Also, the tap will



A PARALLEL EXPANDING TAP

not hug the expander as it should. In other words, the tap will make a smaller hole than it measures before using.

The check expander corrects these faults. It causes the tap to expand parallel and enables one to measure the tapping size correctly. This feature should prove valuable in shell work, where the limits are fairly close.

Kenosha, Wis. ERIC HAWKINSON.

Spring-Plunger Gages and Two Other Small Tools

Two gages that are used in a factory where accuracy is important are shown in Figs. 1 and 2.

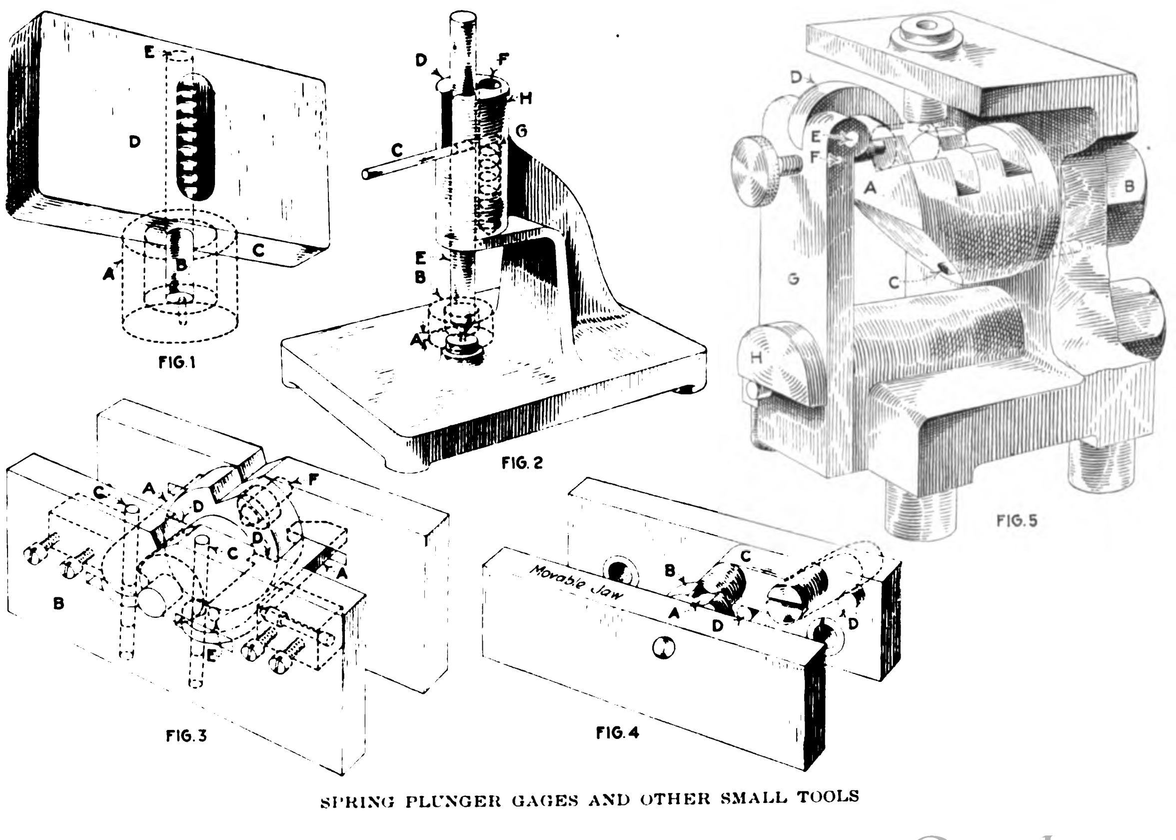
In Fig. 1 is shown a tool for gaging the depth of the piece *A*. Assuming the depth is to be 0.406 in., the plunger *B* must project 0.406 in. from the bottom edge *C* of the body *D*, while the top of the plunger must be flush with the top *E* of the body. Any difference between the top of the plunger and the edge *E* can be detected by feeling. The spring must be made strong enough to insure a good bearing on the bottom.

Fig. 2 shows a good gage for measuring the thickness *A* of the bottom of piece *B*. In this gage the plunger is pulled down upon the piece by the handle *C* instead of the spring, as in Fig. 1. The body *D* is made of cast iron. The handle *C* is driven into a hole drilled in the drill-rod plunger *E* and extends into the hole *F*, which contains the spring *G*, placed underneath the handle. The pin *H* keeps the plunger from coming out. The body *D* is slotted out for the handle.

A vise jaw which pulls the work off the locating pin when the jaws are opened is shown in Fig. 3. The ejectors *A* are fastened to the movable jaws *B* by the pins *C*. With the jaws open, the piece is placed between the ejectors in the openings *D* and upon the pin *E*. The ejectors slightly pinch the piece, hold it in an upright position and keep the hole in the piece opposite to the locating pin *F*. After the cut is made, the jaws are opened and the hooks on the ejectors catch hold of the piece and pull it out to a position where it can easily be taken off.

In Fig. 4 are shown vise jaws for making the clearance cut *A* in the piece *B*. The part that makes the jaw quick acting is the block *C*. To take off the piece *B*, loosen the vise a quarter turn and throw the block into the position shown by the dashed lines. The throw of the block is regulated by the pins *D*.

A handy little jig used mostly for studs is shown in Fig. 5. The locating V-block *A* is made of round tool steel. It is fastened to the body of the jig by a tenon, turned on the end and clamped tight by the nut *B*. The dowel pin *C* keeps it in place. The equalizing part of the jig is the part *D*, which pivots on the pin *E*. The pin *F* holds the clamp approximately in place. The hole



SPRING PLUNGER GAGES AND OTHER SMALL TOOLS

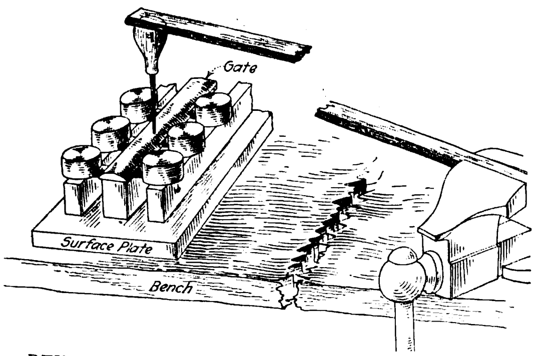
in the clamp D is slightly larger than the pin F, to take care of any variation which might be in the work. The swinging part of the jig is part G, which moves on the stud H.

BERT MAXMAN.

Dayton, Ohio.

Fastening Gates in Making Metal Patterns

The illustration shows a holding device for use in making metal patterns. We have used all kinds of devices for holding gates while soldering the patterns to them, but I think this simple kink is the best.



DEVICE FOR HOLDING PATTERN GATE WHILE SOLDERING PATTERNS

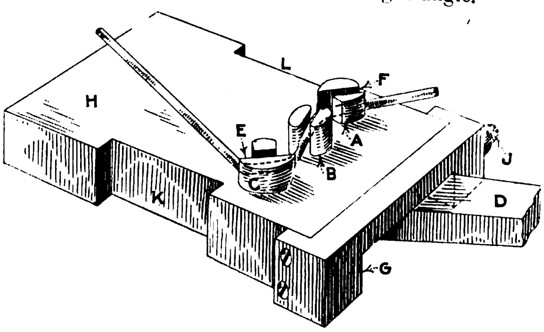
The patterns and the gate are placed on parallels, and the gate is held in place by a piece of wood acting as a spring. One end of the strip is held in a vise so that, when the other end is raised and an awl is placed between it and the work, the spring of the strip holds the work in place. While the gate is firmly held, there is room to work all around it.

A. E. HOLADAY.

Naugatuck, Conn.

Wire-Bending Fixture

The fixture shown in the illustration is of the multiple-operation type, as it performs in one operation a bend that at first seemed likely to require two or more handlings. The wire is received in the form of a right angle.



WIRE-BENDING FIXTURE

The view shows the fixture and the work as it is when completed. A, B and C are tool-steel wipers operated by the handle D, which is fixed to the center wiper B by a squared end and washer. The wire itself swings the wipers A and C to the position required to conform to the bend, and they are returned to their normal position by two pins in the handle operating against the surfaces E and F. The steel piece G is attached to the steel main part H carrying the adjustable stop J, which regulates the travel of the handle.

The fixture is milled at K and L for holding in a vise.

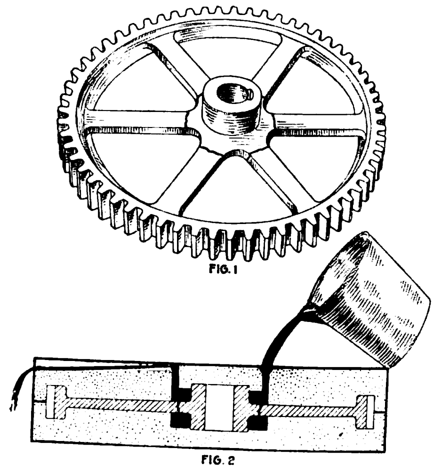
G. P. BREITSCHMID.

Arlington, R. I.

Repairing a Large Gear Wheel

A breakdown that looked like a hopeless job was recently solved in an interesting way. A large cast-iron gear wheel about 4 ft. in diameter had every one of its six spokes broken, as shown in Fig 1. The following solution of the problem proved successful:

The gear was put into a flask and the hub lined up true. Then it was rammed in place and the whole gear withdrawn, to permit the molder to cut out the mold for the "patch." The gear was replaced and a gully made on the cope from the riser to the ground, so that



METHOD USED FOR REPAIRING GEAR WHEEL

the metal could flow away. About 300 lb. of iron was poured through the mold, to heat the gear and make the new metal bite. Then the overflow was stopped and the remaining metal allowed to cool.

JACK HOMEWOOD.

Alberta, Canada.

Tracing-Cloth Curtains

Direct sunshine on work is usually avoided whenever possible, as shadows interfere with proper lighting. Also, in summer the direct sunlight becomes uncomfortably warm, and a curtain is usually drawn down to cut it off, at the same time preventing a desirable amount of light from being admitted.

All this trouble can be overcome by making the curtains of tracing cloth or by tacking a sufficiently wide strip of the cloth to the bottom stick of the regular curtain. This arrangement will allow almost as much light to enter as if no curtain were present, but the light will be diffused, no shadows will show, and the objectionable hot sunshine will be kept out.

F. W. BUERSTATTE.

Pullman, Wash.

Discussion of Previous Question

Best Way To Do Certain Things

I have no doubt that many of the readers of the *American Machinist* have become tired of my preaching improvements in mechanical construction. When some months ago I suggested, on page 936, Vol. 43, that your readers tell the best way to do the everyday things, there were not as many responses as I had hoped for; but the criticisms called out were better acknowledgment than if no responses had been made.

The point I wished to make was that, if one gave some way to do one thing applicable to various jobs, it was better than to describe the same thing in connection with some machine. For instance, when a lever or a pulley is to turn between two ears or cheek pieces, it is much better in nearly every case to have the pin or pivot tight in the lever or pulley than, as is almost universal practice, loose in the internal element.

A good way to do this in pieces of moderate size is to drill through all three parts and ream with a standard taper-pin reamer, relieve the holes in the two outside parts, drill the oil holes, assemble the elements and drive in the taper pin.

It does not seem necessary to argue why this is the better way. JOHN E. SWEET.

Syracuse, N. Y.

Grinding-Operation Kink for Hardened Rollers

On page 474 Mr. Breitschmid describes a method he employed in preparing for grinding some small hardened-steel rolls which were to be driven by the live center. That plan is all right, but it seems to me a good deal of time must be lost in guessing at the center, if the square center punch is used. Further, since it is certain that the punch mark must be tried again and again before even an approximate center can be found, the latter must be considerably battered by the time it reaches the grinder.

Why not locate the square center true and save all the time and patience expended? In the absence of a centering machine the place to center work is in the lathe. It is the quickest, most workmanlike and accurate in the end.

Were I doing the work described by Mr. Breitschmid, I should have both ends of the rolls centered in the lathe, using a small universal chuck. Afterward I should simply square one of the drilled centers with a square or three-cornered center punch, grind the grinder center to correspond, have the rolls hardened and proceed as Mr. Breitschmid says.

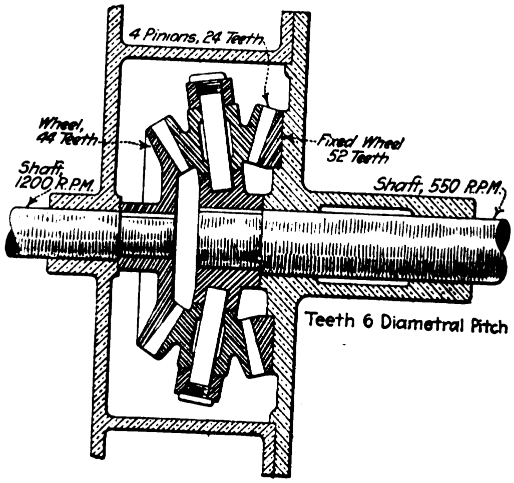
It must be borne in mind, however, that if good work is to be done, the center is of great importance; and a bad center is a very undesirable thing, whether the center be round, square or three cornered. Both the square center punch and the driving center of the grinder should be put in a dividing head and ground truly square—the punch to an angle of 59 deg. and the machine center 60 deg. This method will give a good, uniform bearing on all four sides of the square and will tend to prevent chatter or running out or round. J. B. MURPHY.

Plainfield, N. J.

New Design for Reducing Gears for Aero Propellers

The illustration shows a simple design of gear to reduce from 1,200 to 550 r.p.m., when the shafts have to be in line and run in the same direction.

The space occupied by this gear is no larger than that required for the design shown on page 79, yet it permits the use of much stronger gears.



REDUCING GEAR FOR AERO PROPELLERS

Ball bearings have not been shown, because the gearing itself was advanced as the difficult problem. A good design should be simple, strong, and cheap to manufacture. R. B. DOMONY.

Barrow-in-Furnace, England.

Grinding Die-Setting Pins

The article on page 518, suggesting a method of grinding die-setting pins, leads me to describe the plan which I have used with entire satisfaction for the past five years.

It is a constant surprise to me to see how many people use hardened and ground pins, working in hardened and ground bushings, when the expense is unnecessary. Drill rod 1 in. in diameter and guaranteed accurate to size within 0.0005 in. can be bought for all sizes of dies from small punching dies 1/4 in. in diameter, with two pins, to blanking dies 6x14 in., with four pins, for $\frac{3}{32}$-in. stock. I have two reamers—one, 1 in., for a running fit; the other, 0.001 in. under size.

The shoe and punch holder are clamped together with care not to spring them. A plate is set on the drill-press

table and leveled with a sweep and indicator. The holes are drilled and reamed by drilling through with a ½-in. drill first, to avoid springing, followed by a $^{63}/_{64}$-in., then by the undersize reamer all the way, and last by the full-sized reamer through the punch holder only.

To get the best results, do not clamp to the drill press. The pins are cut to length, the ends finished in the lathe and driven into the shoe. I allowed from 1¾- to 2½-in. bearing in both the shoe and the punch holder. This work can be done in a quarter the time necessary for hardened pins and bushings.

Sometimes the pins are fitted last; but more often—always with small punching dies—the pins are first put in and located, the punch plate and punches last. The punch plate is so much lighter than the whole punch holder that it is easier to get a nice fit that way. Furthermore, the screws can be put in place in oversize holes and will hold the plate more securely than clamps while fitting and placing the taper pins.

I believe that the natural surface of good drill rod makes a better bearing with cast iron than a ground surface.

W. B. GREENLEAF.

Plymouth, Mich.

Take Warning!

Apart from the relative merits of the metric and the English systems of measurements your reference to Dr. Stratton as "the most dangerous enemy of our industries which our country harbors" savors of abuse and slander, which neither the controversy nor the long record of meritorious public service that Dr. Stratton has rendered justifies.

Any manufacturer who may have taken the trouble to visit the Bureau of Standards in Washington and acquaint himself with the work that Dr. Stratton is conducting there in a most efficient and helpful manner in the interests of American industries leaves that institution with the feeling of admiration for its work and profound respect for its Director. You could render a far greater service, in my estimation, to American industry by urging manufacturers to get into closer touch with Dr. Stratton and the Bureau of Standards and to consult more freely with him on problems that confront them from time to time than to raise false alarms such as are conveyed in your editorial on page 563, Vol. 44.

Dr. Stratton, in preparing his report on "Metric System in Export Trade," acted upon instructions from his superior officer and had no intention of "foisting" the metric system on this country overnight.

My personal experience with both the English and the metric system of measurements in designing and manufacturing has demonstrated to me the superiority of the latter system. I believe there are few engineers who would today question the advisability of ultimately making a change from the English to the metric system, which is relatively as much superior to the English measurements as the system of dollars and cents is to the pounds, shillings and pence method, when used in calculation and manufacturing.

Even in Russia, where the English system was first introduced and adopted, the metric system has superseded it during the past ten or fifteen years in almost every industrial enterprise. It was done gradually, to be sure, but the fact is that now in all engineering works through Russia the metric system is standard. It is only a question of time when the metric system will be universally adopted in all South American countries with which we are endeavoring to extend business relations.

Would you favor handicapping the American manufacturer of the future in doing business with South American or European countries by urging him not to be far-sighted enough, nor to take the necessary steps, to adapt himself, his personnel and his equipment to execute contracts for export to the metric system with the same facility with which he executes contracts to the English system of measurements? It is this point that Dr. Stratton had in mind in making his report on "Metric System in Export Trade."

No one, and Dr. Stratton in the least, advocates that the change to the metric system be made overnight, but it is highly important that this question be agitated and that serious consideration be given to it by all manufacturers and particularly by a publication such as yours. The metric system should be gradually introduced by our manufacturers in the execution of orders for engineering products for export. It should also be obligatory that all trade and engineering colleges and universities teach their students the use of the metric system in their calculations, so that they can think in both units and form their judgments in the metric and in the English equivalents with equal facility.

Your attitude against the adoption of the metric system shows the same lack of foresight and adaptability that is evident in the English railways, which alone, against the railways of the entire world, including the British colonies, continue to base their statistics on car- and wagon-miles instead of the ton-mile basis universally adopted.

CHARLES M. MUCHNIC.

New York City.

The Suggestion System

On page 561 J. H. Davis discusses the suggestion system and gives one very good argument in favor of it—namely, that when it gets to the point where only 20 or 30 suggestions are received a year, it helps in finding the men who are above the average.

There is also another reason that is perhaps important enough to justify the slight expense of starting or maintaining a suggestion system. In every shop there are a few mechanics who think they are a little better than the rest. The suggestion box gives them an opportunity of proving it. Without such a system in the shop, the chances are that they would write a letter to the department head and tell him in what way this or that might be improved.

This action necessitates going over the foreman's head, and many hesitate to do it. Other men who may be more reserved and not quite so self-confident would not be likely to take this roundabout way of showing that they know something too. Consequently, both they and the firm would lose. With the suggestion system this injustice is avoided, and everyone gets a square deal.

The latter point is an important one in favor of the suggestion plan, for undoubtedly many mechanics hesitate in making suggestions under the impression, false or otherwise, that full credit will not be theirs unless submitted direct.

J. LIMBRUNNER.

Shelton, Conn.

Industrial Preparedness the Keynote at New Orleans

EDITORIAL CORRESPONDENCE

SYNOPSIS—One of the most successful spring meetings ever held by the American Society of Mechanical Engineers convened at New Orleans from Apr. 11 to 14. The keynote topic of discussion was organizing for industrial preparedness. The social features of the meeting were unusually enjoyable.

The usual practice of holding the spring meetings of the American Society of Mechanical Engineers in May or June was broken this year because of the selection of the Southern City of New Orleans as the place for the convention. The attendance was very satisfactory considering the distance of the convention city from the great industrial centers of the North. The total registration numbered 113 members and 363 guests.

The members and their friends from the North chose three general routes to reach New Orleans. One party assembled in New York and went through to the convention city in special cars, making a stopover for one day at Birmingham, Ala. The party from Chicago and Cincinnati also made this day's stopover in the "Pittsburgh of the South." A few members who wished to enjoy the recreation that the spring meetings usually offer preferred to go from New York to New Orleans by water.

THE DAY IN BIRMINGHAM

A representative of the Birmingham local section met the party at Chattanooga on Sunday evening, for the start from New York was made on Saturday afternoon. The day's program in Birmingham began at 9:30 o'clock in the morning and continued until 10 o'clock in the evening—or just in time to catch the train for the rest of the journey. The program included visits to the plants of the Republic Iron and Steel Co., the Tennessee Coal, Iron and Railroad Co. and the American Steel and Wire Co. The visits were made in the order given. At noon a Southern barbecue was served at Bayview—a picnic park on an artificial lake used for impounding the water-supply of the Tennessee company.

The visit to the Republic Iron and Steel Co. included the Thomas furnaces. These were reached from Birmingham in a special train that was at the disposal of the party for the entire day, taking them on from one point to the next and finally bringing them back to the city in time for a brief rest before dinner in the evening.

Several plants of the Tennessee company were visited, including the blast furnaces, openhearth department, rail mill, rail-mill power station, Edgewater coal mine and Fairfield byproduct coke plant. These visits and the journey from plant to plant on the company's railroad gave an excellent opportunity to observe the industrial betterment work that has been planned and carried out on an extensive scale. It is possible that this work and the byproduct coke plant aroused the keenest interest among the visitors.

The byproduct plant is now producing benzol, toluol, zylol, naphtha and ammonium sulphate. Another byproduct produced at another plant from blast-furnace slag is a commercial fertilizer high in phosphoric acid.

The Tennessee company employs a working force of some 18,000 men, who with their families represent a population of about 50,000. Some 66 per cent. of them live in the cities, villages and country sides contiguous to the mines and works. The other 34 per cent. of the employees live in houses owned by the company. About 53 per cent. of the employees are negroes, 37 per cent. white Americans and 10 per cent. white Europeans. Although the mines and plants of the company are distributed over a wide territory, by far the greater portion are comprehended within an area having a 15-mile radius from Birmingham.

The industrial betterment work as now organized was started some three years ago by Dr. Lloyd Noland, who had had several years' experience in similar work on the Panama Canal. At the outset it was believed that general sanitation and preventative medical care not only constitute a moral responsibility, but give results that pay. It is cheaper to prevent disease than to cure it. The workman who is sickly himself or has a sickly family is always an expensive investment. The soundness of this viewpoint has already been demonstrated. The average earnings of the employees have increased in a higher percentage than their rates of wages. The average number of working days per month has increased from 16 to 22.

For convenience the work of the health department is separated into three divisions—the sanitary, the medical and the welfare. The first is responsible for the purity of the water-supplies, disposal of all wastes, the cleaning and draining of all streets, the supervision of living premises, the elimination of mosquitoes, prevention of fly breeding, the supervision of dairies supplying milk and the inspection of the commissaries, including the safeguarding of the purity of all the food supplies. All this work is under the direct charge of a supervising physician, who has a sanitary corps that devotes its entire time to these matters.

The medical department consists of a staff of resident physicians and nurses. Their duties include the physical examination of all applicants for employment, the physical examination of all school children (with frequent inspections of the schools), the care of all sick and injured employees and their dependents (without regard to the nature of the illness or its cause) and close coöperation with the sanitary division in general health work.

The welfare division has charge of the clubhouses, the conducting of courses in cookery, sewing and practical housekeeping, the kindergarten instruction of children below school age, home visiting, supervised play and the oversight of the various social organizations.

FIRST SESSIONS AT NEW ORLEANS

Tuesday, the first day of the meeting in New Orleans, was devoted to registration, sight-seeing about the city, including points of historical interest for the ladies and some of the engineering features for the men. The first social event was an informal reception on Tuesday evening.

The keynote professional session was held Wednesday morning. It was opened by a paper by Spencer Miller, member of the United States Naval Consulting Board, on

"Organizing for Industrial Preparedness." An unusual amount of discussion followed, which showed conclusively that engineers as a profession are unanimously and wholeheartedly in favor of industrial preparedness—and in fact, preparedness in its broadest meaning. Because of the volume of this discussion only a small part can be incorporated in this report, and the remainder will be presented in full in next week's *American Machinist*. Mr. Miller's paper will be found on page 672 of this issue.

FUNDAMENTAL PRINCIPLES UNDERLYING PREPAREDNESS—DISCUSSION BY H. L. GANTT

In considering the subject of preparedness, either for peace or for war, it is imperative that we learn as quickly as possible the lessons that are being made clear to us by the developments in Europe.

In order to do this we must ask ourselves why it is that Germany has shown so much greater efficiency, both from a military and an industrial standpoint, than have the Allies.

It is becoming perfectly clear that the principles underlying industrial and military efficiency are the same and that, if a nation is to be efficient in a military sense, it must first be efficient industrially.

We have talked efficiency in this country for several years, and many books have been written on the subject; but many of us feel that the actual results so far have been lamentably small and that we should be much more nearly in the class with England than with Germany if we were suddenly confronted with England's problems. It would seem therefore that we should find the fundamental reasons why England presented such a strong contrast to Germany and see if we cannot learn something therefrom.

It is only a short time since England led the world in the arts, but recently Germany has demonstrated her superiority to both England and France.

We must ask ourselves how this happened. It would seem to be something in this wise: The financiers of England, feeling that wealth could purchase whatever was needed for themselves and their national life, have devoted their energies for a number of years to securing the wealth that was produced by others rather than making strenuous efforts to produce it themselves. In this attempt they have sent abroad millions of dollars to develop industries in foreign lands, which brought them great returns.

The leaders of Germany, on the other hand, not being able to exploit foreign people to the extent that was possible in England, turned their attention to developing their own resources and the ability of their own people.

When the supreme test came, Germany was found to be a nation of people who, in general, knew what to do and how to do it, while the industries of England were in too many cases controlled by people who understood only their commercial side.

We, following the footsteps of England, have regarded financial strength as the most important strength, forgetting the comment which the ancient philosopher made to the rich man who boasted of his possessions, when he said: "What availeth all thy wealth? He that hath better iron than thou will come and take away all thy gold." In those days iron meant weapons. Today iron may be taken as the symbol of both weapons and tools of industry, and the statement is just as true today as it was two thousand years ago that he that hath the better tools is more powerful than he that hath the wealth.

The move, therefore, to get the engineers of the country working together for preparation is a most hopeful sign, for in the strenuous times in which we are living our wealth may be of little more value to us than it would have been to Great Britain but for the 20 miles of water which separate her from the Continent of Europe.

On the other hand, the power to do things cannot be taken away from us. The greater that power the more important will its possessor become, as we realize the real meaning of the titanic contest which is now going on in the world.

The man who knows what to do and how to do it is preeminently the engineer. The new world, therefore, which is being ushered in by the great struggle now taking place is one in which the engineer is destined to be the supreme power, for it is becoming increasingly clear that in future the man who owns things will not be as important a factor in the world as the man who can do things.

IMPORTANCE OF MACHINE TOOLS IN INDUSTRIAL PREPAREDNESS—DISCUSSION BY L. P. ALFORD

Mr. Miller, in his excellent outline of the need of organizing for industrial preparedness, points out that consideration should be given to machine tools from several aspects of their design and supply. The importance of these machines in time of war is strikingly proved by comparing the machine-tool exports from the United States for the calendar year 1915 with the record of the best previous year in our history. In round figures $42,000,000 worth of machine tools was shipped during 1915, while the highest preceding yearly record was about $16,000,000 worth. The influence of the European War has multiplied our average machine-tool exports some three times. Tables 1 and 2 are compiled from the reports of the Department of Commerce of the United States Government.

TABLE 1. EXPORTS OF MACHINE TOOLS FOR LAST THREE YEARS OF CALENDAR

	1913	1914	1915
France	$2,088,515	$2,309,635	$11,700,299
Germany	2,838,268	1,086,404	....
United Kingdom	3,491,050	5,441,575	16,633,648
Other Europe	3,689,123	3,280,402	8,045,995
Canada	1,888,463	767,064	4,336,065
Australia	....	....	325,263
Other countries	1,562,793	1,956,300	996,509
Total	$15,558,212	$14,841,380	$42,037,779

TABLE 2. EXPORTS OF MACHINE TOOLS FOR PAST TEN FISCAL YEARS

1905	$4,332,665	1910	$5,975,503
1906	6,445,612	1911	9,626,965
1907	9,369,056	1912	12,151,819
1908	8,696,235	1913	16,097,315
1909	3,640,034	1914	14,011,359

These relate to the exports of machine tools, and from them the figures quoted have been taken.

Although there has been some scattered buying during the last 20 months, the greater number of the machine tools exported from the United States have been taken by Great Britain, France and Russia. Exports have been cut off from Germany and Austria, while the Scandinavian countries, Holland and Italy have increased their buying much beyond the normal amount. But little is known in this country of the methods that Germany has employed to build and maintain the machine tools necessary to produce her munitions of war. On the other hand, there is considerable information available in regard to the methods employed by Great Britain and France. Thus it is with the experiences of these latter-named countries that we are at the present moment concerned. From their methods we can formulate the principles of action to govern the design, purchase, production and distribution of machine tools in preparing for a national emergency of war.

The events of the past 20 months justified the statement that the machinery-building industry is the backbone of any defensive or offensive warfare at the present day. This statement emphasized anew the need of carefully considering machine tools in any plan for industrial preparedness.

The machine tools shipped abroad within the past 20 months analyze into three general classes: First, simple, plain machines that were either standard with certain manufacturers before the outbreak of war or have been designed and built under the stress of the tremendous foreign demand; second, regular machine tools of a more highly organized grade, particularly automatic machines that were standard product of some manufacturers prior to the outbreak of war; third, special machine tools developed for some operation or series of operations in the manufacture of some particular detail of munitions. These group into (a) lathes for the outside turning of shells; (b) lathes for boring shells; (c) lathes for waving, grooving and undercutting shells. The first class comprises by far the greater volume of the exports, and simple lathes are the predominating machines. In like manner lathes predominate in the third class.

The methods adopted by Great Britain, France and Russia in buying these machine tools need brief consideration. The early orders were placed by European machine-tool agents who had handled American machine tools for years. Their knowledge of the business gave them the first entrance into the field.

These dealers' contracts were followed by others given by special agents or government commissions who came over to this country during the first year of the war. These orders brought about a condition of scarcity of machine tools in the United States and at the same time filled all the regular machine-tool building plants with such a volume of business that deliveries in many cases have been seriously delayed. The third class of buying has been by government commissions in shops making high-grade machinery other than machine tools, as printing presses and wood-working machinery, and in general have been for machines of the third class previously mentioned. Their buying has been most ably managed, and the results of their work have been more uniformly successful and satisfactory than that of any of the private buyers.

The private buying—that is, the buying done by machine-tool dealers—can be roughly divided into three periods. Dur-

ing the first period simple lathes and turret machines were bought almost exclusively. The demand during the second period was for grinders, drilling machines and millers. The demand during the third period was for planers, shapers and toolroom machinery.

After learning from the hard school of experience it is now realized that toolroom machinery should have been bought during the first period. The reason is obvious, for such machines are needed to produce the jigs, fixtures and gages that are the necessary accompaniment of machine tools for duplicate production.

In case of war with a first-class power the United States would unquestionably need to add an enormous number of machine tools to the present equipment of her machine shops. Based on the record of the years immediately preceding the outbreak of the war, the normal surplus of machine-tool production of the United States, as represented by the amount shipped abroad, has a value of about $15,000,000. This supply would naturally be kept at home, but in addition thereto we would have to draw from the industrial nations of Europe, provided we were not involved in a European war. This buying would have to be done by some organization not now in existence, for the reason that there are only a few agencies in this country that market European machine tools here.

Thus the European buying for the United States would have to be placed in the hands of experienced men, perhaps civilians representing both builders and users. The present British Ministry of Munitions with its subcommittees might well form a model for the American organization charged with the duty of buying machinery abroad. There are facts that tend to prove that the work done by the British commission has been most efficiently handled and has brought excellent results. This is an experience well worth careful weighing.

One of the early acts of the British Ministry of Munitions was the prohibition of the importation of machine tools into Great Britain, except under license of the ministry. A number of reasons led up to this decision. Among them is the necessity of suppressing speculative buying and selling, controlling the kinds of machine tools bought abroad, the effective utilizing of ocean-borne freight, the distributing of machine tools in a manner to best further the manufacture of munitions, and the control of quality.

But little is known of the conditions that have surrounded the machine-tool industry in Germany during the war. However, at the outbreak of war edicts of the Ministry of War placed a prohibition upon the exportation of machine tools as one of the items in a list of articles that might be of value to the enemy. As the war progressed, the ministry formed two committees—one the War Raw-Materials Committee and the other the Industrial Committee. These committees have controlled the machine-tool building industry as well as other German industries. They have directed what machines should be built, where they should be built, have handled the supplies of raw materials for machinery building and have arranged for the distribution of the new machines as well as other machines that could be released from their regular employment.

It is reported that France mobilized the machine tools of the Republic as one of the early war measures. The purpose was to bring together the machine-tool equipment into units of such a size that manufacturing could be carried forward expeditiously and efficiently.

Thus from the experience of Great Britain, Germany and France the necessity of controlling the supply and distribution of machine tools is evident in case of war between first-class powers.

No exact estimate can be given of the number of machine tools that might be immediately available in Germany in case there should be an emergency demand from the United States. A careful estimate for Great Britain, however, is that under normal conditions there are some 1,200 to 1,500 lathes in the stocks of dealers and builders at any normal time. In any event it is fair to assume that the stock of machine tools in the possession of dealers and builders in Europe would not be very great and in fact would be a very small factor in the number that we should be likely to need. Accepting this situation as a starting point, a decision can be made as to whether the United States should buy standard machines regularly manufactured abroad or order special machines particularly adapted to our own needs. It is conceivable that it might be much better to have machines built to our own drawings and specifications than to attempt to use the regular products of European builders.

Mr. Miller has pointed out the necessity of standardizing machine tools. If they are to be standardized for our own makers and needs, it follows that the machines brought from Europe should be uniform with those produced here. Without question, machine tools should be standardized, and the motive of industrial preparedness should be sufficient to inaugurate the study and work of standardization at once.

Turning again to the European situation, it is estimated on reliable authority that plain lathes of, say, 16 to 24 in. in swing could begin to be shipped from British machine shops in 12 weeks from the receipt of detailed drawings of their parts and detailed specifications for their manufacture. Not only could they be procured in this time from machine-tool building shops, but also from other machine shops accustomed to doing high-grade work. Broadly speaking, any machine shops that are accustomed to do accurate planing and scraping can build machine tools under the conditions of demand such as exist at the present time.

Because of the small stocks of machine tools in Europe, it is evident that not many could be obtained during the brief period of waiting for American standardized construction to be produced. It is of course possible that the essential standardized details could be reduced to a minimum, with the insistence that these should be incorporated in the regular designs of European builders. In this way the essential needs of uniformity with American products would be met, and it is possible that a certain amount of time could be saved over the estimates just given.

From the experience of the allied nations in purchasing machine tools during the past 20 months it seems justifiable to lay down the following principles for the standardization and procurement of machine tools in organizing for American industrial preparedness:

1. Organize at once in skeleton form an industrial committee to control the standardization, design and preparation of machine tools for the production of American munitions.

2. Through joint action of this committee, the American Society of Mechanical Engineers and the National Machine-Tool Builders Association standardize the details of regular machine tools and design whatever additional special machine tools may be necessary for the rapid and economical production of American munitions.

3. Immediately on the outbreak of war prohibit the exportation of any machine tools from the United States.

4. Immediately on the outbreak of war prohibit the importation of any machine tools into the United States except under license and control of the committee mentioned under 1.

5. Order all machines abroad through this committee or its representatives in the capitals of Europe and intrust these men with the responsibility of securing the desired deliveries and quality.

6. Order no machine tools abroad except to standardized American designs, either for the complete machine or the essential details, as the committee may determine.

Turning now to the important matter of standardization of machine tools, this subject was thoroughly talked over at a convention of the National Machine-Tool Builders Association a few years ago. However, as that body is a business rather than a technical organization, no efforts have been made to bring about uniformity. The suggestion has been offered that this work of standardization should be done jointly by the American Society of Mechanical Engineers, the industrial committee outlined in this paper and the National Machine-Tool Builders Association. I believe this society should initiate and prosecute the work.

As a possible aid in bringing this matter forward for consideration, Mr. Alford offered an appendix which contained excerpts from an address he made before the 1911 annual convention of the National Machine-Tool Builders Association. It outlined a number of features of machine tools that might properly have consideration at the hands of a standardizing committee and was published in full in *American Machinist*, page 725, Vol. 35.

The preparedness session was both enthusiastic and emphatic and indicated a unanimous sentiment in favor of organizing. A resolution was passed providing for a committee to standardize details of machine tools.

Another paper of interest to machine builders was presented by N. W. Akimoff, on "Dynamic Balance." This paper and the discussion on it will be published in a later issue.

Wednesday afternoon was devoted to a boat trip, giving an opportunity to inspect the harbor, the recently constructed cotton warehouse and its mechanical equipment. A visit was also paid to the new reinforced-concrete grain

elevator that is being erected by the Board of Commissions of the Port of New Orleans.

Following the usual custom, Wednesday evening was devoted to an address of general engineering interest, at which the ladies and the public were made welcome. The speaker was W. B. Thompson, Commissioner of Public Work of the City of New Orleans.

Interesting Social Features

The City of New Orleans lived up to the reputation for Southern hospitality. An informal festival was held on Thursday evening at the New Orleans Country Club, and this was followed by a tea at the Newcomb College of Art Pottery. A reception dance was held on Thursday evening. Many technical excursions for the men were arranged to the various pumping plants, drainage and irrigation projects, and automobile rides to the local points of interest were pleasantly arranged for the ladies.

From all points of view, this spring meeting was one of the most successful in the history of the society.

Measurement of Viscosity and New Form of Viscosimeter*

By H. C. Hayes and G. W. Lewis

This article deals with the measurement of viscosity. It predicts the errors which are introduced by the various types of viscosimeters and verifies these predictions in case of the short capillary types, such as the Saybolt, Engler and Redwood, and the orifice types, such as the Carpenter, by comparing the temperature vs. viscosity curve for a light and a medium lubricating oil as given by these meters with the true curves as determined by a modified form of Poiseuille's capillary-tube method.

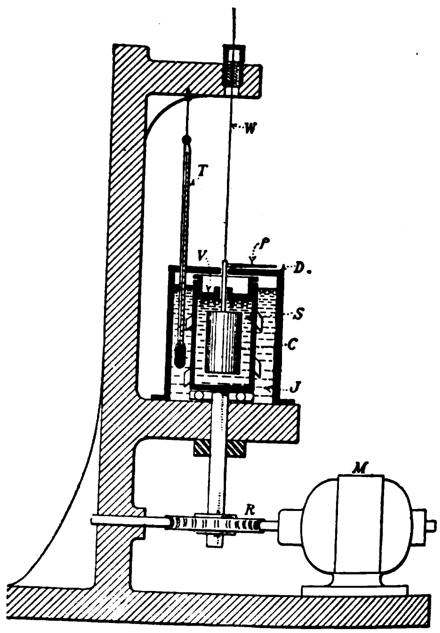
The work shows that the short capillary types give results about 50 per cent. too small, and the orifice types give results about 100 per cent. too small; and further, that none of these meters give accurate comparative results for two different oils or for the same oil at different temperatures.

The only type of viscosimeter on the market that can be expected to give accurate results on theoretical grounds is the Stormer. This instrument attempts to measure the viscosity in terms of the torque required to spin a disk within the liquid, but the mechanical difficulties met with are such as to debar this type.

The authors have designed and thoroughly tested out a viscosimeter which is believed to embody all the good points of the Stormer and none of its defects. This machine measures the viscosity in terms of the torque that a cylinder experiences when suspended within a rotating liquid. This method eliminates all error due to friction. The results given by this meter agree with the true curves for the light and medium oils to within 1 per cent. and can safely be used as a standard.

The advantages of such a viscosimeter are evident: The instrument can be calibrated to give direct readings of the viscosity; the oil is not handled during a complete test at various temperatures; the design of the instrument is such that the temperature of the specimen follows closely the temperature of the bath, so the data for the temperature vs. viscosity curve can be taken while the sample is cooling; the meter gives the viscosity of mixtures, such as paints, as well as for liquids that have been carefully filtered; there are no glass parts to break; the personal error is eliminated; and the meter can be made self-recording.

This viscosimeter operates in accordance with the principle that a solid body having a surface of revolution experiences, when suspended in a rotating liquid, a torque that is proportional to the viscosity of the liquid. The instrument is shown diagrammatically herewith. The specimen is contained within a cylindrical chamber that is caused to rotate uniformly by a motor *M* through a worm drive *R*. A cylinder *C* is suspended within the specimen by a thin steel wire *W* so that the axis of the rotating liquid coincides with the axis of the cylinder. The specimen chamber is provided with a cap *V*, so shaped that the excess liquid can overflow when the cap is seated and thus give constant conditions within the chamber.



THE NEW VISCOSIMETER

The specimen chamber is surrounded by an oil jacket *J*, in which a thermometer *T* is suspended. The jacket oil may be brought to any desired temperature by means of a heating coil or by a side coil not shown in the diagram. The cover *P* of the jacket chamber is provided with a scale which is marked in degrees or may be calibrated to read off directly, through the deflection of the pointer *P*, the viscosity in terms of a standard liquid. The specimen chamber and the suspended cylinder are both made of copper, to insure constant temperature throughout the specimen, and the outside of the specimen chamber is provided with blades that keep the jacket oil thoroughly mixed as the chamber revolves, thereby exposing the latter to a uniform temperature. This is an important factor toward insuring constant temperature throughout the specimen.

(Continued on page 702)

*Abstracted from a paper presented to the spring meeting of the American Society of Mechanical Engineers.

Editorials

Machine-Shop Power Tests as an Aid to Economy

The difficulties surrounding power measurements by mechanical means are well known to those who have experienced the simplicity of the electrical measurements connected with similar processes. Thus the operations involved in the measurement of the mechanical-power output of an electric motor by means of a prony or strap brake and balances or scales may be contrasted with the exceedingly simple measurement of electrical-power input of the same motor, requiring, as the latter does, merely several indicating electrical instruments that are read at a glance.

Nor is the difficulty of the mechanical measurement, in contrast to the electrical observations, limited only to inconvenience, for there are many sources of probable error in the former that may be reduced practically to negligible proportions in the latter. Accuracy, therefore, is one of the greatest points favoring electrical measurements in comparison with former methods, and these two features—namely, convenience and accuracy—no doubt largely account for the widespread use of the electric current in some shop measurements at the present time.

With all the many advantages of the indicating electrical instruments, typified by the well-known voltmeter, ammeter and wattmeter, the more recent development of graphic electrical instruments has been a marked step forward toward still more highly specialized methods in the practice of measurement. In the graphic instrument we have the means for inscribing in a convenient form an indelible record of past operations, which may be used later for a study at length of the various steps of an operation or for analyzing the parts of a cycle of operations, for the purpose of locating, for example, time losses not readily discernible by an observer.

A striking example of the more modern methods of shop analysis is that of the graphic meter when applied to an electric motor that drives its individual machine tool. The power-input-time record resulting from a graphic meter on such a tool gives to the operator and foreman a most instructive chart of the cycles followed in the work on a given operation. It tells the number of minutes during which the machine has worked and during which it has been idle. If the crane service is poor and undue delays are experienced in getting the material for his machine, the operator has a proof, in the form of the graphic chart, on which to base suggestions.

Perhaps of equal importance, however, is the information of the exact power transmitted to a given machine tool, made possible by the graphic chart. With line-shaft drive and belt transmission there is no very convenient method for determining the exact quantity of power being imparted to the machine tool, save that of calculation on a more or less empirical basis. If an electric motor is employed to drive this same tool, a graphic meter arranged to record the electrical input to the motor furnishes an accurate record of exact power transmissions; and the proper size of the motor for driving the machine most economically is readily determined.

These advantages, however, do not apply so much to the determination of exact power requirements of the machine as to the effects of suitable power input on the time of production. As has often been pointed out, the power consumption of almost any machine tool represents an expense that is virtually negligible in comparison with the corresponding labor and overhead charges against this same machine. The economic effect of having adequate power available, on the ability of the operator to get out his work in the minimum practical time interval, is therefore of far more consequence than the mere determination of power input, and it is this function that is performed so conveniently by modern graphic meters.

There is but little doubt of the fact that the intelligent use of suitable measuring devices is capable of reducing much shopwork to a more highly systematic basis than was possible with former methods, where the foreman and operator were almost entirely at the mercy of line-shaft speeds of fixed values and given belt widths; and incidentally the electric motor comes in for a share of the credit in making such a method of measurement possible, because of the medium of electric rather than mechanical supply on which its operation depends.

Machine Tools in South America

Almost 40 per cent. of the machine tools in the shops in South America were made in the United States of North America. This may be a confounding statement to the alarmists who say that we never have had much machinery trade with our southern neighbors and are not likely to. We have been told that the demands for cash business have debarred North American manufacturers from selling in South American countries. The long credit has been held up as the only basis for South American business. But in spite of these facts and many others that have been held up as barriers against the northearn business man, 39.3 per cent. by number of the machine tools in South America machine shops were imported from the United States.

The statistics from Mr. Hood's report bearing on the nationality of the machine tools are as follows: "British machine tools, 43.2 per cent.; United States, 39.3 per cent.; German, 13.4 per cent.; French, 3.2 per cent.; Belgian, 0.5 per cent.; all others, 0.4 per cent."

As regards the nation of origin, Great Britain leads, with the United States a close second. The reason for the predominance of British-made machines is undoubtedly found in the financial arrangements that have existed between South American countries and English capitalists. British gold has financed South American

railroads, mines and other enterprises. Many of these projects have been organized and operated by British engineers. It was very natural, therefore, that they should buy British machinery.

Perhaps the second most surprising fact brought out by these percentages is the smallness of the German importation. Only about one-eighth of the machine tools in South America are German made.

It is evident that there is nothing disheartening to American machine-tool builders in these statistics. If the past lays a foundation for the future, the United States builders will surely reap their share of the coming South American business.

It is of interest to present some further figures in regard to the number and distribution of these machine tools. Quoting again from Mr. Hood's report, there are in the South American machine shops that were plotted on the map on page 652 of last week's issue a total of 11,681 machine tools. Distributed according to the size of the shops, the classification is: In shops employing up to 20 men each, 4,747 machines; from 21 to 50 men each, 1,361; from 51 to 150 men each, 862 machines; from 151 men upward, 4,711 machines.

The statistics referred to also divide these machine tools into eight classes according to kind. Of the 11,681 machines, 3,417 are lathes, 885 planers, 425 millers, 522 boring machines, 1,695 drilling machines, 997 grinders and 3,740 of various kinds, including woodworking machinery. It is interesting to calculate a few percentages from these figures. Thus, lathes comprise about 30 per cent. of the total, drilling machines about 15 per cent. and planers about 8 per cent. It is fair to assume that these figures indicate roughly some of the proportions in which various kinds of machine tools will be bought in South America in the immediate future.

Lobsters and Machine Tools

Necessity is said to make strange bedfellows, and it seems that war can reclassify both necessities and luxuries.

A recent announcement has been made of articles prohibited for importation into Germany. This act is taken as a war measure and is stated to be aimed at luxuries that the German people can do without. Here is the list: "Lobsters, caviare, liquors, champagne, fans, hats, caps, pineapples, raisins, silk, silk clothing, pictures, sculptures, jewelry, gold, silver, toys, artistic ironware and machine tools." The list begins with lobsters and ends with machine tools. Queer bedfellows, surely!

We have been wont to understand that machine tools are a humdrum product of industry, bought only because they are needed and used only because they have to be. In fact, we have always placed them at the bottom of the scale of everyday necessities to keep the world going. But this order shows that we were mistaken. Machine tools should properly be classed with champagne, caviare and lobsters—never mind if they are more indigestible than any of the others.

In a changed mood, is it worth while asking: Why this prohibition? Will it hold after the war is over? In connection with these questions it must be recalled that some three or four years ago an effort was made in Germany to prohibit the importation of machine tools from abroad. This movement had its inception in the minds of the leaders of some of the machinery builders' associations. The *American Machinist* was credibly informed at the time that the matter had been brought to the notice of Government officials, who might take action. However, nothing was done officially.

Let us hope that there is no basis or reason for being disturbed over this order. On its face, it is nothing but a war measure. May it be such in fact!

Belting Specifications

The purchase of leather belting has lagged behind the progress made in exact specification and testing now common in the many other shop materials and supplies. Even today, price is usually a controlling factor when a belting contract is let. Wherever specifications are used, more often than not they attempt to control the process of manufacture rather than to set up requirements that the belting must meet in use. The unsatisfactory situation is well outlined in the article on page 683.

This presentation of a new basis for writing leather-belting specifications is a definite challenge to both belting manufacturers and belting users. These suggestions turn the entire discussion from one that might be merely destructive to something that is definitely constructive. The *American Machinist* hopes that there will be full and free discussion of these new specifications, with the purpose of improving the basis upon which belting is bought.

Vital Factor of All Munitions

The more one sees of munitions the more evident it becomes that the designers and those who prepared the specifications know little or nothing of economical manufacturing methods. They do not realize how much easier it is to call for concentricity of shells within 0.003 in. than to secure this in actual manufacturing, nor how slight an error in the curve of the nose will affect the exact profile. Yet gages are called for that require almost absolute perfection of product to pass the inspection honestly.

If this perfection were necessary for the proper functioning of the shell, no objection could be made to its being demanded. But when one nation requires holes reamed glass smooth in high-explosive shells and another accepts them just as they come from the forging punch, the extreme smoothness cannot be absolutely necessary. One nation insists that the relieved surface on the shell be turned smooth or ground, while others consider the coarse thread left by the tool to be not only good enough, but better, as it affords a good painting surface.

The one vital consideration in preparing both designs and specifications for munitions, just as in all other mechanisms, is that the product shall function properly; all else should be secondary. All vital dimensions should be held within as close limits as necessary; all other dimensions should be given as large tolerances as possible without affecting the proper functioning of the shell. And so throughout the list. There can be no better form of preparedness than that which will eliminate useless expenditure of time, money and material and enable a larger supply to be made at short notice.

Some of the testing gages are fearfully and wonderfully ingenious; but were half the gray matter expended on these turned to making the designs and specifications simple and more easily complied with, all concerned would be far better off.

Shop Equipment News

A Single-Belt Automatic Screw Machine

The illustrations show a front and a back view of the latest form of automatic screw machine developed by the Chicago Automatic Screw Machine Co., Chicago, Ill., for the John Macnab Machinery Co., 90 West St., New York City.

The machine is operated by a single belt run directly from the lineshaft, making unnecessary any countershaft. A fast-and-loose pulley is arranged on the spindle head, the power being transmitted to the spindle through two trains of gears, one of which is changeable to obtain the spindle speed desired. The intermediate shaft is extended to the rear end of the machine, where it is connected to the feed bracket by a clutch that is operated by a hand lever conveniently located at the operator's right hand; the desired feeds are obtained by changing two gears on the feed bracket. The feed can be operated by a handwheel to assist the operator in setting up the machine.

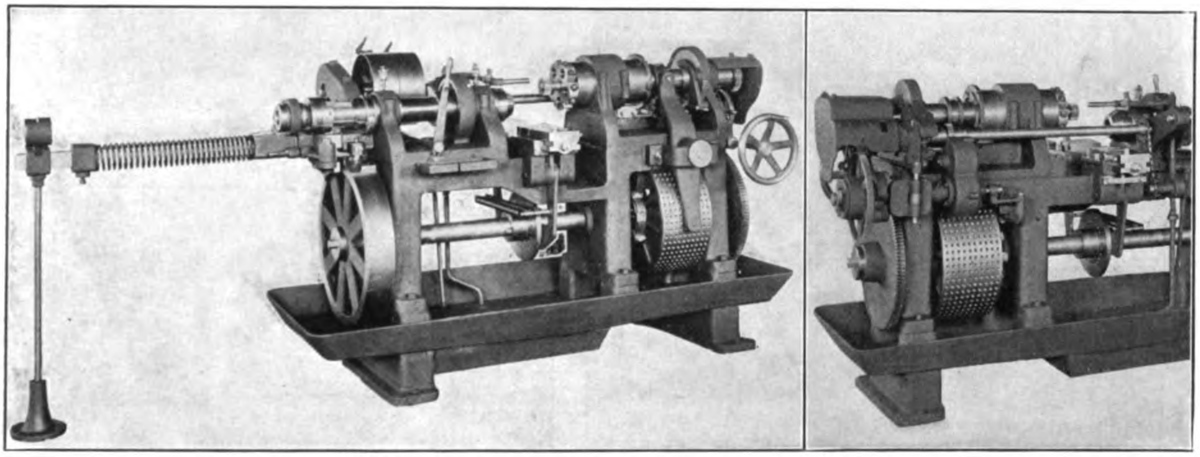
The turret is indexed by a clutch mechanism that is positive and can be arranged to skip any number of holes in the turret, when all the turret holes are not being used. The feed to the turret is transmitted from the cam drum by a lever which allows the turret tools to be brought up to their cutting position rapidly. A tool-steel plate, hardened and ground, is used to align the turret, provision for wear being made by a wedge under this plate.

The two cross-slides are operated independently of each other by two separate cams and levers. They have broad bearing surfaces that are scraped. A rapid method of adjustment is provided by a screw and nut which are locked in position when the desired adjustment is obtained.

As the spindle runs in a left-hand direction and is not reversed, right-hand threads are cut with a die or tap holder that runs slightly faster than the spindle. When the desired number of threads are cut, the turret returns; the driving gears for the die or tap holder are disconnected, the die or tap stops revolving and so runs itself off the work. Button or spring dies are used. Left-hand threads are cut by running the die or tap slightly slower than the spindle when cutting and faster when running the die or tap off the thread.

The die- or tap-holder gear is driven by a gear on a shaft that runs through the center of the turret. This shaft can be readily taken out when the machine is not being used for threading.

A fast and a slow motion for the feed mechanism are provided on the larger machines, thereby cutting idle-movement time down to a minimum. This feed is operated by dogs mounted on a disk on the camshaft, where they can be readily adjusted to their correct positions.



CHICAGO AUTOMATIC SCREW MACHINE DESIGNED FOR QUICK CHANGE OF WORK

Spindle capacity, 2 in.; width of belt, 4 in.; diameter of turret, 7½ in.; number of holes in turret, 4 or 5; diameter of holes in turret, 1¼ in.; milling distance, 6 in.; longitudinal adjustment of tools, 2 in.; floor space, 36x124 in.; approximate weight, 3,450 lb.

The stock feed and the chuck-operating mechanism are of the usual types, the stock feed being adjustable to feed any length up to the capacity of the machine. This arrangement eliminates wear on the feeding fingers in pushing back the stock to the correct length.

The oil pump is located at the rear of the machine and is driven by a silent-chain drive from the feedshaft. An oil pan and tank, allowing an ample supply of cutting lubricant, are provided with strainers so that chips cannot interfere with the pump or pipe fittings.

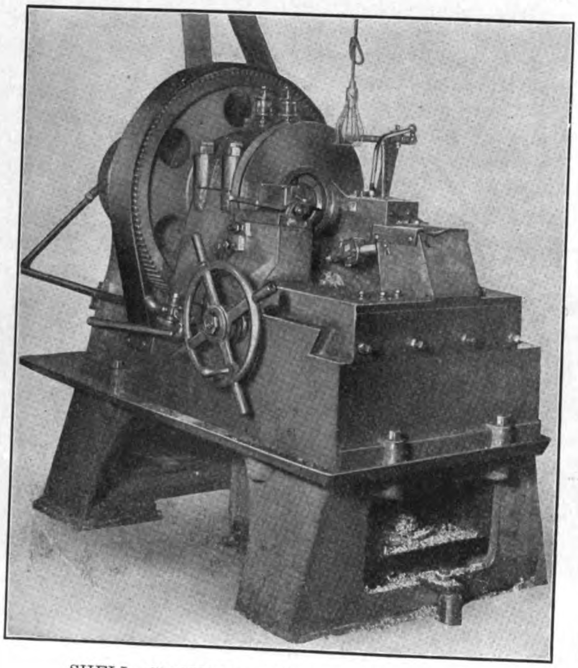
Frictions are used only to prevent breakage of parts but do not form a part of the driving train in that they cannot act until the load or stress greatly exceeds that due to normal operation.

In the design of this machine one of the chief aims was to provide simple construction throughout and to enable quick change from one job to another. In carrying out this purpose all the cams, tools, the spindle speed and the feed-charge gears were made readily accessible. The machine is made in a number of sizes.

Machine for Grooving and Waving 6-In. Shells

The shell-grooving and waving machine shown represents the latest development of the Traylor Engineering and Manufacturing Co., Allentown, Penn. It was designed for 6-in. shells, weighs approximately 9,000 lb. and occupies a floor space of 6x4 ft.; but other sizes have been designed and manufactured.

The machine is equipped with an air chuck (the piston being 9 in. in diameter) that holds the shell securely during the machining operations. The drive is by a belt 4 in. wide, operating through a quick-acting chuck. The tool is of rigid construction, the main spindle bearings



SHELL GROOVING AND WAVING LATHE

being 11 in. in diameter by 12 in. long and lined with a peened babbitt that is afterward bored and scraped. The spindle and the gears are made of semisteel, the teeth afterward being machine-cut.

The shell-holding chuck is a steel forging, which is split into six segments after being turned and bored to the correct size. The longitudinal traverse table is fitted with a take-up gib held and adjusted by four setscrews with check nuts. A chute cast on the machine carries the chips away from the tools and shell. Cutting lubricant is fed through a pipe and flows back by gravity through a screen into a tank in the bed of the machine.

In operation, after the shell has been slid into the chuck, the adjustable stop, shown at the forward end, is raised and the shell end brought up against it. The air pressure is then turned on, which not only grips the shell by means of the segmental chuck, but also pushes the shell against the stop. This insures precise positioning of each shell in relation to the tools. The channel or groove is machined by a tool held under the shell and fed across by the handwheel, shown in front. Thus the correct depth of groove is machined after the tool has been once properly set, as the operator does not have to depend on any gage measurement. The undercut surfaces are machined with the tools shown in front, the handle carrying them first to the right and then to the left against adjustable stops provided for the purpose.

The wave is formed with the tool at the rear, the operator drawing back the tool to the correct depth, determined by an indexed dial on the spindle on which the handwheel is mounted. The proper form of the wave is obtained by the large face cam, which may be seen on the outer surface of the chuck-holding flange. A roller presses against this face cam, which operates the tool, being held against it by a tension spring.

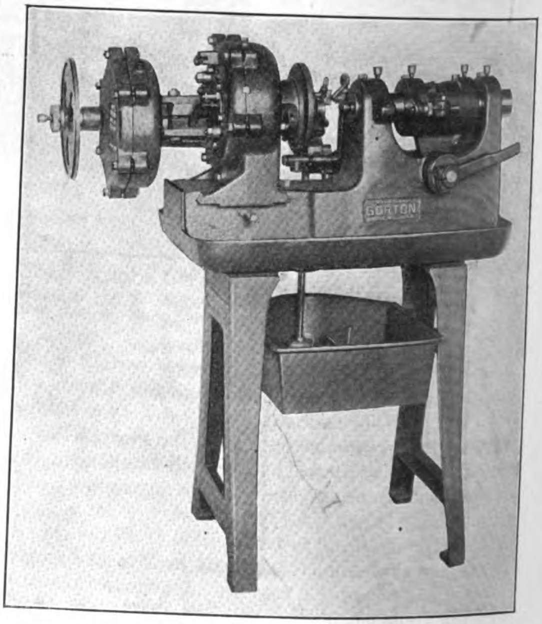
The average time required for machining the groove, undercutting and forming the wave of a 6-in. shell, from floor to floor, is $3\frac{1}{2}$ min.

Routing Machine for Fuse Rings

The illustration shows a machine designed and built by the George Gorton Machine Co., Racine, Wis., for the sole purpose of routing the rings of fuses for shells.

Ample adjustments are provided for, so that the powder groove can be milled any circle up to 4 in. in diameter. It may also be of any length from 0 to 360 deg. Gage holes on the rings may be in any position on top, bottom or side. The spindle of the machine runs approximately 3,200 r.p.m., but may be varied to suit the work.

The groove is finished smoothly and accurately in one cut, and a production of 25 to 30 rings per hour can be



HORIZONTAL ROUTING MACHINE FOR FUSE RINGS

maintained. The ring is clamped on a hardened and ground steel plate by means of a drop-forged fork and hardened cam.

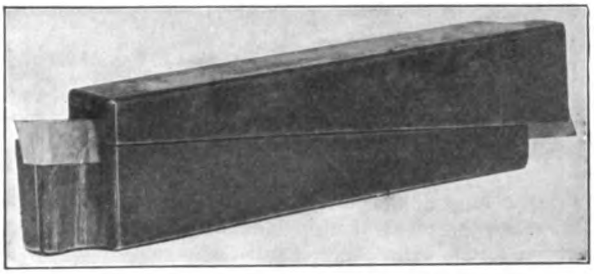
The stops are made of hardened tool steel and operate inside the work-holder case. The feed pulley is mounted on the rear case and operates the work holder by two pairs of reduction spur gears.

The spindle, pump and feed pulleys are all driven from a jackshaft that can be made long enough to drive a number of machines, eliminating the use of individual countershafts and being more practical.

A cutter-lubricating system, including pump tank, strainer, relief valve, piping and flexible nozzle, is provided with the machine, which is mounted on legs. It can be furnished as a bench machine, however, in which case no pump is supplied.

Lathe and Planer Tool Holder

With the type of tool holder shown, in which the cutter is supported directly under the cutting edge and throughout its entire length, it is calculated that cutter breakage will be reduced to the minimum. By the elimination of bosses and setscrews it is possible to bring the holder



LATHE AND PLANER TOOL HOLDER

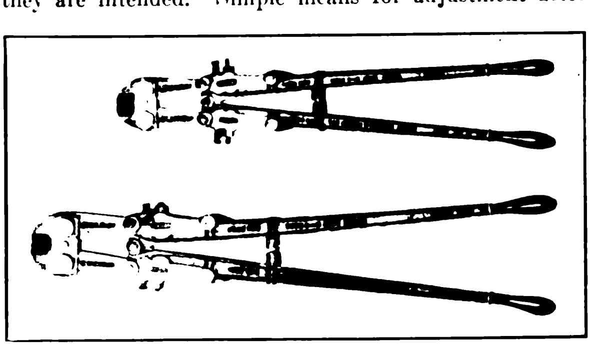
closer to the cutting edge, providing a rigid support and removing the possibility of breakage through setscrews playing on the tool steel.

The holder can be used either as a right- or a left-hand holder by simply reversing it in the tool post.

The tool holder illustrated is made in nine sizes, to take square cutters ranging from $\frac{3}{16}$ to $\frac{7}{8}$ in. It is a recent product of the Worcester Flexible Tubing Co., Worcester, Mass.

Bolt Clippers

The American Metal Products Co., Chicago, Ill., is making bolt clippers in several sizes, as shown. All castings are of the best malleable iron, and the knives are of special tool steel, tempered to meet the specific service for which they are intended. Simple means for adjustment after



BOLT CLIPPERS

Specifications—Made in four sizes: No. 300 cuts threaded bolts to $\frac{5}{16}$-in. diameter, soft steel to $\frac{1}{4}$-in. diameter, and weighs $3\frac{3}{4}$ lb.; No. 400 cuts bolts to $\frac{3}{8}$-in. diameter, soft steel to $\frac{5}{16}$-in. diameter, and weighs $5\frac{1}{2}$ lb.; No. 500 cuts bolts to $\frac{1}{2}$-in. diameter, soft steel to $\frac{3}{8}$-in. diameter, and weighs $9\frac{1}{2}$ lb.; No. 600 cuts threaded bolts to $\frac{5}{8}$-in. diameter, soft steel to $\frac{1}{2}$-in. diameter, and weighs 13 lb.

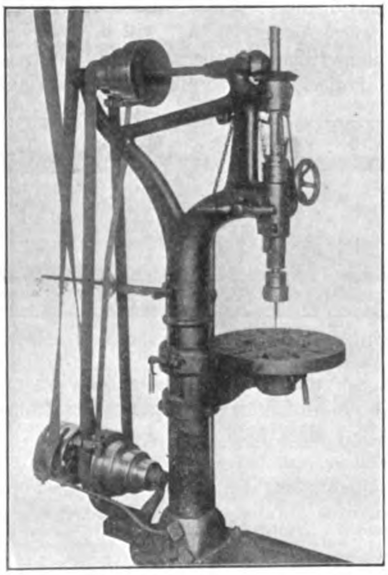
grinding are provided. All parts are interchangeable and can be easily replaced if necessary.

The nuts on the bolts that hold the blades are securely locked by a die-cut lock set in between the two nuts and so shaped as to allow twelve different positions for each hexagon locknut. The bumpers on the handles are designed to really act as such and are not useless parts, as is often the case. The castings are finished in black enamel noted for its wearing qualities.

Automatic Belt Shifter

The belt shifter shown on an upright drilling machine was designed to provide a quick means of shifting the belt from step to step of the cone pulley. The shifter is equally applicable to all classes of cone-driven machine tools. It is of simple construction, consisting of only five parts.

The vertical shifter rod and upper part of handle are a single unit; the pivot rod is screwed into the rear of the drilling-machine column; the belt loops are secured to the shifter rod by set-screws; the retaining strap is



AUTOMATIC BELT SHIFTER

secured to the column of the machine and limits the movement of the handle. The lower leg of the retaining strap is adapted to engage a notch cut in the lower portion of the handle or operating arm, thereby locking the belt in normal position on each step and so preventing the belt from slipping off under heavy drilling.

Viewed from the top of the machine the pivot rod is parallel with the corners of the cone-steps on the belt-entering side and by sliding the handle on this rod, the shifter loops are moved in a way that enables them to move the belt easily from one step of the pulley to another. It will be seen that the handle projects beyond the shifter rod and is there bent over to form a lug in which is drilled a hole to admit the pivot rod freely.

To operate, the handle is lifted slightly to disengage the notch and move the handle forward (or backward) to the next notch engaging the lower portion of the retaining strap and the belt has been moved from one cone-step to the next. When the belt is shifted on to the

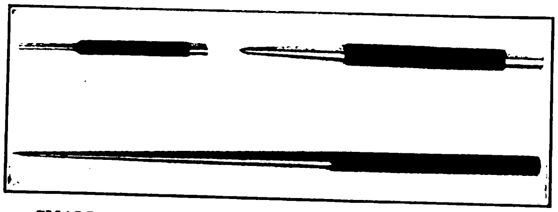
nearest cone-step (the one closest to the column) the operating handle would project in front of the machine column and probably interfere with some work. To overcome this difficulty the handle arm is hinged and can be swung to the side out of the way.

The device can be worked with one hand and is within convenient reach of the operator when he is in front of the machine. If it is desired to shift the belt from one end of the cone pulley to the other, it is unnecessary to shift it from step to step; in such a case the operator simply lifts the handle up to the limit of the retaining strap, pulls or pushes the handle to the limit of its movement in the proper direction, stops being provided so that the handle cannot be moved far enough to throw the belt off the pulley.

This belt shifter is made by Nils E. Larson, 3939 Park Ave., Chicago, Ill.

Scribers, Pin and Center Punches

The West Haven Manufacturing Co., New Haven, Conn., has brought out a line of scribers, center and pin punches, examples of which are shown in the illustration. These tools are manufactured of a good quality of steel, nicely knurled and finished. The pin



SMALL HAND PUNCHING AND SCRIBING TOOLS

punches are made with parallel driving ends from $\frac{1}{16}$ to $\frac{3}{8}$ in. in diameter and in lengths from $2\frac{1}{4}$ in. for the smallest sizes to 6 in. for the largest.

The center punches are furnished in three sizes—with body diameters of $\frac{3}{16}$, $\frac{1}{4}$ and $\frac{3}{32}$ in. The scribers are made in three diameters and lengths.

Measurement of Viscosity and New Form of Viscosimeter

(Continued from page 696)

The experimental work has shown that the temperature of the specimen is uniform to within a small fraction of a degree. Moreover, the temperature of the specimen follows the temperature of the jacket oil so closely that the temperature-viscosity curve can be taken while the temperature is slowly raised or lowered. This proves to be a great saving of time. It also saves labor, for one does not need to stand by the instrument continually. The deflection of the pointer is at any instant a measure of the viscosity, so all that is required it to take simultaneously readings of temperature and deflection at intervals during the heating or cooling process. The new viscosimeter of the nonflow type described has the following advantages:

1. It gives values for the viscosity which are in agreement with those given by the standard capillary-tube method.

2. During a series of tests at various temperatures the oil is not handled.

3. The sensitiveness of the instrument can be made anything desired by changing the speed of rotation of the specimen or by using suspension wires of various diameters.

4. The density or change in density is not a factor in computing the results; in fact, the instrument may be graduated to read off the viscosity directly.

5. The viscosity of liquids which contain particles in suspension can be measured, and the operation of the meter is independent of the color of the specimen.

6. The temperature-viscosity curve can be taken with a fair degree of accuracy while the temperature is rising or falling, as the temperature of the specimen closely follows the temperature of the jacket.

7. The personal error which arises in determining time intervals with a stop watch is removed.

8. The instrument is simple, rigid and self-contained. It has no separate parts to get lost or glass parts to get broken.

Plan for Classification of Technical Literature

The Joint Committee on Classification of Technical Literature, composed of representatives of the leading technical, engineering and industrial organizations of the country, met on Saturday, Apr. 1, in the Board room of the American Society of Engineers. Henry W. Peck, of Schenectady, presented a progress report, outlining the way in which the committee came into being and reviewing its work to date. W. P. Cutter, librarian of the Engineering Societies Library and secretary of the executive committee, presented a paper on "How To Make a Classification." After considerable discussion as to the relative merits of the plan recommended by the executive committee, of the proposal to assign the classification of various divisions of the subject to the societies dealing with those specialties and of the suggestion to employ a professional to prepare a tentative classification for later discussion and revision by the respective societies it was decided to adopt the recommendation of the executive committee as more in accord with the means at the disposal of the committee.

F. R. Low resigned the chairmanship of the executive committee in favor of Henry W. Peck, who has been actively identified with the movement from its inception.

NEW PUBLICATIONS

ELEVATORS—By John H. Jallings. Two hundred and seventeen 5½x8¼-in. pages; 172 illustrations; indexed; cloth bound. The American Technical Society, Chicago, Ill. Price, $1.50.

This book, written in rather popular style, describes and illustrates all the common forms of elevators. It is divided into three parts, of which the first takes up hand-power elevators, belt-power elevators and worm and gear elevators. The second part includes steam elevators and hydraulic elevators, while the third part takes up electric elevators.

The historical development of the elevator as a lifting device is quite fully covered and with a sketch of the early developments of the various common types of today fits the book for anyone who wishes to acquaint himself with the general features of construction and operation. However, but very little information is given which would be of value to the elevator designer or erector.

The illustrations have been drawn from commercial types, and generous credit has been given to the firms who have supplied the photographs, drawings and information.

AUTOGENOUS WELDING AND CUTTING—By Theodore Kautny. Translated from the German by the author and James F. Whiteford. One hundred and forty-two 5x7-in. pages; 133 illustrations; indexed; cloth bound. McGraw-Hill Book Co., New York City. Price, $1.

This is one of the most valuable books that has appeared in English, dealing with flame welding and cutting. Its author, Mr. Kautny, is a recognized expert in Germany and has been intrusted by the Prussian Government with the organization of a large number of welding schools throughout the empire.

The book is written entirely from a practical viewpoint and is intended to cover in a brief compass information of value to the works engineer, foreman and welder. Its scope is indicated by the headings of the 19 chapters, which are: Autogenous Welding Flames, Acetylene Manufacture and Apparatus, Oxygen Manufacture and Apparatus, Gas Mains and Fittings, Autogenous Welding Burners, Autogenous Cutting Burners, Autogenous Welding of Iron, Repairs on Gray Cast-Iron, Welding of Sheet Iron, Manufacture and Repairs on Boilers, Manufacture of Cylindrical Vessels, Manufacture of Rectangular Vessels and Miscellaneous Articles, Manufacture and Installation of Large Pipes and Conduits, Manufacture and Installation of Gas and Water Pipes, Construction of Pipe-Shaped Apparatus, Welding of Copper, Welding of Aluminum, Welding of Nickel and Other Metals, Conclusion.

The book should find a place in the hands of everyone who is interested in any way in the flame welding or cutting of metals, either for repair work or in manufacturing.

PERSONALS

P. J. Krentz, for sometime superintendent of the Buffalo Foundry and Machine Co., has become works manager.

G. Strom, formerly tool designer with the Titusville Iron Co., Titusville, Penn., has joined the ship-drafting force at the Brooklyn Navy Yard.

E. S. Cullen, for a number of years associated with the Niles-Bement-Pond company has established the E. S. Cullen Machinery Co., Cleveland, Ohio.

Clarence K. Prince, for over 25 years associated with the H. B. Smith Co., Westfield, Mass., has been appointed general superintendent to fill the vacancy caused by the death of George H. Cushing.

Fred. Kent, general manager of the Lodge & Shipley Machine Tool Co. made an address before the Engineering Society of Buffalo at a meeting on April 12 on the general subject of modernizing the shop.

Axel Malm, an occasional contributor to our columns, has resigned his position as superintendent of the Egry Register Co., Dayton, Ohio, in order to establish the Malm Machine Co., of which he has become vice-president and general manager.

W. V. Houck, for the past two years assistant superintendent of the King Sewing Machine Co., Buffalo, N. Y., and for ten years prior thereto associated with the Garvin Machine Co., has accepted the position of factory manager of the Sterling Engine Co., Buffalo, N. Y.

C. H. Halcomb and William P. Davidson, for many years executives of the International High Speed Steel Co. have organized the firm of Halcomb & Davidson, Inc., 149 Broadway, New York City. The new company will specialize in the manufacture and sale of alloy steels.

TRADE CATALOGS

American Saw & Mfg. Co., Springfield, Mass. Price List. Lennox hacksaws.

Vanadium-Alloys Steel Co., Pittsburgh, Penn. Circulars. Vasco Non-Shrinkable and Vasco Choice tool steel.

American Roller Bearing Co., Pittsburgh, Penn. Bulletin No. 1003. Roller bearings. Illustrated, 22 pp., 7x10 in.

Joseph Dixon Crucible Co., Jersey City, N. J. Booklet. Dixon's waterproof graphite grease Illustrated, 18 pp., 3½x6 in.

The Lodge & Shipley Machine Tool Co., Cincinnati, Ohio. Manual for Operating Lodge & Shipley Lathes. Illustrated, 16 pp.

Dodge Sales and Engineering Co., Mishawaka, Ind. Catalog C 16. Power transmission machinery. Illustrated, 614 pp., 6x9 in.

St. Louis Machine Tool Co., St. Louis, Mo. Catalog No. 15. Grinding, polishing and tapping machines. Illustrated, 20 pp., 6x9 in.

The New Haven Trolley Supply Co., New Haven, Conn. Bulletin No. 6. Sterling counting machines. Illustrated, 16 pp., 4x6½ in.

S K F Ball Bearing Co., 50 Church St., New York. Pamphlet. Ball Bearings as an Automobile Sales Factor. Illustrated, 70 pp., 6x9 in.

W. S. Rockwell Co., 50 Church St., New York. Bulletin No. 30. Automatic furnaces for annealing, hardening, tempering, etc. Illustrated, 16 pp., 8½x11 in.

Worcester Flexible Tubing Co., Worcester, Mass. Catalog A. Efficiency tool holder. Illustrated, 4 pp., 3½x6 in. Folder. Worcester flexible tube. Illustrated.

CATALOGS WANTED

The Liberty Fuse and Arms Corp., Jackson Ave. and Crane St., Long Island City, N. Y., would like to receive catalogs of machinery and tools used in the manufacture of fuse parts and other brass work.

Count S. I. Shulenberg, Imperial Russian Railway Commission, 140 Broadway, New York City, requests catalogs of all kinds of machine shop equipment, and equipment for steel mills. Count Shulenberg does not wish such catalogs for himself or for the Russian Government, but wants them for many friends in Russia who continually send him inquiries in such lines.

BUSINESS ITEMS

The Desmond Stephan Mfg. Co., Urbana, Ohio, has bought the business of The Rupert Co., Indianapolis, Ind., manufacturers of Huntington dressers.

The Malm Machine Co., Dayton, Ohio, has been organized to take up the manufacture of the recently invented Malm rotary punch press. The following officers have been elected: A. G. Stevens, president; F. Kiefaber, vice-president; Axel Malm, vice-president and general manager; H. M. Estabrook, secretary and treasurer.

The Cyclops Steel Works, Titusville, Penn., operated for many years by Charles Burgess has been purchased by the Cyclops Steel Co., Carl F. Boker, president, and will be enlarged and developed. F. C. Kirkpatrick and Walter Bould, managers of the works under Mr. Burgess, will continue with the new company and the organization will remain unchanged. Carl F. Boker has parted with his interest in the H. Boker Co. The New York office of the Cyclops Steel Co. is at 115 Broadway, N. Y.

FORTHCOMING MEETINGS

National Metal Trades Association. Annual meeting, Apr. 27-28, New York, N. Y., Hotel Astor. H. D. Sayre, secretary, Peoples Gas Building, Chicago, Ill.

American Society for Testing Materials. Annual meeting June 27 to July 1, 1916, Hotel Traymore, Atlantic City, N. J. Edgar Warburg, secretary, University of Pennsylvania, Philadelphia, Penn.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Wednesday each month. J. A. Brooks, secretary, Brown University, Providence, R. I.

New England Foundrymen's Association. Regular meeting second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. J. H. Warder, secretary, 1785 Monadnock Block, Chicago, Ill.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Technical League of America. Regular meeting second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York, N. Y.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points indicated:

	Apr. 14, 1916	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$15.00	$15.00	$9.25
No. 2 X Northern foundry, New York	20.50	19.75	14.25
No. 2 Northern foundry, Chicago	19.00	18.50	13.00
Bessemer, Pittsburgh	21.95	21.45	14.55
Basic, Pittsburgh	19.20	18.70	13.45
No. 2 X, Philadelphia	20.50	20.00	14.25
No. 2, Valley	18.50	18.25	12.75
No. 2, Southern Cincinnati	17.90	17.90	12.40
Basic, Eastern Penn	20.50	19.50	13.25
Gray forge, Pittsburgh	18.70	18.45	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger from jobbers' warehouse at the places named:

	New York Apr. 14, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Steel angles, base	3.15	2.70	1.85	3.25	3.10
Steel T's, base	3.20	2.75	1.90	3.25	3.10
Machinery steel (bessemer)	3.15	2.70	1.80	3.25	3.10

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse at the places named:

	New York Apr. 14, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
No. 28 black	3.50	3.50	2.60	2.95	3.20
No. 26 black	3.40	3.40	2.50	2.85	3.10
Nos. 22 and 24 black	3.35	3.35	2.45	2.80	3.05
Nos. 18 and 20 black	3.30	3.30	2.40	2.75	3.00
No. 16 blue annealed	4.30	4.30	2.35	3.70	3.60
No. 14 blue annealed	4.20	4.20	2.25	3.60	3.50
No. 12 blue annealed	4.15	4.15	2.20	3.55	3.45
No. 28 galvanized	5.65	5.65	4.00	5.50	5.50
No. 26 galvanized	5.35	5.35	3.75	5.20	5.20
No. 24 galvanized	5.20	5.20	3.55	5.05	5.05

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot:

	Black Apr. 14, 1916	Black One Yr. Ago	Galvanized Apr. 14, 1916	Galvanized One Yr. Ago
¾ to 2 in. steel butt welded	72%	80%	53½%	69½%
2½ to 6 in. steel lap welded	71%	79%	52½%	68½%
Diameter, In.				
¾	3.12	2.30	5.35	3.51
1	3.91	3.40	7.91	5.19
1¼	6.44	4.60	10.70	7.02
1½	7.70	5.50	12.79	8.39
2	10.36	7.40	17.21	11.29
2½	16.97	12.29	27.79	18.43
3	22.19	16.07	36.34	24.10
4	31.61	22.89	51.78	34.34
5	43.12	31.08	68.30	46.62
6	55.68	40.32	91.20	60.48

Bar Iron—Prices are as follows in cents per pound at the places named:

	Apr. 14, 1916	One Month Ago
Pittsburgh, mill	2.50	2.20@2.30
New York	2.75	2.40@2.45
Warehouse, New York	3.15	2.70
Warehouse, Cleveland	3.25	...
Warehouse, Chicago	3.10	...

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-size lots, the following quotations hold:

New York	15% above list price
Cleveland	20% above list price
Chicago	10% above list price

Boiler Tubes—From Pittsburgh, the following are the less-carload basing discounts for lap-welded boiler tubes:

1¾ and 2 in.	51%	3½ to 4½ in.	60%
2¼ in.	48%	5 and 6 in.	53%
2½ and 2¾	54%	7 to 13 in.	50%
3 and 3¼	59%		

These discounts apply to standard gages and to even gages not more than 4 gages heavier than standard. For long tubes charge 10% net extra as follows: 1¾ in. size over 18 ft. and not exceeding 22 ft.; 2 to 3 in. sizes over 22 ft. and not exceeding 24 ft.; 3¼ to 13 in. sizes over 22 ft. and not exceeding 25 ft.

Swedish Steel Sheets—To consumers requiring fair-sized quantities tool steel sheets sell at 16c. base and spring steel sheets at 12c. base. These prices are f.o.b. warehouse, New York.

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York Today	New York One Year Ago	Cleveland	Chicago
$4.75	$3.75@4.00	$5.05	$4.10

In coils an advance of 50c. is usually charged.

High Speed Tool Steel containing from 10 to 18% tungsten sells as follows per pound in New York:

Billets .... $2.35 Bars $3.00

METALS

Miscellaneous Metals—The present quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	New York Apr. 14, 1916	One Month Ago	One Year Ago
Copper, electrolytic (carload lots)	28.50	27.25	16.87½
Tin	54.00	42.00	55.00
Lead	8.00	6.30	4.20
Spelter	19.50	20.50	10.00
ST. LOUIS			
Lead	8.00	6.15	...
Spelter	19.00	6.20	...

At the places named, the following prices in cents per pound prevail:

	New York Apr. 14, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Copper sheets, base	36.50	35.00	21.50	36.00	34.50
Copper wire (carload lots)	35.50	35.00	19.75	34.50	36.00
Brass rods, base	41.50	37.00	18.75	36.00	37.00
Brass pipe, base	44.50	40.00	20.00	43.00	45.00
Brass sheets	40.50	37.00	19.00	36.00	37.00
Solder ½ and ½ (case lots)	37.87½	36.50	34.50	35.50	32.00

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York Apr. 14, 1916	One Year Ago	Cleveland
Copper, heavy and crucible	23.50	23.00	22.00
Copper, heavy and wire	22.50	22.00	21.00
Copper, light and bottoms	19.50	20.00	19.00
Lead, heavy	6.00	5.25	6.75
Lead, tea	5.50	4.75	5.50
Brass, heavy	14.50	14.00	18.00
Brass, light	12.00	11.50	12.00
No. 1 yellow rod brass turnings	15.25	13.50	16.25
Zinc	13.00	13.50	14.50

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	31.50	32.00	32.50	33.00	36.00
¼ to 5/16	31.25	31.75	32.25	32.75	35.75
⅜ to 1⅞	31.00	31.50	32.00	32.50	35.50
1 15/16 to 2⅞	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3 7/16	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3½ to 3 15/16	32.25	32.75	33.25	35.75	36.75
Squares					
3 1/16 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4 15/16	33.00	33.50	36.00	36.50	37.50
5 to 6 15/16	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Aluminum—Quotations in cents per pound are as follows for ton lots:

No. 1 virgin 98-99%	58.00@60.00
Pure 98-99% remelt	57.00@59.00
No. 12 alloy remelt	47.00@49.00

Jobbers usually charge 2c. per pound over these figures.

Antimony—Chinese and Japanese brands are quoted in cents per pound for spot delivery, duty paid:

New York. 43.00 Cleveland. 50.00@55.00 Chicago. 45.00@50.00

Copper Bars from warehouse sell as follows in cents per pound:

New York.... 41.00 Cleveland.... 31.50 Chicago.... 37.25

Copper Sheets—In New York hot rolled 16 oz. (large lots) base per lb. is 35.50c.; cold rolled 14 oz. and heavier add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places named:

	New York	Cleveland	Chicago
Best grade	55.00@60.00	61.00	60.00
Commercial	25.00@30.00	22.50	28.00@30.00

SHOP SUPPLIES

Nuts—From warehouses at the prices named, on fair sized orders the following amount is deducted from list:

	New York	Cleveland	Chicago
Hot pressed square..........	$2.75	$3.50	$3.70
Hot pressed hexagon	2.75	3.75	3.80
Cold punched square	2.50	3.00	3.25
Cold punched hexagon	3.00	3.75	4.00

Semifinished nuts sell at the following discounts from list price:

New York.... 65% Cleveland....70-10% Chicago.... 70%

Carriage Bolts—From warehouses at the places named the following discounts from list price are in effect:

	New York	Cleveland	Chicago
⅜ by 6 in..................	50 and 5%	65%	65%
Larger and longer........	40 and 5%	50 and 5%	50 and 15%

At this rate the net prices are as follows:

Length, In.	New York ¼	New York ½	New York ⅜	Cleveland ¼	Cleveland ½	Cleveland ⅜	Chicago ¼	Chicago ½	Chicago ⅜
1½	$0.48	...	...	$0.35	...	...	$0.35	...	...
2	.53	...	...	.38	...	...	.38	...	...
2½	.57	$1.85	$4.85	.42	$1.55	$4.04	.42	$1.38	$3.61
3	.62	1.41	5.16	.45	1.68	4.27	.45	1.50	3.82
3½	.67	2.17	5.42	.49	1.81	4.51	.49	1.62	4.04

Machine Bolts—From warehouses at the places named the following discounts hold:

	New York	Cleveland	Chicago
⅜ by 4 in. and smaller....	50 and 10%	65 and 10%	65 and 5%
Larger and longer up to 1 in. by 30 in...............	45%	50 and 15%	50 and 20%

Length In.	New York ¼	New York ½	New York 1	Cleveland ¼	Cleveland ½	Cleveland 1	Chicago ¼	Chicago ⅝	Chicago 1
2 ...	$0.81	$2.13	$8.80	$0.57	$1.22	$5.04	$0.59	$1.55	$6.40
2½ ...	.84	2.27	9.30	.60	1.30	5.32	.62	1.65	6.76
3 ...	.88	2.41	9.79	.63	1.38	5.61	.65	1.75	7.12
3½ ...	.91	2.55	10.29	.67	1.46	5.89	.68	1.85	7.48

Wrought Washers—From warehouses at the places named the following amount is deducted from list price:

New York.... $4.25 Cleveland.... $6.00 Chicago.... $6.30

At this rate, the net prices follows:

Diameter, In.	New York	Cleveland	Chicago
5/16	$9.25	$8.00	$7.70
¾	7.45	6.20	5.90
⅞	6.65	5.40	5.10
1	5.75	4.50	4.20
1¼	4.95	3.80	3.50
1⅜	4.45	3.40	3.10
1½	4.35	3.30	3.00
1¾	4.25	3.20	2.90
2, 2¼, 2½, 2¾	4.05	3.10	2.80
3, 3¼	4.25	3.20	2.70
3½, 3¾	4.25	3.20	2.90
4, 4¼, 4½	4.75	3.50	3.20

For cast-iron washers the base price per 100 lb. is as follows:

New York.... $2.50 Cleveland.... $2.00 Chicago.... $1.90

Rivets—The following quotations are allowed for fair sized orders from warehouse:

	New York	Cleveland	Chicago
Steel 7/16 and smaller...........	60%	60—10%	60%
Tinned	60%	60—10%	60%

Button heads ¾, ⅞, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.:

New York.... $4.75 Cleveland.... $3.40 Chicago.... $3.50

Cone heads, same sizes:

New York.... $4.85 Cleveland.... $3.50 Chicago.... $3.60

For the following sizes, the extras over the above prices in cents per 100 lb. are as follows:

1¼ to 1¾ in. long, all diameters..................	$0.25
⅝ in. diameter	0.15
½ in. diameter	0.50
1 in. long and shorter........................	0.50
Longer than 5 in........................	0.25
Less than kegs........................	0.50
Countersunk heads	0.50

Copper Rivets and Burs sell at the following rate for orders 100 lb. and over:

	Rivets	Burs
Cleveland	List price	List price
Chicago	List price	List price
New York	20% from list price	List price

Nails—Wire nails f.o.b. Pittsburgh sell at $2.40; galvanized, 1 in. and longer, $4.40, and shorter, $4.90. These prices are to regular customers and delivery is made at the mill's convenience. From warehouse wire and cut nails sell as follows:

	New York	Cleveland	Chicago
Wire	2.90	2.95	2.70
Cut	2.90	2.85	2.70

MISCELLANEOUS

Seamless Drawn Tubing—The base price in cents per pound from warehouse is as follows:

	New York	Cleveland	Chicago
Brass	41.50	44.50	42.00
Copper	42.50	45.50	39.00

For immediate stock shipment the following quotations prevail:

Diameter, In.	Copper, New York, Apr. 14, 1916	Copper, New York, One Year Ago	Copper, Cleveland	Brass, New York, Apr. 14, 1916	Brass, New York, One Year Ago	Brass, Cleveland
¾ to 2½.....	45.50	22.50	44.50	43.50	19.50	45.50
3½	45.50	22.50	44.50	43.50	19.50	45.50
4	45.50	23.50	44.50	45.00	20.50	45.50
4½	46.50	24.50	45.50	46.00	21.50	46.50
5	47.50	26.50	47.50	48.00	23.50	48.50
6	49.50	28.50	49.50	50.00	25.50	50.50
7	51.50	29.50	51.50	51.00	26.50	52.50
8	52.50	31.50	51.50	53.00	28.50	52.50
	54.50	33.50	55.50	55.10	30.50	56.50

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire	
⅜, 11/32, 5/16, ¼, 7/32, 3/16	8.50
No. 8, 5/32 and No. 10....	9.25
⅛	10.00
No. 12	11.00
3/32, No. 14 and 1/16......	12.00
No. 18	14.00
No. 20	16.00

Special Welding Steel	
⅛	33.00
5/32	30.00
3/16	28.00

Cast-Iron Welding Rods	
¼ by 19 in. long.......	22.00
3/16 by 12 in. long.......	26.00
⅜ by 19 in. long.......	20.00
½ by 21 in. long.......	20.00

Vanadium Wire in Coils or Sticks	
1/16	15.50
3/32	15.00
⅛	14.00
5/32	12.00
3/16 and larger...........	11.00

Bolt Ends—Fair-sized orders of bolt ends with hot-pressed nuts, from warehouses at the places named, sell at the following discount from list price:

New York.. 45% Cleveland.. 50—5% Chicago.. 50—20%

Tin Plates—The following prices are in effect from warehouses at the places named:

Coke tin plate, 14x20:			New York, Apr. 14, 1916	New York, One Month Ago	Cleveland	Chicago
100 lb.						
I. C. 107 lb................			$5.75	$5.00	$5.00	$5.50
			5.90	5.15	5.15	5.65
Terne plate, 20x28:						
Base Weight	Net Weight	Coating				
100 lb.	200	8........	$10.00	$9.00	$9.10	$8.50
I. C.	214	8........	10.30	9.30	9.35	9.10
I. X.	270	8........	12.30	11.30	11.60	11.25
I. C.	218	12........	12.00	12.00	10.25	10.60
I. C.	221	15........	13.00	13.00	10.50	11.55
I. C.	226	20........	13.50	13.50	12.50	12.35
I. C.	231	25........	14.25	14.25	13.50	13.60
I. C.	236	30........	15.50	15.50	14.50	14.60
I. C.	241	35........	17.00	17.00	15.75	15.70
I. C.	246	40........	19.00	19.00	16.75	16.90

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Mar. 25	Apr. 1	Apr. 8	Apr. 15
Prompt furnace	$3.50@3.75	$3.25@3.75	$2.75@3.00	$2.75@3.00
Prompt foundry	3.75@4.00	3.75@4.00	3.75	3.75@4.00

Cotton Waste—The following prices are in cents per pound:

	New York, Apr. 14, 1916	New York, One Year Ago	Cleveland	Chicago
White	11.00@13.00	6.25@8.00	10.00@13.00	11.00@12.50
Colored mixed	8.00@10.00	4.50@6.50	7.50@10.50	8.00@10.50

Sal Soda sells as follows per 100 lb.:

New York............... $1.90 Cleveland.............. $2.25 Chicago..............$1.90

Roll Sulphur in 360-lb. bbl. sells as follows per 100 lb.

New York.... $2.25 Cleveland.... $2.75 Chicago.... $2.85

Foundry and Fire Clay in New York sells at $2 per lot of 300 lb. This does not include delivery charges.

Zinc Sheets—The following prices in cents per pound prevail:

Carload lots, f.o.b. mill.................................. 25.00

	New York	Cleveland	Chicago
In casks	26.00	26.00	26.50
Broken lots	26.50	26.50	27.00

Linseed Oil—These prices are per gallon:

	New York	Cleveland	Chicago
Raw in barrels	$0.81	$0.80	$0.83
5-gal. cans	.91	.90	.91

Boiled, it is 1c. per gal. higher.

White and Red Lead, in cents per pound, sell as follows:

	Red, Dry	Red, In Oil	White, Dry and In Oil
100-lb. keg	10.50	11.00	10.50
25- and 50-lb. kegs...........	10.75	11.25	10.75
12½-lb. keg	11.00	11.50	11.00
1- to 5-lb. cans..............	12.50	12.50	12.50

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

Plans are being prepared for the construction of 3 factory buildings for the Gillette Manufacturing Co., Boston, Mass.

Samuel Altman, 726 Commonwealth Ave., Brookline, Mass., will construct a 1-story, 65x150-ft. garage at Brookline. Estimated cost, $25,00.

The contract has been awarded for the construction of a 4-story, 100x234-ft. factory at Holyoke, Mass., for the Holyoke Valve and Hydrant Co.

Bids have been received for the construction of a 6-story, 58x110-ft. factory at Lynn, Mass., for the Campbell Electric Co. Noted Dec. 23 and Feb. 24.

The W. J. Connell Co., Boston, Mass., will construct a 1-story, 100x100-ft. garage on Adams St., Quincy, Mass.

The contract has been awarded for the construction of a 4-story, 64x91ft. foundry at Springfield, Mass., for George W. Kimball, 120 Spring St., Springfield. Estimated cost, $40,000.

The New England Brass Co. will construct a 60x125-ft. rolling mill and a 50x60-ft. casting shop at Taunton, Mass. William M. Lovering is Pres.

The contract will soon be awarded for the construction of an addition to the plant of the American Steel and Wire Co. on Prescott St., Worcester, Mass. Noted Mar. 30.

The United Wire and Supply Co. contemplates constructing a factory at Cranston, R. I. (Providence post office). Estimated cost, $150,000.

The General Electric Co. will build a plant at Providence, R. I.

The Fafnir Bearing Co. has awarded the contract for a 1-story, 50x100-ft. addition to its plant at New Britain, Conn. Noted Jan. 13.

C. W. Murdock will build a 1-story, 50x116-ft. garage at New Haven, Conn. Estimated cost, $20,000.

The William Scholhorn Co., manufacturer of pliers and tools, plans to construct a 4-story, 40x40-ft. addition to its plant on Wooster St., New Haven, Conn.

Plans have been prepared for the construction of a 2-story, 55x60-ft. garage at New Haven, Conn., for the White Way Garage, 376 Congress Ave., New Haven. Estimated cost, $12,000.

The Smith & Winchester Co. plans a 2-story, 60x127-ft. foundry addition to its plant at South Windham, Conn.

The A. H. Wells & Co., manufacturer of brass and copper tubes, has purchased a site on Watertown Ave., Waterbury, Conn., and plans to construct a plant.

MIDDLE ATLANTIC STATES

The Buffalo Pattern Works, Buffalo, N. Y., has awarded the contract for the construction of a 2-story factory. Estimated cost, $25,000.

Samuel B. Steinmetz and Max Hoffman, 14 Glovers St., New York, N. Y. (Borough of Bronx), plan to construct a 2-story, 100x100-ft. garage on St. Ann's Ave., Bronx. Estimated cost, $20,000.

Plans are being prepared by Charles Schaefer, Jr., 401 Tremont Ave., New York, N. Y. (Borough of Bronx), for a 5-story, 85x152-ft. garage on Morris Ave., Bronx, for Charles Weihe, Bay St. and William Ave. (Borough of Brooklyn). Estimated cost, $25,000.

Bracia Lilpop, 11 Broadway, New York, N. Y., is in the market for the following tools for export to Russia: Tool steel, bolts, nuts, etc., steel, copper and brass pipes, valves, brass fittings for steam and water, files handles, twist drills, saws, screw plates, pipes, wrenches, pliers, pincer, pipe cutters, forgers, screwdrivers, breast drills, pulleys, lathes, turret lathes, tool grinders, grinding wheels, oil sharpening stones, vulcanized fiber in sheets, planes, chisels, wood carving tools and hatchets.

Manuel Nacher, representing the firm of Valencia Steam Navigation Co. of Valencia, Spain, has registered at office of Bureau of Foreign and Domestic Commerce, 409 Custom House, New York, N. Y. He is anxious to get in touch with manufacturers of shipbuilding machinery, oil refining machinery, electric welding machinery and marine diesel motors. Catalogs and offers may be addressed to him at the above office in care of the Commercial Agent in charge.

Plans are being prepared for a factory for the Kent Manufacturing Co., manufacturer of vacuum cleaners, Rome, N. Y. F. T. Kent is Pres.

The H. H. Franklin Manufacturing Co., West Marcellus St., Syracuse, N. Y., has awarded the contract for the construction of an auto factory. Noted Apr. 13.

Plans are being prepared by E. V. Warren, Arch., Essex Bldg., Newark, N. J., for a 2-story, 50x110-ft. garage and factory on Nassau Pl. for the Kelly-Ackerman Co., Inc., 23 South Burnett St., East Orange, N. J. Estimated cost, $10,000.

Charles Hvass & Co., 509 East 18th St., New York, N. Y., manufacturer of machinery, will construct a 2-story concrete factory on State St., Jersey City, N. J. Estimated cost, $25,000.

The W. F. Taubel Co., Millville, N. J., has awarded the contract for a hosiery mill. Estimated cost, $70,000. Noted Mar. 23.

The General Electric Co., Newark, N. J., will construct a new garage on Boyd St. for the care and repair of the company's automobiles.

A. J. Hedges & Co., Newark, N. J., manufacturer of jewelry, is building a new factory on East Kinney St., to replace one recently destroyed by fire.

The National Marine and Motor Co., Newark, N. J., has acquired a site on Adams St. and will establish a plant for the manufacture of motors for motor boats and kindred specialties. R. H. Lindy is Pres.

The Keystone Watch Case Co., Philadelphia, Penn., will build an addition to its plant at Riverside, N. J.

The Ajax Metal Co., Frankford Ave. and Richmond St., Philadelphia, Penn., will build a 4-story addition to its plant.

The Hess Machine Co., 45th St. and Lancaster Ave., Philadelphia, Penn., plans to construct a new machine shop.

We have been informed that the plant of the Union Furnace Manufacturing Co., Union Furnace, Penn., manufacturer of shovels and hardware specialties, recently destroyed by fire with a loss of $50,000, will be rebuilt. Noted Apr. 6.

The contract has been awarded for the construction of a 1- and 4-story garage and service building at 23rd, 24th, Walnut and Locust St., Philadelphia, Penn., for John Wanamaker, 13th and Market St., Philadelphia. Estimated cost, $400,000. Noted Mar. 30.

Plans are being prepared by Boal & Brown, Arch., 1715 H St., Washington, D. C., for a 3-story, 60x200-ft. reinforced-concrete garage at 1128 Connecticut Ave. for the Harper Overland Co., 1022 Connecticut Ave.

The contract has been awarded for the construction of a 4-story garage at 1307 Cathedral St., Baltimore, Md., for J. Wilson Leakin, 813 Fidelity Bldg., Baltimore. Noted Mar. 30.

SOUTHERN STATES

According to press reports the Heiness Motor Plow Co., Ft. Wayne, Ind., plans to construct a plant at Goshen, Va.

The Nelson-Myers Iron Tie Co., Ft. Wayne, Ind., plans to construct a plant at Goshen, Va.

The Piedmont Motor Co. plans to construct a plant at Lynchburg, Va.

Walter Sachs, Petersburg, Va., states that Richmond capitalists and interests connected with the Norfolk & Western Ry. plan to construct a steel plant at Hopewell, Va. (City Point post office). Estimated cost, $2,000,000.

The contract has been awarded for the construction of a plant for the Charleston Steel Co., Charleston, W. Va. Estimated cost, $150,000.

The contract has been awarded for the construction of a 2-story garage for Arthur Stifel, 4th and Main St., Wheeling, W. Va. Estimated cost, $10,000.

Bids will be received about Sept. 1 for a 2-story concrete garage for the Green-Adler Co., Magnolia St., Daytona, Fla. Estimated cost, $20,000.

The Central Foundry Co. has leased the plant of the Smith Manufacturing Co. at Bessemer, Ala., and plants to enlarge same.

The Coosa Pipe and Foundry Co., Gadsden, Ala., plans to enlarge its plant.

The Citizens Auto Co. plans to construct a 3-story, reinforced-concrete factory at Chattanooga, Tenn. Dodge Bros., Joseph Campau Ave., Detroit, Mich., is interested.

The Illinois Central R.R. will soon award the contract for the construction of car repair shops at Memphis, Tenn. Estimated cost, $200,000. A. S. Baldwin, 135 East 11th Pl., Chicago, Ill., Ch. Engr.

MIDDLE WEST

The Akron Mold and Machine Co. plans to construct an addition to its plant at Akron, Ohio.

We have been advised that the Enterprise Manufacturing Co., manufacturer of fishing tackle and metal specialties, Akron, Ohio, is in the market for stamping, screw, wire forming, die and tool manufacturing machinery. Noted Apr. 6.

The Berger Manufacturing Co., manufacturer of steel roofing, ceiling and metal filing devices, plans to construct a factory at Canton, Ohio.

The contract has been awarded for the construction of a 3-story, 100x300-ft. addition to the plant of the Lunkenheimer Co., manufacturer of brass, iron and engineering specialties, at Cincinnati, Ohio. Noted Jan. 20 and 27.

The American Steel and Wire Co. has awarded the contract for the construction of an addition to its plant at Cleveland, Ohio. Noted Mar. 30.

Plans are being prepared for construction of a 3-story garage at Cleveland, Ohio, for H. W. Clark, 608 Bolivar Rd., Cleveland. Estimated cost, $30,000. Noted Dec. 2.

Preliminary plans are being prepared for the construction of a 2-story, 87x110-ft. and 31x50-ft. addition to the factory of the D. G. Hutchcraft & Sons Co., 1318 West 78th St., Cleveland, Ohio, manufacturer of automobile bodies.

The contract has been awarded for the construction of the 1st unit of the plant on East 152nd St., Cleveland, Ohio, for the Jordan Motor Car Co. Estimated cost, $50,000.

Preliminary plans prepared for 1-story, 92x230-ft. garage at Cleveland, Ohio, for Henry P. Oster, 10550 Euclid Ave., Cleveland. Estimated cost, $30,000. Noted Mar. 9.

We have been informed that the Republic Structural Iron Works Co., 1270 East 53rd St., Cleveland, Ohio, does not plan to enlarge its plant on Lakeside Ave., Cleveland as stated in our issue of Apr. 6.

The contract has been awarded for the construction of a 5-story, 100x300-ft. garage and service station at Cleveland, Ohio, for the Willys-Overland Co. Estimated cost, $50,000. Noted Nov. 25 and Jan. 20.

Plans are being prepared for the construction of a 1-story addition to the plant of the Burke Machine and Tool Co. at Conneaut, Ohio.

The Safety Auto Light and Manufacturing Co. plans to build a plant at Erlin, Ohio (Fremont post office).

The contract has been awarded for the construction of a 2-story garage at Logan, Ohio, for the Main Motor Car Co. Estimated cost, $10,000. Noted Mar. 30.

Plans are being prepared for the construction of a 1-story, 120x200-ft. foundry and machine shop at Lorain, Ohio, for the American Shipbuilding Co. A. G. Smith is Gen. Mgr. Noted Apr. 6.

Plans are being prepared for the construction of a 1-story, 40x80-ft. addition to the plant of the Peerless Drawn Steel Co. on Sippo St., Massillon, Ohio.

The contract has been awarded for the construction of a 2-story factory on Washington St., Springfield, Ohio, for the Myers Auto Top Co.

The Griffith & Wedge Co., manufacturer of steam engines, boilers and clay machinery, plans to enlarge its plant at Zanesville, Ohio. C. B. Wedge is Pres.

Plans are being prepared for the construction of a 2-story, 66x113-ft. garage at Zanesville, Ohio, for Charles N. Harvey, Main and 2nd St., Zanesville. Estimated cost, $25,000. Noted Nov. 11.

The contract has been awarded for the construction of a 5-story factory at Ft. Wayne, Ind., for the General Electric Co. Estimated cost, $350,000. Noted Apr. 6.

Jnagy Bros. will construct a garage at Hamilton, Ind. Estimated cost, $10,000. Noted Jan. 20.

The Lima Locomotive Works, Lima, Ohio, plans to construct a foundry at Huntington, Ind. Estimated cost, $50,000. A. L. White, Lima, is Pres.

Plans have been prepared for the construction of an addition to the plant of the Link-Belt Co. on Addison St., Indianapolis, Ind. Estimated cost, $12,000. Noted Jan. 13.

The contract has been awarded for the construction of a 1-story, 50x327-ft. foundry at Kokomo, Ind., for the Kokomo Brass Works. J. W. Johnson, 1412 North Webster St., Kokomo, is Mgr. Noted Mar. 16.

The contract has been awarded for the construction of a factory at Detroit, Mich., for the Packard Motor Car Co. Estimated cost, $50,000.

The contract has been awarded for the construction of a 2-story, 300x350-ft. addition to the plant of the Buick Motor Co., Flint, Mich. Noted Feb. 24.

The Sparks-Withington Co., manufacturer of roller bearings and pressed metal products, is constructing an addition to its plant at Jackson, Mich., and is in the market for presses. Noted Mar. 23.

We have been advised that plans have been prepared for the construction of a 90x175-ft. machine shop at Chicago, Ill., for the Albaugh-Dover Co. Estimated cost, between $25,000 and $30,000.

We have been informed that the A. Finkel & Sons, 1322 Cortlandt St., Chicago, Ill., is constructing a 1-story, 25x110-ft. machine shop at Chicago. Estimated cost, $10,000. Noted Apr. 6.

The contract has been awarded for the construction of a 1-story addition to the garage at 39th St. and Wabash Ave., Chicago, Ill., for the U. S. Auto Supply Co., 3845 South Wabash Ave. Estimated cost, $12,000. Noted Feb. 17.

The contract has been awarded for the construction of a 1-story box shop at Granite City, Ill., for the National Enameling and Stamping Co. Estimated cost, $12,000.

The Claus Automatic Gas Cock Co. is constructing a 1-story foundry and machine shop on Kefe Ave., Milwaukee, Wis., and is in the market for turret lathes, hand miller and milling machinery. Estimated cost, $15,000. Noted Mar. 16 and 23.

T. Weinand contemplates constructing a 1-story garage and salesroom at West Bend, Wis. Estimated cost, $10,000.

WEST OF THE MISSISSIPPI

The Shrauge & Johnson Co., Atlantic, Iowa, manufacturer of lighting rods and hardware specialties, plans to construct an addition to its plant.

The Great Northern Ry. plans to construct shops in the Kendon Addition, Sioux City, Iowa. Estimated cost, $200,000. A. H. Hogeland, St. Paul, Minn., is Ch. Engr.

M. D. Prendergast, Port Huron, Mich., plans to construct a plant at Stillwater, Minn., for the manufacture of wire fencing.

The Chillicothe Gun Manufacturing Co. is constructing a plant at Chillicothe, Mo.

The Keys Piston Ring Co., St. Louis, Mo., plans to install new equipment.

Plans are being prepared for a 1-story, 70x90-ft. auto repair shop for the Old Line Carriage Works, Springfield, Mo. Estimated cost, $10,000. C. G. Levan is Mgr.

The Denver Boiler and Iron Works, Denver, Colo., is negotiating with the manufacturing committee of the Chamber of Commerce, El Paso, Tex., with the view to constructing a foundry at El Paso.

WESTERN STATES

The Ford Motor Co., Detroit, Mich., plans to construct an assemblying plant at Salt Lake City, Utah. Estimated cost, $400,000.

The Columbia Iron Works, Astoria, Ore., contemplates to construct an addition to its welding mill and will install new equipment.

The Electric Steel Foundry Co., 24th and York St., Portland, Ore., is constructing an addition to its plant at Portland. Estimated cost, $40,000. Noted Feb. 24 and Mar. 16.

The Cowels Investment Co. plans to construct a 60x100-ft. garage and machine shop at Spokane, Wash. Estimated cost, $20,000.

Plans are being prepared for the construction of a 3-story, 32x100-ft. factory at Tacoma, Wash., for the Atlas Foundry and Machine Co. Estimated cost, $10,000.

Henry Abrahamson plans to construct a garage at Broadway and 29th St., Oakland, Calif. Estimated cost, $20,000.

The contract has been awarded for the construction of a 3-story assembling plant at Oakland, Calif., for the Chevrolet Motor Co. Estimated cost, $200,000. Noted Dec. 9.

Edward Somarstrom, 202 East 12th St., Oakland, Calif., plans to construct a 1-story garage on Broadway, Oakland. Estimated cost, $25,000.

The J. D. and A. B. Spreckels Securities Co., Union Bldg., San Diego, Calif., will build a garage and machine shop at 409 Broadway, San Diego. Estimated cost, $10,000.

The contract has been awarded for the construction of a 1-story plant at Folsom and 11th St., San Francisco, Calif., for the manufacturer of auto trucks, for Kleiber & Co. Noted Feb. 10.

CANADA

The Hull Iron and Steel Co., Montcalm St., Hull, Que., plans to construct an addition to its plant at Hull. Estimated cost, $5,000.

The contract has been awarded for the construction of an addition to the plant of the Canadian Iron Corporation, Sherbrooke, Que.

The Canadian Foundries and Forgings Co. plans to construct an addition to its plant at Brockville, Ont.

The Canada Wire and Iron Goods Co., plans to build an addition to its plant on King William St., Hamilton, Ont. Estimated cost, $3,500.

The Hydro Electric Radiation, Ltd., contemplates constructing a factory at Listowel, Ont. G. E. Harrison, 704 Traders Bank Bldg., Toronto, Mgr.

The contract has been awarded for the construction of a machine shop for Whitfield & Co., 33 Sherbourne St., Toronto, Ont. Estimated cost, $12,000.

The Volta Manufacturing Co., manufacturer of specialties for electric furnaces, etc., plans to build a 2-story, 50x60-ft. factory at Welland, Ont.

GENERAL MANUFACTURING

NEW ENGLAND STATES

The contract has been awarded for the construction of a 1-story, 50x65-ft. addition to the plant of the Saunders Cotton Co., Saundersville, Mass. Estimated cost, $5,000.

The contract has been awarded for the construction of a 4-story, 84x220-ft. addition to the plant of the Baltic Mills Co., Baltic, Conn. Noted Jan. 13 and Mar. 23.

The contract has been awarded for the construction of a factory at Hope, R. I., for the Hope Mill, manufacturer of shirting. Noted Mar. 16 and 23.

The Sidney Worsted Co. has awarded the contract for the construction of a 2-story, 77x120-ft. mill at Woonsocket, R. I. Estimated cost, $30,000. Noted Mar. 23.

The Winchester Woolen Co. plans to construct a plant at Thamesville, Conn. Estimated cost, $200,000.

MIDDLE ATLANTIC STATES

The General Chemical Co. plans to construct a 1-story addition to its plant at 350 Abbott Rd., Buffalo, N. Y. Estimated cost, $14,000.

The Clayville Knitting Co., Clayville, N. Y., plans to enlarge its plant. Estimated cost, $200,000.

Bids are being received by the Isco Chemical Co., Niagara Falls, N. Y., for a plant at Royal and Union St. Estimated cost, $300,000. Noted Mar. 6.

The Arlington Co., Arlington, N. J., manufacturer of celluloid and pyroxlin specialties, will construct 2 additions to its plant.

The Carbo-Hydrogen Co. of America has acquired a site at Hobart Ave. and Oak St., Bayonne, N. J., and will construct a plant.

Thomas Oakes & Co., Bloomfield, N. J., manufacturer of woolens, will construct a 2-story addition to its plant.

The Martin Dennis Co., Newark, N. J., manufacturer of chemicals, has awarded the contract for the construction of a factory at Kearney, N. J. (Arlington post office).

The Central Dyestuff and Chemical Co., Newark, N. J., will improve and enlarge its plant on Plum Point Lane.

The Duratex Co., Newark, N. J., manufacturer of leather, will construct an addition to its plant on Frelinghuysen Ave. Estimated cost, $30,000.

The Heller & Merz Co., Newark, N. J., manufacturer of colors and dyes, will construct a 1-story factory on Hamburg Pl.

Felix C. Holmes, Newark, N. J., has acquired a site on Halsey St. and will establish a plant for the manufacture of automobile seat covers and tops.

The Imhoff-Berg Silk Dyeing Co., Paterson, N. J., will construct a dye and finishing plant at Paterson. Estimated cost, $40,000.

The Union Silk Co., Summit, N. J., recently incorporated, has had plans prepared for a silk mill on Morris Ave.

Preliminary plans are being prepared for a 1-story, 200x 250-ft. factory for the Sommer Co., Washington, N. J., manufacturer of pianos. Estimated cost, $50,000. John H. Sommer, Pres.

Bids are being received by the Lee Tire and Rubber Co., Conshohocken, Penn., for a 2-story fireproof mill construction building.

The Juniata Hosiery Mill, Mifflintown, Penn., is building an addition to its plant.

The contract has been awarded for the construction of an addition to the plant of the Cramps Shipbuilding Co., Philadelphia, Penn. Estimated cost, $6,000.

Bids are being received by Harry C. Eisenbise, Arch., Philadelphia, Penn., for a 3-story belting factory on Cottman St., Philadelphia, for L. H. Gilmer Co. Noted Mar. 30.

Plans have been prepared by Day & Zimmerman, Arch., 611 Chestnut St., Philadelphia, Penn., for reconstructing a 2-story factory at 37th and Tasker St., Philadelphia, for the Nitrogenous Chemical Manufacturing Co.

Bids will soon be received by F. A. Muhlenberg, Arch., 706 Colonial Trust Bldg., Reading, Penn., for a 100x229-ft. factory on South 8th St. for the Pennsylvania Optical Co., Reading. Noted Dec. 16.

Sheldon & Leach, Wilkes-Barre, Penn., plan to construct a silk mill at New Grove and Gilligan St., Wilkes-Barre. Andrew K. Leach is Pres.

The Chemical Products Co., Washington, D. C., has awarded the contract for the construction of a 1-story factory. Estimated cost, $24,000.

SOUTHERN STATES

The Davis Hosiery Mills, Chattanooga, Tenn., has awarded the contract for the construction of a plant at Bristol, Va. Estimated cost, $200,000.

State contemplates construction of lime-grinding plant at Tidewater, Va. Estimated cost, $25,000. H. C. Stuart, Governor.

R. J. Morrison plans to construct a knitting mill at Cherryville, N. C.

The Ware Shoals Manufacturing Co. plans to construct a 2-press cotton seed oil mill at Ware Shoals, S. C.

The Southern Cotton Oil Co. plans to improve its plant at Columbus, Ga. Estimated cost, $10,000.

Armour & Co., Chicago, Ill., plans to construct a cold-storage plant at Hattiesburg, Miss.

The plant of the Carcolite Chemical Co., Copper Hill, Tenn., recently destroyed by fire with a loss of $250,000, will be rebuilt. Noted Apr. 6.

MIDDLE WEST

The contract has been awarded for the construction of an addition to the plant of the Blumenstock & Reid Co., 3261 West 65th St., Cleveland, Ohio. Estimated cost, $20,000. Noted Apr. 6.

Plans are being prepared for the construction of a 1-story, 43x250-ft. addition to the factory of the Climax Cleaner Manufacturing Co. at Cleveland, Ohio.

The Champion Coated Paper Co. will construct an addition to its plant at Hamilton, Ohio. Estimated cost, $10,000. Noted Apr. 6.

The McKee & Bliven Button Works plans to construct a factory on 3rd St., Marietta, Ohio.

The Sullivan Packing Co., Detroit, Mich., has awarded the contract for the construction of a 2-story, 50x50-ft. addition to its plant at Toledo, Ohio. Estimated cost, $10,000.

The Starr Piano Co. will build a 6-story addition to its factory at Richmond, Ind. H. Gennett s Pres.

The Farmers Ground Limestone Co. plans to construct a plant at Vernon, Ind.

The contract has been awarded for the construction of an addition to the factory of Morgan & Wright, manufacturer of rubber goods, at Detroit, Mich.

Plans are being prepared by H. P. Henschien, Arch., 37 West Van Buren St., Chicago, Ill., for the construction of a 2-story, 76x166-ft. packing plant at Elgin, Ill., for the Kerber Packing Co.

Plans are being prepared for the construction of a packing plant at Quincy, Ill., for the Fair Abattoir Co. Estimated cost, $50,000. R. J. Connery, 20th St. and Broadway, Quincy, is interested. Noted Mar. 23.

The contract has been awarded for the construction of a cold-storage plant at Eau Claire, Wis., for H. Cary & Son, 407 Galloway St., Eau Claire.

Plans have been prepared for the construction of a 2-story, 50x100-ft. factory at 6th and State St., La Crosse, Wis., for the Fisk Rubber Co., Chicopee Falls, Mass. Noted Mar. 23.

The contract has been awarded for the construction of a 4-story, 60x200-ft. factory and a 55x70-ft. addition to the milling department of the La Crosse Rubber Mills Co. at La Crosse, Wis. A. P. Funk is Gen. Mgr. Noted Mar. 9.

Bids will soon be received for the construction of a 3-story, 50x120-ft. factory at Waupun, Wis., for the Paramount Knitting Co., Chicago, Ill. Estimated cost, $40,000. Noted Feb. 17.

WEST OF THE MISSISSIPPI

The Hugo Manufacturing Co., manufacturer of specialties, 310 West 2nd St., Duluth, Minn., will construct a 2-story factory. Estimated cost, $25,000.

P. J. Neel will build a box factory and lath mill at Ranier, Minn.

Henry Meinecke, Tomah, Wis., plans to construct a packing plant at Fairbury, Neb. Estimated cost, $250,000.

The Ohio Oil Co., Findlay, Ohio, plans to construct an oil refinery at Greybull, Wyo.

The American Manufacturing Co., manufacturer of cordage and bagging, 220 North 4th St., St. Louis, Mo., has awarded the contract for the construction of a 2-story factory. Estimated cost, $40,000. Noted Apr. 6.

J. S. Thompson, Grit, Tex., will build a cotton gin about 16 mi. south of Brady, Tex.

The Houston Packing Co., Houston, Tex., plans to enlarge its plant.

The Lockhart Oil Mill Co., Lockhart, Tex., has awarded the contract for the construction of a cotton seed oil mill. Estimated cost, $50,000. Noted Dec. 23.

The McKinney Compress Co., McKinney, Tex., will rebuild its plant recently destroyed by fire with a loss of $50,000.

The Texas Co. plans to enlarge its oil refinery at Port Neches, Tex.

The Sugarland Manufacturing Co., Sugarland, Tex., plans to construct a sulphuric acid plant at Sugarland. Estimated cost, $300,000.

The Texas City Handle Factory, Texas City, Tex., plans to enlarge its factory.

A tire manufacturing plant will be equipped by the White Springs Tire Co., Edmond, Okla., recently incorporated with $50,000 capital stock. J. W. White and M. J. O'Connor are interested.

J. C. Palmer, Orr., Okla., plans to construct a cotton gin at Ringling, Okla. Estimated cost, $12,000.

WESTERN STATES

The Malaga & Thompson Grape Growers Association plans to build a packing plant at Clovis, Calif.

The White Star Canning Co., San Pedro, Calif., will construct a canning plant in East San Pedro.

The California Bag and Paper Co. plans to equip a factory at Emeryville, Calif. Walter Mackey, Oakland, is interested.

The California Fruit Products Co. plans to construct a cotton gin at Holtville, Calif.

The Elderwood Packing Co. is constructing a packing plant at Lindsay, Calif. Estimated cost, $10,000. H. B. McClure is Pres.

The California Orange Jelly Co. plans to construct a factory at 9th and McGarry St., Los Angeles, Calif.

Work will soon be started on the construction of a plant at Oakland, Calif., for the Pacific Thread Tire Co. Estimated cost, $250,000. V. K. Sturges, 26th and Union St., is Pres.

The Orange County Valencia Association, recently incorporated, plans to build a packing plant at Orange, Calif.

Swift & Co., Chicago, Ill., has awarded the contract for the construction of a potash-manufacturing plant on the water front near E St., San Diego, Calif. Noted Feb. 17.

The Wheeler-Chase Canning Co. plans to build a fruit canning plant at San Diego, Calif.

Plans are being prepared by D. B. Day for the construction of a packing plant at Woodlake, Calif., for the Elderwood Packing Co.

Classified Advertising

The Classified Advertising section appears on pages 177, 178, 179, of this issue and will in future appear in the same relative position in the paper.

American Machinist

L. P. ALFORD, *Editor*

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VOLUME 44 — APRIL 27, 1916 — NUMBER 17

CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormsay processes, protected by United States patent issued June 22, 1915, and another pending

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Advertising is the Great National Business Science

BY ARTHUR BRISBANE, *Editor N. Y. Journal*

Written for the Associated Advertising Clubs of the World.

ADVERTISING is the art of transferring an idea from your mind to the minds of others.

The advertiser's task is to see a thing clearly, DESCRIBE IT SIMPLY and convincingly:

The business man is the DYNAMO, the advertising man is the electric BULB that tells of the dynamo's work.

The bulb that thinks itself more important than the dynamo is foolish.

The big dynamo that thinks it can get along without any bulb and make a success of a lightning plant all by itself, is a foolish dynamo.

Advertising is an art of science important to all the nations and to every man in the nation.

Advertising is to business, industry, manufacture, WHAT PRINTING AND LANGUAGE ARE TO THE HUMAN RACE. Advertising is the SPEECH OF BUSINESS. Without it, business is dumb. Long since we enumerated four things that the advertiser must do or fail.

1—He must make the public SEE his advertisement.

2—He must make the public READ it.

3—He must make the public UNDERSTAND it.

4—He must make the public BELIEVE it.

Is advertising difficult? It is, indeed. It would be easier to start a new religion or a successful career in the United States THAN TO START A NEW BRAND OF SOAP.

Get the name of your client's product so thoroughly in the public brain that the product and the name you advertise become synonymous.

If in the United States you say "Tiffany" it means jewelry. If you say "Delmonico" it means food.

Advertising genius properly encouraged can actually take a meaning as old as the language, and transfer it to a new word, to a new name.

How is this done? First of all, BY REPETITION.

"Repetition is reputation."

The great French revolutionist said that success called forth "audacity, audacity, more audacity." Advertising success calls for REPETITION, REPETITION, MORE REPETITION.

There is advertising in every year of the human being's life. The new born baby advertises its need of food and a bath with pitiful squalling.

The little boy twisting his hat in his hand, asking for work, seeks to advertise his qualities as an office boy.

The young man in his courting is a tremendous advertising agent, hoping that he will favorably impress one who is the entire public to him, and persuade her to accept what he has to offer.

To every advertiser of every kind these things are of vital importance in bringing success.

Know exactly what it is that you have to say.

Know that you are telling a truth which is useful to the public.

Express yourself with SIMPLICITY, for that is the greatest of literary art.

You must avoid dryness, which discourages the reader.

You must avoid unnecessary words; everyone of them cost money; every surplus word discourages the reader and drives away from your advertisement.

You must know where to begin—just where your reader's interest begins. You must know where to stop, just where HE would stop if you did not.

You must avoid the appearance of preaching at the people, for the people get all the preaching they want on Sunday.

You must write exactly as though you were TALKING to the reader, for an advertisement writer is a salesman.

Many a man in business can wait patiently while a factory is going up brick by brick—knowing that the bricks must be bought and laid first. But he cannot wait patiently while his reputation is being built up brick by brick through advertising. He wants to get returns on the first load of bricks thrown on the vacant lot.

To keep him while he teaches the public is difficult—but difficulty is what makes advertising interesting.

Advertising is important, not only because it helps business, but because it increases the efficiency of labor.

Advertising renders public service, the great advertiser puts his fortune INTO HIS REPUTATION, and if he dies the successor cannot AFFORD TO DAMAGE THAT REPUTATION.

No man sets fire to a factory that has cost millions.

No man sets fire to an advertising reputation that has cost millions and injures the quality of the advertised goods. That would destroy the reputation.

Every man excepting the fool, knows that the foundation of advertising success is honesty. And the higher you hope to build THE MORE POWERFUL YOUR FOUNDATION MUST BE.

Theory of Economic Milling

By Reginald Trautschold

SYNOPSIS—The theoretical factors affecting the economy of milling operations analyzed and differentiated. Milling-cutter charasteristics taken up and their co-relationship explained. "Revolution factors" established and the question of speed resolved to a "basic speed." Feed requirements considered and a system of milling-cutter classification described, together with the relative economy of the system proposed.

But three factors affect the efficiency of milling operations—the depth of cut, the feed and the cutting speed of the milling cutter—yet their co-relationship is not generally understood, so that the economic operation of a miller is today largely a matter of chance, and rarely are two pieces of work cut with the same degree of efficiency or with equal economy. Particularly is this true when the milling cutters are of different diameters. High cutting speeds are aimed at and the use of milling cutters of large diameters recommended, in order that the speed of revolution may be at a minimum for a maximum cutting speed. Further than this, milling operations, as practiced today, call for a more or less definite cutting speed for a cut of certain depth on a particular piece or kind of work; that is, a piece of soft cast iron, for instance, is now cut at quite a different speed from that at which a piece of hard tool steel is cut, the depth of cut being the same in the two cases. The feed for the harder machined work would also be reduced, so from the point of view of work done but one of the three variables remains the same—the depth of cut. Obviously then, with only one of the three factors affecting the efficiency of the operation considered constant, any standardization of milling operations is well-nigh impossible, and a satisfactory standard for one shop would not necessarily represent the best practice in another. If two of the three variables could be taken as constant, on the other hand, standardization would be greatly simplified and equally efficient milling of various materials and in different shops would be much more nearly realized.

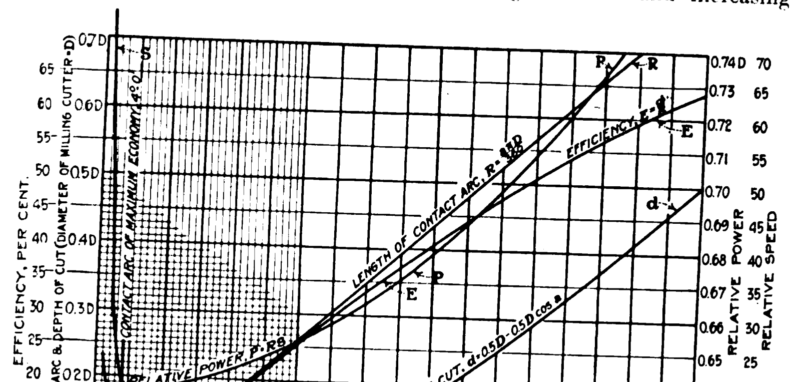


CHART 1. MILLING-CUTTER CHARACTERISTICS

Fig. 1 diagrammatically shows a milling cutter engaging a piece of work. A study of this illustration sheds considerable light on the characteristics of milling operations. Disregarding for the time being the question of feed, it is quite evident that both the depth of cut and the length of arc contact between the cutter and the work are dependent upon the diameter of the milling cutter and the angle of contact, so that a definite relationship must exist between the depth of cut taken and the length of the arc of contact. As the action of a milling cutter, after the work has passed the center line of the cutter, is to shear off material normal to the arc of contact, the length of this arc accurately measures the resistance of the work for a given feed; and also the product of the depth of cut and the feed measures the amount of work accomplished. Evidently, then, the efficiency of the operation is the ratio of the depth of cut to the length of contact arc—the work accomplished to the resistance overcome.

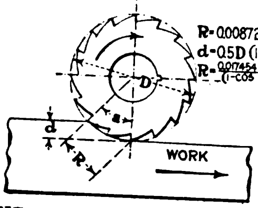


FIG. 1. DIAGRAM OF MILLING CUTTER AND WORK

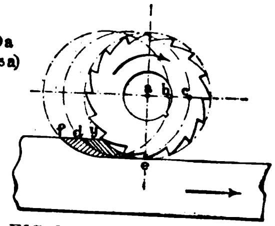


FIG. 2. DIAGRAM OF ACTION OF MILLING CUTTER

The same amount of work could be accomplished by decreasing the feed and increasing the depth of cut. Increasing the depth of cut would increase the arc of contact—in a somewhat lesser ratio, it is true, but nevertheless increase it. The relationship existing between the depth of cut and the arc of contact is such that the resistance does not increase as rapidly as does the depth of cut; therefore, a deeper cut and a finer feed would result in more efficient operation, permitting a corresponding reduction in the cutting speed. Theoretically, the increase in efficiency would continue at a somewhat diminishing rate until the arc of contact was 90 deg., at which value the depth of cut would also be at a maximum.

With maximum efficiency the cutting speed would be at a minimum for accomplishing a specified amount of work and would be proportionally greater for any reduction in efficiency, if an equivalent amount of material be removed by the milling cutter. If a speed of unity is

then arbitrarily adopted for the maximum depth of cut—that is, the depth the cut could be taken under the most efficient conditions, the contact angle equal to 90 deg. and the depth of cut equal to half the diameter of the milling cutter—the "relative speeds" for any lesser depth of cut and corresponding smaller angle of contact can easily be arrived at, being inversely proportional to the efficiency of operation.

Since the resistance overcome and the speed of cutting measure the power consumed in the operation, the product of the "relative speed" and the length of contact arc is proportional to the amount of power required to make the cut, and this "relative power" measures the economy of the operation.

The angle of contact, length of contact arc, depth of cut, efficiency of the operation of milling, "relative speed" and "relative power" are then the characteristics of milling-cutter operation, and such data are listed in Table 1, per degree of contact arc, in terms of the diameter of the milling cutter. The same data are also graphically depicted on Chart 1, from which it is evident that the most economic arc of contact is one of about 4 deg. The efficiency of operation with such a small arc of contact would be quite low, about 3½ per cent., and the depth of cut extremely shallow unless a milling cutter of very large diameter were employed. A cutter nearly 9 in. in diameter would have to be used before a cut 0.01 in. deep could be taken at this most economic arc of contact. As the efficiency of the milling operation increases materially with but a comparatively slight increase in the power requirements, with the increase of the arc of contact, there is really little sacrifice contracted by the inability of making practical use of "the most economic arc of contact." A considerably larger arc of contact may therefore be employed to advantage, as an actual gain is so realized on account of the better efficiency.

Table 2 presents the milling-cutter characteristics of a cutter 1 in. in diameter for cuts from 0.01 to 0.25 in. in depth, a range that covers all practical workable require-

TABLE 1. CHARACTERISTICS OF MILLING CUTTERS

Angle of Contact, Deg.	Length of Contact Arc, R*	Depth of Cut, d*	Efficiency, $\frac{d}{R}$ 100, E, Per Cent.	Relative Speed, S	Relative Power, SR, P*
1	0.00873	0.000075	0.859	74.16	0.647+
2	0.01745	0.000305	1.748	36.44	0.637
3	0.02617	0.000685	2.618	24.34	0.636+
4	0.03490	0.001220	3.495	18.22	0.636
5	0.04363	0.001905	4.370	14.57	0.636+
6	0.05236	0.002740	5.230	12.18	0.637
8	0.07981	0.004865	6.980	9.13	0.637+
10	0.08727	0.007595	8.700	7.32	0.638
15	0.13090	0.017035	13.010	4.89	0.640
20	0.17454	0.030155	17.270	3.68	0.642
30	0.26180	0.066895	25.580	2.49	0.652
45	0.39270	0.146445	37.290	1.71	0.672
60	0.52360	0.250000	47.750	1.33	0.698
75	0.65450	0.370590	56.700	1.12	0.733
90	0.78540	0.500000	63.700	1.00	0.785

* In terms of the diameter of the milling cutter.

ments; and though such a cutter would rarely be used on account of its small diameter, it serves as an excellent basis of comparison for cutters of greater diameter. Arbitrarily designating the "relative speed" for such a cutter when taking a cut 0.01 in. deep as a "proportional speed" of 100, the "proportional speeds" for other depths of cut are listed in Table 2. The relationships existing between the depth of cut and the "proportional speed" of cutters from 1 in. to 8 in. in diameter are graphically depicted upon Chart 2, which representation really illustrates the complete requirements for efficient and economic milling operations. The "proportional speeds" are directly proportional to the best cutting speeds for the respective depths of cuts at the feeds best suited for the character of the work machined.

TABLE 2. CHARACTERISTICS OF 1-IN. MILLING CUTTER

Depth of Cut, d, In.	Angle of Contact, Deg.	Angle of Contact, Min.	Length of Contact Arc, R, In.	Efficiency $\frac{d}{R}$ 100, E, Per Cent.	Relative Speed, S	Proportional Speed, PS
0.01	11	28	0.1000	10.00	6.37	100
0.02	16	16	0.1420	14.10	4.51	71
0.03	19	57	0.1742	17.20	3.70	58
0.04	23	4	0.2015	19.85	3.20	50
0.05	25	10	0.2195	21.60	2.95	46
0.10	36	52	0.3220	31.00	2.05	32
0.15	45	34	0.3980	37.70	1.69	27
0.20	53	8	0.4640	43.00	1.48	23
0.25	60	0	0.5240	47.70	1.34	21

From a practical point of view, however, the data depicted upon Chart 2 are not satisfactory, for the machinist

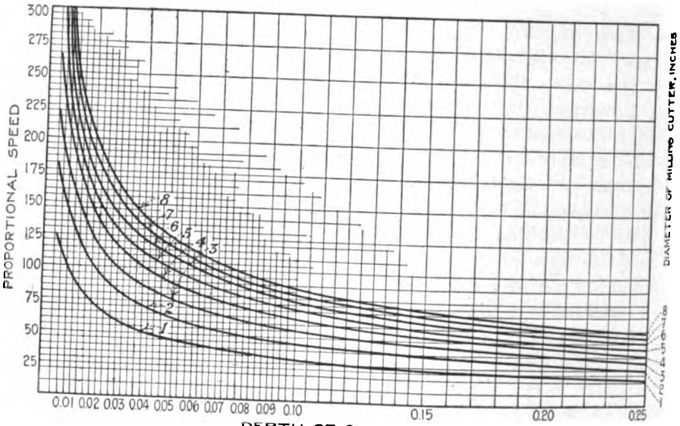


CHART 2. PROPORTIONAL SPEED OF MILLING CUTTERS AND RELATIONSHIP OF DEPTH OF CUT

would have to convert the "proportional speeds" into the true cutting speeds and then calculate the required revolutions per minute for each diameter of cutter. These tedious computations are avoided by transforming the "proportional speeds" into what may be termed "revolution factors," which when multiplied by the most economic cutting speed for a milling cutter 1 in. in diameter will give directly the revolutions per minute for the particular cutter. Such "revolution factors" are depicted upon Chart 3 in a manner that permits easy and accurate reading, the curves being resolved into straight lines by making the horizontal scale of the chart proportional to the variations in speed due to the diameter of the cutter. For instance, Table 3 lists the correct revolutions per minute for milling cutters from 1 to 8 in. in diameter, taking a cut 0.075 in. deep on the basis of a cutting speed of 75 ft. per min. for a cutter 1 in. in diameter removing 0.01 in. of material.

A "basic speed" of 75 ft. per min. cannot be taken as a definite standard, however, for this very important consideration is governed not by the requirement of advisable speed for a cutter 1 in. in diameter, though arbitrarily adopted for such tool in order to facilitate computations, but by the speed limitations of the largest milling cutter employed. A cutting speed of 75 ft. per min. for a cutter 1 in. in diameter would call for a cutting speed of over

200 ft. per min. for a cutter 8 in. in diameter, in order to maintain the same relative economy in milling, the "proportional speed" for a milling cutter 8 in. in diameter being 2.83 times as great as for a cutter 1 in. in diameter. Should the 8-in. cutter be larger than any employed in the particular shop, a higher "basic speed" could safely be employed so as to secure the better efficiency of higher speed milling and vice versa.

Feed Factor in Milling Operations

Theoretically there is no limit but the question of feed to the cutting speed that may be employed for a milling cutter, other than the limit fixed by centrifugal force. No matter how difficult the machining of a piece of work, the cutting speed need not vary, provided the feed is adjusted to conform to the difficulty of cutting. The cutting capacity, upon which the feed depends, is affected

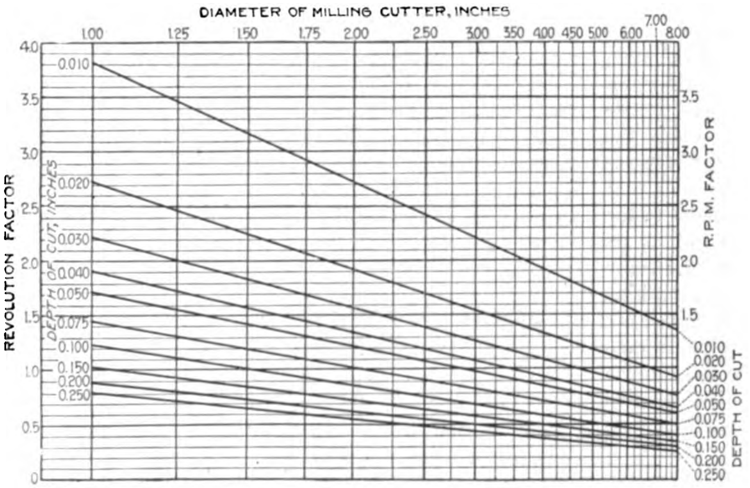


CHART 3. REVOLUTION FACTORS FOR MILLING CUTTERS. DEPTH OF CUT: 0.01 TO 0.25 IN.

by a number of conditions that are individual with each miller, each milling cutter and the difficulty with which the material machined can be cut. First, there is the power capacity of the machine to be considered. This

TABLE 3. REVOLUTIONS PER MINUTE OF MILLING CUTTERS

(Depth of Cut, 0.075 In.)

Diameter of Cutter, In.	Factor, Revolutions	R.P.M.	Diameter of Cutter, In.	Factor, Revolutions	R.P.M.
1.00	1.445	112.0	5.00	0.65	49.0
1.25	1.305	98.0	5.25	0.63	47.0
1.50	1.200	90.0	5.50	0.61	46.0
1.75	1.100	83.0	5.75	0.60	45.0
2.00	1.025	77.0	6.00	0.59	44.0
2.25	0.970	73.0	6.25	0.58	43.0
2.50	0.910	68.0	6.50	0.57	43.0
2.75	0.875	66.0	6.75	0.565	42.0
3.00	0.840	63.0	7.00	0.55	41.0
3.25	0.800	60.0	7.25	0.54	40.5
3.50	0.780	58.0	7.50	0.53	40.0
3.75	0.750	56.0	7.75	0.525	39.0
4.00	0.730	55.0	8.00	0.52	39.0
4.25	0.700	52.5			
4.50	0.685	51.0			
4.75	0.670	50.0			

must be ample, if the best efficiency of the machine is to be realized; that is, there should be a plentiful supply of power to meet possible increase in requirements. The number of teeth of the milling cutter materially affects the allowable feed in low-speed operations; but the variations are largely overcome in high-speed work, so that the number of cutting edges to a cutter usually need not be taken into consideration. The relative ease with which a particular piece of work can be machined cannot be controlled, however, and should therefore be the governing condition upon which the feed should be based.

With the speed fixed, the economy of operation for a definite depth of cut by a milling cutter of certain diameter is dependent upon a definite feed, and a control based on this fact is preferable to one calling for a variation in speed as well as in feed. The definite feed should of course be the maximum for the speed employed, so an increased feed—one greater than can be maintained with the constant speed—would necessitate a reduction in cutting speed, which in itself would tend to reduce the efficiency of the operation. Furthermore, an increased feed increases the resistance against which the cutter works and so also reduces the efficiency of the operation.

TABLE 4. REVOLUTIONS PER MINUTE OF 4-IN. MILLING CUTTER

("Basic Speed," 75 Ft. per Min.)

Depth of Cut, In.	"Factor"	R.P.M.	Depth of Cut, In.	"Factor"	R.P.M.
0.010	1.92	144.0	0.075	0.73	55.0
0.020	1.35	101.0	0.100	0.61	46.0
0.030	1.10	82.5	0.150	0.51	39.0
0.040	0.95	71.0	0.200	0.45	34.0
0.050	0.87	55.0	0.250	0.39	29.0

Fig. 2 illustrates the increased resistance caused by an increase in feed. With the milling cutter in the position indicated, first consider the work having advanced in a certain time a distance equal to *ab*. During such progress the resistance encountered would be proportional to the curve *de*, the material represented by the area *yed* having been removed. Increasing the feed so that the work advanced during the same period of time a distance equal to *ac* would increase the resistance encountered to an amount proportional to the curve *fe*, the material represented by the area *yef* measuring that removed. The difference in resistance encountered—the difference in the length of the curves *de* and *fe*—would be directly measured by the increase in feed and would be quite an appreciable proportion of the total resistance encountered with the shorter feed. The increase in percentage would depend upon the diameter of the milling cutter and therefore upon the arc of contact.

Selection of "Basic Speed."

Accurate adjustment of feed and also of cutting speed is not always possible, so certain variations from the best practice must be resorted to in even well-equipped shops. The "basic speed"—the best speed for a milling cutter 1 in. in diameter taking a cut 0.01 in. deep—should be accurately established, however; and departure from this base should be as slight and as infrequent as possible, in order to maintain an equally high degree of efficiency and economy in various milling operations. Accuracy in establishing the "basic speed" is best secured by experiment with several different sizes of milling cutters taking cuts of various depths as efficiently as possible, averaging the "basic speeds" computed from such data and adopting the mean value as the base from which to vary as little as possible. For instance, the best speed for a cutter 3 in. in diameter taking a cut 0.04 in. deep is 1.1 times the "basic speed"; the best for a cutter 4¼ in. in

diameter when removing material 0.10 in. in thickness is equal to 0.59 times the "basic speed"; etc. (see Chart 3). The multiple of the "basic speed" is the "revolution factor" for the depth of cut taken by the milling cutter of specified diameter. The greater the number of such experiments performed with cutters of appreciable difference in diameter and their results averaged the more accurate the established "basic speed." Once this has been established to the best ability, it should be used exclusively for ascertaining the best speed for milling cutters of other diameters and for the various depths of cuts which may be taken—the necessary computations being simply the multiplication of the "basic speed" adopted by the proper "revolution factor" from Chart 3.

Variations from the Best Cutting Speed

When the limitations of the miller make it impossible to secure the most economic cutting speed for some particular depth of cut, it is preferable to use a higher speed and reduce the feed than to employ a lower cutting speed and increase the feed—the economic balance always being in favor of the speedier operation, as the increased resistance encountered by the more rapid feed discounts the heavier work accomplished per revolution. Better practice still is to use a milling cutter of a diameter such that the capabilities of the miller permit the attainment of the best cutting speed for the desired depth of cut at its suitable feed, as by such balance the best overall economy can be realized and the full capacity of the machine developed. This may necessitate the use of a milling cutter of slightly greater diameter than the smallest cutter which might be employed, thereby departing from the old dictum, "Always use the cutter of smallest possible diameter," but such departure from this excellent rule will result beneficially.

Classification of Milling Cutters

A system for a shop to employ might be to list the milling cutters according to the best speed for a specified depth of cut and also to list the best speeds for various depths of cuts by cutters of a certain diameter. The shop should then adopt the exclusive use of only such cutters as its equipment will permit to be operated under the best conditions. Investigations should be made for each depth of cut usually taken, to ascertain the desirable feed, and the proper speeds for each diameter of cutter should be filed in the stockroom for ready reference by the machinist.

A typical record for milling cutters of various diameters when employed to take a cut 0.075 in. deep is given as Table 3. For such a record and for all milling-cutter records the "basic speed" adopted for the particular shop should be used in the computations. This may be greater or less than the speed of 75 ft. per min., upon which speed the tables presented are computed. Table 4 illustrates a record for a milling cutter of particular diameter. Similar records should be made for all usual depths of cut and for all sizes of cutters, the data applying to cutters of diameter suited to the equipment of the shop tabulated or presented in convenient chart form, a copy of the record being attached to the miller or placed in a position suitable for ready reference by the machinist.

To summarize, efficient and economic milling is possible only when the proper relationships of the factors affecting the operation are recognized and differentiated. The speed factor is dependent upon the depth of cut and vice versa, both of which factors are quite independent of the feed for the best overall results. The feed factor, on the other hand, is dependent upon the ease with which a piece of work can be cut and is quite independent of the question of speed, although affected by the depth of cut. The speed factor can be accurately calculated for any diameter of cutter and depth of cut, once the "basic speed" has been carefully ascertained by experiment, and should not be varied from to any great extent if economy in milling is to be realized. The feed factor, on the contrary, can only be ascertained by experiment and will be affected by any variation in the hardness of the work or other condition affecting the ease with which the material is cut. The feed should always be the maximum that can be maintained with satisfactory results.

Once such a system has been installed in a shop, the only variable factor requiring the attention of the machinist is that of feed, and even this becomes pretty well standardized if the quality of the material worked is reasonably uniform.

Varying both the speed and the feed to conform to the requirements of the work undertaken, as is the usual practice, not only makes the attainment of economic milling largely a matter of chance, but is productive of much wasted time, as the machinist has two factors instead of only one to adjust and balance in order to produce satisfactory work.

Some Methods of Measuring Screw Threads

By William Ferguson

This article deals primarily with the measuring of Whitworth screw threads, but the methods are applicable to any form of V-thread. They apply more particularly in testing screw gages or master taps, the dimensions of which must be very accurate.

Three dimensions are involved in measuring a screw—the outside diameter, the effective diameter and the root diameter. The outside diameter is of course quite easily

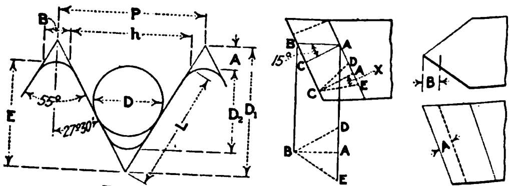


FIG. 1 FIG. 2 FIG. 3

METHODS OF MEASURING AND GRINDING MASTER TOOLS FOR WHITWORTH GAGES

measured by means of a micrometer and must be accurate when this method of gaging is employed. The depth to which the tool should be fed in chasing the screw is gaged by a piece of round wire, the diameter of which is equal to the diameter of the inscribed circle in a triangle of thread section, as shown in Fig. 1. The diameter of wire used may be made 0.0001 in. above or below the calculated size of wire, thus giving a very fine limit gage, yet a difference which is quite easily felt. The wire is best applied under the face of a micrometer that has been closed on the outside diameter of the thread, but a straight-edge may be used, held upon the top of

the threads. To obtain the diameter of wire, the following calculations must be made, in which

P = Pitch (threads per inch);
D_1 = Depth of thread with sharp top and bottom;
D_2 = Actual depth = $\frac{2}{3} D_1$;
A = Amount cut off = $\frac{1}{6} D_1$;
B = Base of triangle of which A is perpendicular;
E = Perpendicular of triangle of which H is base;
$H = P - B$;
L = Length of side of triangle of which H is base;
D = Diameter of inscribed circle.

D_1 may be found from

$$D_1 = \frac{P}{2} \cot 27 \text{ deg. } 30 \text{ min.}$$

or from

$$D_1 = \frac{D_2}{4} \times 6$$

(D_2 being taken from tables)

$$A = \frac{D_1}{6} \text{ or } \frac{D}{4}; \quad B = 2A \tan 27 \text{ deg. } 30 \text{ min.}$$

$$P - B = H$$

or

$$H = \frac{5}{6P}$$

by similar triangles.

$$E = \frac{5}{6D_1}; \quad L = \sqrt{\left(\frac{H}{2}\right)^2 + (E)^2}$$

The radius of the inscribed circle in the triangle of which H is the base given by

$$r = \frac{area}{semiperim} = \frac{\Delta}{S}$$

$$S = \frac{H + 2L}{2}$$

or

$$Area = \frac{H}{2} \times E$$

$$r = \frac{\frac{HE}{2}}{\frac{H + 2L}{2}} = \frac{HE}{H + 2L}$$

$$D = 2 \frac{HE}{H + 2L}$$

If the values are found for E, H and L in terms of P, a formula of the nature of $D = \frac{C}{N}$ is obtained, where C is a constant for a particular form of thread and N is the number of threads per inch (single thread). Thus:

$$D = \frac{0.5054}{N}$$

for the Whitworth form of thread.

The accompanying table of values gives the diameter of wire required for different numbers of Whitworth threads per inch.

Lathe tools for accurate thread chasing must have a cutting face that is flat and that lies in a plane containing the axis of the screw to be cut. The front rake of a tool of this description is usually made 15 deg. To obtain the angle that the tool should be ground, so that section AB is the correct thread angle, assuming 15 deg. front rake (see Fig. 2), let $AB = 1$. Then

$$AD = AB \tan 27 \text{ deg. } 30 \text{ min.}$$
$$AC = AB \cos 15 \text{ deg.}$$
$$\frac{AD}{AC} = \tan \frac{X}{2}; \quad X = \text{angle required}$$

If the tool is ground to a sharp edge, an amount A, indicated in Fig. 3, must be ground off and the square edges rounded to the required radius for the number of threads per inch to be cut. This amount A is usually ground off in a direction as shown at B. The amount to be ground off is therefore equal to $A \times \cos 15$ deg. If this is ground off the nose of the tool and a groove is cut on a piece of round steel of diameter D, of a depth such that the wire gage just fits between the micrometer face and the sides of the groove, the diameter D_2—that is, the root diameter of the groove—should just be the correct root diameter corresponding to D. This root diameter may be found to be large, owing to the fact that in grinding the tool a sharp edge is not really obtained. A little less than A_1 is next ground off and a

TABLE OF WIRE DIAMETERS FOR TESTING WHITWORTH THREADS

$$D = \frac{0.5054}{N}$$

N, Threads, per Inch	Depth of Thread	Radius	D, Diameter of Wire	N, Threads per Inch	Depth of Thread	Radius	D, Diameter of Wire
2¼	0.2846	0.0610	0.2246	18	0.0356	0.0076	0.0281
2⅜	0.2696	0.0578	0.2128	20	0.0320	0.0069	0.0253
2½	0.2561	0.0549	0.2021	22	0.0291	0.0062	0.0230
2⅝	0.2439	0.0523	0.1925	24	0.0267	0.0057	0.0211
2¾	0.2328	0.0499	0.1838	26	0.0246	0.0053	0.0194
2⅞	0.2227	0.0478	0.1758	28	0.0229	0.0049	0.0181
3	0.2134	0.0458	0.1685	30	0.0213	0.0046	0.0168
3¼	0.1970	0.0422	0.1555	32	0.0200	0.0043	0.0158
3½	0.1830	0.0392	0.1444	34	0.0188	0.0040	0.0149
4	0.1601	0.0343	0.1263	36	0.0178	0.0038	0.0140
4½	0.1423	0.0305	0.1123	38	0.0169	0.0036	0.0133
5	0.1281	0.0275	0.1011	40	0.0160	0.0034	0.0126
5½	0.1164	0.0250	0.0919	42	0.0152	0.0033	0.0120
6	0.1067	0.0229	0.0842	44	0.0146	0.0031	0.0115
7	0.0915	0.0196	0.0722	46	0.0139	0.0030	0.0110
8	0.0800	0.0172	0.0632	48	0.0133	0.0029	0.0105
9	0.0711	0.0153	0.0561	50	0.0128	0.0027	0.0101
10	0.0640	0.0137	0.0505	52	0.0123	0.0026	0.0097
11	0.0582	0.0125	0.0459	56	0.0114	0.0025	0.009
12	0.0534	0.0114	0.0421	60	0.0107	0.0023	0.0084
13	0.0493	0.0106	0.0389	..	......	......	......
14	0.0457	0.0098	0.0361	..	......	......	......
15	0.0427	0.0092	0.0337	..	......	......	......
16	0.0400	0.0086	0.0316	..	......	......	......

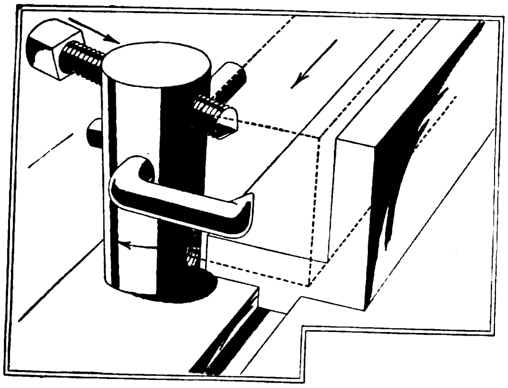
groove cut as before, the root diameter accurately measured and the error noted. If the groove root diameter is too small, an amount equal to half the error should be ground off the nose of the tool. This should give the correct root diameter when the thread is cut to suit the wire gage.

The tool should now be honed to the correct radius, and a female tool for rounding the tops of the threads should be made from this prepared tool. To measure the diameter at the bottom of these grooves, two conical thimbles may be fitted to an ordinary micrometer, the angle of cone being of course less than the thread angle. If a thread is cut with a tool thus prepared and gaged with a wire gage for effective diameter, it will also be correct for the root diameter.

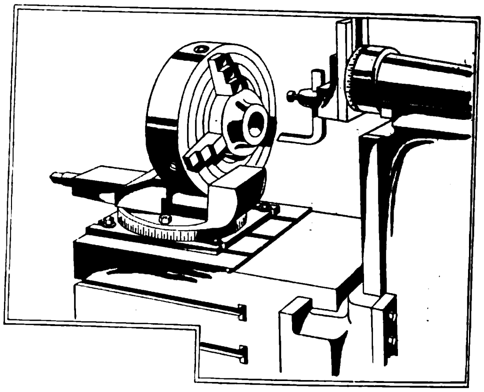
Considerations in Good Furnace Practice—It is pointed out in the "Brass World" that in avoiding the ever-present danger of oxidation, good manipulative furnace practice consists in minimizing exposure of molten metal to atmospheric contact and the intelligent understanding and judicious use of fluxes and deoxidizing agents, whether neutral or active. Of the two considerations the former is the more valuable. It is better not to do a bad thing than to try to undo it.

From a Small-Shop Notebook

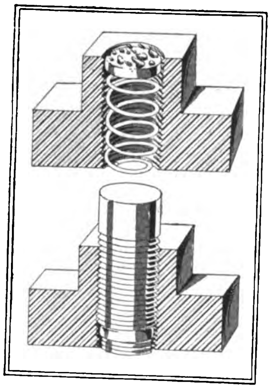
By John H. Van Deventer



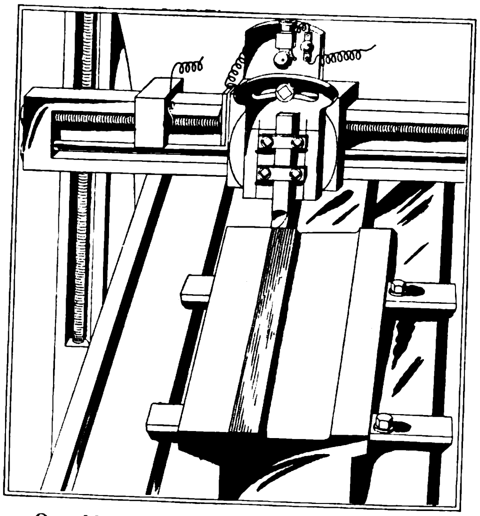
Combination End Stop and Side Clamp



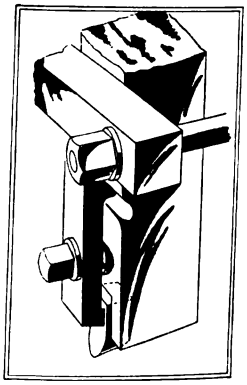
The Shaper Borrows the Lathe Chuck



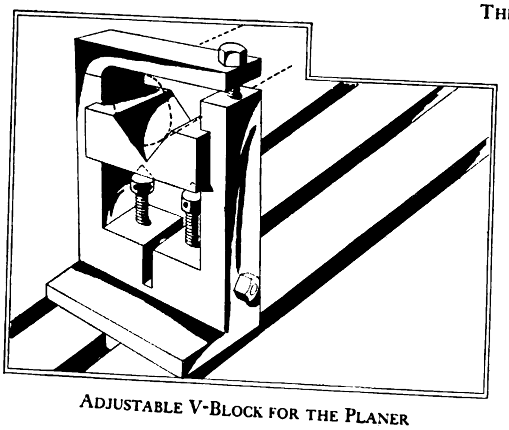
Chip Ejectors for Table-Nuts



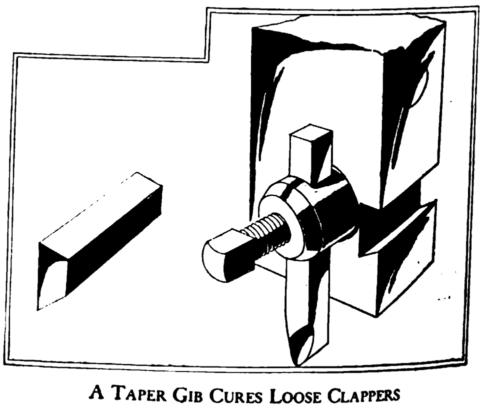
One Man Running Two Planers Needs This Signal



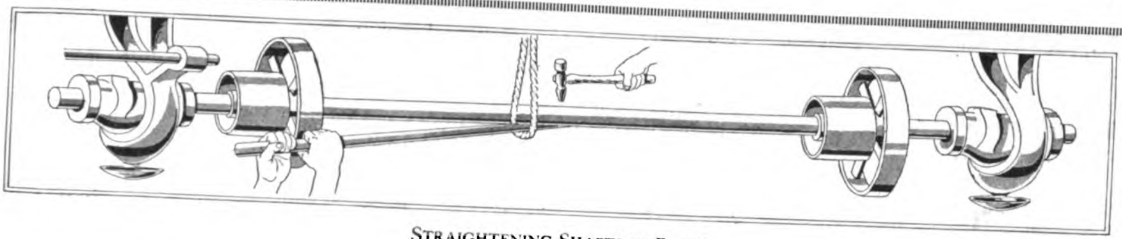
Home-Made Steel Economizer



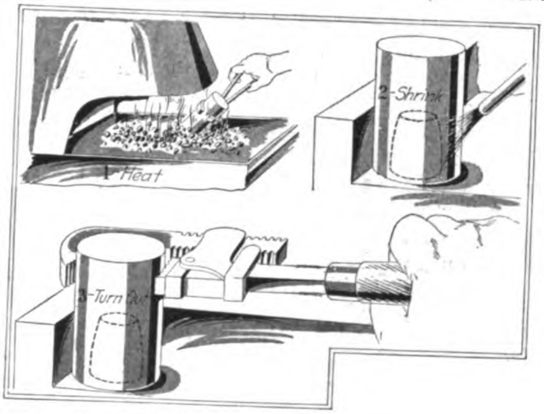
Adjustable V-Block for the Planer



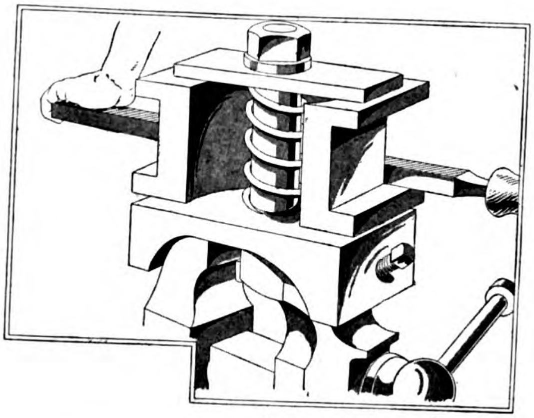
A Taper Gib Cures Loose Clappers



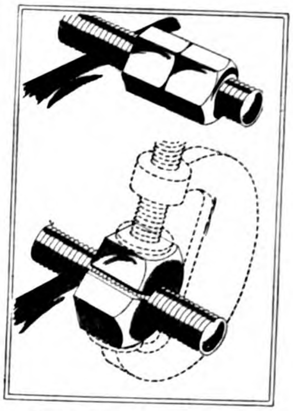
Straightening Shafts in Place



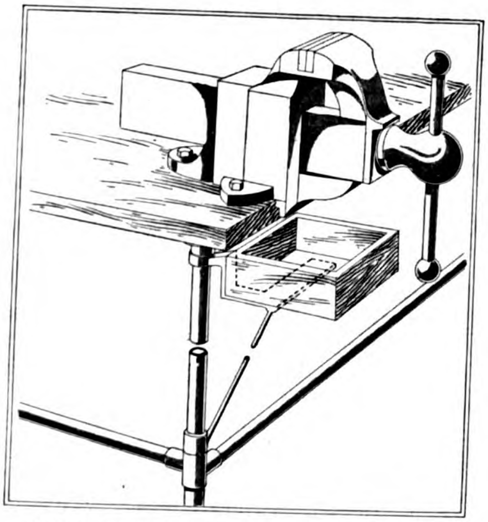
Getting a Grip on a Stubborn Pin



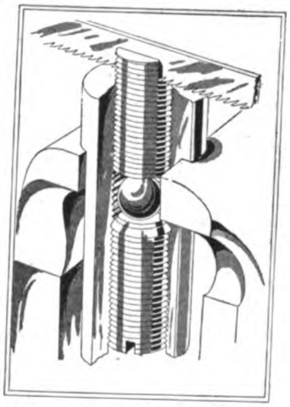
Jigs Can be Used on Vises Too



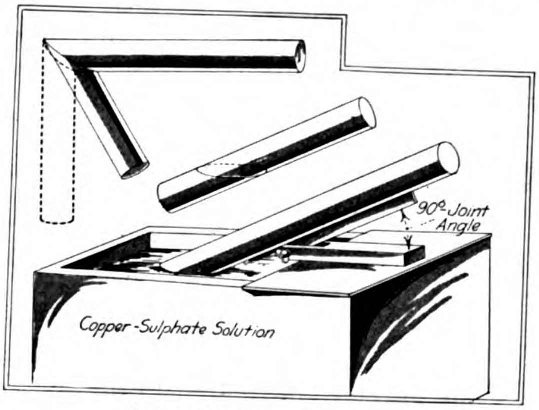
Pulling a Stud With a Split Nut



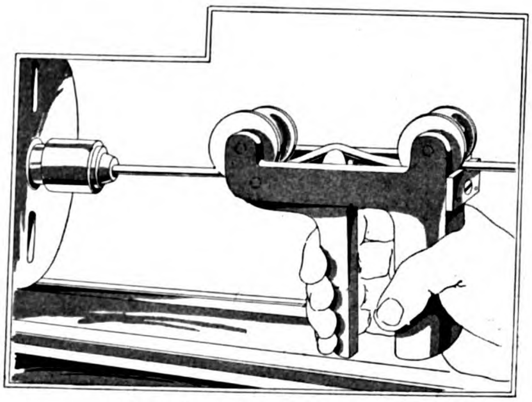
A Swinging Drawer for the Small Tools



Holding Short Screws for Slotting



Laying Out Miters on Bars



Adjustable Wire Kink-Remover

Foolish Regulations

An intelligent and observant mechanic who has had access to a number of the manufactories in the United States where ammunition for the Allies is made has noticed a number of foolish regulations and restrictions imposed by the governments whose contracts are being filled. One of the most outstanding idiocies is the requirement covering heat numbers.

All steel is required to pass a rigid chemical and physical test before it is accepted as suitable for the manufacture of shells. Having passed the tests, it is given a heat number. The government requires that this heat number be stamped on each bar of rolled steel and on each forging blank cut from a cast ingot. When the rolled bars are cut into machining blanks for shells made from bar stock (such as the 18-pounder British high-explosive shell), each blank must be stamped with the heat number.

The shell blanks are shipped to the manufacturers from the steel mills in large lots, usually carload lots. The steel mills, as a usual thing, do not seem to pay any attention to the heat numbers which go to make up a shipment, beyond taking care of course that the blanks shipped are properly tallied and from heats that have passed inspection. In other words, they do not seem to exert themselves to send large numbers of shell blanks of any one heat number, but take them as they come, sending to a manufacturer often as few as one single shell blank of a heat number. For this reason a shipment of shell blanks as received from the steel mill would run something like the following:

Heat No.	No of Blanks
23	3
31	1
43	15
58	4
137	24
269	7
648	1
964	21
averaging 8½ per heat number.	

At present a series (of shells) consists of 250 shells, each of which carries a series mark. For instance, the first series will be marked with the series symbol A, the next B and so on till the alphabet is exhausted. The next series is AA, then AB, AC, etc.

Heats in Series Restricted to Fifteen

The government requires that the series shall be made up from steel that has passed inspection, but it restricts the number of heats represented in a series to 15. This requirement would not be difficult to follow if the shell blanks were shipped from the steel mill in sufficient quantities of each heat number. But as previously stated, there is often only a single shell blank from a certain heat. To be made up from 15 heat numbers, a series of 250 shells requires that the average number of shell blanks for each heat number in the series be nearly 17. But many heat numbers are represented by a single shell blank. And for each such number in a series some other number must be represented by 33 shell blanks.

This rule results in an accumulation of finished shells that cannot be marked with the series symbol, because there are so few of each heat number that the series would represent more than 15 heat numbers. And yet the steel used in the shells has passed the government inspection and has been declared suitable for the use to which it has been put. There are at present many thousands of shells held up by this senseless restriction. That there is no sense to it is proved by the fact that in some shops the accumulation of very large lots of shells representing a great variety of heat numbers (but only a few shells of any one heat number) has led the manufacturers to petition the government to permit making up some series from shells representing a large number of heats. These requests have in a number of instances been granted. In one case a series (250) was made up from shells representing nearly 200 heat numbers. If it is permissible that one such series should be made up, then it is permissible that any series should go through in the same way.

Besides the cost of storage of these large numbers of shells till a place can be found for them in series that are to go out of the shop, there is another element of cost directly chargeable to the heat-number foolishness. In the course of manufacture it is necessary to efface the heat number; that is to say, the part of the metal which bears the heat number is cut away. Whenever this happens, the heat number must on the completion of the operation be again stamped on the work.

In a certain shop with a capacity of 5,000 shells per day, where the system of keeping track of heat numbers is nearly perfect, the cost of sorting (to make series that contain 15 heat numbers) and transferring heat numbers from base to side, from side to base and back to the nose again is estimated at $50 per day. In this same plant before the present system was installed the cost of this work was $250 per day.

Another proof, if further proof is necessary, that the heat-number requirements are foolish lies in the fact that after the series has been made up, packed in 41 boxes containing six shells each (in the case of the 18-pounder high-explosive) or in 125 boxes containing two shells (in the case of the 4.5 high-explosive shell) and shipped to the loading station, no further notice is taken either of heat numbers or of the series symbol. In the process of loading, the series from the various manufacturers are apt to be mixed. When a series is shipped from the loading station, it will contain 41 boxes (in the case of the 18-pounder high-explosive shell), but the 41 boxes may contain shells from 41 different manufacturers; and further, it is within the range of possibility that each box may contain shells representing six different heat numbers.

There is no doubt that a series symbol is of use, as by means of it shells which prove to be in one way or another objectionable may be traced to their original source. There is, however, no good reason why a series should contain any arbitrary number of shells.

It has been suggested by men well posted in the manufacture of shells that it would be much more sensible to make the daily output of a factory determine the size of a series and have it contain all the shells made at the factory on a given date. The date stamps are changed daily in the marking machine. The series stamp could also be changed at the same time and not, as now, with every 250 shells.

Useless Work and Unnecessary Accuracy

Another government requirement is that test pieces from base plates shall be pulled to destruction. When the gun is fired, the base plate is under compression, not tension; and while the strength of the metal under compression may bear some relation to its strength under tension, in the case of the base plate there is a difference, because the base plate is surrounded and supported by the

metal in the shell body itself. Wasted work and material! The undercut in the 18-pounder British shell at the inner end of the thread in the fuse hole is optional, and yet the government inspectors are required to see that the recess is absolutely clean. There must be no varnish in it. This requirement means that the recess must be scraped out with a bent scraper. When the screw gage is run in the fuse hole, any particles of varnish in the thread are carried down by the end of the gage and deposited in the undercut. The government requirements are that this varnish shall be removed. Useless work!

Another foolish requirement with regard to varnishing is that, should a drop of varnish adhere to the varnished surface at the bottom of the shell, it must be removed. The same rule also applies to the accidental adherence of a bristle from a varnish brush to the bottom or walls of a shell. Useless work!

When the wave ribs are formed on the bottom of the driving-band groove, there are three or more points—little moon-shaped ribs or burrs—left by the tool. These burrs would not in any way interfere with the pressing on of the band. They would, however, assist in holding it more securely when pressed on. The government requires that these burrs be removed, which is done with hammer and chisel and file. Useless work!

The angle of the fuse hole in the nose of the 18-pounder shell is required to be "dead" smooth. This surface forms a seat for the leather washer, which in turn seats the fuse, and there is no reason for making this seat smooth.

The diameter of the check on the nose of the same shell on the outside is required to be held within 0.005 in. There is no reason why the tolerance should be anywhere near so small as this. Needless accuracy!

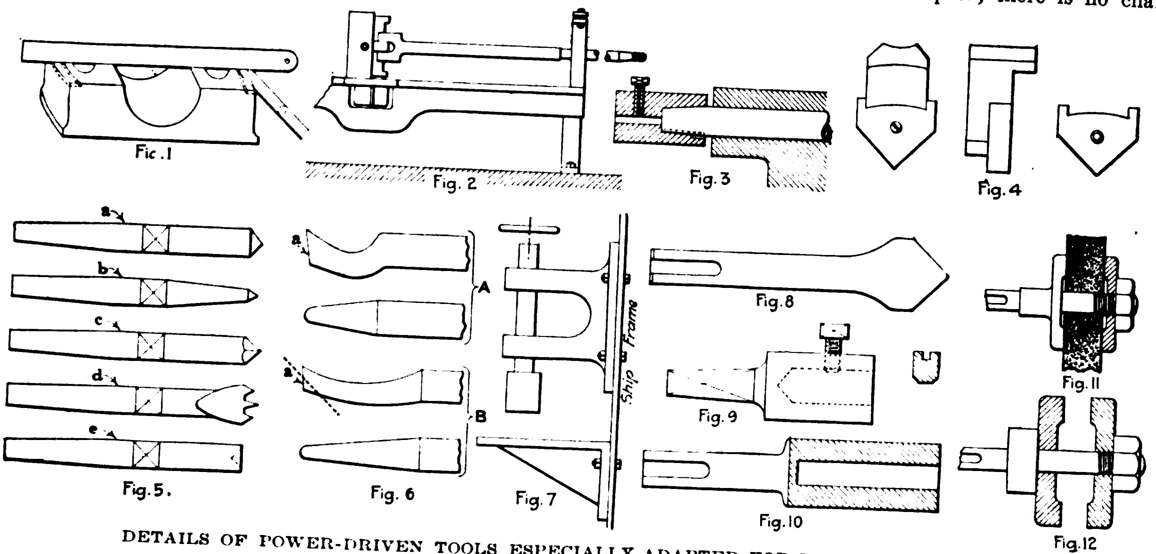
Shells are painted before they leave the factory where they are made. There are many instances where government inspectors have ordered shells repainted because the color has been slightly darker at one part of the shell surface than at another. The shells were not merely given another coat of paint on top of the paint already there; but they had to be sandpapered before the new coat could be applied, as the painted shells must pass through a ring gage, which the extra coat would prevent.

Power-Driven Tools on Ships*

By J. H. Thomson

It might be thought that in the present age of machinery there would be little need to plead for uptodate power-driven tools for executing the everyday mechanical work on board a modern steamship; yet the majority of ships will be found deficient in this respect, many possessing no power tools whatever, others only a nondescript lathe put on board with considerable disregard of the probable requirements, size of ship, etc., and of the large range of work which can be economically carried out, given suitable and suitably equipped tools.

Any repair that can be efficiently performed on board ship by the ordinary staff, without entailing the neglect of other duties and without entailing any overtime work, will cost anything from 75 per cent. and upward less than such repair would cost ashore. For there are no extra wages to pay for such repair; there is no charge



DETAILS OF POWER-DRIVEN TOOLS ESPECIALLY ADAPTED FOR DUTY ON BOARD SHIP

for the use of shore machinery; the profit required by the shore firm is saved; much scrap material that usually goes ashore for a very small return can be profitably worked up on board; there is an enormous saving in the time taken to execute the repair, a saving which in some cases would keep the ship from being detained in port; owing to the quickness and ease with which the work can be done, the machinery will be kept in better repair, as the ship's staff will have more time to devote to it; there will be a saving in the bill for files and other hand tools used on board; and last, but not least, it will tend to minimize discontent from overtime.

To take a simple illustration of everyday routine work: Suppose a 3-in. diameter by 2-in. wide bearing wants stripping, the amount of metal to be removed—ascertained in the usual way by leads—is 0.025 in. The bearing could be put in the lathe, the amount required taken off to within 0.001 in., a true plane surface left, parallel with the opposite plane surface of the bearing or parallel with the bearing itself, as may be required, sharp edges and rags removed—all in well under half an hour, with a

*Condensed from paper presented to Institute of Marine Engineers

minimum of physical labor, by anyone with a slight knowledge of turning. In the vise, with a good file, the same job would take from 1 to 1½ hr., and a good tradesman might have the required amount off to within 0.002 in. and in that time have an approximately plane surface, nearly parallel with the other surface of the bearing. With a poor tradesman there might be 0.005 in. or more of error in the parallelism of the two surfaces, and the new surface might resemble the Bay of Biscay on a rough day more than a true plane. In contrasting these two methods of doing the same job remember that such work often has to be carried out in an engine room at a high temperature, particularly so in the tropics. Doing the job in the lathe has been a pleasure to the engineer, and he is practically as fresh after its completion as he was before he started. Doing it in the vise is mere mechanical drudgery, and the engineer is wet with perspiration and has lost a considerable amount of energy. In passing, a simple method of taking off exactly the right amount of metal in the lathe may be given: Face up only about a quarter or less of the surface to be stripped, until when laying a good straight-edge across the old surface, the required feeler will just slip in between the straight-edge and the new surface, after which the remainder of the old surface can be faced down to the same plane (see Fig. 1).

An illustration of common repair: The valve spindle of a steam stop-valve is broken on the day of sailing. With a power-driven lathe on board and a small stock of various sizes of brass rod, such a spindle could be replaced in about 4 hr., possibly less if it so happened that there were on board any old valve spindles that could be worked up for the job. Without a lathe and with the necessity of sending the spindle ashore to be made good, the time lost may be anything from a half day upward.

Arrangement of Machine-Tool Equipment

The minimum power-driven tools advocated on board a ship are a lathe, a drilling machine and a high-speed grinder. These tools should be so arranged that each can be used independently of the others, or so that all three can be in use simultaneously. It will be most convenient if the three machines are grouped together, so that all may be driven off the one countershaft, fitted in the usual way with driving and loose pulleys. For driving the countershaft an electric motor complete with starting switch, etc., will be required, the power of the motor depending upon the size of the tools that it is proposed to install; one of 2½ hp. should be ample for all ordinary requirements. A point which might be considered is whether the motor might not be fitted so as to be capable of assisting the lathe gearing in getting the required slowness of speed for turning a job of large diameter; such a job being of infrequent occurrence, there would be no objection to running the countershaft temporarily at a reduced speed. Getting the lathe to revolve slowly enough is sometimes a bit of a problem on board; it can occasionally be solved by running the dynamo at a reduced voltage.

It is difficult to fix definitely the size of the lathe that should be fitted on board ship, and the point is one that will bear discussion. The suggestion is put forward that the aim should be to have a lathe which, with the gap removed, would be capable of dealing with the high-pressure junk-ring, the high-pressure piston being the one which usually gives the most trouble from wear. In length the lathe should be capable of dealing with any of the main-engine valve spindles, not that it is thereby implied that the valve spindle should be accommodated between the lathe centers; it will be sufficient if by the aid of a fixed stay, Fig. 2, that part of the spindle which works through the neck bush, stuffing-box, gland and guide can be efficiently dealt with. Space in a ship for a lathe of such size is not always obtainable; but with a little contriving it should be managed, except in very small boats, where the length may require consideration. A suitable position in a turbine-driven ship is often found in the shafting space, which usually extends right across the engine space. There the lathe, drilling machine and grinder can be ranged along the ship's side, using the ship's frames for the purpose of attaching countershaft brackets, motor, etc. The forward starboard side is usually the more suitable, thus leaving the ends of the shears clear for any extra long job to overhang. This point should also be kept in mind if the lathe is placed in the engine room, as one often sees the end of the shears close up against the ship's skin, which renders the turning of a long job impossible. If the space is so limited that the end of the shears cannot be left clear, then they may abut on a hold or bunker bulkhead, which can have a circular hole cut in it in line with the lathe centers, such hole being made water-tight with a covering plate. This means that for doing any job which is extra long, a time must be selected when the bunker is clear of coal or the hold of cargo. It may be mentioned that such a hole, by bolting a suitably shaped piece of wood to it, may be utilized as a fixed stay.

Pointers on Tools for Ship-Board Duty

There is one point that must on no account be lost sight of in selecting a position for these tools. The space selected must be well ventilated and cool enough at all times, even with steam on the main engines and the ship in the tropics, for a man to work in comparative comfort. The speed at which the ship's lathe can be driven requires more consideration than it usually gets; for seeing that there is only the one machine, one would think it stands to reason that it is necessary to have it capable of a very much larger range of speed than would be the case in shop practice. Thus if the suggestion that the lathe should be capable of dealing with the junk-ring be accepted, then it follows that the lathe spindle should be capable of being driven from a speed suitable for such ring up to the speed suitable for turning a small-diameter brass pin; and if the suggestion made later on regarding the supplying of one or two emery wheels for use in the lathe be carried out, then the lathe spindle should be capable of a higher speed still—say 1,500 r.p.m.—which is suitable for a 14-in. diameter wheel.

The ship lathe must be capable of cutting screws of all the standard pitches, and it may need to have one or two odd wheels for bastard pitches, if the engine builder happens to be one of those who use bastard threads—a practice resorted to in order to compel the user to come back to the maker for renewals. The usual compound saddle rest is required with crossfeed, etc. The quadrant should be marked off in degrees. The moving headstock should have a cross-adjustment for purposes of alignment or turning up tapers. A suggested fitting for the moving headstock—one that would be of great use—is a drill

chuck. It would be attached to the moving cylinder of the headstock, the boring of holes in work attached to the running spindle being of much more frequent occurrence than that in which the drill is attached to the running spindle. Drills are sometimes supplied capable of being placed in the taper hole that holds the fixed center or a special drill holder; but the practice is not good, as the hole gets damaged and so renders the fixed center shaky or out of alignment. A suggestion for a holder is given in Fig. 3. It is self-centering, free from shake and can be detached by drawing in the cylinder by means of its screws, when the holder will abut on the barrel and be forced off; a sunk feather is fitted to the holder, engaging in a keyway on the under side of the cylinder end. The attachments for the running spindle will consist of one large faceplate for use with gap removed; one faceplate for use with gap in place; one driver plate for driving work held between the centers; one chuck with four independent dogs, each having three steps and capable of being reversed to hold circular work securely. A shortcoming of most dogs is that they will not readily catch small work, say of 1/4-in. diameter.

In Fig. 4 is shown an attachment which will be found useful in this connection. Anyone wishing to use it should make a wooden pattern a neat fit for the dog and get four forged off it in tool steel. True up one flat surface of the forgings and fit them to the dogs. Make sure when boring the holes and fitting the pins that the strain in screwing up the job will not come on the set-pins; the set-pins will last better if they are also made of tool steel. After the forgings have been fitted to the dogs, true up the sides of the V-shaped portion until the four points meet in the center of the plate. The dogs are lying in a true circle, and the sides of the V-shaped portions form true radii of a circle. The front faces of the segments may be faced up with the chuck running on the lathe spindle. The V-shaped portions should not come to absolute points, but be left about 1/16 in. wide. A small rack, consisting of a piece of 1/8-in plate with four tapped holes to take the set-pins, is desirable to hold pins and segments when not in use.

A Few Special Devices

There should also be supplied one drill chuck which will hold the drills supplied to the ship (this may be one of the numerous small self-centering grip chucks or a chuck with a plain parallel hole, say 5/8 in. in diameter, if the drills are, as is very common, forged from 5/8-in. round tool-steel bar); one fixed stay, which can be bolted down to the lathe shears; one running stay, which can be attached to the saddle (those with adjustable metal dogs are more useful than those requiring the fitting of various-sized wooden blocks); one hand rest for wood-turning tools.

Fig. 5 shows the lathe centers required: Two ordinary pointed centers, one ordinary pointed center with end of reduced diameter for small work, one cutting center, two or more driving centers for wood-turning, one hollow center (optional). A list of tools is given of the ordinary form, 1/2-in. or 5/8-in. square-section common tool steel, this steel being selected as the many special self-hardening steels require an experienced toolsmith to deal with them. While tools made of such steel could be dressed ashore, there is always the possibility of their getting broken when away from port.

The tool list comprises three ball-point roughing tools—two for iron, one for brass; two right-hand side-cutting tools—one for iron, one for brass; two left-hand side-cutting tools—one for iron, one for brass; one spring scraper; one right-hand knife tool; one left-hand knife tool; two Whitworth standard-thread screw-cutting tools—one medium, one small and both to be dressed as right-hand tools; three parting or square thread-cutting tools, of widths 1/12 in., 1/8 in., 1/6 in.; five inside screw-cutting tools, to correspond with outside screw-cutting tools, the smaller size V-thread and the 1/12-in. square thread to be capable of cutting a thread in a 1/2-in. hole. In the event of the shifting headstock not being fitted to hold drills one drill holder suitable for fixing in the tool rest should be provided, and there should be a set of inside and outside combs.

Finishing Tools Principally Used

Other tools may be added from time to time as may be required, but with the foregoing outfit any ordinary job can be tackled. In getting tools made or dressed for ship's use, it should be remembered that they will be principally used for light duty—that is, taking a light cut or skimming off work that has been previously machined—and they can therefore be dressed of lighter shape than would be the case for shopwork. Further, the facilities for grinding tools on board being usually of the most crude description, the under side of the tools should be cut well back, so that there may be as small a surface of steel to grind as possible. Fig. 6 shows a ball-point roughing-tool *A* as used in the shop; *B* is a similar tool for light duty in a ship's lathe. It will be noticed that the surface to be ground *a* when the tool requires sharpening is only about one-third in tool *B* of what it is in tool *A*.

For shipwork a drilling machine that will bore holes from 1/32 in. up to 1 1/2 in. is required, and it must therefore have the range of speeds and power required for such sizes. It will not matter if the speed is not quite so high as boring a hole of 1/32 in. permits, but it must be able to revolve slowly enough and have the requisite power and rigidity for the 1 1/2-in. hole. A speed ranging from 30 revolutions per inch to 300 revolutions per inch per minute should be obtainable. When space can be had, a useful type of machine is the one which has the drilling spindle and its driving and feed gear mounted on a short cast-iron pedestal or column, a double bracket capable of swinging round, being raised or lowered and clamped in position on the column. One end of the bracket supports a round table capable of revolving on its axis and of being clamped; the other end consists of small shears, on which slides a parallel vise. This is a well-known type of machine, familiar to all engineers and made by practically all the well-known tool makers. It has the further advantage that the brackets, when swung at right angles to the spindle, leave the floor space clear for putting any extra-large job under the spindle.

Devices for Saving Space

When space is not available, various modifications can be made. Thus instead of a double-swing bracket a single one can be used, allowing the machine to go close against a bulkhead or the ship's side, when the flat revolving table should be retained and a parallel vise supplied, which can be bolted on top of the table. The advantage

of the vise fitted on the shears is the clearance which is available under the vise, the limit to the length of the work which may be held being the floor underneath. A ship's frame can be utilized instead of the cast-iron column, the drilling spindle and its gears being secured to the frame at a suitable height. The table could consist of an ordinary good-sized cast-iron knee plate, capable of being bolted to the frame at various heights or of being removed to allow the job to sit upon the floor. A parallel vise should be supplied, which will be suitable to attach to the table. Fig. 7 is a rough sketch of a drilling machine attached to the ship's frames; in both instances all driving, feed gear, etc., are omitted.

The Forms of Drills Used

The drills for the machine are the next consideration. Should they be twist, flute or common? Should they have parallel round shanks, taper round shanks or taper square shanks? The ideal would be to have two complete sets of drills—the twist or flute for use in the machines and the common drills for use in the ratchets or machines. Failing this, choice must be made of the one kind for all purposes. The drill which can be most easily made, repaired and ground is the common drill forged from plain $\frac{5}{8}$-in. round-bar tool steel, with a flat at the one end to take the point of the set-pin, Fig. 8. The sockets of the ship's ratchets should suit this or a loose socket with square tapered male end, Fig. 9, and round $\frac{5}{8}$-in. parallel female end be supplied. Such sockets are not very difficult to make, and two or three of various lengths are most useful for ratchet work and will often save a lot of time being spent in hunting up and fixing packing. The set-pins for these sockets should be of tool steel, with the cheese points slightly tempered, each socket having two set-pins—one with a square head, the other of a grub-screw shape. The latter is only for use when there is not clearance room for the one with the square head. If flute or twist drills are to be supplied, the flute shape will be the more useful. They are more easily ground, and they are more efficient for use in reaming out a hole parallel and true to size, at which class of work a twist drill has a great tendency to draw itself into the work, seize and snap. In attempting to ream a hole with a twist drill it usually pays to plug up the original hole first with hardwood or brass.

Drill Sizes Generally Required

The sizes of drills should range at least from $\frac{3}{16}$ in. to $1\frac{1}{2}$ in., advancing by $\frac{1}{16}$ in., with four extra drills for $\frac{3}{8}$-in., $\frac{1}{2}$-in., $\frac{5}{8}$-in. and $\frac{7}{8}$-in. tapping sizes and one good large countersink point, making 27 drills in all. It would be better still if the sizes ranged from $\frac{1}{16}$ in. to 1 in. by $\frac{1}{32}$ in. and from 1 in. to $1\frac{1}{2}$ in. by $\frac{3}{16}$ in., with countersink point, making 36 drills in all. There remains the question of sizes smaller than $\frac{3}{16}$ in. For this purpose a good method is to have them forged from $\frac{1}{16}$-in., $\frac{3}{32}$-in. and $\frac{1}{8}$-in. square tool-steel rod, a short length, say 2 ft. of each size, being also supplied to provide for any breakage or odd-length drill that may be required. Steel rod of this size and section requires the minimum of forging, and the square section provides a most efficient grip for the ordinary shark-jaw chuck with which the American brace is usually fitted. For use in the power-driven drilling machine a chuck should be supplied. A useful chuck for the drilling machine and lathe can be made by making a male part, as shown in Fig. 10, to suit the shark jaws and outer nut removed from either the American or the wood brace.

Why, it may be asked, should the engine room of a modern ship—a space full of intricate machinery—have placed in it a dirty, inefficient, manual-power grindstone? The most suitable grinder for a ship should open up some discussion and suggestion from those who have expert knowledge of the subject. A machine with a 12-in. to 14-in. by $1\frac{1}{2}$-in. wet wheel on one end of the spindle and a similar-sized emery facer on the other end, with suitable rests, etc., should prove a useful and satisfactory machine for ship use. An attachment should be supplied for grinding twist or flute drills. Those who have to contend with the old-fashioned grindstone will find the expedient of getting an emery wheel and using it in the lathe a welcome help. A sketch of such a wheel fitted on a suitable spindle to fit the drill chuck is given in Fig. 11. In ordering a wheel for this purpose get as large a diameter wheel as the lathe will accommodate with the gap in place, in order to get a good peripheral speed; a small wheel at the usual fastest lathe speed is not of much utility. It should be possible to provide a lathe with a sufficiently high speed for driving an efficient wheel of medium size, and this might be done when, for reasons of want of space, a grinder could not be installed. The drawbacks to the emery wheel being used in the lathe are the difficulty of keeping the wheel running true and the grit that tends to get into the spindle bearings and under the saddle. With due care the latter can be much minimized. As the spindle in Fig. 11 requires a special forging, a sketch is given in Fig. 12 of a construction that can be carried out on board ship. The spindle is turned out of a good-sized piece of steel, in order to get as large a collar as possible. The washers are made of $\frac{1}{4}$-in. plate, one-third the diameter of the wheel, faced on one side sufficient for a collar and nut respectively and recessed on the other side in order that they may grip the wheel at their edges; or instead of recessing, a ring of $\frac{1}{16}$ in. of paper or fiber on either side will give the same result.

Forge Considerations on Board Ship

The forge may not be, strictly speaking, a power-driven tool, unless the term may be permitted if the blast is supplied from a power-driven fan. Why it should not be so is difficult to understand, as the cost would be not much greater than supplying the usual hand forge, with which machinists on ships are doubtless familiar, possibly painfully so. Seeing that the average steamer is provided with power-driven fans for the boiler furnaces, it should not be a difficult matter to provide a forge with an air pipe led to it from a convenient fan trunk. The following are details of an expedient that was carried out: The cyclone part of the forge was removed and the remaining cast-iron pan and tuyere on its stand were bolted down in a corner of the stokehold, immediately under a fan trunk. Some old 3-in. iron pipes, flanges and elbows that happened to be on board were utilized to make a connection from the bottom of the fan trunk to the tuyere. A thick asbestos millboard joint was put between two of the flanges, with a portion of the joint cut away and one bolt left out. In the space thus provided a bit of sheet iron of U-shape was inserted, which acted as a valve. The result was an excellent forge,

capable of melting cast iron, as was conclusively proved by the prompt disappearance of the tuyere. However, a new one protected by firebrick and fireclay lasted better and gave most efficient service. A water-cooled tuyere of the usual type would of course be better still.

Still, a coal forge is not the ideal fitting for a steamer. One is required that is smokeless or nearly so, able to be put in operation on short notice and capable of heating up ¾-in. square tool steel to white heat in a reasonable time—say 5 min. It is seldom that any larger job than this turns up on board; and if it did, it could probably be dealt with in one of the boiler furnaces.

This paper has not covered the whole ground of power tools for a ship. There are many other tools which could be suggested, which would be most useful and not very costly, such as an arrangement for driving a hacksaw, a small shaping machine (both of which could be arranged as lathe attachments), a portable electrically driven driller that can be used in any part of the ship, the current being obtained from the nearest lamp socket, etc. It is hoped that enough has been said to initiate a good discussion, and to induce others to give details of any useful contrivance they may have seen or evolved. It is suggested that such details should refer to power-driven contrivances only; otherwise so large a subject is opened up as to be unwieldy. Possibly at some future time the author or someone else will take up the subject of the outfit of hand tools for a ship. Such an article should render available a large store of personal experience, both for the use of those who go to sea and have to use the tools and for those who have to do with putting a suitable outfit on board.

Making and Testing a V-Block

By Gustave A. Remacle

An accurate V-block is a valuable aid in manufacturing precision gages. The block may be pronounced accurate when it proves true under the following tests: Clamping a ground and lapped cylindrical rod in the V, as in Fig. 1, the ends of the rod should be tested with a good indicator. When the side of the block *A* is on the surface plate, points *B* of the rod should register alike on the indicator. Reversing the block so that the side *C* rests on the surface plate, points *D* of the rod should register the same as the points *B*. Testing in the same manner to ascertain the truth of the V to the bottom of the block, the rod is clamped as in Fig. 2 and tested at points of the rod *A*. However, as the block is often used for holding cylindrical pieces on the magnetic chuck of the grinder in squaring the ends, the test in Fig. 3 may be applied to determine further the accuracy of the block by strapping it to the faceplate of the bench lathe, which has been carefully tested for truth. The block is adjusted so that the point *A* of the rod runs true. If points *B* also run true, the block may be pronounced satisfactory for use in manufacturing gages.

An interesting feature in the making of the V-block was the use of the sine bar for obtaining the angle. A piece of ¼-in. flat stock was sawed off to about the desired size and angle (45 deg.) and two sides were ground at

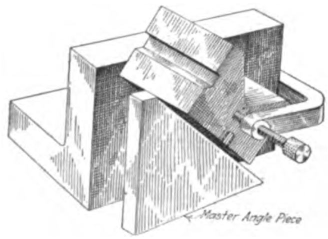
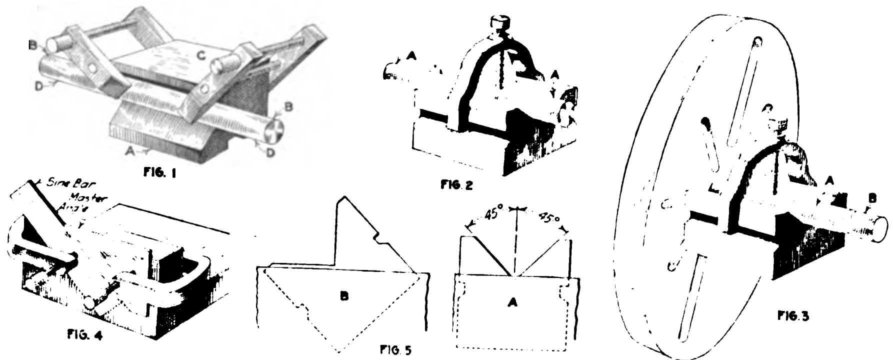


FIG. 6. SET-UP FOR GRINDING THE V

right angles. A sine bar was easily and accurately set to 45 deg. and clamped on an angle plate, to which the flat stock was also clamped, Fig. 4, properly located by the sine bar. Removing the sine bar, the third side was ground and later used as a master angle for obtaining the angle in the V.

While the V in a job of this kind is generally machined in the shaper, as at *A*, Fig. 5, the work was accomplished most rapidly in the manner shown at *B*. In machining the block it was unnecessary to disturb the head of the shaper. The block was inclined at the angle of 45 deg. by allowing it to rest upon the master piece. The set-up for grinding the V is shown in Fig. 6. Both angle plate and master piece are held firmly in place by the magnetic chuck. After one side of the V was ground, the block was reversed, the pin in the master piece locating it at the same height and angle. The remaining side was ground so nearly central and true to the rest of the block that a minimum amount of lapping was necessary to complete the job.



FIGS. 1 TO 5. DETAILS OF TESTING DEVICES FOR ACCURATE V-BLOCKS

The Physician in Industry

Apart from the medical aspect, enlightened employers are beginning to see clearly the value of a physician as a staff member. This conclusion is reached by W. W. Alexander in *American Industries,* and he is also of the opinion that employers have learned to appreciate that a physician's peculiar relationship to employees as a friendly medical adviser enables him to exert a wholesome influence upon their mental attitude as well as upon their physical welfare. It should therefore not be surprising to find physicians in future regularly attached even to small plants.

Punches and Dies for a Door-Hanger Carriage

By Robert Mawson

SYNOPSIS—In this article are described the tools for the last four operations in manufacturing a door-hanger carriage. This includes countersinking in the punch press, drawing out metal for riveting and upsetting the drawn portion to fasten the two parts together, so that assembling as well as stamping and riveting is handled in these dies. A testing fixture is also shown, which is used to determine whether the width between the rollers is to the prescribed limits.

On page 622 were illustrated some of the punches and dies used by the McCabe Hanger Manufacturing Co., New York City, in making the carriage that is part of the equipment on various types of door hangers. Other punches and dies are here given. These tools, as well as those shown in the previous article, are of good design and produce accurate results quickly.

The first operation described in this article is countersinking. The plate is placed on the die, and the punch, guided through a stripper plate, is fed down to the piece and the operation performed. The countersinking is done on only one hole on a plate. The other end of the plate has the hole drawn out in a similar manner.

The plates are placed in the die, shown in Fig. 8, located by stop surfaces at the rear and the ends. The punch is fed down by the press and the plate bent to the desired contour. Two of the plates are then placed together, the drawn surface around one hole being placed into the countersunk hole of another unit. The two plates are put on the die bed, shown in Fig. 8. The punch, which is fitted with a pilot, is placed in position as shown and, being fed down with the press, upsets or rivets the projecting metal. The operation is repeated at the other end of the plates, thus uniting them. The assembled plates are tested to see if they come within the prescribed limit of 0.005 in.

These tools have been so well designed that very little variation is found, and practically all the pieces are accepted as being correct in form and to the required dimensions.

The cups and ball bearings are placed in the plates afterward. The rollers, either steel or fiber, as the design demands, are assembled and riveted in position. The carriage is then ready for either placing in service or stock, as desired.

The cups are made of pressed steel by means of punches and dies but it is thought that the tools shown for manufacturing the side plates are of greater interest. The company also made other types of door-hanger carriages with the side plates of other shapes. One of these has the plates straight instead of being bent as described in this article, but this makes no material difference in the manufacturing methods here employed.

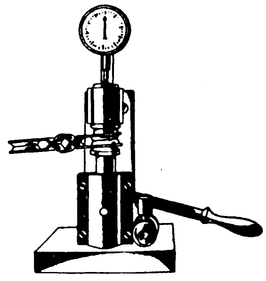
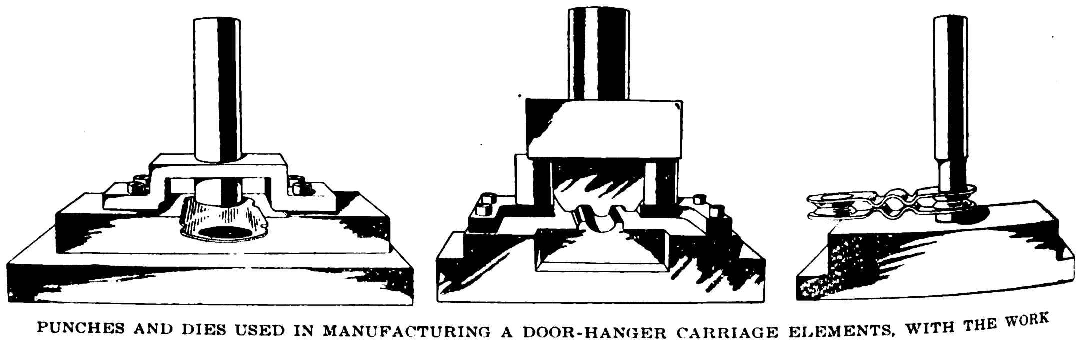


FIG. 9. TESTING DEVICE FOR HANGER



PUNCHES AND DIES USED IN MANUFACTURING A DOOR-HANGER CARRIAGE ELEMENTS, WITH THE WORK SHOWN IN POSITION ON THE DIES

FIGS. 2 AND 2-A

Operation—Countersinking the plate, as shown in Fig. 1. The blank is placed in the die, being located in a steel bushing in which the embossed head rests. The punch, when made to descend, produces the countersunk hole.

FIG. 4-A

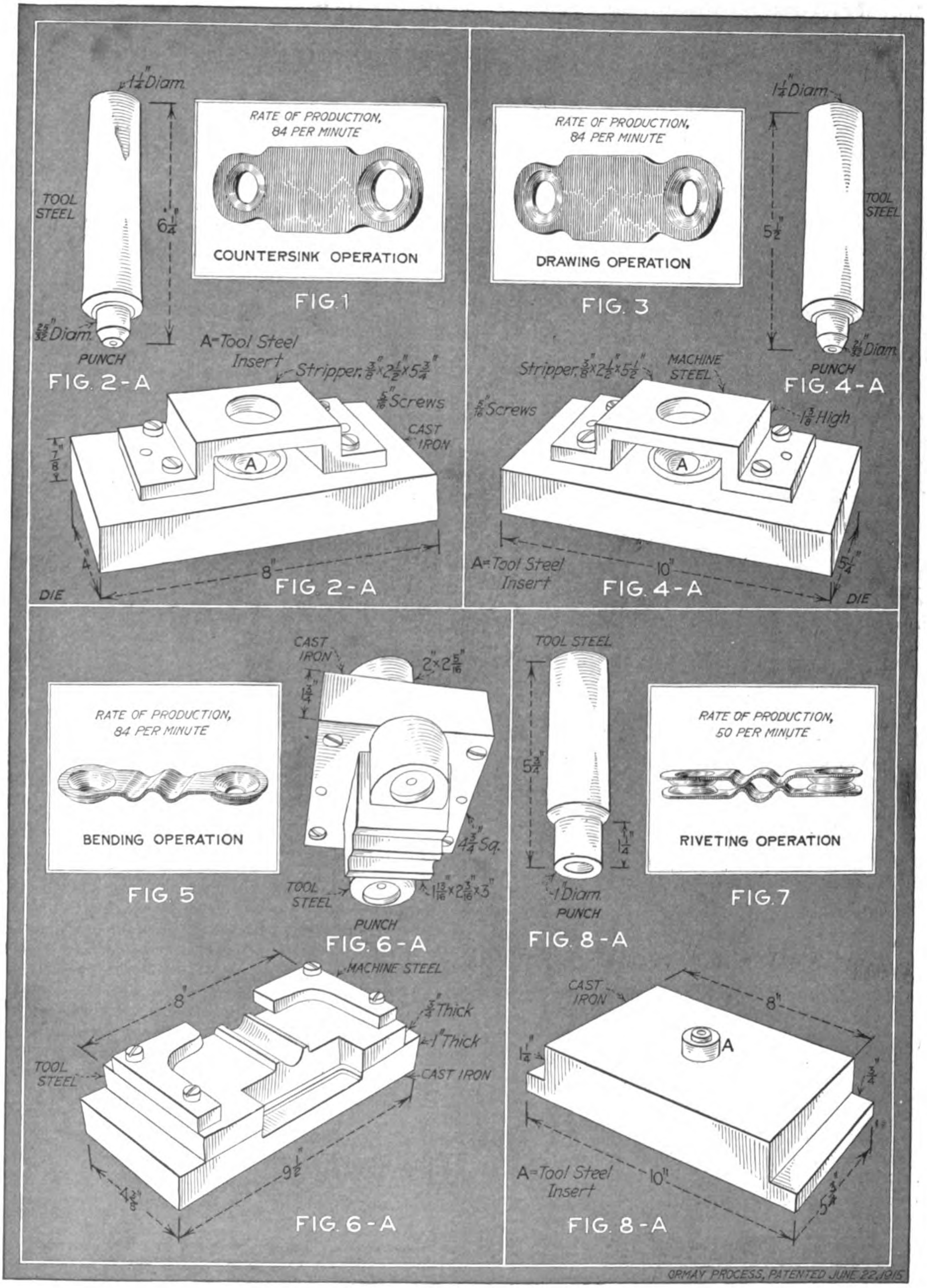
Operation—Drawing the hole to the contour shown in Fig. 3. The piece is located in a manner similar to that described in the previous operation, and the punch, by descending through the stripper, produces the desired drawn lip.

FIGS. 6 AND 6-A

Operation—Bending to the contour, Fig. 5. The pieces are located in the die by means of the stop plates at the ends and the rear. The contour is produced by the punch as shown in the illustration.

FIGS. 8 AND 8-A

Operation—Riveting two plates together to form the assembled part illustrated in Fig. 7. One of the plates produced up to this operation is being countersunk, and the other plate having the drawn lip is placed on the die. The punch, which is made with a pilot, is then fed to the plates, and the two are riveted together. In Fig. 9 is shown a complete door-hanger carriage being tested to see if it will pass under the required limits.



DETAILS OF PUNCHES AND DIES USED IN PRODUCING DOOR-HANGER PARTS

Drilling Suggestions for Munition Work

SPECIAL CORRESPONDENCE

The manufacture of munitions of various kinds has brought out many interesting problems, the methods and results obtained in drilling being of especial interest. This work may be divided into two classes—the heavy drilling, as in shell manufacture, and the light drilling of the fuses and gaine tubes.

The making of small shells, particularly the 3-in. or thereabouts, is handled in two ways—by using forgings with the hole drawn approximately to size and shape and by drilling from the solid. The latter method is in the minority, but is used in some shops and has developed several drilling problems. One of the difficulties was to secure a hole that was straight and fairly true with the outside. Drills and reamers have been condemned when in reality the trouble was in the method.

As with most things in life, success depends upon what kind of start you make. The truth of the first 2 in. of the hole is very important. If this is straight, no trouble is likely to develop. For this reason the hole should be started with a short, stiff drill, through a fixture with a hardened bushing. Then the piece can be passed to the long drill and the hole finished without difficulty and without a guide bushing. This practice has the further advantage of affording a means of using up drills that have become too short for drilling the full depth of the hole, and in these days of high steel prices this point counts considerably.

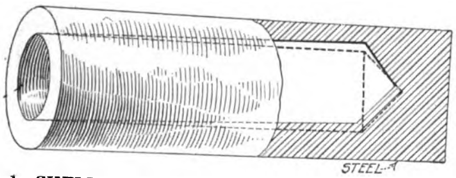


FIG. 1. SHELL DRILLED OFF CENTER; DOTTED LINES SHOW PATH OF REAMER

Many shells were rejected on account of the reamer not cleaning out the hole at the bottom, the reason being that the drilled hole was off center, as is shown somewhat exaggerated in Fig. 1. The reamer in trying to cut straight would clean out only part of the hole, leaving a portion of one side rough as it came from the drill.

Actual Drilling Performances

One large shell shop, well equipped with heavy machinery, is drilling holes $2\frac{1}{16}$ in. in diameter at the rate of 166 r.p.m., or 90 ft. per min., with a feed of 0.024 in. per revolution. These shells are 20- to 25-point carbon, and a hole 8 in. deep is obtained in 2 min. Lighter drilling machines will not stand this feed, and in some cases they will not give the desired speeds.

In another shop on slightly smaller work $1\frac{3}{4}$-in. holes are drilled at 146 r.p.m., or 65 ft. per min., with a feed of 0.018 in. per revolution. These shells are harder and take about 3 min. each. A good working average for drills of this size would be 150 r.p.m. with 0.018-in. feed.

Best results are obtained by heating the cutting compound to about 150 deg. F. before starting to drill. The drills for this work have to be tempered harder than for ordinary work, and they are tougher (and so less likely to break) when warmed up to 150 deg. After they have drilled a few holes, the heat of drilling keeps the lubricant warm enough.

In drilling small holes speed is the main requisite, to which may be added sensitiveness in the spindle, so that the operator can feel the cut. Drilling the small holes in the gaine tube with No. 68 or 69 drills was difficult until high speeds were used. Now that this hole has been enlarged to $\frac{1}{16}$ in. the problem is not so difficult, although that is not a very large drill.

Success in Drilling Small Holes

Special machines have been made in many cases, whereby the work and the drill revolve in opposite directions. Others, with equal experience, advocate the less complicated method of revolving only the drill in a simple machine. One successful fuse maker has used simple drilling heads, Fig. 2, holding the work in V-blocks. The spindle A is of $\frac{1}{4}$-in. or $\frac{3}{8}$-in. drill rod, ground and polished. It is mounted in a head with two bearings B, this being a heavy iron casting, and the holes are drilled and reamed straight and true. The bearings should be six diameters long.

The drill is held in the end of the spindle by a small screw D, a similar screw E being put in at the opposite side for balancing, as perfect balance is essential. The pulley F is small—about $\frac{3}{4}$ in.—and the spindle is driven by a rubber band $\frac{1}{8}$ in. wide. The button G is loose on the spindle and allows the operator, usually a girl, to feel the cut of the drill perfectly. The head must be heavy to absorb vibration and to take care of heat, very litle lubrication being used and a light oil of high quality being necessary.

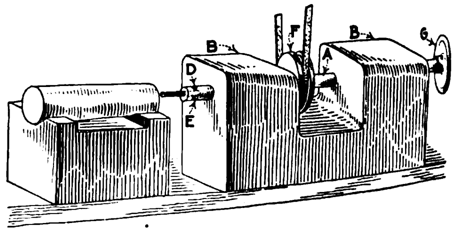


FIG. 2. SIMPLE AND CHEAP DRILLING RIG FOR SMALL HOLES IN GAINE TUBES

The girl wipes the drill with a brush dipped in lard oil, clears away the chips and lubricates the drill at the same time. When sharp, the drill rolls tiny chips out of the hole; when dull, it is restored by stoning, taking care to keep the center sharp. The spindle is so sensitive that the slightest dullness is easily detected, which also prevents snapping the drills, many hundred holes being drilled with no breakage. One No. 69 drill that had been used for 2,300 holes, each $\frac{7}{16}$ in. long, was in fine condition and good for many more.

Invar and Related Nickel Steels—The Bureau of Standards, Department of Commerce, proposes to issue a series of circulars of information on the properties of the more interesting or technically important metals and alloys. The first of the series, describing the properties of the nonexpansible alloy Invar and other nickel steels, has been published. The magnetic, electrical, thermal and mechanical properties are given with numerous illustrations, together with statements concerning microstructure, constitution and applications.

Forge Shop at Naval Station, Pearl Harbor, Hawaii

By J. A. Furer*

SYNOPSIS—The forge shop at the new naval station, Pearl Harbor, is a steel structure 200 ft. long by 100 ft. wide, consisting of a main bay 50 ft. wide and two side bays each 25 ft. wide. The height of the main bay under the 15-ton traveling crane is 31 ft. 9 in.; and of the side bays under the roof-truss chord, 15 ft. 8 in. The building has three open sides. This unusual feature in the construction of a shop building was rendered possible by the remarkably favorable climatic conditions at Pearl Harbor. Only the north side of the shop is closed—this to a height of 12 ft.—so as to break the force of the wind which blows almost constantly from that direction and to protect the oil fires from the strong breeze.

The naval station is located on the leeward side of the Island of Oahu. A mountain range on the windward side of the island precipitates the moisture carried by the northeast trade winds before they reach Pearl Harbor. It therefore seldom rains at the naval station, except in times of southerly storms. Bad weather from that direction is, however, infrequent and not of long duration.

As the Hawaiian Islands are situated in the tropics, sides for the buildings are not necessary to make them habitable in winter. Although the climate of the islands is described as tropical, it is nevertheless remarkably cool at Pearl Harbor even during the summer months. The range in temperature is in fact so unusual that it is worth mentioning.

The maximum temperature during 1914 was 86 deg. F. This temperature was registered only a few hours during the month of August. The usual maximum at the middle of the day in the summer months is 82 or 83 deg. F. By comparison many of the large cities in the northern part of the United States are more tropical in summer than Pearl Harbor.

The only objections to open sides for the buildings at Pearl Harbor are the occasional southerly rainstorms already mentioned and the dust that is blown up by the trade winds. These are not, however, vital considerations for a forge shop, as compared with the advantages of better light and better ventilation resulting from this construction. Buildings in which more delicate tools are housed, such as the machine shop, pattern shop and woodworking shop, are inclosed. In order to prevent pilfering outside of working hours the forge shop and other open buildings are fitted with wire-mesh sides.

MONTHLY TEMPERATURE AVERAGES FOR THE PAST THREE YEARS AT THE NAVAL STATION, PEARL HARBOR

Month	1912, Deg. F.	1913, Deg. F.	1914, Deg. F.
January	70.0	71.8	69.1
February	69.8	70.4	71.4
March	71.4	72.2	70.9
April	73.3	72.8	72.5
May	74.3	74.8	74.3
June	75.3	76.2	76.6
July	76.4	77.4	78.2
August	78.1	78.2	79.2
September	76.8	78.2	78.7
October	75.2	77.6	77.7
November	74.7	74.6	75.0
December	72.4	74.0	72.5

The usual smithing work will be done in this shop and also the plate and angle furnace work that at shipyards is ordinarily carried on in a separate building.

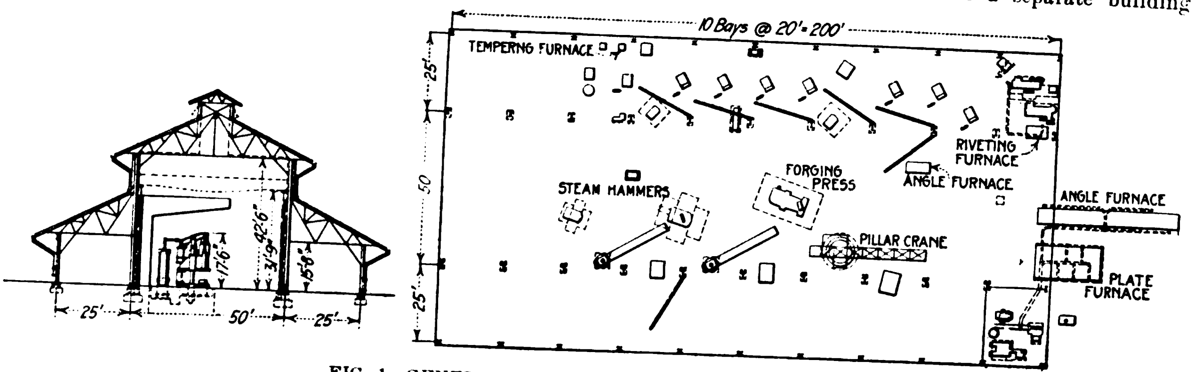


FIG. 1. GENERAL ARRANGEMENT OF FORGE SHOP

The advantages of combining the latter class of work with that ordinarily done in a forge shop are obvious, as the trades are allied and lend themselves well to supervision by one foreman. Moreover, duplications of equipment, such as blowers, pipe lines, cranes, etc., are avoided by having the angle smiths also in the forge shop. The plate and angle furnaces are located at one end of the shop, as will be seen from the layout plan of the building, Fig. 1. Only the working ends of these furnaces are under the roof of the shop. Corrugated-iron hoods are fitted over the parts of the furnaces that project beyond the building, so as to protect the brickwork from the occasional rains. In Fig. 2 the outside of the building is shown.

All the furnaces and forges are oil burning. The burners and collateral equipment were purchased, and the installation was made by the Government. The burners are of the combination type, using air at a pressure of 30 lb. for atomizing the oil and low-pressure air at 6 oz. for combustion. The blowers and pumps are installed in one corner of the shop and are illustrated in Fig. 3.

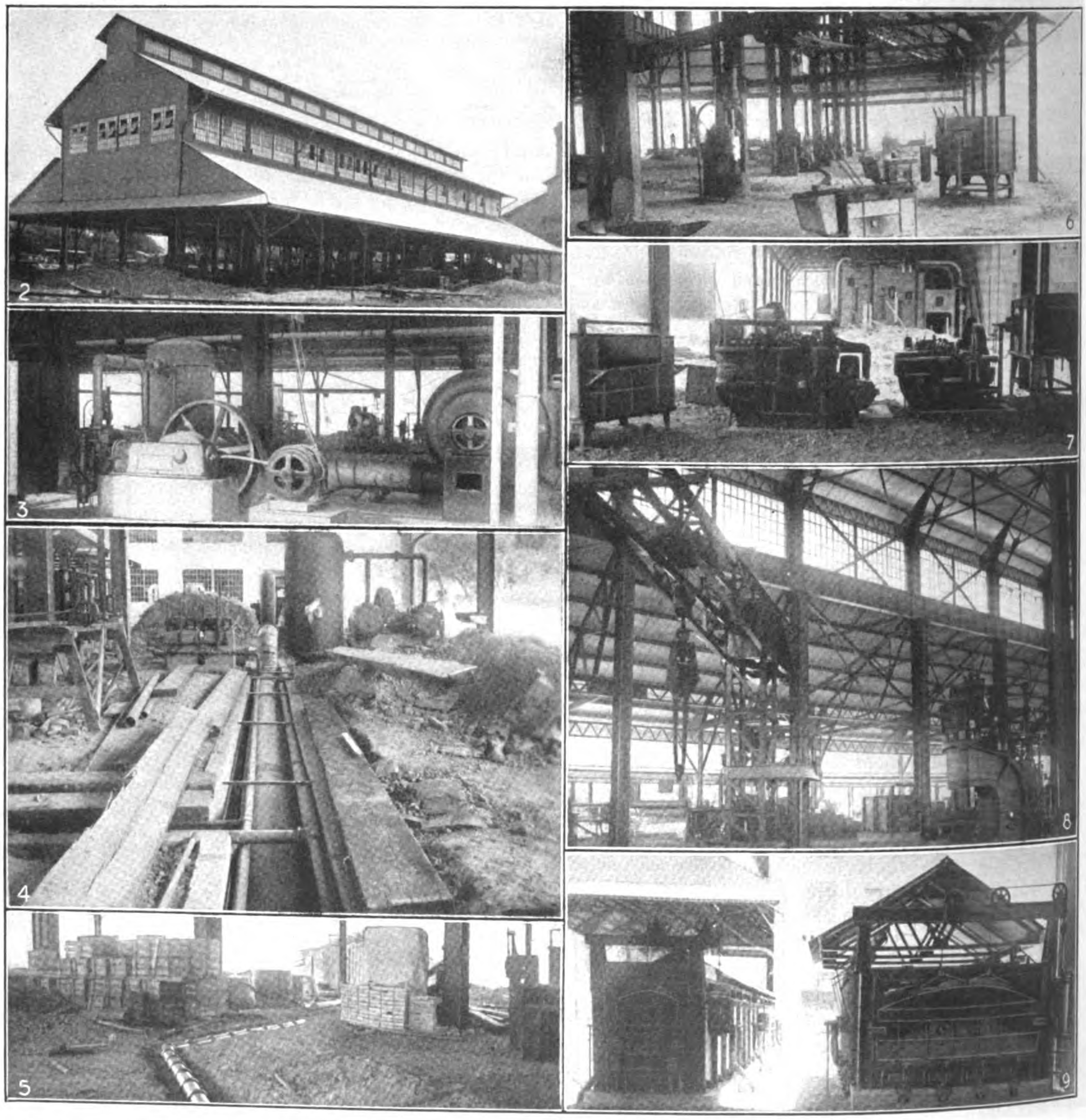
*Naval constructor.

The outfit consists of a blower having a capacity of 7,500 cu.ft. of air per minute, driven by a 50-hp. motor—two rotary pressure pumps each driven by a 2-hp. motor delivering oil at 30 lb. pressure—and a small individually driven air compressor for providing the atomizing air. Only one pump is actually in service at a time for delivering oil to the distribution system. The duplicate is provided as a relief in case of breakdown or choking of the working pump. An air receiver is installed in the compressed-air line, to equalize the pressure in the main and to separate the entrained moisture.

The most satisfactory combustion results are obtained by keeping the air pressure on the atomizing line the same or slightly higher than the oil pressure—in this case approximately 30 lb. If the air pressure is allowed to fall below the oil pressure, the oil is apt to be forced into the high-pressure line by way of the burners.

Various methods of leading the blast and oil piping to the forges and furnaces were considered. A concrete conduit of sufficient size to accommodate all the pipe lines was finally adopted as providing the most satisfactory arrangement. The conduit, with the pipes in place, is shown in Fig. 4. Openings were left in the walls for the branch piping to the forges and furnaces. The top is covered by plates, flush with the floor, thus providing ready access to the piping.

This conduit runs along two sides and across one end of the shop. It contains the low-pressure blast main, the high-pressure air line, the oil main and a steam pipe, close to the oil pipe, for heating purposes. This was



FIGS. 2 TO 9. SPECIAL FEATURES OF THE CONSTRUCTION OF THE NEW UNITED STATES NAVAL FORGE SHOP AT PEARL HARBOR, HAWAII

Fig. 2—View of forge shop from outside. Fig. 3—Blower and oil-pump equipment. Fig. 4—Concrete-pipe conduit. Fig. 5—Split-tile conduit for oil and steam piping beyond the concrete conduit. Fig. 6—Hand forge and tool-dressing equipment. Fig. 7—Rivet-making and power forging machines. Fig. 8—Steam hydraulic forging press. Fig. 9—Plate and angle furnaces

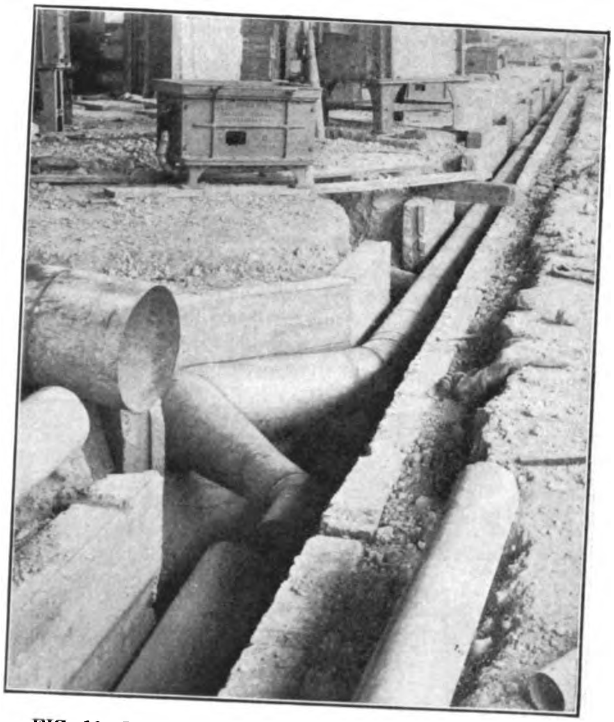


FIG. 10. PIPE CONDUIT. SHOWING OPENINGS FOR BRANCHES TO FORGES AND FURNACES

found to be a desirable part of the equipment, because the oil used is of the heavy California variety and must be brought to a temperature of about 130 deg. F., if entirely satisfactory combustion is to be obtained. The improvement in combustion when using warm thin oil as against cold thick oil is particularly noticeable at the open forge burners.

The oil and the steam lines form a complete loop around the shop. Oil in excess of what is consumed at the burners is pumped back into the loop and is kept from returning to the supply main by check valves. The oil consumption is measured by a meter in the supply main. The oil and steam lines are laid in hollow split tiles as illustrated in Fig. 5, where these lines cross the far end of the shop to complete the loop.

The blast piping is made of galvanized sheet steel ranging in thickness from 20 gage to 24 gage, depending on the diameter of the pipes. Such light metal could hardly have been used had the main been buried or installed overhead in accordance with customary practice. The joints in the blast piping were made tight by wrapping them with canvas soaked in red lead. The pipes were also given a heavy coat of asphaltum after having been placed in the conduit. While the first cost of this installation may be somewhat higher than the construction usually adopted, the upkeep cost should be small.

Russia's Industrial Requirements—After agricultural machinery and farming implements, Russia's greatest needs, according to "American Industries," are machinery in general, industrial machinery, both hand and power, machine tools and ordinary tools of all kinds, gas and petrol motors, steam engines, stationary and portable, electric-power machinery and electric motors, ironmongery, files, saws and cutlery. All sorts of hardware are needed, including tin-plate, enameled ware and all kinds of sheet-iron manufactures. Excluding the trade in munitions, the buying done by direct purchases here is insignificant in comparison with the enormous sales now effected by American representatives and salesmen now in Russia.

Safety Instructions for Guidance of Machine Operators

By C. B. Hayward

Many different plans have been worked out by various employers of labor to inculcate individual care and thoughtfulness among workmen in matters of safety for themselves or their neighbors. It is realized by all interested in the safety movement that, in order to blot out many of the trivial accidents, especially around machinery, it is necessary to make the employee think of safety and avoid dangerous points and practices. Hence, we try to get at the root of the trouble and, instead of caging a machine and endeavoring to operate it from the outside, give to the operator personal instructions in safety. He has always been taught the requirements needed to turn the wheel and give out the product. Now we are adding another important phase—get out the work, but do it safely.

When a new man is introduced to an unfamiliar piece of mechanism, he is apt to give more thought to the production than to the safe procedure. He will listen to the foreman's discourse on what to do and what not to do and then start to work, forgetting safety in his endeavors to satisfy the "boss" as to his efficiency. It is in this way that some, if not all, of the cautions that go with the first lessons are forgotten until an accident occurs.

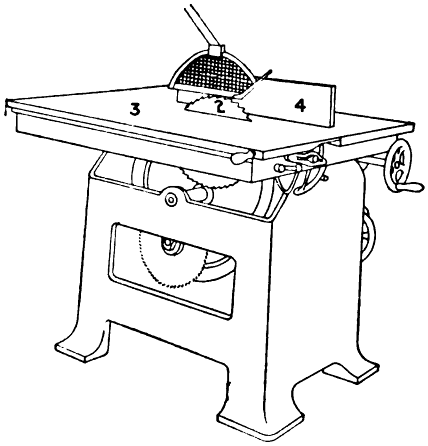


FIG. 1. CIRCULAR SAW

The views and text herewith present a method of pointing out to the workmen the dangers connected with the machines. This way of presenting the subject has a tendency to keep the matter of safety ever before them. It is a descriptive method of educating employees in the importance of caution and personal responsibility in the prevention of accidents and ought to leave a lasting impression, causing each man to think and act with careful consideration for his own and others' safety.

These illustrations and worded cautions give only an example of what may be done with all types of machinery in use in any industry. The drawings are made by outlining a sepia photograph and then washing the silver coating of the photograph off with a bichloride of mercury solution. This leaves the paper white with only the india ink outline and from this the ordinary zinc cut is made.

The warning paragraphs in connection with the illustration of the circular saw are as follows:

Torn parts or loose ends of wearing apparel should not be worn by employees while working around moving machinery.

Before oiling or cleaning machine and before adjusting any part of machine, shut off all power and wait until moving parts come to a standstill.

Keep hands away from revolving saw (2).

Always wear leather protection apron when using saw.

Do not push work away from back of saw with fingers—use stick.

Before removing work from table (3), be sure to push it beyond back of saw.

When sawing narrow stock, always use stick.

Where practicable, do not stand directly in line of revolving saw.

All guards should be kept in place.

Treat all uncovered gears as being dangerous.

Shut off power when it is necessary to put any belts on pulleys with hands.

When sawing lumber, keep straight edge of lumber against guide (4).

Be careful at all times not to expose yourself or your fellow-workmen to accidents.

Report all dangerous conditions to the foreman.

All injuries, however slight, should be cared for immediately, to prevent infection.

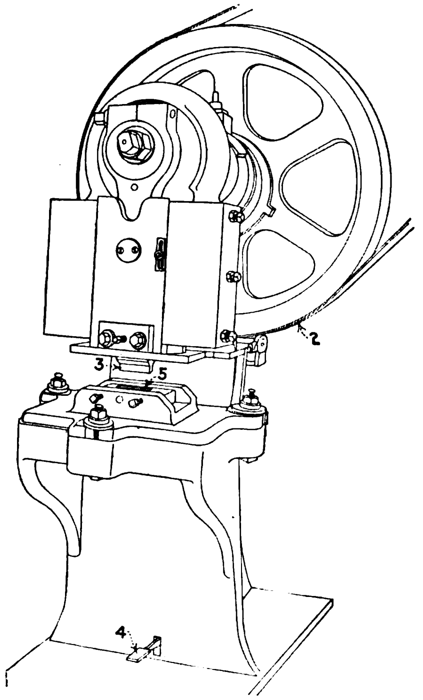


FIG. 2. PUNCH PRESS

The text accompanying the view of the punch press repeats the general cautions already given and adds some especially needed in the operation of this machine:

Torn parts or loose ends of wearing apparel should not be worn by employees while working around moving machinery.

Before oiling or cleaning machine and before adjusting any part of machine, shut off all power and wait until moving parts come to a standstill.

See that no person is working on or about machine, before setting flywheel (2) in motion.

Be sure the hands are out of the path of punch (3) when treadle (4) is operated by the foot.

Shut off power when it is necessary to put any belts on pulleys with hands.

All guards should be kept in place.

Treat all uncovered gears as being dangerous.

When putting work into die (5), keep mind and eyes on the operation and foot off treadle (4).

Do not adjust punch (3) or die (5) while flywheel (2) is in motion.

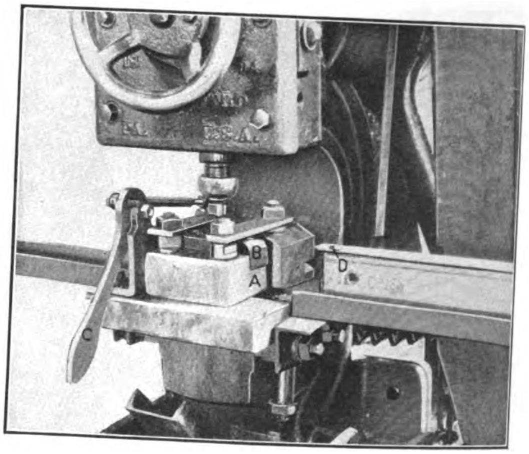
Be careful at all times not to expose yourself or your fellow-workmen to accidents.

Report all dangerous conditions to the foreman.

All injuries, however slight, should be cared for immediately, to prevent infection.

Punching Channel Sides

To punch holes in the bottoms of structural-iron channels is easy, but to punch holes in the sides is not so simple. As a rule, these holes are drilled; but if many parts are used and the channels are not too large, punching is much quicker. The Standard Dry Kiln Co., Indianapolis, Ind., requires a large number of short pieces of channel iron for



PUNCHING HOLES IN CHANNEL SIDES

making small trucks. Holes in the sides of these pieces are punched out in a press fitted as illustrated.

The die block is shown at *A*. This is so made that the lower side of the channel will fit in under its edge. The die may be seen at *B*. The channel is shoved in through the opening until it is in the correct position for the hole. The lever *C* is then pulled down. It operates a lever at the back and forces a pin in toward the channel, pressing it firmly to the die block. By pushing up on the lever the channel is released and may be shoved along or removed altogether. The hole punched in this particular piece is indicated at *D*.

In a South American Office

A Northern salesman was in the office of a South American business man and was waiting for an earlier caller to finish his interview. From the place where the second visitor was sitting, the desk of the South American was in view. Suddenly a small panel behind this desk, but in view of both visitors, glowed with the words *Sea breve.* Translated, the legend is, "Be brief."

Shortly after this little occurrence the first visitor left, and the North American was ushered to the desk of the man upon whom he had called. Following the usual cordial greetings, the Northerner laughingly said to the man who was receiving him, "Please don't light that sign for me." The South American then explained that he had a push button concealed under his desk and within reach of his foot, so that a polite warning could be flashed for the benefit of the caller who was outstaying his welcome. Perhaps a similar device might be a time-saver elsewhere.

War Problems of the German Machine-Tool Industry

Special Correspondence

SYNOPSIS—At the outbreak of war the machine-tool industry of Germany was prostrated, owing to the cutting off of foreign trade. Later on came an enormous demand for machines to produce war material. Meanwhile many workmen had been mobilized. Women were then taken into the machine-tool building shops. All stocks of partly built machines and parts have long since been exhausted. Today, plans are being made for the rebuilding of foreign trade when the war ends. The solutions of the problems have been largely due to the control of the industry exercised by the Ministry of War through two committees—one for war raw material, the other for industry. All distribution of material and product and the direction of the manufacturing capacity are in the hands of these committees.

The interruption of the commercial and economic intercourse between Germany and other countries did not take place at the beginning of the war, but was the result of a slow development that gave the German manufacturer time to accommodate his work to the new conditions. Further, the commercial isolation of Germany is not entirely the result of the so-called British blockade, but is also due to a self-imposed restraint having as its final object the withholding of goods necessary for the conduct of the war. So one of the first steps taken by the German Government after the declaration of war was an edict, published on Aug. 3, 1914, prohibiting the exportation of all goods and wares necessary for the defense of the country, or likely to be of assistance to the enemy. This edict, general in its first wording and merely intended to stop commercial intercourse for the first days of the war when all Europe was preparing for the ensuing great struggle, was soon followed by more explicit orders. Machines of all descriptions were included in the list of those goods not to be exported without special permission; but not all classes of metal-working machines were originally excluded from foreign trade, although most classes of machine tools were covered by the general description, "necessary for the defense of the country."

Initial Surplus of Production

Germany until then had exported yearly about $20,000,000 worth of metal-working machines of all kinds, while the import value given in the statistics of the Government was only $2,000,000. As it has been shown, however, that the estimated value of the imports of machine tools into Germany is much too low, one may take it that the real commercial value of those machines was some $5,000,000 to $6,000,000. Even so, there remains the fact that Germany, being a machine-tool exporting country, had left at the beginning of the war an uncalled-for yearly productive capacity of at least $14,000,000 worth of machine tools.

The first and initial difficulty arising out of the war was therefore a surplus of production. This difficulty existed for some time, until it found its solution in the natural progress of events. Outside of a few men who were especially able to judge the importance of the struggle, most people in Europe were still under the impression that the war would be a short one and that its economic results might be insignificant, owing to the firm economic position of the countries engaged. So it seemed to be a disadvantage for the German machine-tool industry to have on hand material and half-finished stock for an output far above the needs of Germany's own consumption and manufacturers were rather inclined to complain about the orders curtailing their export business. Losses occurred during the first months of the war, and the Association of Machine-Tool Manufacturers, at its first meeting after the declaration of war—early in 1915—complained mostly about the accumulation of half-finished stock that could not be sold, while the manufacturers seemed to be unable to finish it, owing to lack of labor.

A great number of the machine-tool plants of Germany belong to the middle-sized industries, having a comparatively small number of workmen. Unfortunately, just those smaller plants were most hurt in the beginning, owing to the withdrawal of workmen for military service. On the other hand, experience shows that in later months all those plants of medium size lying outside the congested industrial districts of Germany had a better chance of securing experienced labor than those in the so-called industrial districts. This fact proves again the correctness of the rule that, generally speaking, industrial decentralization will be more elastic in times of need than the accumulation of large industries in over-populated industrial centers.

Changes Wrought by the War

With the progress of the war and the realization of its possible long duration, reorganization began to take place. Some of the smaller plants ceased to operate entirely; others changed over to the manufacture of more important goods than those made before the war, allowing a redistribution of labor, which brought about a fair solution of the labor problem.

As we are now in the midst of the event itself, when the economic forces created by the war have not run their full course and new developments have to be expected, it is of course extremely difficult to give anything like a complete and coherent picture of all that happened. From the mass of information and experiences collected from time to time only certain tendencies seem to stand out, and it is practically impossible to concentrate the whole into anything like a system of industrial organization directed by one will. Much had to be done according to circumstances and convenience, and it must be left to the observer to extricate all those movements especially descriptive of the situation as a whole.

Therefore, in discussing the question of labor in the German machine-tool industry during the first 18 months

of the war no hard and fast rules can be laid down. The individual manufacturer had to deal with the local problem as it arose, and the solution has not been uniform. Excluding from the inquiry all those plants which either ceased to work or changed over to other fields of production, it appears that during the first months of the war the lack of labor in all the larger machine-tool plants of Germany had rather a beneficial influence, as it relieved the owners of the necessity of dismissing workmen. This step would otherwise have been unavoidable, owing to the disarrangement of the foreign trade. Later, when conditions began to change, the industry had to accommodate itself to the lack of man-labor, and several of the largest metal-working plants of Germany resorted to the expedient of hiring women. The actual figures of the woman-labor employed in the production of machine tools cannot be given now, but they are certainly very large; and it is only too possible that woman-labor will have gained more than a casual foothold in this industry. The employment of woman-labor seems to have been particularly large in the more populated industrial districts, as in the Rhineland. Here, the necessity of finding labor, as well as the need of furnishing employment so as to eliminate as much as possible the effects of the war upon the poorer classes, assisted very much in this development.

Later in the war the industrial conditions in the machine-tool building industry in Germany began to settle down to a routine. It would be incorrect to say that they became normal, but a state of normality was reached by a natural process of accommodation to circumstances and by becoming familiar with the conditions of war and the limitations it imposed upon German economic life.

Germany in the meantime had become a fortress surrounded by enemies, with few means of communication with the outside world. German economic life therefore was thrown back on its own resources. Out of the common danger and privation there sprang a new sense of entity and common purpose, which was ably directed by the Government. It is quite natural that the German machine-tool industry could not separate itself from this uniformity, but that, on the contrary, it had to become a subservient and important part of it. While the powers on the outside of the ring were able to replenish their diminishing stocks of industrial material by buying abroad, Germany was prevented from doing so; and its industry had to take up the battle, backed solely by the resources existing in Germany, Austria and the Balkans or that had been preserved during the first months of the struggle. Not only did the German machine-tool industry have to supply the great number of machines wanted owing to the expansion of the internal activity, but part of its energy was directed into other channels—mostly in the manufacture of war material, such as ammunition, guns, etc.

Significance of Change of Industrial Purpose

It is difficult to understand the significance of this great change of industrial purpose in Germany and its effect upon the German machine-tool industry without understanding as well the forces that brought it about. Thirteen per cent. of all the imports into Germany had consisted of manufactured goods, while 63 per cent. of the exports were manufactured articles. With the cessation of the exports, therefore, there was set free an enormous surplus of manufacturing energy, which only had to be regulated to be useful. This transformation, even now only partly carried through, needed time, and even with all the statistical data in the hands of the Government it could be effected only step by step, so as not to disarrange and endanger the industries affected. Certain industries, as the textile, toy making and ceramic, which suffered especially from the loss of exporting and from the reduction of labor by the mobilization, could not overcome the depression. In those industries women had taken a prominent position before the war.

The machine business soon began to feel the lack of orders coming from the other industries. On the other hand, the decrease in the output of machines for general purposes began to liberate the productive energy of the machine builders, including the machine-tool makers, for the immediate and growing military needs, which came rapidly into prominence. Large quantities of iron and steel otherwise used in industrial production were now also free for Government purposes.

How large this military demand has grown can only be guessed. It is, however, interesting to observe that the Verein der Eisen- und Stahlindustriellen (Association of Iron and Steel Industries) reports in 245 of the associated plants an increase of persons employed from 417,000 during August, 1914, to 447,000 during August, 1915. This record is probably a good guide for all the industries employed in defensive work. Another example worth mentioning is the increase of the profits of the Krupp works from $9,000,000 in 1914 to $22,000,000 in 1915, which figure is especially significant if viewed in connection with the higher cost of raw materials and production resulting from the war.

Activity of Metal-Working Industry

The activity in the metal-working machine industry, which became more and more prevalent during the early part of 1915 and continued throughout the whole year, was influenced by a number of things, of which the large demand for machines for the armament industries was the most outstanding. Outside of that there was an apparent tendency to replace human labor more and more by that of machines. Not only was this action necessitated by the lack of skilled labor, but the employment of woman-labor made desirable the use of automatic machines for all possible purposes. So it will probably be seen that the German machine-tool industry has taken up the manufacture of certain types of automatic machines formerly bought abroad, which may affect materially the German machine-tool business both at home and abroad after the war.

The lack of machine tools for special purposes was much felt at the beginning of the war. Before the war America supplied a large percentage of the automatic machines imported into Germany. Further, Germany and America were strong competitors in many of the European countries, Germany furnishing the more simple machines, while it fell to the lot of America to supply the complicated types. There is no information to indicate how far Germany may have been able to make use of stocks of American machines of that class in the hands of German firms in neutral countries at the outbreak of the war. It is, however, said that those stocks were not large; and even if there have been loop-

holes through which German manufacturers were able to secure American machine tools for some time, this practice has become increasingly difficult with the progress of the war. Consequently, German industry has been compelled either to go along as well as possible with the machines on hand or to build such machines in her own plants.

To prevent Germany from spending her industrial strength in the beginning of the conflict and also to conserve her economic energies, measures were soon taken to put a brake on the waste of energy and material wherever such existed. A careful preservation of resources was inaugurated, which possibly forms one of the most noteworthy economic and industrial features of the present war. The machine-tool industry was affected by those measures in several ways, both with regard to the supply of raw material and in its own production.

Industrial Department of the Ministry of War

Early in the war there was formed an economic and industrial department of the War Ministry. This department apparently has not been copied by any of the other nations at war, but has its counterpart in some degree in England in the Ministry of Munitions, which is intrusted with arbitrary powers in every direction. The method of precedure of the War Ministry is not to apply for legal powers from the Reichstag, but to issue edicts that become effective immediately. So there stands nothing in the way of that body, which can proceed without loss of time and can enforce compliance with its orders. This industrial and economic department is divided into a number of different committees, the members of which have been selected from among the leading German experts.

The machine-tool industry has to deal especially with two of those committees—the War Raw-Material Committee and the Industrial Committee. Bodies of the same sort have been formed in Austria. The working of those departments in their relation to the machine-tool industry is best explained by several examples. As previously explained, it has become necessary to close the frontiers for the export of certain machine tools, in fact for any trade that might benefit the enemy. Such an arrangement, however, might prove detrimental to the home industries if carried out too strictly. Relief had to be given in some way—mainly where it was necessary to keep up good commercial relations with neutral countries. So a special commission was formed for the purposes of passing export permits to manufacturers who could prove to the department the necessity of such licenses. To facilitate this work, it was soon necessary to form subcommittees in larger industrial centers. The machine-tool industry by those permits has been able to keep up necessary connections.

Machine Tools and Raw Materials

It may be mentioned that German machine tools had apparently been obtained through some loophole by manufacturers in countries at war with Germany and that in consequence a close observation of buyers from neutral countries had to be kept, which was a continual source of inconvenience to both the German manufacturer and the bona fide neutral buyer.

The enormous consumption of iron, steel and raw materials for manufacturing purposes was also felt seriously in machine-tool building, and the steps taken to relieve the shortage are of more than a passing interest. These relief steps were of different kinds. Germany was able to produce sufficient steel for her own purposes, but there was a cessation of the movement of other metals. A close investigation by the War Raw-Material Committee disclosed the fact that the difficulty was not so much a shortage of the materials in question as insufficient elasticity in the existing means of distribution. It was therefore necessary to bring about changes. Already in the first months of the war this lack of elasticity had shown itself, and there had been attempts to corner the market for the benefit of certain users. So the Government stepped in and decreed highest prices for the more important materials.

It would take too much space to cover the whole field of those preventive measures, but the following prices (for 100 kg., equivalent to 220 lb.) may be of interest: Electrolytic copper, 200 marks ($50); best old brass, 145 marks ($36.25); old bronze, 175 marks ($43.75); aluminum, 325 marks ($81.25); nickel, 450 marks ($112.50); antimony, 150 marks ($37.50); tin, 475 marks ($118.75). The mark price is given without reference to the present exchange rate, but at its former value, which was about four marks to the dollar.

It became evident, however, that the schedule of maximum prices was not sufficient to keep the market supplied. More serious steps had to be taken, and a general disclosure of all the stocks of metals was enforced by a system of registration. Other materials were included later in the list of raw materials to be reported. But the registration was intended not only to secure an unhampered supply of raw materials necessary for the defense of the country, but to collect as well all data affecting the industrial resources of Germany. Further edicts made compulsory the registration of unused electrical and power machinery, and this system has been slowly extended into other fields.

Organization for Scrap Recovery

Again, to give an example, this time from the Austrian system, a special Old-Iron Commission was formed to take charge of the scrap-iron resources of the country. Owners of scrap were compelled to disclose their stocks, which were registered and taken charge of by the commission. No removal from the holder took place and no interference with sales between merchants of old metals, as long as the stock itself was not decreased. But such sales had to be reported, so that the commission might know where stocks could be found. All transactions between the holders of the stock and consumers, however, must pass through the hands of the commission. The same system applies to all disclosed stocks of raw materials held in Germany, where special holding companies have been formed for the distribution of such holdings to consumers.

The registration of electrical material, machines, transformers and dynamos was ordered for a twofold purpose: First, it became necessary to collect as much copper as possible, and for this reason the committee that had in hand this section of the organization of German reserves had powers to order the destruction or reconstruction of the registered machines in such a way as to exclude the use of copper wherever possible; second, there is the desire not to expand unnecessarily the productive

energy of the electrical industry in Germany during the war, owing to the lack of raw material. By registering all unused machines, however, there are possibilities for employing all existing machines where there is need for them. A manufacturer desiring a motor for his plant can be put in touch with one who has a power plant, but is unable at present to use it. The feared shortage of leather for belts was overcome in a similar way.

To facilitate the distribution of materials, a special organization was set up. As in the case of export permits, special offices distributed over Germany have the right to issue permits for the sale and consumption of raw materials, machines and so on.

Compensating for Economic Disarrangements

The industrial department of the War Ministry has been especially useful for the purposes of the machine-tool industry. As mentioned, at the beginning of the war the conditions seemed to be rather disadvantageous for the industry, and overproduction was feared by the manufacturers. The progress of events brought a change, and for some time there was every conceivable difficulty in filling all the incoming orders for new machines. The industrial department was able to spread information that relieved the situation, making it possible for manufacturers to organize their production according to the needs of the market. In this connection there must be mentioned the Kriegswirtschafts A. G., which has done much to equalize demand and supply.

It is only too natural that, during a war like the present one, considerable economic disarrangement must take place, depressing industries of one class or in one part of the country while bringing about excessive demands in others. So it becomes necessary to curtail the output in any certain direction, while in others an immediate increase is imperative. This event has of course occurred in Germany, resulting in the slowing down of machinery of certain sorts and doubling the work of others. Very much as in the case of electrical machinery, steps have been taken to facilitate the exchange of industrial machines from places where not wanted to others where there is a demand. Machines can be registered for exchange, and manufacturers desiring to buy can register their needs. The Kriegswirtschafts A. G. has taken in hand the sales of machines and material found in conquered territory. This applies to machine tools and other kinds.

Importance of Machine-Tool Industry

The part played by the German machine-tool industry in the present struggle is a very important one. The war has shown that only strict coördination of all interests for the benefit of the whole can obtain results in a time when all the known rules of ordinary economic life have ceased to operate. While it is therefore impossible to view the German machine-tool industry during the last 18 months independently from all the other German industries, it is, however, useful to enumerate briefly the special effects of the war on that industry. In doing so we see early in the war a short but very heavy depression, owing to the sudden stoppage of export facilities. With the progress of the war the cessation of foreign imports of machine tools, in combination with the large demands for machine tools from all the industries having war orders, begins to create a contrary tendency. The machine-tool industry therefore is compelled to resort to the use of woman-labor. It is further called upon to construct certain classes of machines formerly largely imported. To relieve the shortage in machine tools in certain districts, it becomes necessary to organize machinery to facilitate exchange and sale. Shortage of raw materials makes necessary changes in constructive methods and in the employment of certain metals. The fact seems to be established that a modern war must invariably increase the demand for machine tools.

Machine Tools After the War

The fact was mentioned that the import as well as the export of metal-working machines has been greatly curtailed, in fact almost entirely interrupted. Except for the small number of machines exported under special permits, none have left the country, and the import has been small in comparison with what it was. The German statistical office has ceased to publish any foreign trade figures since the outbreak of the war, and the full history of the foreign business of Germany during the war most likely will never be written. So no figures are obtainable with regard to foreign sales of metal-working machines. Germany, however, has ceased to trouble about the export business of today. She is now preparing for the future, and there is no doubt that the machine-tool industry will try to regain at least a large part of the market lost. It is doubtful whether the industry will be able to start exporting at once after the cessation of hostilities.

Probable Future Requirements

The lack of raw material naturally has restricted ordinary manufacturing, and consequently only those machines have been constructed for which there was most urgent need. Further, the mobilization of all machine resources will have used up all the hidden reserves. Many a machine that had done quite satisfactory service before the war has been scrapped, and the machine-building industries have been living from the fat of the prosperous years. When the war is over, it will take some time before the previous comfortable state is reached again. Consequently, there will be a great demand for machines. Many will have to be imported, many will have to be built in German plants, and consequently German machine-tool builders most likely will prefer to supply the home market at first before entering the foreign field. On the other hand, even with these restrictions there must take place a certain amount of export. Stocks in the whole world have become low. For a while the surplus manufactured in the United States and still under order will help to overcome the shortage, which, however, will become more pronounced when normal conditions return.

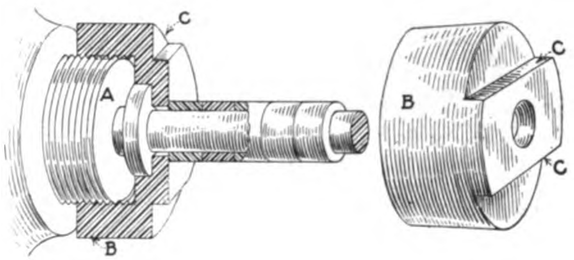
The German economic war committees have taken precautions for that event, and for several months there has existed a special department for the reëstablishment of German foreign trade after the war, conducted by one of Germany's most prominent experts.

German machine-tool construction has also undergone considerable changes during the war. It will be interesting to see how those changes will ultimately affect the sale of German-made machine-tools in foreign markets after the war.

Letters from Practical Men

Holding an Arbor in the Miller

The illustration shows a method of securing a miller arbor in the taper of the spindle, thereby preventing



HOLDING THE ARBOR TO PREVENT TWISTING OFF THE TANG

the twisting off of the tang, when it is necessary to take heavy cuts.

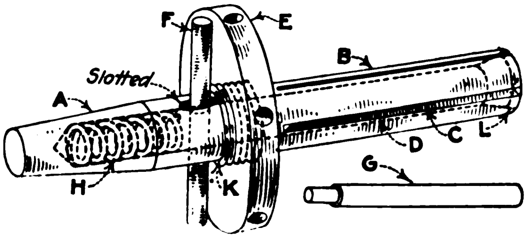
The spindle *A* was removed from the machine and an ordinary 8-pitch right-hand U. S. F. thread cut on its nose. A shouldered nut *B*, with flats *C* fitted to a standard wrench, was employed to draw the arbor into the spindle hole. CHARLES G. KAELIN.

Buffalo, N. Y.

Expanding Arbor

A satisfactory arbor is made with a taper shank *A* to fit the lathe spindle and is turned to the desired size at *B* for the work. It is splined in the usual way with any desired number of slots *C*. We have found four to work well.

The draw rod *D* is made of soft steel fitting loosely in the bore and seating against the taper *L* and the



AN EXPANDING ARBOR

heavy spring *H*. The disk *E* is made of soft steel and is about ¾ in. thick, 4 in. diameter. It is threaded 12 pitch and fits the arbor at *K*. There are four holes equally spaced around it to receive the handle *G*, which is a ¾-in. rod 12 in. long.

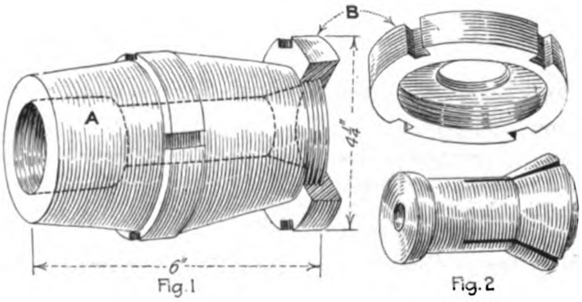
The $\frac{5}{8}$-in. tool-steel rod *F* is a driving fit through the hole in the draw rod *D*. The disk *E* is screwed on and against the rod *F*, drawing the tapered end against the taper *L*. The arbor is slotted to allow the rod *F* to travel and draw the expander rod *D* inward. A spring forces the rod *D* out and releases the work. P. S. SMITH.

St. Louis, Mo.

Adapter for Spring Collets

The adapter, Fig. 1, was designed for lathes that did not have a draw-collet attachment, but had the style of collet shown in Fig. 2.

The body *A*, Fig. 1, is made of cast iron, threaded to fit the nose of the spindle of a 16-in. lathe. The casting is screwed to the spindle and bored in position to receive



SPRING-COLLET ADAPTER FOR THE LATHE

the collet. The outer end is threaded to fit the nut *B*, which is made of machinery steel and pack-hardened.

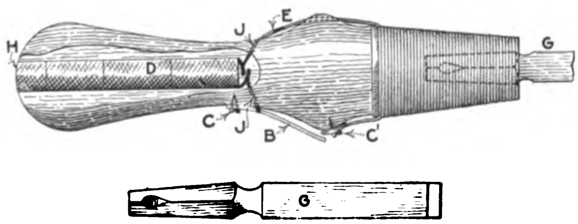
In use, the nut *B* is screwed up against the face of the collet, which forces it back into the casting and against the taper, squeezing it down on the work.

Of course, this contrivance was not as handy as the draw-collet arrangement on the modern toolroom lathes; but it was very convenient around a shop where most of the machines were old-timers, and it enabled us to use collets which we already had on hand. H. M. DARLING.

Greenfield, Mass.

Magnetic Screwdriver

I arranged a Clark patent screwdriver as shown, making it magnetic. I drilled an $\frac{11}{16}$-in. hole 4 in. long in the wooden handle of the screwdriver and in it placed a "fountain-pen flashlight" battery *D*, which is a little over



A MAGNETIC SCREWDRIVER

3 in. long by ⅝ in. in diameter. Previously, a 5-in. length of No. 22 double cotton-covered wire had been soldered to each pole.

These pieces of wire must be at least 5 in. long, as it is necessary to solder them on the battery with the wires coming through the two holes *J* and through the $\frac{11}{16}$-in.

hole. After the soldering the battery is drawn into the hole by the wires. Each wire is cut off, leaving about 1 in. projecting outside the holes *J*.

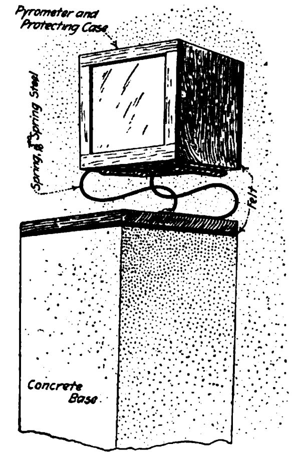
One wire is soldered to the brass spring *B*, $1 \times \frac{1}{4} \times \frac{1}{32}$ in., which is held by a wooden screw *C*. Six layers of No. 22 double cotton-covered wire are now wound on the front end of the steel nose piece. One end is soldered to the wire *E* and the other end to the $\frac{3}{8}$-in. brass washer held by the wooden screw C^1. A wooden plug *H* keeps the battery in place.

Normally, the spring *B* is not in contact with the washer *A*; but when pressed into contact with it, the current passes to the coil around the nose piece. As the nose piece is of steel, it becomes magnetized. When the blade *G* is inserted in its socket, it also becomes magnetized and will hold steel screws. JAMES MCINTYRE.

Bridgeport, Conn.

Spring Support for Pyrometers

The illustration shows a spring mounting for pyrometers, to counteract shocks and protect the instruments. Pyrometers in the blacksmith shop, while not very close to any of the large heavy steam hammers, gave a lot of trouble, as the operation of the large hammers interfered with the readings. Several different things were tried, among them alternate layers of felt and wood. The method shown proved satisfactory, and there is now no quivering of the indicator when hammers are working. On top of the concrete base *C* are a layer of felt, a board and then the springs, made of $\frac{3}{16}$-in. round spring steel. These support the pyrometer and protect the case and the board that forms a back for the device.



PYROMETER SPRING SUPPORT

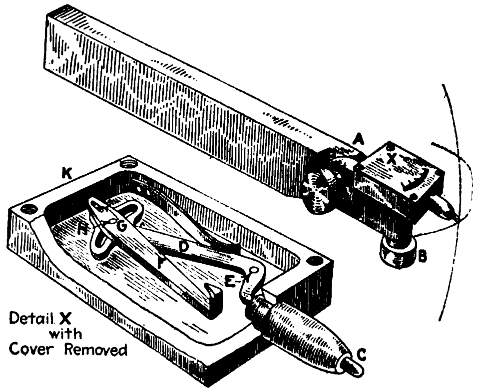
Renovo, Penn. JOSEPH K. LONG.

Multiplying Lever Test Indicator

The accompanying illustration shows a test indicator which has proved satisfactory in the toolroom. The working parts are simple, compact and well protected from dust and injury. The joints *A* and *B* give a wide range without additional change of position in the tool post. When the indicator is removed from the holder, it is so small ($\frac{3}{4} \times 1\frac{1}{8}$ in.) that it can easily be clamped to a surface gage for button work.

An enlarged view of the mechanism, which consists of two levers and a flat spring, is given. The plunger *C* moves the lever *D*, which pivots at *E*. This lever in turn moves *F* by means of the pin *G*, which is riveted to the lower lever and is a free fit in *F*. The lever *F* pivots on the pin *H*, and its extremity *J* has been pointed and bent so as to act as a pointer for the graduation on the cover. A simple scheme to get the correct spacing for these graduations is as follows:

Take a 2-in. micrometer and caliper the indicator at the points *C* and *K*. For each 0.001-in. movement of



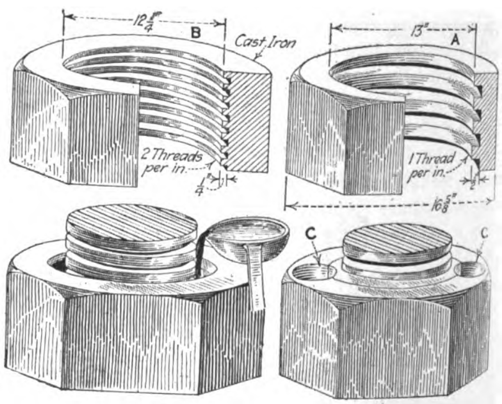
DETAILS OF TEST INDICATOR

C, lay out the corresponding spaces on the cover, as shown by *J*, the pointer. LAWRENCE E. OLSEN.

Schenectady, N. Y.

An Emergency Repair on a Stone Crusher

The sketch shows a cast-iron adjusting nut for a stone crusher. The nut has two square threads per inch, some of which broke off at the root. There was no extra nut



EMERGENCY JOB ON A STONE CRUSHER

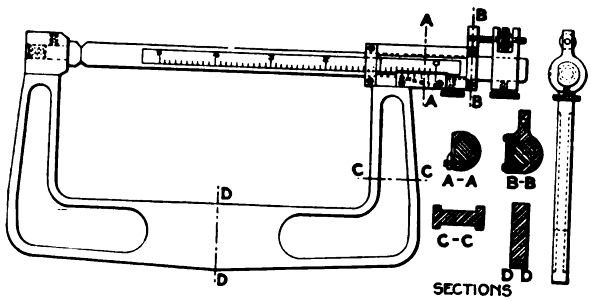
on hand, so the damaged one was bored to the dimensions shown at *A*. The original dimensions are given at *B*. After the nut was bored, the shaft was placed where it belonged, which is in a vertical position. Babbitt was poured in the nut and around the threaded shaft.

In about six months it was necessary to adjust the shaft, to get the proper size of stone going through the crusher. A new nut was on hand, so two $1\frac{1}{2}$-in. holes were drilled at *C*, and a punch was driven in to break the nut. The babbitt threads were found to be in good shape. W. F. JOHNSON.

Howes Cave, N. Y.

Adjustable Vernier Gage

The illustration shows the combination of a vernier and a micrometer into one tool. To get the graduations accurate on the sliding rod, I inserted a scale from a B. & S. depth gage. I found that, after this tool is once



AN ADJUSTABLE VERNIER GAGE

set, its accuracy can be relied upon without the use of a standard test rod. It will measure from 0 to 5 in. by thousandths.

This is an original idea with me, and I have one tool that has given good service. I should have made this tool to measure 6 in., but I did not have any way to graduate the rod, so I hit upon the idea of inserting a scale. Unfortunately, the scale was graduated for only 5 in.

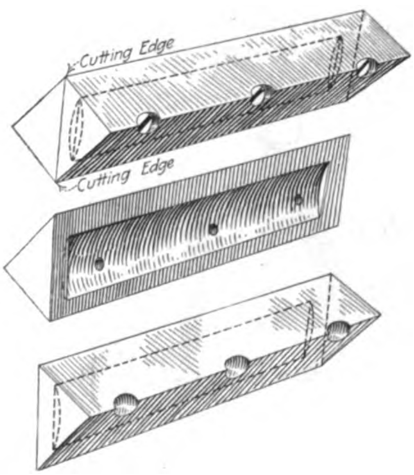
KARL J. FENNELL.

Davenport, Iowa.

Lap for Square Corners

The illustration shows a useful lap for finishing sharp square female corners. I had some difficulty in getting good results in making molds of tool steel hardened and ground to sizes within a limit of 0.0002 in.

I designed the tool shown, which proved satisfactory. Diamond dust, mixed with oil to suit, was applied be-



LAP FOR SQUARE CORNERS

tween the two halves, which were then screwed together, allowing the mixture to press out between the two thin edges.

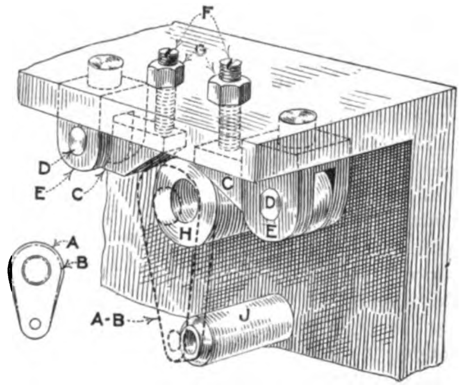
In lapping, the mixture will soon appear in the corner of the work. The tool should be made of tool steel, left soft and ground square on the surface grinder. The center should be hollow about 0.005 in., to receive the diamond and oil mixture.

ALFRED ERICSON.

Chicago, Ill.

Jig for Drilling Cranks

In two cranks A and B the center distances between the holes are the same, but the large diameter and the large holes vary about $\frac{1}{16}$ in. in diameter. The work is blanked and pierced and then placed in a jig, the large hole to be reamed and the small hole drilled. As the output is not very great, it was decided to change



ADJUSTABLE JIG FOR DRILLING CRANKS

the jig used on the large crank so that it would handle both cranks. The illustration shows how this plan was carried out.

The solid V-block is taken off and the adjustable one put on. The parts C are made of tool steel and beveled off to have the shape of a V-block. The parts C pivot on pins D in the slotted studs E. The adjustment is made by the setscrews F, locked by the nuts G. The same resting blocks H and J are used, as well as the bushing for the small hole and the method of bringing the work into the V-block and holding it. Slip bushings are put in the jig in place of the solid one for reaming the large holes.

M. BASS.

Dayton, Ohio.

Balancing the Machines in a Trade-School Course

One common error in purchasing machines for a trade-school machine shop is to follow the established precedent of buying one planer, one shaper, one universal miller, one upright drill, one universal grinder and a varying number of lathes. This practice tends toward giving an unbalanced course, because the course is made to fit the machines. This is decidedly wrong; the machines should fit the course absolutely. The right thing to do is to decide the number of hours that should be devoted to each unit, find what relation each unit bears to the total number of required hours and buy enough machines to give an adequate balanced training to each boy.

A trade-school course, as a matter of time economy, must be condensed. The training must be continually progressive, with very little repetition of unit training.

Classroom work infringes so much on the shop end of the teaching, as compared with a commercial apprenticeship, that every minute of a boy's time in the shop must be utilized to his advantage. To do this, the course must be carefully predetermined and well balanced.

An apprentice in a machine shop generally receives three years of training, 52 weeks in the year, for 54 hr. each week, or 8,424 hr. Sometimes this total is greater, sometimes less. In trade-school work the hours required in the machine shop range from 2,000 to 4,000, according to the school. Some technical high schools demand only 250 hr. in the whole course. So it may be seen that this condensation of time required for the stipulated work must be met by well-studied methods in the presentation of the subjects.

Taking into consideration the fact that in a commercial machine shop the apprentices are carefully selected from a number of applicants, whereas in a trade school the boys are generally taken as they come (dumped down a chute into the machine shop, so to speak), the problem of properly balancing a course to suit conditions has difficulties all its own.

It makes no difference whether the boys are to spend each alternate week in the machine shop, each alternate hour or only 1½ hr. each day; the training on each machine should be properly proportioned. This is true whether the work is under the project system or mass production.

Let us take a machine shop for 30 boys. It is equipped in the usual way with one miller, one planer, one shaper, one upright drill and one grinder. Let us see the number of hours each boy can spend on any one machine, assuming that there are 25 lathes to accommodate the pupils who are not assigned to these five machines mentioned and also assuming that 4,000 hr. are required for a complete course, as that seems to be the maximum number of hours among trade schools. In 4,000 hr. each one of the 30 boys must get his turn at the miller, for instance, or 133⅓ hr. Now, 133⅓ hr. on the miller for any boy, however bright, is far from being sufficient, as all must admit, and naturally more time should be given to such work. This is how things stand among a great number of trade schools, and the condition should be corrected. The courses are made to fit the equipment.

The proper way to purchase machines for a trade school is to come to a decision regarding the length of time that is going to be assigned to the different units of a trade and then to purchase the machines accordingly. This practice gives a balanced course and makes the machines harmonize with it. For example, many commercial machine shops divide the apprentice's 3-yr. course into three months of milling, three months of planing, three months of shaper work, three months of grinding, etc.; that is, one-twelfth of the apprenticeship period is devoted to each of these five things. Now, if in the commercial shop experience has taught that one-twelfth of the boy's time on the miller gives him a sufficient working knowledge of that machine to suit the demands, then it is safe to accept this proportion as a beginning for use in the trade-school machine shop.

If one-twelfth of the pupil's time is set aside for milling, each boy will receive 366⅔ hr. of this branch of the trade. In order for each one of 30 boys to get 366⅔ hr. of milling, the number of millers to be purchased would be found by multiplying the number of boys by the number of hours of each unit and dividing by the number of hours in the course. For instance, $30 \times 366\frac{2}{3} = 11{,}000$ hr.; $11{,}000 \div 4{,}000 = 2\frac{3}{4}$ millers. Buying three millers, three planers, three shapers, three upright drills and three grinders would be a fraction over the required number of machines and would allow for a little future growth.

The criticism of this plan would be that it is much easier for a trade school to secure lathe work than it is for it to get milling, planing, drilling and grinding, but a little more scouting on the part of the shop superintendent can accomplish the desired end. It is much better to give the shop superintendent a part of his time exclusively for the purpose of going about among the factories looking for their superfluous planing, milling, drilling and grinding than to let the pupils fail to receive sufficient training in five of the fundamental machines of the trade.

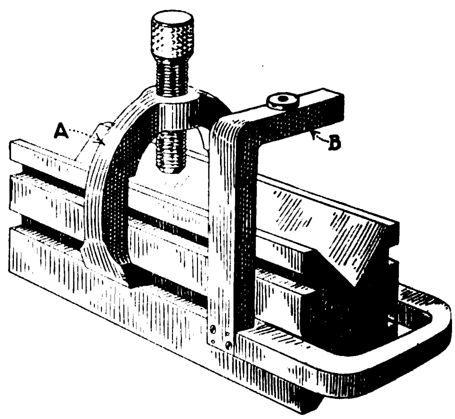
The boring mill, radial drill, gear cutter, turret lathe, etc., should have as many hours assigned to them as seems proper to their local importance.

As the attention of the shop instructor should be devoted entirely to the supervision of the operation of the different machines under his charge, all such things as the teaching of the lacing of belts, chipping, filing, scraping, tapping, assembling, etc., should be treated as shop-instruction subjects under the head of classroom work. I fail to see where a trade-school shop with its already limited number of hours can provide time in the shop for these essential things without encroaching on the hours set aside for the operation of machines. If left to the discretion of the machine-shop instructor, the attention given them might be of a haphazard nature, whereas if assigned a definite number of hours in a certain classroom, they would be given the methodical attention due their importance in a well-balanced course.

Worcester, Mass. ROBERT J. SPENCE.

Drill Jig for Crossholes in Round Stock

The illustration shows a V-block with attachment for drilling crossholes in round stock. Both the clamp A



DRILL JIG FOR CROSSHOLES IN ROUND STOCK

for the stock and the bushing holder *B* are made adjustable. FRANCIS J. DITTMAR.

Elizabeth, N. J.

Discussion of Previous Question

Straight and Taper Forced and Shrunk Fits

The three papers on the subject of forced and shrunk fits, published in *Engineering News*, Mar. 17, 1910, and in *American Machinist*, page 377, Vol. 42, and page 275, Vol. 44, are a valuable contribution to the subject of force fits, since they give us a much needed coördination and selection of the large amount of information supplied by many experimenters.

The alignment charts given by Professor Jenkins in the last two papers are clear and simple enough, but they do not readily show the comparative difference between the results obtained by using the formulas for straight fits and those for taper fits and do not show how the theoretical formulas published in *Engineering News* differ from the empirical formulas for either straight or taper fits.

I have plotted in a different way the fundamental equations and the empirical formulas derived by Professor Jenkins. I believe that this method is more handy and gives a more comprehensive idea of the relative meaning of the three sets of formulas. My results are shown graphically by means of the curves on the charts, Figs. 1 to 4, from which it will be noted that all four combinations of cast iron and steel are covered.

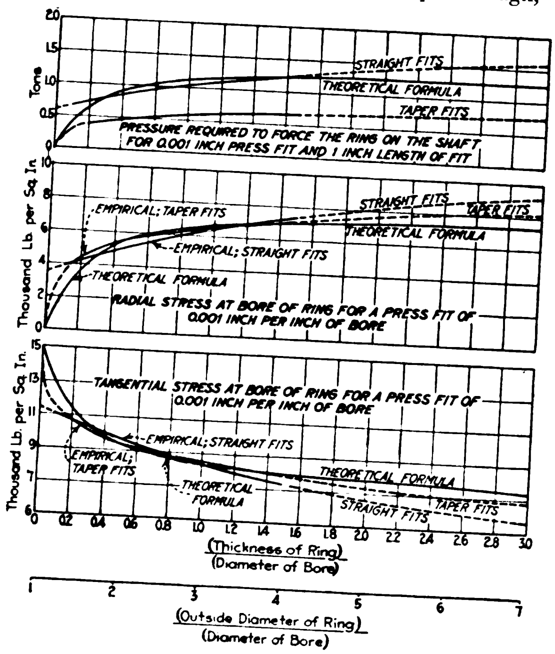


FIG. 1. CAST-IRON RING FORCED ON A STEEL SHAFT

"Fundamental Equations for Press Fits" published in the "Engineering News" Mar. 17, 1910. "Formulas for Forced and Shrunk Fits" published in the "American Machinist," Vol. 42, page 377. "Formulas and Alignment Charts for Taper Press Fits" published in the "American Machinist," Vol. 44, page 275. Note—The empirical formulas were derived from data corresponding to the full-line portion only of the curves shown

Radial and tangential stresses and forcing pressures are plotted against both ratios:

$$\frac{\textit{Outside diameter}}{\textit{Diameter of bore}} \quad \text{and} \quad \frac{\textit{Thickness of ring}}{\textit{Diameter of bore}}$$

The stresses are for a press fit of 0.001 in. per inch of diameter of bore, and the forcing pressures are for 0.001-in. force fit and the 1-in. length of fit. For any force fit J for a ring having an outside diameter D and a bore d find out to what fraction of 0.001 in. per inch of bore the given press fit coresponds and multiply the value of the stress obtained from the diagram for that fraction.

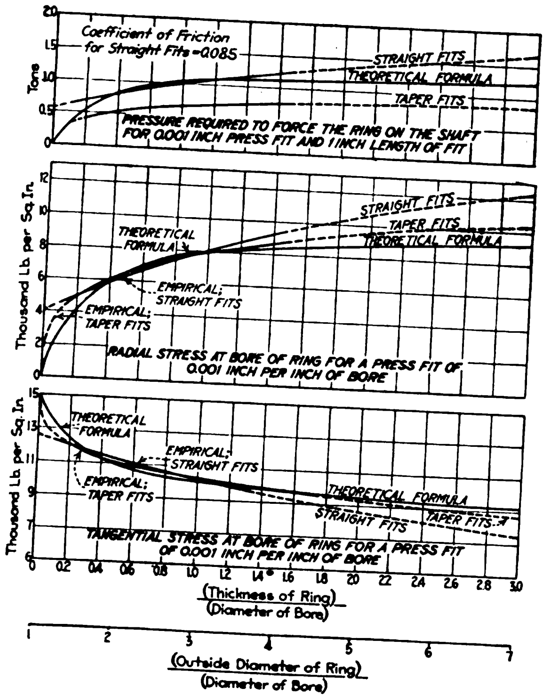


FIG. 2. CAST-IRON RING FORCED ON A CAST-IRON SHAFT

"Fundamental Equations for Press Fits" published in the "Engineering News," Mar. 17, 1910. "Formulas for Forced and Shrunk Fits" published in the "American Machinist," Vol. 42, page 377. "Formulas and Alignment Charts for Taper Press Fits" published in the "American Machinist," Vol. 44, page 275. Note—The empirical formulas were derived from data corresponding to the full-line portion only of the curves shown

The result will be the stress (tangential or radial) corresponding to the press fit J.

For example: If we have a cast-iron ring 13 in. outside diameter and 5-in. bore forced on a steel shaft with 0.003-in. force fit, we find from the diagram that for $\frac{D}{d} = \frac{13}{5} = 2.6$ the tangential stress for 0.001 in. per inch of bore (or 0.005 in. total) is 10,200 lb. per sq.in. (using the curve corresponding to the fundamental equation). In this case the force fit per inch of bore is $\frac{0.003}{5} = 0.0006$ in., which means that it is only 0.6

of 0.001 in. per inch of bore, and the corresponding stress will be 10,200 × 0.6 = 6,120 lb. per sq.in.

If we want to know what is the pressure to be used to force the ring on the shaft, we find that for 0.001-in. press fit and 1-in. length of fit we need to use 1 ton. In our case we have 0.003-in. force fit, and we shall need to use 3 tons for every inch of length of the fit (for every inch of width of the ring, independently of the length of the fitted surface that may be relieved at the center, always assuming that the ring is of practically a uniform section on all the width).

In the case of a taper fit, if h is the taper per inch of length and U is the relative axial displacement of the ring and the shaft, the total press fit will be Uh, and the press fit per inch of bore will be $\frac{Uh}{d}$. Proceed also in this case in the same way as before, but use the proper curve in the diagrams shown corresponding to the equations for taper fits.

Professor Jenkins' empirical formulas can be relied upon only between the limits found in the data that he investigated (between $\frac{D}{d} = 1.4$ and $\frac{D}{d} = 4$ for taper fits), and the corresponding portions of the curves are shown in full lines; the remaining portions of the curves are shown in dotted lines.

As I have stated before, there is no doubt that Professor Jenkins with his investigation has made a very useful contribution to the practical knowledge of forcing pressures that may be expected between certain limits and for a given class of work; but I believe that his empirical formulas are expressed in such a form that they cannot be relied upon for values of the variables outside of the limits of the experiments investigated, because the equations fail to satisfy the fundamental requirements of the dimensional theory, not having all the terms of the same dimensions, and so the formulas cannot be generally correct. This is a very undesirable feature for any empirical formula and may lead to serious errors when the limits inside which it may be used are not kept in mind.

If a ring having a bore d, a length L and a section A is forced on a shaft with a press fit J and the pressure used is P, these five quantities must be connected by some sort of relation, which may be symbolized by $F(d, L, A, J, P)$. Applying Buckingham theorem (see "Model Experiments and the Forms of Empirical Equations," by E. Buckingham, "Proceedings" of American Society of Mechanical Engineers, 1915) we find:

$$P = d^2 Y\left(\frac{A}{d^2}, \frac{J}{d}, \frac{l}{d}\right)$$

where Y is an unknown function which remains to be found from the experiments that Professor Jenkins has investigated. An equation of this form would undoubtedly be correct, because all the terms of the unknown function are independent and dimensionless, and we should not be led to the absurd results that we get when in the empirical formulas for straight fits (except for steel on steel) we put $d = D$.

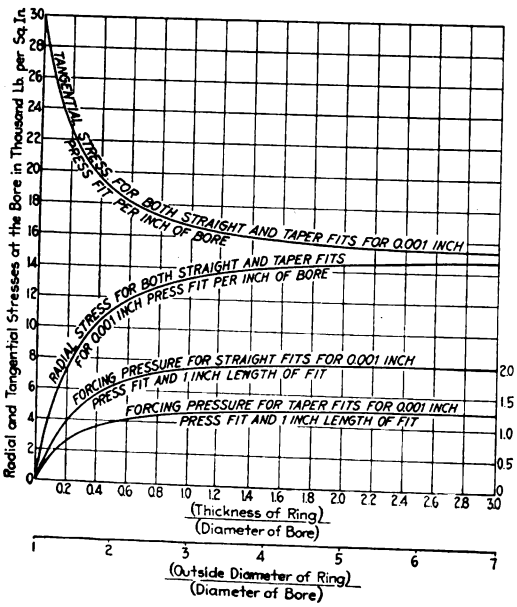


FIG. 3. STEEL RING FORCED ON A STEEL SHAFT

"Fundamental Equations for Press Fits" published in the "Engineering News," Mar. 17, 1910. "Formulas for Forced and Shrunk Fits" published in the "American Machinist," Vol. 42, page 377. "Formulas and Alignment Charts for Taper Press Fits" published in the "American Machinist," Vol. 44, page 275.

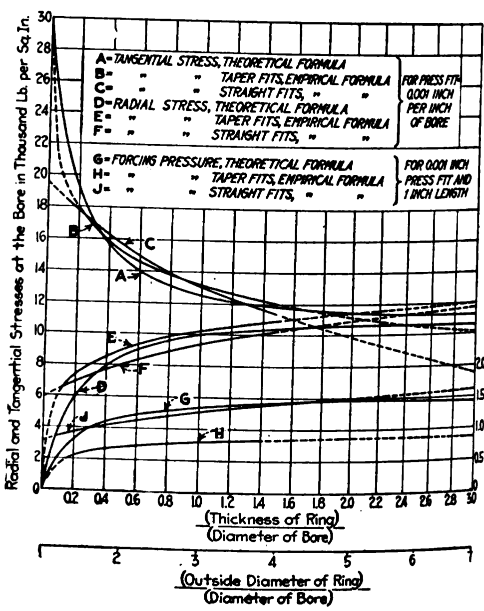


FIG. 4. STEEL RING FORCED ON A CAST-IRON SHAFT

"Fundamental Equations for Press Fits" published in the "Engineering News," Mar. 17, 1910. "Formulas for Forced and Shrunk Fits" published in the "American Machinist," Vol. 42, page 377. "Formulas and Alignment Charts for Taper Press Fits" published in the "American Machinist," Vol. 44, page 275.

Note—The empirical formulas were derived from data corresponding to the full-line portion only of the curves shown

I believe that, since Professor Jenkins has made such a thorough study of the problem of force fits and he has all the data from which he derived his empirical formulas, it would be an easy matter for him to rewrite his formulas in a way more consistent with the dimensional requirements of empirical formulas and more generally correct for any value of $\frac{D}{d}$, this being a step in the direction of logical analysis.

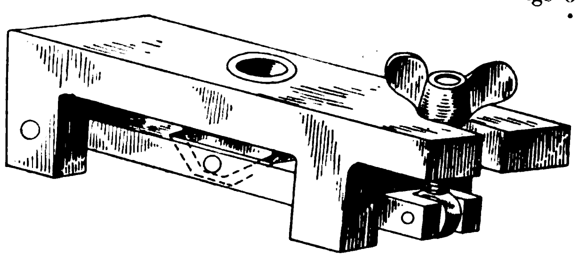
W. W. KNIGHT.

Ampere, N. J.

Best Way To Do Certain Things--A Leaf Jig

Speaking of the best way to do certain things, the jig and fixture field is certainly rich in opportunity. One case is the leaf type of jig. Since this design of jig is used in all sizes for many kinds of work, remarks on the subject will apply to the whole field. The best arrangement in this jig is to have the leaf support the work—in other words, drill against the leaf. The bushings should be placed in the frame of the jig and the work should be located there, thus accurately registering the work with the bushings.

The mistake often made in the design of these jigs is to place the bushings in the leaf of the jig and support the work in the frame. While it is possible to make such a jig give passable results on finished stock when conditions are favorable and the jig is carefully built and new, such a design is a failure when used on pieces like rough castings and drop forgings. Furthermore, if the size of the stock varies, the bushings will stand at an angle with the drills, and the drills are likely to break. Or in the case of larger holes, where considerable clearance is allowed in the bushings, either the bushings or



A LEAF TYPE OF JIG

the drill will be sadly chewed up. Also as the jig grows old and the pin bearing holes wear, lots of work will be spoiled.

The correct idea is shown in the illustration for the leaf type of jig. The part drilled is a flat piece, and it is necessary to use an equalizer in the leaf.

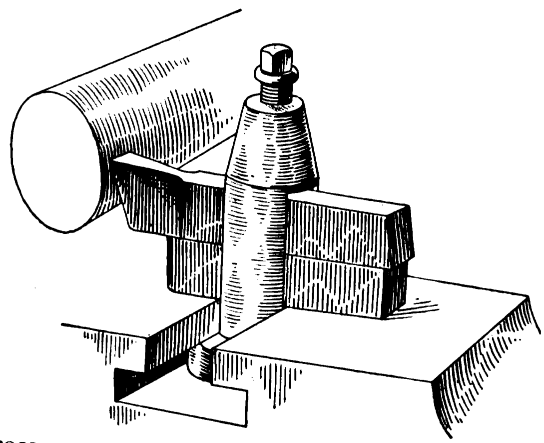
Bridgeport, Conn. W. Burr Bennett.

Cutting Off Steel in the Lathe

Replying to the article on page 294 by G. A. Remacle, I agree with him that the causes of chattering and digging in of the tool are not (in any case) the cause or fault of the lubricant. The tool rest illustrated does not promote chattering. To avoid it, the circular segment for the height of the tool adjustment should be removed, and plain flat packing, as long as possible, should be substituted, as here shown. This change will be found to rectify to some extent the lack of foresight of the lathe designer.

The article ends by saying, "And once the cut is started the tool should be fed in without stopping." This remark is of the greatest importance.

The height of the tool must be governed by the condition of the main bearings and the method of holding. If the job is held in the chuck with the center against one end, the trouble is increased. When the parting tool hits the work, the latter will rise exactly the amount of play in the main bearings and the chuck. If the tool is kept constantly cutting, the piece will stay up; but once the cut is allowed to ease off, the work will drop and chatter. Therefore, the tool should be set a trifle high,



TOOL ARRANGEMENT FOR REDUCING CHATTER IN CUTTING OFF STEEL IN THE LATHE

according to the requirements of the job and the intelligence of the operator.

Luton, England. Archibald Young.

Paying Pupils in the Public-School Machine Shop

The question of paying pupils in public-school machine shops has from time to time stirred the vocational schools in Massachusetts, and it is open to some discussion. The reasons for proposing this scheme are two, though they are to all intents and purposes one. While these schools are still new and it is hardly probable that the best methods of conducting them have been discovered, yet the number of boys who really finish their allotted time at the school is small compared with the number that enter.

In a majority of cases the reason for leaving is generally the fact that there is a position at fair wages open, or else the pinch of poverty at home makes it necessary to take the first job that offers. The result is the same in either case—Massachusetts has added another unskilled or semiskilled citizen to her ranks.

In comparison, with this condition as a basis, the corporation school presents a much better showing, and in searching for the reason the fact that the apprentices at these schools receive wages is considered by many to be the chief. While it may be the principal cause, still there are two other very important factors that may have a bearing on the case. One is that the group at the corporation school is selected, and the other is that they are older boys, 16 years of age at least. Because of these two things they stick better and progress more rapidly than if they were younger and no selection was made.

To overcome this difference in the length of attendance, it is proposed that the community supporting one of these schools be asked to pay the boys who attend a nominal sum, say $100 per year. It is believed that by doing this they will stimulate the boy to greater effort and at the same time enable him turn enough money into

the family exchequer to enable him to continue at the school and complete his course.

While I believe that the advocates of this scheme are honest in their intentions, still is seems to me that they have not considered the other side of the case. Some people still feel that it is not the duty of the public to support trade schools, thinking that the manufacturer is the only beneficiary of such training and therefore he should pay the expense of it. There are others who feel that the cost of vocational education is excessive and that too much of a burden is placed on the taxpayers. Imagine then the injured state of mind that these two classes of people would be in if it was seriously proposed to make such payment; and too, such action would fail of support from the very people who now favor it.

It would seem that we must have a very poor opportunity to offer our boys if, after providing everything free of charge, we have to go down into our pockets still farther and pay pupils to come and partake of the advantages. While on the face of it the idea seems absurd, I have heard so much talk of it that I should not be surprised to hear of someone actually trying to put such a plan through.

I can readily see that, if the sales account of any of these schools should exceed the maintenance charges, such money would be in excess of the amount the community had expended, and it would then be good policy to take this surplus and divide it among the boys who had earned it. But to pay them artificial wages would have a very pernicious effect, similar to that which free textbooks and supplies have had in framing the attitude this nation holds toward public property.

Westfield, Mass. BURTON A. PRINCE.

Small-Shop Apprenticeship

There seems to be much comment of late regarding the proper training of machinist apprentices. Many of the larger firms have originated and installed systems whereby the apprentice receives a standardized form of mechanical training and is given the opportunity to acquire enough technical knowledge to enable him to develop into a high-grade mechanic. This schooling is given at regular periods by skilled instructors who are held responsible for its success, and together with the shop training they receive, it must be very beneficial to the boys who are mechanically inclined.

But how about the boy who undertakes to learn his trade in the average small shop? What encouragement does the average small-shop owner give his apprentice? How many of them will endeavor to teach him something about shop mathematics, for instance? The average small-shop owner will not teach a boy any more than is absolutely necessary for him to know in order to perform the work on hand. It is true that the boy will generally have a greater variety of work to do in the small shop, and most small-shop owners believe that this opportunity should be sufficient inducement to make a boy select such an apprenticeship in preference to one in a large plant. Although he will receive a greater variety of work to perform, the supervision of his mechanical training is usually left to a busy foreman who is too interested in production to devote much time to the training of apprentices and will leave it to the mercy of fellow-employees who may take an interest in the boys. We all know that the average small-shop owner cannot afford such apprenticeship schooling as some of the larger plants are installing. However, he should endeavor to teach the boy whose previous schooling has been cut short enough shop mathematics to enable him to develop into a first-class machinist capable of working in any line of the business. I have seen many young machinists who had served their apprenticeships in small shops and were really good workmen, but could not make ordinary change-gear calculations. Although any of them could read a micrometer, nine out of ten could not change fractions to decimals without the aid of a decimal-equivalent chart. The ambitious boy who has the ladder-climbing spirit and finds himself in such a predicament at the end of his apprenticeship is not yet prepared for his climb and must make way for the boy who has acquired during his apprenticeship a knowledge of shop mathematics and the self-confidence that accompanies this knowledge.

However, the question as to whether a boy should select the large plant with its apprenticeship-schooling system or a small one with its greater variety of work to offer is a rather knotty problem to answer. Much depends on the boy's present education, his future plans and the intended employer's record as a developer of machinist apprentices. The boy should know what percentage of the employer's apprentices have turned out successful mechanics and how much of their mechanical training was acquired during the apprenticeship.

Although such records would be hard to keep, the boy who is selecting the foundation place of his career should know whether he is going to exchange his services merely for the profit of the employer or whether the employer is going to give him the knowledge and training agreed upon.

South Bend, Ind. A. J. CHAMBERLAIN.

Who Can Make This Nail?

On page 604 F. P. Ronnan asks who can make a special nail. Unless he has given detailed information about the kind and quality of metal, whether the corners must be sharp, whether the diameters and length of shoulder must be kept within close limits, whether the exact length over all and all dimensions must be closely adhered to or otherwise—it is small wonder that he has received no bid for the job.

At first glance it looked to me like an easy task to design tools to make this nail, but when I began considering its probable use and the essential requirements, I was at a loss to know where to begin. From past experience in upsetting and forming bar iron I believe the nail can be made commercially in upsetting dies.

Rochester, Minn. GEORGE G. LITTLE.

Glass-Cutting Experience

In reply to the letter by George G. Little, on page 516, detailing his experience in cutting glass plates, I wish to say that it is impossible to cut glass with a diamond that has an artificial or ground and polished point or cutting edge. The only type of diamond that will cut glass is a stone having natural points or cutting edges. A diamond with ground and polished edges or facets will scratch glass, but will not cut it.

New York City. THOMAS L. DICKINSON.

Industrial Preparedness From the Engineer's Viewpoint

SYMPOSIUM OF DISCUSSION

SYNOPSIS—Many points of view were brought out at the New Orleans meeting of the American Society of Mechanical Engineers in the discussion of the paper dealing with the timely subject of organizing for industrial preparedness. Abstracts of the most important discussions are presented.

A Unique Opportunity for Engineering Endeavor

TELEGRAM BY H. E. COFFIN

I am sorry not to be able to take part in the discussion of Mr. Miller's paper, that I might in person help to bring home to every man at the New Orleans meeting the obligation and at the same time the great opportunity resting with him as a member of the American Society of Mechanical Engineers. In this paper, you have before you in brief outline the main features of a patriotic national engineering endeavor unique in this world's history.

We as engineers and chemists had harnessed the resources of this country for the people's service, and now at the direct request of the President of the United States we are asked to make a careful inventory of these resources for the use of our defensive line. A successful performance of this great task, to which the governing bodies of our technical societies have pledged us, cannot but bring the American engineer enhanced reputation and closer future relations with the national Government.

Organization of Volunteer Industrial Associations

BY H. E. HARRIS

The program for preparedness, as it affects the engineering profession and industrial America as a whole, is well thought out and should be supported by every engineer and manufacturer. However, there is one point of vast importance which could stand considerable emphasis, and that is the outlined plan for organizing an Industrial Reserve.

It is not only necessary to enlist the engineers and the manufacturers, but it is necessary also to get the loyal support of every man who is a skilled workman and who is necessary to this country as such. Let these skilled employees know more about the plans of the industrial-preparedness program, enlist their sympathies and obtain their pledge of willingness to be depended upon in case of emergency. Make them feel that in case America is called upon to defend herself that their interests and their employers' interests are in a common cause and that the employers and the men will stand shoulder to shoulder in such an emergency. Skilled workmen who are floaters and otherwise undependable are of no value as a part of the industrial bulwark of the nation and will hesitate to pledge themselves to the country's service in time of need; and it is well to know upon whom dependence may be placed to stand at their posts when called by their country and for employers to give to such as can be relied upon the responsible positions in their factory organizations.

It is up to employers who are patriotically inclined to reach the men by individual talks, meeting them on common ground and obtaining their views and their willingness to enlist as members of the Industrial Reserve, if called upon. In view of the present conditions of unrest it does not seem as though any time should be lost in making a coalition as far as possible between the employer and employee on a patriotic basis.

As an example of what may be done in this direction, this is what has been accomplished along these lines by the company with which I am connected: The men were invited to meet together; and at the meeting, abstracts from the paper written by Mr. Miller were read, a general discussion invited and an impromptu talk given to the men. This meeting took over an hour. Men who for various reasons had neglected to take out their naturalization papers were earnestly advised to do all they could to get on record as to their intentions. Men who had their first naturalization papers, but had not taken out their second, were also given similar advice; and every man was invited to join in forming an association which pledged them to put all other considerations aside in case of a call for the defense of the country and to pledge them to serve in its defense as members of the Industrial Reserve. Resolutions were passed as follows:

We the undersigned, do solemnly and patriotically pledge ourselves to the defense of the United States of America in case of war against any enemy whatsoever.

We have associated ourselves together as members of the Square Deal Industrial Volunteer Association, employees of the H. E. Harris Engineering Co., and as native and naturalized citizens of the United States of America and further voluntarily pledge ourselves to patriotically serve in the Industrial Reserve of the United States of America as skilled workers of the H. E. Harris Engineering Co., whenever called upon by the Government to do so, irrespective of our several religious, political beliefs, other associations, prior nationalities, antecedents or individual prejudices.

This pledge and agreement is binding upon the Square Deal Industrial Volunteer Association as a whole, but any member leaving the employ of the H. E. Harris Engineering Co. and being released from his membership in the foregoing association prior to the call of the United States Government is also automatically released from this pledge.

The men evinced a hearty interest, exhibited a large share of patriotism and demanded permission to sign at once, with the exception of one or two not skilled men who were desirous of joining either the navy or army in case of war. There were no restrictions made in regard to the men's prior nationality or whether they had obtained naturalization papers partly or completely. If any aliens wished to sign, they were allowed to do so after signifying their intentions of becoming citizens of the United States at their earliest opportunity.

The enthusiasm that this meeting created was rather more than was expected, and those men who were aliens got very busy the next day to see how soon they could get their citizenship papers.

So I am able to come here with the feeling that the men in my factory are 100 per cent. strong in patriotism and with the feeling that I could offer my country and the Naval Consulting Board the support and services of the company and its employees' support as a unit, without a dissatisfied or dissenting vote.

It is important to distribute information in a simple form to the engineers of the country, so that they may be in a position to help those who are desirous from reasons of loyalty to their adopted country to become full-fledged citizens, by giving the necessary information as to just what steps are to be taken.

Getting Our Money's Worth

BY F. J. MILLER

Engineers have always paid far more attention to efficient organization than has been paid to it by any others, and it seems to me that they might render their best possible service at this time by suggesting such improvements in organization as would result in getting more for the money and effort expended than is at present secured.

From an English statistical authority I take the following figures, showing the army budgets of various countries for the year 1913-14:

Japan	$48,500,000
Italy	82,000,000
Great Britain	137,000,000
United States	146,000,000
France	178,000,000
Germany	292,000,000
Russia	327,000,000

We thus see that there are only three nations that spent more money in the period named than we spent, and the figures given do not include our state troops, but only the Federal budget. Yet we are told by many people who should know that our army is a negligible factor and that even for such a job as pursuing a few bandits over the Mexican border its showing is "pitiful."

If that is so and if substantially the same is true of our navy, as we are told that it is, then is it not time for us to try to discover what the $146,000,000 does buy and whether or not some results worth while can be secured by an expenditure of money exceeding that of Great Britain and exceeded only by the three great military nations—France, Germany and Russia?

Modern warfare has been shown by the war now going on in Europe to be more than ever an engineering operation. It is organization pitted against organization, and machine pitted against machine.

Preparation for war is also largely an engineering work, and the nation which does most in making this work of preparation efficient—that is, in getting the largest possible results for each dollar expended—will have gone a long way in the work of "Preparedness" and will get the best support from its people, upon whom the burden of taxation falls.

Need of Legislative Action

By Ernest H. Peabody

The mistake this paper makes is in presupposing that the enormous work of organizing for industrial preparedness can be effectively projected and completed, with the dispatch which the circumstances make imperative, by the engineering fraternity of this country as represented by the engineering societies, working in the odd moments snatched from the task of making a living, without compensation and paying its own expenses.

It is indeed a satisfaction for us all to know that this important movement of Industrial Preparedness has been initiated and is being carried forward to far better purpose than the facilities available might promise. But the mere preliminary step of making an industrial inventory is a tremendous piece of work in itself. Can it be done by a society like ours or by representatives of similar societies? May we expect that even the enthusiastic army of engineer census-takers referred to by the author—in the little time available and with, comparatively speaking, a limited backing—may we expect that these men can satisfactorily accomplish this important work? Have we time to do it in this way? I think not.

It is our Government that must do this work and not the United States Naval Consulting Board, whatever may be the enthusiasm, self-sacrifice and ability of its members and whatever may be the help which this society's membership at large can give. I believe that the steps that this society should take are those which will put pressure upon our legislators to make an organized Government measure of this industrial census and all the thousand other important features which must be included in complete "preparedness against war" (to quote Mr. Garrison).

It is a mistake, in my opinion, to allow the impression to go abroad that the work which the Naval Consulting Board has begun and which is being promoted by the action of the allied engineering societies is sufficient and satisfactory and that it will fulfill the great needs of our country. We must go deeper to make this work effective; we must bend our energies along the line of stimulating public opinion, so that our representatives at Washington will be impressed and take the necessary steps to make the whole question of preparedness a Government policy.

The appointment of the United States Naval Consulting Board was an inspiration and of incalculable benefit to the country, but anything short of putting this matter of preparedness straight up to the legislative and executive heads of our Government as a national duty is merely playing with a problem that vitally affects our very existence as a nation.

Thorough Co-operation Needed

By J. P. Brophy

Industrial preparedness is an extremely vital question and the word "industrial" is so deep and reaches so far that it requires a vast amount of labor to impress those in a country of such magnitude as ours with its actual meaning.

To be industrial in the extreme means a genuine commingling of all lines of business and labor of all descriptions. It might easily be said that this country has at all times been awake to the meaning of the word industrial because we have up to the present time in all sections of the world been considered real leaders in a vast number of enterprises. To improve upon what has happened in the past means a genuine amalgamation of all with whom we deal. This means that the leading business men should have one thought—never to allow the business of this country to go backward.

I believe that the big thing in preparedness in any undertaking involves the best use of your thinking powers to plan in advance, being ever ready to meet the business enemy.

Competition after this war ceases will be somewhat severe from all sections of the world, although a vast number of bright business men are under the impression that we control the world from a manufacturing standpoint. Perhaps we do in a certain sense, but from an industrial standpoint business men should, if posible, have those in their employ thoroughly satisfied. Get men to work as a thoroughly organized body. This means homogeneous brain power, all thinking in one direction, as nearly as possible, and constantly having self-protection in mind.

This cannot be of great benefit to this nation, if it is not genuinely universal. An educational campaign seems absolutely necessary to teach all to work together, and this must be done with a great pride for our own country. It is a subject that requires a vast amount of thought, and it may be a difficult problem to get all bodies of men in business to think anywhere nearly alike. The trouble is, selfishness is too strong. We rarely ever give our neighbor any thought; and if we do not, there is little chance of real success. There is no question in my mind that the countries abroad will get busy immediately after this war ceases and unquestionably will be anxious to find markets in this country for their produce, at very inviting prices, for the reason that they will need the money and need it badly. It will be vastly different from the past. Their only alternative is to reach out for new markets with the idea of making headway regardless of large profits. Then it will be absolutely necessary for all lines of business in this country, which have to meet this kind of competition to be prepared to stand the test.

It is a difficult problem and will need a vast amount of time to get those interested in business, as well as the workingmen, thinking in the same direction. If they do not, the matter of industrial preparedness is liable to be forgotten, because it will not reach an actual working condition. To utilize the industrial resources of this country to the very best advantage, there must be a complete unification of all who participate either in a large or small degree. This can never be accomplished by a few individuals. The assistance of the Government must be had when taking into consideration new business in South America, the different colonies and the Orient.

Our banking facilities are extremely inadequate, and our merchant marine is not worth considering when we seriously contemplate doing business with South America. Notice the embargo on freight in the East in the last two months—no boats to carry our product abroad, and those that will be used for this purpose are not American ships.

An undertaking of this kind means not working at cross-purposes, but in conjunction with one another, having love of our country uppermost in our minds and taking into consideration that one man is intellectually stronger than another, not expecting too much from those who have not had equal opportunities. In other words, a little more solicitude for one another would be approaching the real foundation of industrial preparedness. We, as a nation, I am inclined to believe, are too far apart as individuals, for the reason that we are not all one people. That there are too many nationalities, many of whom have forgotten that this is their home for all time and that this great and free country should come first, while love of the place from which they came should have only second consideration, is partly responsible for this condition.

Industrial preparedness must be forced to a successful issue through the channels of governmental control. It means the proper distribution through the daily papers of advice, gathered after searching investigation, thereby getting into the minds of the masses the actual meaning of this word industrial.

Steel for Rifle Parts

By K. A. Juthe

The present activity in small arms and ammunition brings out several factors that seem serious enough to warrant a general discussion. I refer mainly to the military rifle. When orders began to come into this country over a year ago, the rifle-manufacturing interests were totally unprepared to take care of hurry-up orders, and the engineers in charge were up against a unique and at the same time serious situation. They were unable to secure the required number of skilled men for the preliminary work and also to secure the necessary material of the high standard wanted by the different governments. Considering that orders were placed with

different manufacturers for from 1,000 to 5,000 complete rifles per day, the magnitude of the undertaking can be partly comprehended; and a few figures show in which particular instance we were worse off than any superintendent or engineer in charge of such work had ever thought possible, for men have always before been procurable for almost all classes of work.

The gage problem was one of the most difficult, as we found that it takes at least 300 first-class gage makers six months to furnish the first working set, inspector's set and the master set necessary for guns in quantity. And when 1,000 complete rifles per day are figured on, it means that the working sets must be increased from one to ten and the inspector's sets from one to five, keeping the master set simply for reference. It has been conclusively shown that out of a total of practically 2,500 to 3,000 first-class gage makers in the country the supply was wholly inadequate to tackle several different propositions at the same time.

Jigs, fixtures and small tools require a small army of tool makers. It would take at least 1,000 tool makers one year to furnish tools of this kind for the output of 1,000 rifles per day. Therefore, in case anything happened that would make necessary an order from this Government for 5,000,000 rifles (which would be needed for a preparedness program, at least 1,000,000 rifles per year) we should be up against a proposition that would tax our tool plants to the utmost.

A suggestion for a central plant wherein tools and gages could be manufactured and sent out to different plants in case of trouble is one which the engineers should give careful consideration, as no manufacturing can be started until gages have first been made. It would seem as though a central plant for the manufacture of gages would be the proper thing. This should, however, be done in one plant laid out for that particular purpose under the supervision of one head, as it would be necessary that all gages bear the same relative characteristics with the same relation to each other as the finished part of the product. The gages can then be made in large quantities and sent to all the different manufacturing establishments doing this work.

As for tool making being done under central supervision, with regard to small tools, jigs and fixtures the proposition takes an entirely different aspect. Jigs and fixtures are largely made by individual concerns to suit their own particular machine tools for rapid interchangeable production. As no two manufacturing plants have the same tool-making facilities, it is practically impossible to standardize tools for such purposes; and jigs and fixtures would be of no value unless they were interchangeable under the majority of conditions existing. There seems to be a necessity for a standardization of parts, or at least some method devised whereby tools could be manufactured and jigs and fixtures made suitable to fit the conditions existing at each of the large manufacturing plants now engaged in similar work. These could be kept in stock; and as soon as occasion required, they could be handed over and manufacturing could proceed with practically no stop, excepting the necessary adjustments and preliminary inspections.

There is also the question of getting raw material into shape for actual manufacturing. The specifications for each government vary largely as to analysis and physical requirements. In some cases such requirements are more than a ballistic test has shown necessary as a factor of safety. There is no trouble to get, by heat-treatment, a certain analysis of steel to meet the required physical specification, but all steel furnished must possess machining qualities within certain limits. Sometimes a little careless handling gives us what we term a "dirty steel"; and although all requirements as to physical qualities can be met, the drilling and rifling of the barrel under such circumstances become a serious and heart-breaking problem.

The following have been thoroughly demonstrated as necessary steps in the making of a standard high-explosive rifle. (The small parts of the rifle can be taken care of, as far as hardening and heat-treatment are concerned, without much trouble): (1) The analysis of steel, (2) Manufacture of such steel with minimum waste, (3) Forging of breech end of rifles without harmful effects to the steel, (4) Heat-treatment of rifle barrels to give the highest physical properties wanted with a high degree of machining qualities.

These points also need careful attention and consideration: (1) Designing and standardization of parts, (2) designing and manufacturing of gages, (3) designing and manufacturing of interchangeable tools, jigs and fixtures, (4) supply of a proper quantity of kiln-dried lumber for the rifle stocks.

Men are being trained at the present time for almost every part of the manufacture of small and large arms and ammunition, so that as soon as the proper facilities are provided, no delay would be necessary.

Necessity for Proper Drawings and a Supply of Gages

By Frank O. Wells and Charles E. Smart

We do not need big armies or navies. What we do need in the way of preparedness to preserve peace is that our machine shops be equipped to manufacture munitions of war at a moment's notice. For over two years all the machine shops in the United States have been working for the Allies, for they had practically nothing else to do; yet even today new designs for jigs and fixtures for this work are upon the drafting boards, and new gages and tools are being made in hundreds of shops all over the country.

People have talked of having the Government make the ammunition, but those who are conversant with the subject know how absurd this proposition is. Well-trained men can be transferred in private factories at a moment's notice from the making of their regular products of peace to munitions of war, if they have tools and gages to work with.

We believe that the following points should be well considered: (1) The Government should call on all the drawings, books of instructions, gages, jigs and fixtures—in fact, all the special equipment necessary to produce munitions of war. (2) Drawings and books of instruction worked out to the minutest detail should be in the vaults in all the arsenals and navy yards, ready to be distributed to the various plants at short notice. (3) Gages, jigs and special fixtures should be also in vaults in the arsenals, to be given out at the same time as the drawings and books of instructions. (4) The operations and methods of handling the work necessary to make munitions of war should be carefully standardized in order that no matter in what section of the country such work is done, the cost will be the same, because the standardization of time means also standardization of price. (5) The present arsenals should be used more as experimental stations from which the private plants will get their instructions and information regarding the best methods of producing the goods they are called upon to manufacture. A number of private plants should be given small yearly orders of the parts that they are best adapted to produce, so as to keep the organization familiarized with the product.

It has been shown that the weakest spot in the present war is the lack of ammunition, particularly from 1- to 16-in. caliber, which is used by both army and navy. Herewith are given some statistics of the time that it would take to get prepared and to make ammunition alone:

A conservative estimate is that it would require 50 engineers, designers and draftsmen at least 50 weeks to prepare the drawings for the 17 sizes of shells now used by the United States Army, together with drawings for gages, jigs, fixtures and tools. To produce the gages, tools and fixtures for this work would probably require 800 men, well trained and in well-organized factories, at least 5 years, calculating that there are 300 working days per year. This would equip 100 factories, employing 2,000 men each, capable of producing a total quantity of 200,000 rounds per day. This number may look enormous, but we must not overlook the fact that twice this amount has been used in a single day in the present war by one of the combatants.

We have not mentioned the question of aëroplanes, rifles, battleships or a large number of other important parts of equipment which must also be provided for. This all talks of war; but what nation would dare to attack us, if they knew how well prepared we were? We, as a peace-loving nation, would surely never attack any other nation, and so perpetual peace would be assured.

Small Arms and Ammunition

By F. O. Hoagland

The shortage of both arms and ammunition in this country in case of immediate need is very apparent, but it is a fact that, owing to the great efforts in this line being made by private manufacturers, it would be possible to change this condition materially at very reasonable cost, if proper steps are taken without delay.

The Springfield and Rock Island arsenals are in good condition to turn out the .30 army Springfield rifle; and the Frankford arsenal can provide the ammunition for this rifle in limited quantities, although all of the arsenals are somewhat short-handed at present. Arrangements are also under way to manufacture the .45 caliber automatic pistol and its ammunition at the same arsenals.

The Government has at times placed contracts for some 10,000,000 rounds of this small-arm ammunition, divided among four or five private concerns in this country, but dur-

ing the last couple of years the orders were not accepted by the ammunition manufacturers on account of the 8-hr. working day being stipulated. This obstacle has now been removed, and the conditions are more favorable in this respect.

The quantities ordered have been too small to make it an object for the interested parties to go into the manufacture of this particular ammunition very extensively; and no private manufacturer has made any quantities of .30 Springfield army rifles, nor has he any special tools, fixtures or gages necessary for making them. The conditions are about the same in regard to the .45 caliber automatic pistol, as the company that brought it out a few years ago for the army service is the only private concern in this country equipped for its manufacture.

Judging from past experience and by the length of time it is taking manufacturing establishments at present, although having good organizations, to get ready to begin to fill orders for a product but slightly different from their regular lines, it is apparent that it will be necessary, if quick service should be required some day, to place several of these concerns in condition to meet the demand by placing orders for arms and ammunition without delay. Such orders should be of sufficient size to keep a small unit at work constantly, so as to keep the equipment in good repair and to have a number of trained workmen to form a nucleus for building up an organization in case of need. The Government arsenals could undoubtedly be of great assistance in preparing the special equipment of fixtures, tools and gages, but a few leaders and workmen in each plant, who are thoroughly familiar with the requirements, are absolutely necessary in order to get quick and sure response.

By loading a small portion of the cartridges only, just enough to check the production of shells and bullets, a fair supply of the latter could be accumulated and carried in stock at a cost of one-half of the loaded cartridges. Any danger of deterioration of the powders or primers would thereby be removed, the present European War having brought out very forcibly the seriousness of the condition when old ammunition failed to respond at the crucial moment.

Powder making has developed to such an extent that with a fair supply on hand at all times the loading could be carried out by the Government arsenals at a rapid rate and the troops supplied with fresh ammunition. Experience has proved that the supply of shells and bullets generally controls the output.

It is very important that, if anything is to be done in this line, it is done without delay, before the ammunition and arms manufacturers break up their engineering organizations, as they have nearly completed this class of work in connection with the contracts now on hand and are about to get down to actual manufacturing. Having had some very costly experience in getting together and training an efficient corps of engineers, they may not be very anxious to go through this same process again in the near future.

It is very important that if orders are placed with any private manufacturers they be employed constantly, as it takes from two to three months from the time the order is entered for the material to be prepared and the product to come through in fair quantities, even with a suitable equipment and a trained organization and under the best of circumstances.

All Gages Should Be Made in Government Shops

By John H. Barr

The industrial inventory for which provision has been made will greatly increase the military value of the industrial resources of the nation. The tentative scheme of this inventory is probably adequate as a basis of development of many of the civil industries into military supply plants. Its provisions will facilitate the production of such equipment as shoes, clothing, food, fuel, etc. Automobiles, aëroplanes and other transportation equipment suitable to military needs can be developed, and plants for making these can be brought to a state of preparedness for a much increased output under the stimulus of this plan. An extension of these methods or other means will develop a large potential supply of explosives.

In the matter of manufacture of arms and ammunition, however, it appears that special difficulties will arise, for uniformity and complete interchangeability are of the utmost importance in these most essential articles. It is well known that the methods and degrees of refinement in tool making vary widely among various factories regularly engaged on similar products. The uniform standard, which is vital in producing guns and ammunition for our military forces, requires a corresponding uniformity in the quality of the gages and tools for producing these supplies.

Clause (c) of the proposed agreement requires each shop to maintain corrected drawings and to construct one set of tools for such products as it might be expected to furnish. It would appear that the desired result may be more certainly attained by construction of such gages and tools in specially equipped Government tool factories controlled by a highly expert staff and manned by workmen of corresponding skill. These Government tool factories can construct all gages required and most of the important special tools. Drill jigs made in these factories can be used in any shop having suitable drill preses. Some variations exist among the machines of the numerous civil shops in the requirements as to drop-forging dies, punch-press dies and milling fixtures, but this will not seriously hamper the wholesale manufacture of such tools by the Government tool factories. The large production concentrated in the Government tool factories would be on a scale to permit real manufacturing methods in constructing standard tools. It is not necessary to expand this thought further, although it is capable of much extension.

There is in this proposed production of all the important tools in Government tool factories one other advantage that tends to a uniform and high standard of product. The prosecution of this high-class tool manufacture will involve some considerable production in the Government shops in thoroughly testing the equipment. This practice will develop a large corps of mechanics skilled not only in the making of these tools, but very familiar with their use and the requirements to be met by their output.

In case it becomes necessary to utilize the industrial equipment of the country to the utmost this corps of specialists would be a source from which to draw inspectors and instructors for duty in the private shops. Even one such man in a large private shop could render inestimable service in putting the plant upon an effective military basis. He would supply just that specialized technical knowledge that could not be expected of even the best of mechanics, who necessarily lack extended experience in production of military munitions.

Government Shops Should Be Sample Shops

By William B. Jackson

There is a tendency on the part of many who have not given the matter considerable consideration to feel that the Government of the United States might place itself in a position to own manufacturing establishments capable of fulfilling all the requirements of preparedness and to produce the necessary supplies and equipment to enable our country to withstand a serious attack from outside nations.

The sooner such an idea is rooted out of the minds of our people the better, since at best the Government can only own and operate what might be considered sample establishments for the production of the materials and supplies that would be necessary in case of a serious attack upon this country. Were the United States to be attacked by a formidable foe, it would require the most intense activity of any reasonable development that the Government might have in the line of the manufacture of munitions and supplies, together with the most intensive activity of every private manufacturing establishment that could be pressed into the service. One of the things that has been clearly demonstrated by the present war is the tremendous advantage gained by the country that is able to start into the fight with the ability to provide at once the necessary supplies to keep the organization going—and this entirely aside from the question of trained officers, engineer corps, soldiers and seamen.

One disquieting feature of our present situation is that the manufacturing establishments do not feel safe in making the broadly conceived and comprehensive plans for assisting the government in case of trouble, owing to the fact that there appears to be no reason for them to feel that the government itself may not enter their fields of activity and take away from them the business which might with propriety come to their hands during the periods of peace.

It would appear that this move on the part of the Government to make a thorough census of the industrial possibilities of our country as a part of the work of our Naval Consulting Board should lead to the development of a plan whereby our manufacturing establishments may be brought into hearty coöperation with the Government with profit to both the manufacturing establishments of the country and of the Government.

Editorials

Preparedness for Industry

Military power is only a form of industrial power. This is essentially the viewpoint of the mechanical engineers, as shown by their discussion at New Orleans of Spencer Miller's paper on "Organizing for Industrial Preparedness." The problems of developing the organizations and managing bodies that must control our industries in case of a national emergency were carefully considered from many aspects. The nature of all this discussion is shown by the excerpts printed on the immediately preceding pages. It is significant to find a large body of professional men, associated in a great national society, that is a unit in its belief on a matter of such vital importance.

Looking a little way into the future, there is another associated subject that the American Society of Mechanical Engineers might properly and profitably discuss at a forthcoming meeting. No man knows what part the United States may play in the future operations of the present European War. But these things we do know: The war will end some time; after its close the United States will face new and uncoped with conditions in the markets of Europe, probably changed conditions in the other foreign markets and possibly new industrial conditions at home. Should not the American Society of Mechanical Engineers at some future meeting discuss the great question of "Preparedness for Industry"?

Organizing for industrial preparedness for war is but one part of a much larger problem. Is it not wise to consider the greater need now that we have gained a little insight into it through discussing one of its most important parts?

Machinists and Shop Executives in South America

The number of machine tools in the machine shops of South America is given as 11,681. It is possible to give from Mr. Hood's records the number of machinists employed in those shops at the time of his recent visit. This total is 14,631, divided as follows into four groups according to the sizes of the shops: In shops employing up to 20 men each 3,243 machinists; from 21 to 50 men, 1,749; from 51 to 150 men, 2,129; and from 151 men each and upward, 7,510.

Dividing this total of 14,631 by the total number of machine tools recorded for the shops in which they work gives us a factor of 0.8 machine per workman. This is of course much higher than the average in the machine shops of the United States. In Vol. 41, page 653, we gave statistics for the machine shops of Cleveland, Ohio, showing that there was 0.36 machine tool for every machinist employed in that city. A comparison of these two ratios indicates the nature of the work done in the shops of South America. Repair work predominates.

As would be expected, the machinists in South American machine shops are very largely native South Americans. They are much like the type that is known in the north as "all round" machinist. Trained, as they are, on a great variety of work, they possess the ingenuity and adaptability of the old-fashioned millwrights. This very adaptability permits them to learn easily to use and operate any new machine tool that may come into their hands. At the same time their knowledge of manufacturing is very limited, and there is no shop which has anything approaching a system of manufacture such as that known as the American system for producing interchangeable parts.

The executives—managers and superintendents—of these shops have been drawn from all the industrial nations of the earth, although nearly one-half of them are native South Americans. Arranged on a number percentage basis according to nationality, they list as follows: Native South American, 47.5 per cent.; English, 18.5 per cent.; Italian, 16.2 per cent.; North American, 2.7 per cent.; German, 2.7 per cent.; French, 2.4 per cent.; Spanish, 2.3 per cent.; Dutch, 2.3 per cent.; Belgian, Portuguese, Austrian, Swiss and others, 5.4 per cent.

This classification according to race shows again the importance of putting all business correspondence and literature for South American countries into the languages that are spoken—Spanish and Portuguese. It also shows how little pioneer work North American executives have done in South American shops.

Modern Standards for Shop Electrical Apparatus

Machinery in any special field is more or less difficult to standardize, depending to some extent on the rapidity of change and the peculiar conditions surrounding its development. If development at any given time is complete and practically no further improvements are made, standardization may usually be brought about without great difficulty. Where, however, the advances in any field are rapid and as a consequence constant changes are taking place in design, standardization becomes difficult at any given time, owing partly to the fact that those responsible for the standards may not themselves be positive regarding fundamentals in the design of specific parts and partly because changes are continually taking place and any particular effort to standardize may be made obsolete before it has had time to prove itself under the test of extended use.

Standards, furthermore, may be of two general classes—namely, those confined to a given shop, on the one hand, and those, on the other hand, which include various plants of a common industry throughout the country, involving many concerns manufacturing approximately the same class of apparatus. In a single shop the problems of standards may well include such items as cutting tools and machine parts, jig and fixture parts, drawings and the like, and the problem resolves itself into fixing these standards for the best interests of the shop itself and in accord as far as possible with general practice.

When the attempt is made, however, to standardize the output of many plants, manufacturing as they do the same general product, the problems are vastly greater and include the necessity for coöperation among the various interests that will be affected.

Standardization in the electrical manufacturing industry involves practically the extremes of these various difficult phases of the problem. It covers a field where changes and developments are continually occurring at a rapid rate, and any attempt at satisfactory standards must of necessity include a great many plants throughout the country, because of the numerous larger and smaller manufacturing centers in the electrical industry. The comparatively recent issue of the Standardization Rules of the American Institute of Electrical Engineers in revised form is therefore an example of the possibilities of concerted coöperation. Coming out, as these rules did, first in 1899 and covering, in general, standards for generators, motors and transformers, we find them revised or changed in 1902 "as a result of changes and developments in the electric art," and subsequent revisions or changes occurred in 1905, 1906, 1907 (a complete rearrangement), 1911, 1914 and 1915.

The main conclusion from the foregoing is that much aggressive effort has been made to standardize the various branches of electrical equipment in spite of the phenomenal growth of the science; and it is of special interest to observe that the recently issued rules include a very complete classification of electrical machinery in general, a speed classification of motors, which is definitely related to shop practice, and a comprehensive treatment on the rating of electrical apparatus, with the proposed standards, as recommended, clearly stated.

To the practical mind, however, one of the items of greatest appeal in these rules is the suggestion that standard information be placed on the rating or nameplate of each piece of electrical apparatus. It certainly seems reasonable to conclude that a move in this direction will prove most beneficial to the user of such machines under shop conditions, thus rendering easier the intelligent transfer of information relating to any given machine from manufacturer to user. Nothing can well be more vexing than to become accustomed to one method of nameplate marking and then in a rush at some later time, when a good motor must quickly be substituted for a disabled unit, to find completely different data on the nameplate of the motor to be used, making it difficult to tell without some study and delay whether it will fill the needs of the case.

An example that may well be followed by other similar committees is the formal statement of the Standards Committee of the institute that suggestions looking toward improvement in these rules, when based upon experience gained in the application of the rules to general practice, are welcome. This kind of coöperation, while always desirable, is particularly so in cases of this kind, where the interests of those affected cover such a wide field and where the opinions of the many rather than of the few must be depended upon.

Life, Leisure and Play

Many of our younger readers and perhaps not a few of the older ones—men who are now hard at their life work—are looking anxiously forward to the time when their reward will be immunity from labor. How often do we hear such terms as, "When I retire," "years of leisure," "afternoon of life" and the like? Yet in those moderately rare cases when the leisure is eventually won and entered upon is it not more often a disappointment than a thing greatly to be desired?

In many cases this long-anticipated leisure often brings such a change of habits as to prove fatal either to health or to life. It seems to be necessary to health that the powers of a man be trained upon some definite task and held there year after year while vitality lasts. Not until the time comes in old age when sleep can no longer restore his vital forces should he stop work. Life seems to need a steady channel to run in, a steady stimulating aim, a definite trend toward something.

We feel a sort of pity for such men as many of our retired generals and admirals, who when they have relinquished their active service, find unused time and vitality upon their idle hands and minds. The current of their lives is thus thrown into eddies or settles into placid pools, and they begin to count themselves out of the world.

The great difficulty with most of us is that we do not play enough. The play of the business man should not be taken in a lump, but should be scattered along his career. It should be enjoyed not only in the spring or summer, but every week, every month. He who looks forward to it most needs it now. Play is a condiment: it is never the grand dish, and he who does not take it with his work never has it. Those men who continue to work when they could retire upon their means or their laurels work not only for happiness, but for life. They well know that play as the real business of life is the hardest work that man has yet devised.

Giving the Manager a Fair Show in a New Plant

Much has been written about the workman and how we can make his lot easier. This has had its effect, and in many shops there is wonderful coöperation, so that the workman has the best chance to make good. Systems have been evolved and the various departments modified to aid in this result. We wonder if similar thought has always been given to the men higher up—foremen, superintendents and managers.

We recently had called to our attention an instance where the ordinary courtesies extended to a workman were denied the manager. After accepting a new position, the manager was allowed to commence his duties without being introduced to the superintendent and foremen who were employed under him. This procedure caused trouble, worry and loss to all the parties concerned. The orders and advice issued were acted upon in a half-hearted manner, as the new manager's position had never been officially stated.

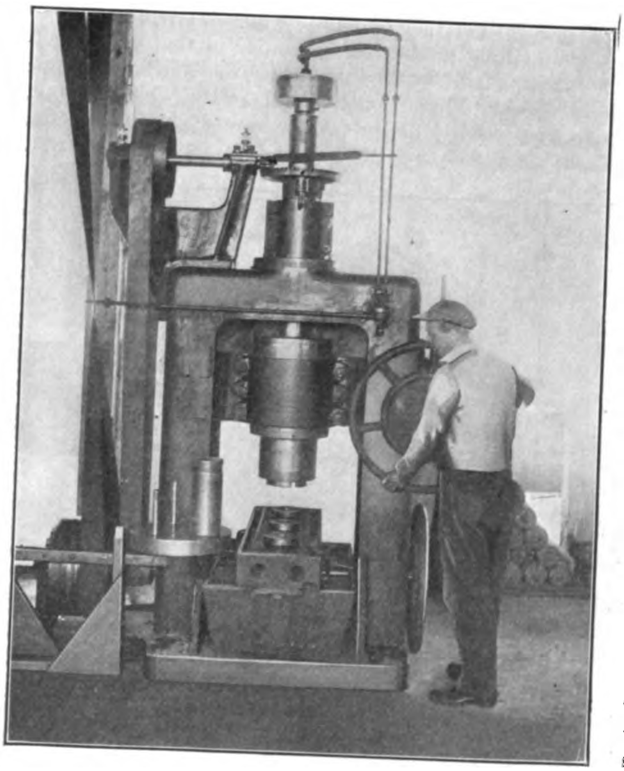
To overcome this disagreeable state of affairs, the manager had to go through the shop and introduce himself. As can be imagined, the result was a delay in production, and for a while there was a certain amount of ill feeling. All this could easily have been avoided if the owners had used ordinary thought and exercised a little horse sense when the new manager entered upon his duties.

Shop Equipment News

Vertical Shell-Boring Machine

In the design and construction of the vertical boring machine illustrated it was aimed to provide sufficient rigidity to insure, for instance, cutting powder pockets and diaphragm seats truly concentric with the outside wall irrespective of any eccentricity of the forged hole. The other special feature is the method of holding the shells inverted in the pneumatic chuck so that the chips drop out immediately upon becoming detached, thus avoiding any interference with the cutting tool.

The spindle is so cored that chuck jaws for any size of shell up to 6 in. in diameter may be inserted. This necessitates the enlargement of the lower end of the spindle and thereby serves to provide a large bearing surface. The bearing is tapered with the larger diameter at the bottom, the spindle surface being of semisteel and the bearing itself of hard babbitt. The feed motion is either by the handwheel, shown in front, or by power feed. The quick return of the spindle, either up or down, is accomplished by power or by hand.



VERTICAL PROJECTILE BORING MACHINE
Capacity, 6-in. diameters; power feeds, 0.007, 0.011, 0.016, 0.023, 0.034, 0.053 in. per spindle revolution; drive, 6-in. double belt; weight, 10,000 lb.

The heavy platen in which the tool holes will be noticed is carried in ways cast integral with the base. A platen centering device is provided so that each tool may be centered with the spindle. After the tool is centered, the platen itself is locked in place so that the centering pin takes none of the strain. The reduction in rotative speed between the lower countershaft and the spindle is in the ratio of 15 to 1.

The machine is a recent development of the Dunlap Machinery Sales Co., Dayton, Ohio.

Tool Post for Use with Multiple Tools

The necessity for rapid turning has developed many methods of using multiple cutting tools. The tool post shown herewith has been designed to secure this advantage in the plain engine lathe and without special tools, no change being necessary unless it is desired to use more tools than the tool block will hold. In this case a wider block is necessary.

The tool block in Fig. 1 is a drop forging, made narrow to allow close setting. It can be turned in any direction, and the blank T-nut can be readily fitted to any tool block.

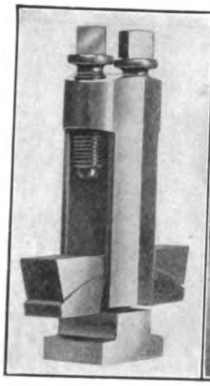


FIG. 1. THE TOOL POST

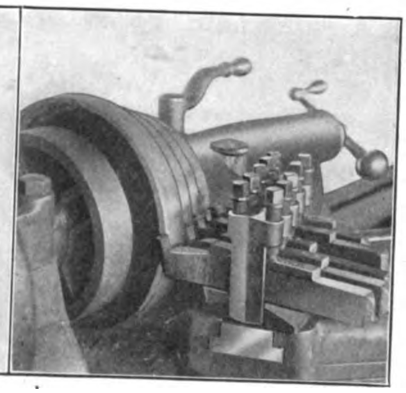


FIG. 2. FIVE TOOL RESTS AT WORK

Tool opening, [illegible]x1$\frac{7}{8}$ in.; width of body, 1$\frac{5}{16}$ in.; combined height of pillow blocks, [illegible] in.; tensile strength of sides, 50,000 lb.

Tilting is secured by two blocks, also drop forged, within the slot, avoiding the usual ring outside and saving the space ordinarily occupied.

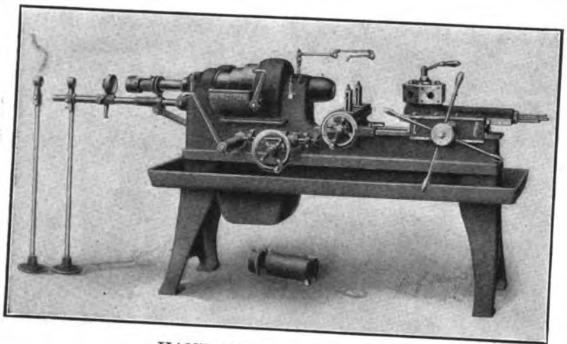
These tool posts can be readily grouped in any way desired; Fig. 2 shows one example—a four-step cone pulley. The two setscrews enable the tool to be held firmly, either level or in any tilted position within its range. A ring is also provided for use when the body of the tool post is turned so that the tool is directly over the slot in the block. Each tool is set to the required height and angle, and any single tool can be removed for grinding without disturbing the rest.

This tool post is known as the Rex and is made by the Rex Manufacturing Co., Hyde Park District, Boston, Mass.

Hand Screw Machine

To secure desired rigidity, the head and bed of this hand screw machine are cast in one piece, and the bed is ribbed to provide additional stiffness.

The spindle is a carbon-steel forging, bored and threaded to receive a collet nose. The turret is revolved



HAND SCREW MACHINE

No. 2 machine: Chuck capacity, 1 in.; diameter of turret holes, 1 in.; swing over bed, 14 in.; swing over cutoff slide, 6 in.; length to be turned, 6 in.; greatest distance from end of spindle to turret, 14 in.; horsepower required, 1½. No. 2 machine: Chuck capacity, 1½ in.; the other dimensions are proportionately greater

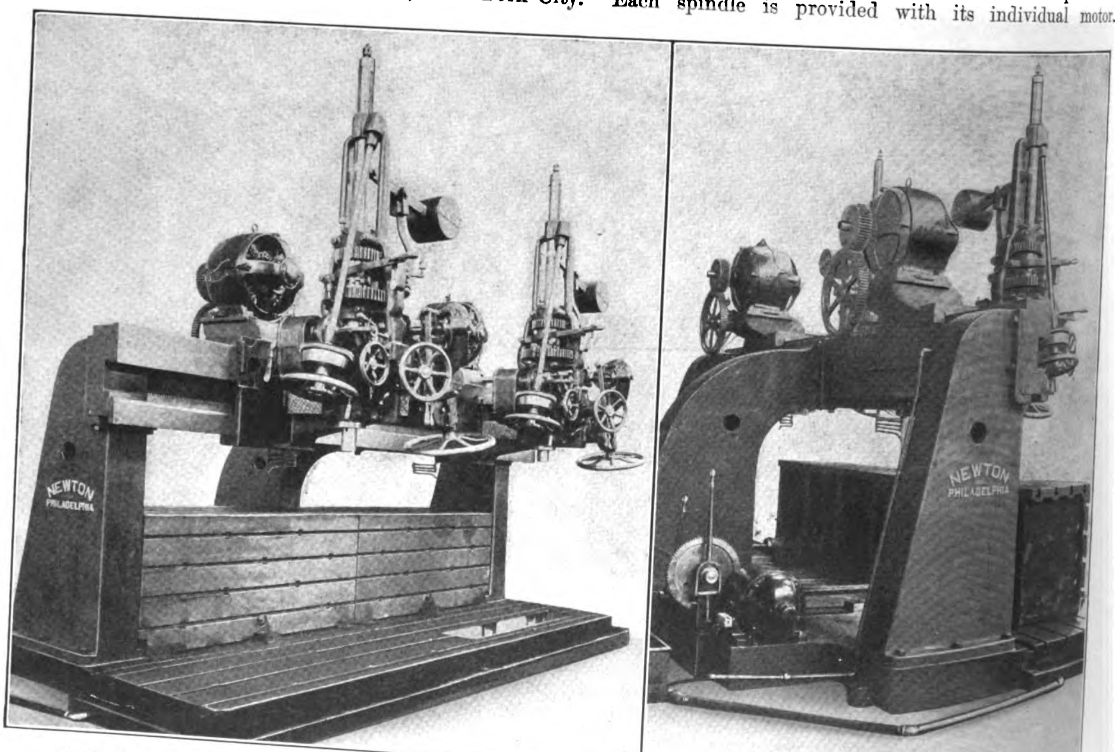
automatically by the backward movement of the turret slide. Handwheel feed for the cross-slide is provided, and positive stops for the longitudinal feed to the cutoff slide may also be furnished. The machine is made by the Himoff Machine Co., 128 Mott St., New York City.

Two-Spindle Drilling Machine

While this machine has been designed particularly for drilling locomotive frames, it can also handle general construction work on both large and small locomotives. The two spindles have an automatic geared feed, with vertical adjustment, through direct-connected gearing for the fast hand traverse and through a friction-clutched worm and wormwheel for slow adjustment. A departure in design makes the top spindle sleeve carry both the clutch and the spur-clutch gears.

Gears regulating the feed are mounted in a box, a small lever controlling the changes by means of a spring key. The spindle saddle has an in-and-out adjustment of 18 in., from 6 to 24 in. from face of rail. The cross-rail is of heavy box construction, with supporting ribs. There are two work tables, both adjustable on the floor plate, the two views showing them in different positions. These tables are also of box construction, with both vertical and horizontal working surfaces. The floor plate itself is provided with T-slots and forms a lower work table. The center upright is of special design to permit the tables, with their work, being adjusted to any desired position. They are handled by coarse-pitch screws, centrally located, which can be operated simultaneously or independently, either by hand or by power.

The drilling mechanism is similar to that of the radial machine built by the same firm—the Newton Machine Tool Works, Philadelphia, Penn.—with which a 3-in. hole was recently drilled at the rate of 3 in. per min. Each spindle is provided with its individual motor.



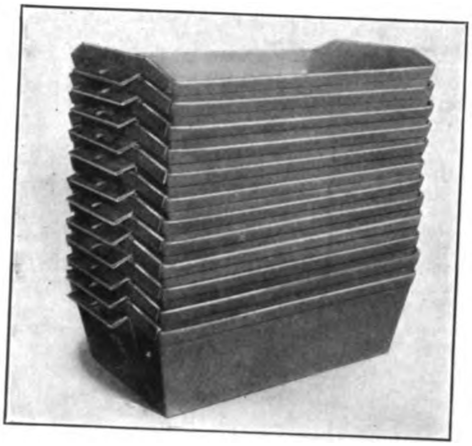
TWO VIEWS OF TWO-SPINDLE DRILLING MACHINE ESPECIALLY ADAPTED FOR LOCOMOTIVE FRAMES

Spindles, 4 in. in diameter; automatic feed, 18 in.; vertical adjustment, 18 in.; spindle speeds, 28 to 456 r.p.m.; feeds, 0.0078 to 0.0128 in. per revolution of spindle; No. 5 Morse taper; spindle centers, 48 in. to 180 in., or 15 ft.; maximum distance from floor plate to spindle 81 in.; work tables, each 20 in. wide by 26 in. high by 7 ft. 6 in.; work surface of floor plate, 39 in. wide by 210 in., or 17½ ft. long; floor space, 19x20 ft.; motors, individual electro-dynamic 10 hp. for each spindle, 300 to 1,200 r.p.m.; for moving tables, 5-hp. C. Q. General Electric

Nesting Tote Boxes

In the design of the tote box illustrated the chief consideration, in addition to strength and durability was to get a shape that would permit close nesting for convenience in transportation and storage.

The box is made from No. 18 gage material and is of one-piece construction, except for the handles. The latter are folded double and welded on. The box is so designed that near the corners, where the strain is greatest, the stock is of quadruple thickness, the side hem being continuous and running under the end hem. The raised end provides additional piling capacity in each box and permits a higher location of the handle, making more complete nesting possible.

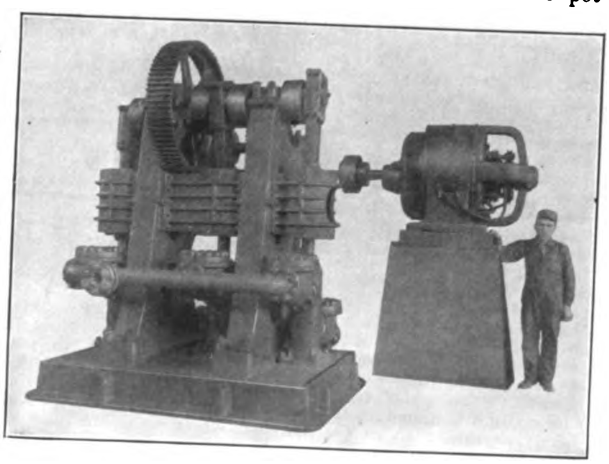


NESTING TOTE BOX
Dimensions at top, 16x10 in.; bottom, 14x8 in.; height per dozen nested, 18 in.; weight, 7 lb. each

The form of box shown is a recent product of the New Britain Machine Co., New Britain, Conn.

Triplex Hydraulic Pump

The illustration shows a new vertical triplex hydraulic pump designed and built by the Hydraulic Press Manufacturing Co., Mount Gilead, Ohio. It is of the pot-valve type and is capable of delivering a large volume of water against high pressure. The volume of water and the pressure depend upon the diameter of the plungers with which the pump may be equipped. These may vary from 4 to 5¾ in. The capacity of the pump varies proportionately with the intervening sizes of plungers.



TRIPLEX HYDRAULIC PUMP

Each plunger has a stroke of 12 in., with a normal speed of 45 strokes per minute.

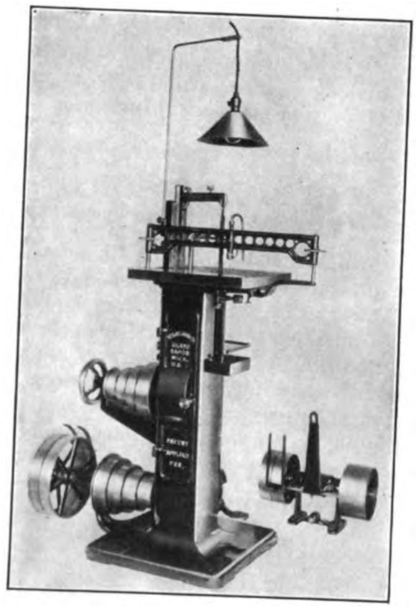
This pump is designed for direct-connected motor drive only and requires a 100-hp. motor for operating. The height of the pump is 10 ft., while the floor space required, without the motor, is 8 ft. by 5 ft. 9 in.

Die-Filing Machine

The illustration shows the most recent model of the die-filing machine made by W. D. Rearwin, Grand Rapids, Mich., and previously described on page 1006, Vol. 43.

An adjustable steel arm holds files from 4 to 12 in., straight or tapered. The machine is provided with a self-contained pump to remove filings from the work, so that the lines can be easily followed.

The graduated table tilts to 7 deg. in four ways independent of each other. A clamping arm holds the work. The arm is easily adjusted and is equally efficient on large or small pieces. A handwheel is provided to adjust the machine, and a foot shipper to start and stop it. The machine can be run with countershaft or a ½-hp. motor.



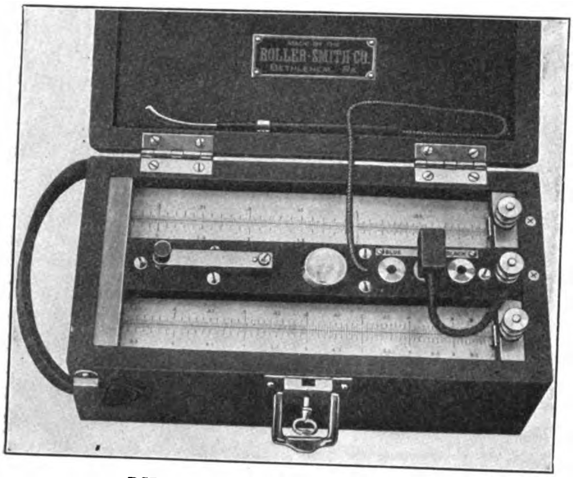
DIE-FILING MACHINE

Direct-Reading Ohmmeter

The direct-reading ohmmeter shown is the latest modified form of the type of portable ohmmeter made by the Roller-Smith Co., 203 Broadway, New York City, and was designed especially for measuring the resistance of relay points in electric signaling systems.

It is in general a slide wire bridge having self-contained galvanometer of sensitive but rugged design, self-contained dry cells which are conveniently located for renewal, galvanometer key, stylus and self-contained resistances.

The case is of hardwood, highly polished and provided with hinged top, latch and lock and leather handle.

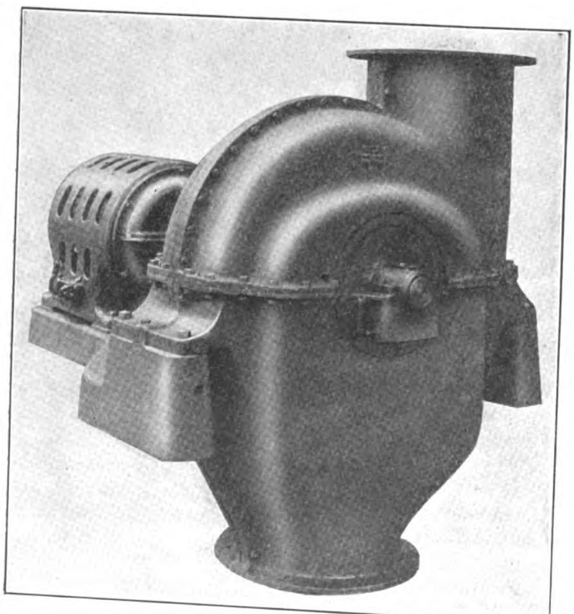


DIRECT-READING OHMMETER

There are three ranges—0-1, 0-10 and 0-100 ohms—each on a scale 15 in. long, each scale being of a different color—namely, blue, red and black. Means are thus provided for making all relay-point tests as well as many other resistance measurements within the range of the device.

Low-Pressure Turbo-Blower

The Ingersoll-Rand Co., New York City, has brought out a low-pressure turbo-blower to handle volumes from 3,000 to 35,000 cu.ft. per min. at from 1 to 2½ lb. This machine is adapted to such service as foundry cupola blowing, atomizing oil for oil burners, supplying blast to heating and annealing furnaces of various kinds, blowing air for water-gas generators, pneumatic conveying and ventilating systems of the various types.



LOW-PRESSURE TURBO-BLOWER

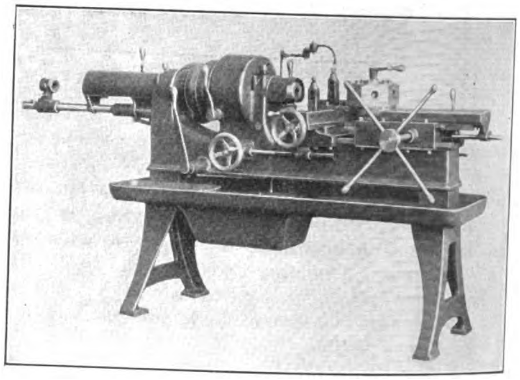
The turbo-blowers are of the single-stage double-flow type and are furnished for electric-motor, steam-turbine or waterwheel drive. Electric drive is generally employed for the classes of service mentioned, the high operative speed permitting direct coupling to the motor.

The turbo-blower maintains constant pressure while delivering any volume from zero to maximum demand and proportionately varying the electrical horsepower input.

Friction-Head Hand-Operated Screw Machine

The illustration shows a screw machine that has recently been placed on the market by the Kent-Owens Machine Co., Toledo, Ohio.

The bed and head are cast in one piece, and all gears are thoroughly protected. The spindle runs in bronze bushings provided with oil reservoirs. The turret is



FRICTION-HEAD HAND SCREW MACHINE
Capacity through wire feed, 1⅝ in.

provided with independent automatic stops for each turret station. The turret-tool locking bolts are offset to prevent injuring the shanks of the tools.

The cutoff slide is provided with a screw-operated hand adjustment in line with the spindle and is operated transversely by screw and handwheel. The machine is furnished either with or without power feed to the turret. Each machine is supplied with a pan and a lubricant pump.

NEW PUBLICATIONS

MILITARY PREPAREDNESS AND THE ENGINEER—By Ernest F. Robinson. Two hundred and twenty-four 4½x6½-in. pages; 75 illustrations; cloth bound. Clark Book Co., Inc., New York City. Price, $1.50.

This little book is the outgrowth of the material prepared by the author, who is a captain in the Corps of Engineers, N. G. N. Y., for a number of lectures given before engineering societies. The purpose behind its preparation is to place before the engineers of the United States accurate information as to the opportunities and limitations that will confront the civilian engineer in the event of war. It also shows what each one might do to prepare himself to meet the personal responsibility that would devolve upon him in case of war.

The entire book deals with the engineer activities of the army and does not touch at all upon the production of munitions. It is therefore of interest to the engineers who would enlist for active service. The subjects treated are indicated by the chapter headings, which are as follows: Introductory. How To Obtain a Military Training, The National Guard, Military Organization, Military Administration, Engineer

Troops in the Field, Fire Action, Field Fortifications, Obstacles, Siege Work, Demolitions, Military Bridges, Topographical Sketching, Needs of the Engineer in War, Conclusion.

It is undoubtedly wise for every engineer who has failed to avail himself of the opportunity to hear the military lectures that have been given during the past winter to read this book. It is estimated that for an army of 1,000,000 men 60,000 engineers would be required. Of these, 2,000 would be officers and 11,500 noncommissioned officers. These figures indicate the extent of the need of engineering experience in case of war. At the same time civilian engineering exeprience needs to edge before the engineer from private life can pass into the be supplemented by an enormous amount of military knowl- ranks of the army and become an efficient unit thereof.

THE TESTING OF MACHINE TOOLS—By George W. Burley. Two hundred and twenty-six pages, 4¼x7½ in.; 110 illustrations; indexed; cloth bound. Published by D. Van Nostrand Co., New York City. Price, $1.25.

Far too little attention is paid to the testing of machine tools. Thus this book enters a field where it should be welcome. In a series of eight chapters the author presents well-known established methods for the testing of individual parts of machine tools, shows numerous testing devices (including indicators of many kinds), shows how feeds and speeds should be observed, how cutting force should be measured, how power should be ascertained, and in Chapter IV presents much illuminating information on machine-tool efficiency.

He gives the overall efficiency of the lathe as 62 per cent., and of its slide rest as 13 per cent. The average efficiency value for a high-speed drilling machine is 77 per cent.; of a milling machine, 86.6 per cent., and of a shaper, 41.8 per cent. No factors are given for the planer, but it is stated that the results are similar to those presented for shapers.

The scope of the work is indicated by the chapter headings, which follow, and these also give a hint of the value of the work to the machine-tool builder and user. The chapter headings are: Introduction, Tests on Machine-Tool Elements for Accuracy, Machine-Tool Speed and Feed Tests, Machine-Tool Mechanical Efficiency Test, Cutting-Force Tests, Output and Power-Consumption Tests, Comparative Tool Testing, Commercial Machine-Tool Testing.

THE THEORY OF MACHINES—By Robert F. McKay. Four hundred and forty 5½x9-in. pages; 407 illustrations; indexed; cloth bound. Longmans, Green & Co., New York City. Price, $4.20 net.

Reviewed by DEXTER S. KIMBALL*

The author of this treatise states that it is an attempt to deal in a comprehensive manner with the large amount of subject matter which is included under the heading of the theory of machines. It is intended for the use of engineering students and practicing engineers. The book is in three parts as follows: Part I, Mechanics; Part II, Kinematics of Machines; Part III, Dynamics of Machines.

Part I consists of five chapters covering about one-sixth of the total subject matter. In it are discussed such topics as plane motion of a particle, force and torque, work and energy and kindred subjects that are commonly included in American books on analytic mechanics, so called.

Part II occupies one-half the volume and deals with motion in machines from the standpoint of pure mechanism. The discussion in this section corresponds closely to similar discussions in American textbooks on mechanism, though in some cases, as for instance in his treatment of belts and rope drives, the author considers the practical design of such machine elements.

Part III occupies about one-third of the book. In this section are discussed friction, static equilibrium of machines, turning-moment diagrams, governors, balancing, brakes and dynamometers. The subject matter of this section, therefore, is partly such as is covered by American books on mechanics and partly such as is discussed in American works on machine design.

It will be evident that it is difficult to make a comparison between this treatise and American books on kindred subjects where the arrangement is quite different. The discussion in Part II on kinematics compares favorably with books on mechanism now in use in American colleges as a preparation for engineering work. The subject matter of Parts I and III is usually included in mechanics in American texts, but the content would not be considered sufficient for the preparation of engineering students.

Portions of the subject matter in Part III are frequently included in books on machine design, and the author's treatment of some of these topics is not, in general, very satisfactory. One is surprised, for instance, to find no mention of the Morse chain, though the Renold chain is described. The discussion of the strength of flywheels is very weak, as is also the treatment of the lubrication of bearings in its influence on friction. The experiments of Tower are referred to, but Lasche's monumental work is not mentioned.

The treatment of the several topics is sound, no doubt, and the book may be of use as a reference for teachers and may perhaps be sufficient for the needs of certain polytechnic schools. With the possible exception of Part II, however, it it too limited in its scope to be of use in the higher technical colleges, where mechanics, kinematics and machine design are specialized and comprehensive courses. Engineering and the sciences on which it rests have become so widely extended that any book which aims to treat of several of these branches must necessarily be so concise, on the one hand, as to resemble a handbook or run a risk of being unbalanced in content or superficial, on the other. An excellent feature of the book is the list of graded problems at the end of each chapter.

*Professor of Machine Design and Construction, Sibley College, Cornell University.

PERSONALS

H. E. Streeter, who for several years was the Canadian representative of the Heald Machine Co., Worcester, Mass., is now works managers of the Precision Tool and Machine Co., Ltd., Montreal, Canada.

H. C. White, formerly production engineer of the Curtiss Motor Co., and previously department superintendent with the Pierce-Arrow Motor Car Co., has become factory manager of the Holt Mfg. Co., Stockton, Calif.

John A. Camm has resigned his position as sales manager of the Kearney & Trecker Co., Milwaukee, Wis., to become vice-president and general sales manager of the recently organized Cleveland Milling Machine Co., Cleveland, Ohio.

BUSINESS ITEMS

The McMaster-Carr Supply Co., Chicago, Ill., announces the election of Harry Channon as president and James A. Delaney as vice-president.

The Hydraulic Press Mfg. Co., Mount Gilead, Ohio, has opened a branch office at 416 Citizens Bldg., Cleveland, Ohio, in charge of Chas. E. Newell.

The headquarters of the S. K. F. Ball Bearing Co., which have been for several years located at 50 Church St., New York City, have been removed to the new home office in Hartford, Conn.

FORTHCOMING MEETINGS

National Metal Trades Association. Annual meeting, Apr. 27-28, New York, N. Y., Hotel Astor. H. D. Sayre, secretary, Peoples Gas Building, Chicago, Ill.

American Society for Testing Materials. Annual meeting June 27 to July 1, 1916, Hotel Traymore, Atlantic City, N. J. Edgar Warburg, secretary, University of Pennsylvania, Philadelphia, Penn.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Wednesday each month. J. A. Brooks, secretary, Brown University, Providence, R. I.

New England Foundrymen's Association. Regular meeting second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. J. H. Warder, secretary, 1785 Monadnock Block, Chicago, Ill.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Technical League of America. Regular meeting second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York, N. Y.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points indicated:

	Apr. 21, 1916	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$15.00	$15.00	$10.75
No. 2 X Northern Foundry, New York	20.75	20.50	14.75
No. 2 Northern Foundry, Chicago	19.00	19.00	14.25
Bessemer, Pittsburgh	21.95	21.95	14.90
Basic, Pittsburgh	18.95	19.20	13.90
No. 2 X, Philadelphia	20.50	20.00	14.25
No. 2, Valley	18.50	18.50	12.75
No. 2, Southern Cincinnati	17.90	17.90	12.40
Basic, Eastern Penn.	20.50	19.50	13.25
Gray forge, Pittsburgh	18.70	18.45	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger from jobbers' warehouse at the places named:

	New York Apr. 21, 1916	New York One Month Ago	New York One Year Ago	Cleveland	Chicago
Steel angles, base	3.15	3.10	1.85	3.25	3.10
Steel T's, base	3.15	3.15	1.90	3.25	3.10
Machinery steel (bessemer)	3.15	3.10	1.80	3.25	3.10

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse at the places named:

	New York Apr. 21, 1916	New York One Month Ago	New York One Year Ago	Cleveland	Chicago
No. 28 black	3.65	3.50	2.60	3.20	3.20
No. 26 black	3.55	3.40	2.50	3.10	3.10
Nos. 22 and 24 black	3.50	3.35	2.45	3.05	3.05
Nos. 18 and 20 black	3.45	3.30	2.40	3.00	3.00
No. 16 blue annealed	4.45	4.30	2.35	3.70	3.60
No. 14 blue annealed	4.40	4.20	2.25	3.60	3.50
No. 12 blue annealed	4.30	4.15	2.20	3.55	3.45
No. 28 galvanized	5.65	5.65	4.00	5.50	5.50
No. 26 galvanized	5.35	5.35	3.75	5.20	5.20
No. 24 galvanized	5.20	5.20	3.55	5.05	5.05

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot:

	Black Apr. 21, 1916	Black One Yr. Ago	Galvanized Apr. 21, 1916	Galvanized One Yr. Ago
¾ to 2 in. steel butt welded	72%	80%	53¼%	69½%
2½ to 6 in. steel lap welded	71%	79%	52½%	68½%
Diameter, In.				
¾	3.12	2.30	5.35	3.51
1	3.91	3.40	7.91	5.19
1¼	6.44	4.60	10.70	7.02
1½	7.70	5.50	12.79	8.39
2	10.36	7.40	17.21	11.29
2½	16.97	12.29	27.79	18.43
3	22.19	16.07	36.34	24.10
4	31.61	22.89	51.78	34.34
5	43.12	31.08	68.30	46.62
6	55.68	40.32	91.20	60.48

Bar Iron—Prices are as follows in cents per pound at the places named:

	Apr. 21, 1916	One Month Ago
Pittsburgh, mill	2.50	2.45
Warehouse, New York	3.15	3.10
Warehouse, Cleveland	3.25	3.25
Warehouse, Chicago	3.10	3.10

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-size lots, the following quotations hold:

		One Month Ago
New York	List price plus 20%	5% from list
Cleveland	List price plus 20%	List price
Chicago	List price plus 10%	List price

Boiler Tubes—From Pittsburgh, the following are the less-carload basing discounts for lap-welded boiler tubes:

1¼ and 2 in.	47%	3½ to 4½ in.	56%
2¼ in.	44%	5 and 6 in.	49%
2½ and 2¾	50%	7 to 13 in.	55%
3 and 3¼	55%		

These discounts apply to standard gages and to even gages not more than 4 gages heavier than standard. For long tubes charge 10% net extra as follows: 1¾ in. size over 18 ft. and not exceeding 22 ft.; 2 to 3 in. sizes over 22 ft. and not exceeding 24 ft.; 3¼ to 13 in. sizes over 22 ft. and not exceeding 25 ft.

High Speed Tool Steel containing from 10 to 18% tungsten sells as follows per pound in New York:

Billets ....$2.35 Bars $3.00

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York Today	New York One Year Ago	Cleveland	Chicago
$5.50	$3.25	$5.05	$4.25

In coils an advance of 50c. is usually charged.

METALS

Miscellaneous Metals—The present quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	New York Apr. 21, 1916	New York One Month Ago	New York One Year Ago
Copper, electrolytic (carload lots)	30.00	27.00	18.00
Tin	50.00	49.50	43.00
Lead	7.75	8.50	4.20
Spelter	19.87½	18.00	12.00
ST. LOUIS			
Lead	7.75	8.40	...
Spelter	19.25	17.87½	...

At the places named, the following prices in cents per pound prevail:

	New York Apr. 21, 1916	New York One Month Ago	New York One Year Ago	Cleveland	Chicago
Copper sheeets, base	37.50	35.50	22.50	36.50	35.50
Copper wire (carload lots)	36.50	35.50	19.00	34.50	37.00
Brass rods, base	41.50	37.50	18.25	36.00	38.00
Brass pipe, base	44.50	41.50	21.00	43.00	46.00
Brass sheets	40.50	37.50	18.50	36.00	38.00
Solder ½ and ½ (case lots)	37.87½	30.50	32.00	35.50	34.75

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York Apr. 21, 1916	New York One Month Ago	Cleveland Apr. 21, 1916	Cleveland One Month Ago
Copper, heavy and crucible	24.50	23.00	25.00	25.00
Copper, heavy and wire	24.00	22.00	24.00	24.00
Copper, light and bottoms	20.50	19.00	24.00	21.00
Lead, heavy	6.00	6.00	7.00	7.50
Lead, tea	5.50	5.50	6.00	6.00
Brass, heavy	14.50	14.00	20.00	19.50
Brass, light	12.00	12.00	13.00	13.00
No. 1 yellow rod brass turnings	15.25	14.00	14.50	15.00
Zinc	13.00	13.00	16.00	16.00

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	31.50	32.00	32.50	33.00	36.00
¼ to 5/16	31.25	31.75	32.25	32.75	35.75
⅜ to 1⅞	31.00	31.50	32.00	32.50	35.50
1 15/16 to 2⅞	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3 7/16	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3½ to 3 15/16	32.25	32.75	33.25	35.75	36.75
Squares					
3 1/16 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4 15/16	33.00	33.50	36.00	36.50	37.50
5 to 6 15/16	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick. Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Antimony—Chinese and Japanese brands are quoted in cents per pound for spot delivery, duty paid:

	Apr. 21, 1916	One Month Ago
New York	40.00	45.00
Cleveland	50.00@55.00	50.00
Chicago	45.00@48.00	45.00

Copper Bars from warehouse sell as follows in cents per pound:

	Apr. 21, 1916	One Month Ago
New York	42.00	39.50
Cleveland	31.50	39.00
Chicago	38.25	37.00

Copper Sheets—In New York hot rolled 16 oz. (large lots) base per lb. is 36.50c.; cold rolled 14 oz. and heavier add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places named:

	New York	Cleveland	Chicago
Commercial	25.00@30.00	22.50	25.00@30.00
Best grade	55.00@60.00	59.50	60.00

SHOP SUPPLIES

Nuts—From warehouses at the prices named, on fair sized orders the following amount is deducted from list:

	New York		Cleveland		Chicago	
	Apr. 21, 1916	One Month Ago	Apr. 21, 1916	One Month Ago	Apr. 21, 1916	One Month Ago
Hot pressed square	$2.75	$3.00	$3.50	$3.70	$3.25	$3.70
Hot pressed hexagon	2.75	3.20	3.75	3.80	3.25	3.80
Cold punched square	2.50	3.00	3.00	3.50	3.00	3.75
Cold punched hexagon	3.00	3.75	3.75	4.25	3.50	4.50

Semifinished nuts sell at the following discounts from list price:

New York.... 65% Cleveland....70-10% Chicago.... 70%

Carriage Bolts—From warehouses at the places named the following discounts from list price are in effect:

	New York	Cleveland	Chicago
3/8 by 6 in.	50 and 5%	65%	60 and 5%
Larger and longer	40 and 5%	50 and 5%	50%

At this rate the net prices are as follows:

Length, In.	New York 1/4	New York 1/2	New York 3/4	Cleveland 1/4	Cleveland 1/2	Cleveland 3/4	Chicago 1/4	Chicago 1/2	Chicago 3/4
1½	$0.48	...	...	$0.35	...	...	$0.38	...	...
2	.53	...	...	.38	...	...	.42	...	...
2½	.57	$1.85	$4.85	.42	$1.55	$4.04	.46	$1.63	$4.25
3	.62	1.41	5.16	.45	1.68	4.27	.50	1.77	4.50
3½	.67	2.17	5.42	.49	1.81	4.51	.54	1.91	4.75

Machine Bolts—From warehouses at the places named the following discounts hold:

	New York	Cleveland	Chicago
3/8 by 6 in. and smaller	50 and 10%	65 and 10%	60 and 10%
Larger and longer up to 1 in. by 30 in.	45%	50 and 15%	50 and 10%

Length In.	New York 1/4	New York 1/2	New York 1	Cleveland 1/4	Cleveland 1/2	Cleveland 1	Chicago 1/4	Chicago 5/8	Chicago 1
2	$0.81	$2.13	$8.80	$0.57	$1.22	$5.04	$0.64	$1.74	$7.20
2½	.84	2.27	9.30	.60	1.30	5.32	.67	1.85	7.60
3	.88	2.41	9.79	.63	1.38	5.61	.70	1.97	8.00
3½	.91	2.55	10.29	.67	1.46	5.89	.73	2.08	8.40

Wrought Washers—From warehouses at the places named the following amount is deducted from list price:

New York.... $4.25 Cleveland.... $6.00 Chicago.... $6.30

At this rate, the net prices follows:

Diameter, In.	New York	Cleveland	Chicago
9/16	$9.25	$8.00	$7.70
3/4	7.45	6.20	5.90
7/8	6.65	5.40	5.10
1	5.75	4.50	4.20
1¼	4.95	3.80	3.50
1⅜	4.45	3.40	3.10
1½	4.35	3.30	3.00
1¾	4.25	3.20	2.90
2, 2¼, 2½, 2¾	4.05	3.10	2.80
3, 3¼	4.25	3.20	2.70
3½, 3¾	4.25	3.20	2.90
4, 4¼, 4½	4.75	3.50	3.20

For cast-iron washers the base price per 100 lb. is as follows:

New York.... $2.50 Cleveland.... $2.00 Chicago.... $2.00

Rivets—The following quotations are allowed for fair sized orders from warehouse:

	New York	Cleveland	Chicago
Steel 7/16 and smaller	60%	60—10%	52½%
Tinned	60%	60—10%	52½%

Button heads 3/4, 5/8, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.:

New York.... $4.75 Cleveland.... $3.40 Chicago.... $3.50

Cone heads, same sizes:

New York.... $4.85 Cleveland.... $3.50 Chicago.... $3.60

For the following sizes, the extras over the above prices in cents per 100 lb. are as follows:

1¼ to 1¾ in. long, all diameters	$0.25
5/8 in. diameter	0.15
½ in. diameter	0.50
1 in. long and shorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

Copper Rivets and Burs sell at the following rate for orders 100 lb. and over:

	Rivets	Burs
Cleveland	List price	List price
Chicago	List price	List price
New York	20% from list price	List price

Bolt Ends—Fair-sized orders of bolt ends with hot-pressed nuts, from warehouses at the places named, sell at the following discount from list price:

New York.. 45% Cleveland.. 50—5% Chicago.. 50—10%

Nails—Wire nails f.o.b. Pittsburgh sell at $2.40; galvanized, 1 in. and longer, $4.40, and shorter, $4.90. These prices are to regular customers and delivery is made at the mill's convenience. From warehouse wire and cut nails sell as follows:

	New York	Cleveland	Chicago
Wire	2.90	2.95	2.70
Cut	2.90	2.85	2.70

MISCELLANEOUS

Seamless Drawn Tubing—The base price in cents per pound from warehouse is as follows:

	New York	Cleveland	Chicago
Brass	41.50	45.50	43.00
Copper	42.50	44.50	42.00

For immediate stock shipment the following quotations hold:

Diameter, In.	Copper New York Apr. 21, 1916	Copper New York One Year Ago	Copper Cleveland	Brass New York Apr. 21, 1916	Brass New York One Year Ago	Brass Cleveland
3/4 to 2½	45.50	22.50	44.50	43.50	19.50	45.50
3	45.50	22.50	44.50	43.50	19.50	45.50
3½	45.50	23.50	44.50	45.00	20.50	45.50
4	46.50	24.50	45.50	46.00	21.50	46.50
4½	47.50	26.50	47.50	48.00	23.50	48.50
5	49.50	28.50	49.50	50.00	25.50	50.50
6	51.50	29.50	51.50	51.00	26.50	52.50
7	52.50	31.50	51.50	53.00	28.50	52.50
8	54.50	33.50	55.50	55.10	30.50	56.50

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire

3/8, 11/32, 5/16, 1/4, 7/32, 3/16	8.50
No. 8, 5/32 and No. 10	9.25
1/8	10.00
No. 12	11.00
3/32, No. 14 and 1/16	12.00
No. 18	14.00
No. 20	16.00

Special Welding Steel

1/8	33.00
5/32	30.00
3/16	28.00

Cast-Iron Welding Rods

1/4 by 19 in. long	22.00
3/16 by 12 in. long	26.00
3/8 by 19 in. long	20.00
1/2 by 21 in. long	20.00

Vanadium Wire in Coils or Sticks

1/16	15.50
3/32	15.00
1/8	14.00
5/32	12.00
3/16 and larger	11.00

Tin Plates—The following prices are in effect from warehouses at the places named:

			New York Apr. 21, 1916	New York One Month Ago	Cleveland Apr. 21, 1916	Cleveland One Month Ago	Chicago Apr. 21, 1916	Chicago One Month Ago
Coke tin plate, 14x20:								
100 lb.			$6.00	$5.00	$5.40	$4.87½	$5.50	$4.75
I. C. 107 lb.			6.15	5.15	5.55	5.05	5.65	4.90
Terne plate, 20x28:								
Base Wgt.	Net Wgt.	Coating						
100 lb.	200	8	$10.00	$9.00	$9.10	$8.60	$8.90	$8.50
I. C.	214	8	10.30	9.30	9.35	8.90	9.25	8.90
I. X.	270	8	12.30	11.30	11.60	11.10	11.40	12.75
I. C.	218	12	12.00	12.00	10.50	10.10	10.75	10.80
I. C.	221	15	13.00	13.00	10.50	10.90	11.60	11.25
I. C.	226	20	13.50	13.50	12.50	12.20	12.50	12.20
I. C.	231	25	14.25	14.25	13.50	13.40	13.75	15.35
I. C.	236	30	15.50	15.50	14.50	12.40	14.75	15.60
I. C.	241	35	17.00	17.00	15.75	15.60	15.85	16.20
I. C.	246	40	19.00	19.00	16.75	16.60	17.10	16.80

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Apr. 1	Apr. 8	Apr. 15	Apr. 22
Prompt furnace	$3.25@3.75	$2.75@3.00	$2.75@3.00	$3.00
Prompt foundry	3.75@4.00	3.75	3.75@4.00	3.75@4.00

Cotton Waste—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	11.00@13.00	11.00@14.00	11.00@13.00
Colored mixed	8.00@10.00	7.50@11.00	8.00@10.50

Sal Soda sells as follows per 100 lb.:

New York.............. $1.90 Cleveland.............. $2.25
Chicago..............$1.90

Roll Sulphur in 360-lb. bbl. sells as follows per 100 lb.

New York.... $2.25 Cleveland.... $2.75 Chicago.... $2.85

Foundry and Fire Clay in New York sells at $2 per lot of 300 lb. This does not include delivery charges.

Zinc Sheets—The following prices in cents per pound prevail:

Carload lots, f.o.b. mill................................ 25.00

	New York	Cleveland	Chicago
In casks	26.00	26.00	26.50
Broken lots	26.50	26.50	27.00

Linseed Oil—These prices are per gallon:

	New York	Cleveland	Chicago
Raw in barrels	$0.81	$0.90	$0.83
5-gal. cans	.91	.80	.91

Boiled, it is 1c. per gal. higher.

White and Red Lead, in cents per pound, sell as follows:

	Red Dry	Red In Oil	White Dry and In Oil
100-lb. keg	10.50	11.00	10.50
25- and 50-lb. kegs	10.75	11.25	10.75
12½-lb. keg	11.00	11.50	11.00
1- to 5-lb. cans	12.50	12.50	12.50

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

The Boston & Maine R.R. will construct a 41x88-ft. machine repair shop at Portsmouth, N. H.

Fire, Apr. 16 damaged the garage of the Haynes Hotel on Portland, St. Rochester, N. H. Loss, $30,000.

The Commercial Garage plans to build a 1-story, 86x126-ft. garage on Commercial St., Adams, Mass. Estimated cost, $40,000.

The George Crow Auto Co. will build a 2-story, 90x193-ft. garage on Commonwealth Ave., Allston, Boston, Mass. Estimated cost, $25,000.

B. Ludwing has awarded the contract for the construction of a 3-story, 50x79-ft. reinforced-concrete garage at Commercial St. and Greenough Lane, Boston, Mass. Estimated cost, $100,000.

The contract has been awarded for the construction of a 2-story, 92x100-ft. garage at Brookline, Mass., for the Brookline County Club.

Plans are being prepared by George P. B. Alderman & Co., Arch., for the construction of a 1-story garage for K. R. Charlton, 243 Elm St., Holyoke, Mass. Estimated cost, $20,000.

The Morse Twist Drill Co. plans to construct an addition to its plant at New Bedford, Mass. Estimated cost, $200,000.

The Gillette Safety Razor Co. plans to construct a 7-story addition to its plant in South Boston, Mass.

The Morris Manufacturing Co., Springfield, Mass., recently incorporated with $250,000 capital stock, plans to construct a plant for the manufacture of die-casting machines. Albert W. Morris, Springfield, is interested.

The contract has been awarded for an addition to the plant of the Spencer Wire Co., Worcester, Mass.

The O. Butts & Son, 73 Grove St., East Providence, R. I., plans to construct a 1-story, 40x60-ft. machine shop on Pawtucket Ave., East Providence.

The American & British Manufacturing Co., Providence, R. I., manufacturer of metals, plans to construct an addition to its plant on Charles St.

A 4-story factory will be constructed at Pine and Cherry St., Bridgeport, Conn., by the Bridgeport Metal Goods Co.

The Sterling Blower Co. plans to construct two 1-story, 32x180-ft. and 42x130-ft. additions to plant at Hartford, Conn.

As soon as the ground permits the J. N. Lapointe Co., manufacturer of broaching machines and broaches, will resume work which was stopped in February on the construction of 3-story, 50x140-ft. building at New London, Conn. This construction will be of stone, brick and concrete and in which the new office will be located. The company has already started the raising of 1-story on the new building completed last year, making same 3-story instead of two and will also extend 27-ft. on the main 2-story building.

The Ellwill Garage and Machine Shop, Stamford, Conn., is in the market for a drill press and shaper.

Plans are being prepared for the construction of a 1-story, 49x82-ft. garage at Warehouse Point, Conn., for J. J. Cahill. Estimated cost, $15,000.

The contract has been awarded for the construction of an addition to the plant of the American Pin Co. at Waterbury, Conn.

MIDDLE ATLANTIC STATES

Plans have been prepared for the construction of a 3-story addition to the plant of the Barcalo Manufacturing Co., Louisiana and Kentucky St., Buffalo, N. Y., manufacturer of brass beds. Estimated cost, $35,000.

The Cyphers Incubator Co. will build a 2-story addition to its plant at Dewey Ave. and the New York Central Railroad Belt Line, Buffalo, N. Y. Estimated cost, $35,000.

Plans are being prepared for the construction of an addition to the plant of the Houk Co., manufacturer of wire wheels for automobiles, at Elmwood Ave. and New York Central R.R., Buffalo, N. Y.

Preliminary plans prepared for 5-story, 85x152-ft. garage for Charles Weihe, Bay St. and Williams Ave., City Island, N. Y. Estimated cost, $50,000.

The Crescent Garage, Hudson, N. Y., has awarded the contract for the construction of a 2-story garage. Estimated cost, $25,000.

Pasquale Santini, 609 Jackson Ave., New York, N. Y. (Borough of Bronx), has had plans prepared by Goldner & Goldberg, Arch., 391 East 149th St., Bronx, for a 6-story garage. Estimated cost, $50,000.

A. C. Grossman, 1262 Boston Rd., New York, N. Y. (Borough of Bronx), has awarded the contract for the construction of an addition to his garage. Estimated cost, $10,000.

The contract has been awarded for the construction of a 12-story automobile service building for the Estate of Mary E. Pinchot, New York, N. Y. Estimated cost, $300,000. A. R. E. Pinchot, 60 Wall St., New York, N. Y. (Borough of Manhattan), interested.

Plans have been prepared by J. H. Oberlies, Arch., Granite Bldg., Rochester, N. Y., for 1-story foundry for Northwestern Brass and Aluminum Co., Rochester. Estimated cost, $10,000. A. Hetzler, 14 Riley St., in charge.

The American Locomotive Co., Schenectady, N. Y., will construct an addition to its plant to be used as a cylinder shop.

The Mica Insulator Co., manufacturer of electrical supplies, 68 Church St., New York, N. Y., will soon award the contract for the construction of an addition to its plant at Schenectady, N. Y.

The Lefever Arms Co., Maltbie, N. Y., is having plans prepared by Taber & Baxter, Arch., Gurney Bldg., Syracuse, for a 2-story factory at Syracuse. Estimated cost, $25,000.

The contract has been awarded for the construction of a 2-story building at Oneida and Temple St., Syracuse, N. Y., for the Engel Manufacturing Co., 239 West Genesee St., Syracuse, manufacturer of hardware.

The contract has been awarded by the Hammond Steel and Forging Co., 1400 Milton Ave., Syracuse, N. Y., for a 1-story addition to its plant.

Plans are being prepared by Tabor & Baxter, Arch., Gurney Bldg., Syracuse, N. Y., for a 3-story garage and service station for the Syracuse Motor Car Co. Estimated cost, $10,000. D. Grody is Pres.

The contract has been awarded for the construction of a 2-story addition to the plant of the Habirshaw Electric Cable Co., Yonkers, N. Y. Estimated cost, $40,000.

The Standard Underground Cable Works is building an addition to its plant at Mechanic St. and De Kalb Ave., Perth Amboy, N. J.

The Ransome Concrete Machinery Co. plans to enlarge its plant at Dunellen, N. J.

F. L. Smith & Co., 50 Church St., New York, N. Y., is constructing an addition to its machine shop on North Ave., Elizabeth, N. J.

Plans have been prepared for an addition to the leather factory of Berkowitz, Goldsmith & Spiegel, Garden St., Newark, N. J. Noted Apr. 6.

The contract has been awarded for an addition to the plant of the Warren Foundry and Machine Co., Phillipsburg, N. J.

The Wycock Machine Co., 190 Jefferson St., Trenton, N. J., has awarded the contract for a 1-story machine shop. Estimated cost, $3,500.

An addition is being built to the plant of the Frog and Switch Manufacturing Co., Carlisle, Penn.

The contract will soon be awarded for an addition to the plant of the Ingersoll-Rand Co., Easton, Penn., manufacturer of machinery. Noted Mar. 16.

The Franklin Railway Supply Co., Franklin, Penn., has awarded the contract for the construction of a 2-story addition to its plant. Estimated cost, $20,000.

Plans have been prepared for the construction of a 4-story, 40x80-ft. addition to the plant of the Ajax Metal Co., Frankford, Penn. Noted Apr. 20.

The Lebanon Boiler Works, Lebanon, Penn., is building several additions to its plant.

The contract has been awarded for the construction of a 5-story factory for James F. Burns, 713 Cherry St., Philadelphia, Penn., manufacturer of brass goods. Estimated cost, $18,000.

The Eynon-Evans Co., 15th and Clearfield St., Philadelphia, Penn., manufacturer of machinery, has awarded the contract for the construction of a factory. Estimated cost, $10,000.

Bids are being received by the Hess Machine Co., 45th St and Lancaster Ave., Philadelphia, Penn., for a 2-story machine shop. Noted Apr. 20.

Plans are being prepared by E. L. School, Arch., 31 North 6th St., Reading, Penn., for a 3-story garage for E. S. Youse Co., 46 North 5th Ave., Reading.

Fire recently damaged the plant of the Silver Co., South Bethlehem, Penn., manufacturer of spark plugs. Loss, $70,000.

Plans are being prepared for the construction of a foundry at Havre de Grace, Md., for the Maryland Metal Cross Tie Co., 627 Munsey Bldg., Baltimore, Md. Noted Feb. 17.

The Hilles & Jones Co., Wilmington, Del., manufacturer of punching and shearing machinery, has purchased the old iron rolling mills adjoining its property, and will improve same for the manufacture of its specialty. Alfred R. Jones is Pres.

SOUTHERN STATES

The International Save-a-Life Fender Co., Parkersburg, W. Va., plans to construct a factory. Estimated cost, $100,000.

The Americus Automobile Co., Americus, Ga., will receive bids about Sept. 1 for a 3-story building.

The Seaboard Air Line Ry., Atlanta, Ga., contemplates an expenditure of $150,000 for improving its shops and yards at Howell, Ga. W. D. Faucette, Norfolk, Va., is Ch. Engr.

The Ford Motor Co., Detroit, Mich., will build an assembling plant and repair shop at Macon, Ga. Estimated cost, $20,000.

Plans are being prepared by Mason Maury, Arch., Bd. of Trade Bldg., Louisville, Ky., for a 2-story addition to the plant of the Louisville Drying Machinery Co. C. E. Geiger, Baxter Ave. and Hull St., Louisville, is Pres. and Mgr.

A. and C. Vogt, Louisville, Ky., plan to organize a company to purchase the plant at 1492 West Main St. and construct an addition for the manufacture of machinery.

E. Keetenacker, Newport, Ky., has awarded the contract for the construction of a garage. Estimated cost, $20,000.

MIDDLE WEST

The contract has been awarded for the construction of a 65x150-ft. addition to the plant of the American Steel Foundries Co., Alliance, Ohio.

Plans are being prepared for the construction of a sheet steel mill at Canton, Ohio, for the Republic Stamping and Enameling Co.

John Eggers will build a garage at 2622-30 Kemper Lane, Cincinnati, Ohio.

The contract has been awarded for the construction of a 2-story, 60x160-ft. factory on McMillan St., Cincinnati, Ohio, for the Gruen Watch Manufacturing Co. Estimated cost, $50,000. Noted Jan. 20 and Apr. 6.

The contract has been awarded for the construction of a plant at Euclid Ave. and Nickel Plate R.R., Cleveland, Ohio, for the Cleveland Milling Machine Co., 313 Engineers' Bldg. Estimated cost, $800,000.

The Cleveland Wire Spring Co. has awarded the contract for the construction of a 1-story, 122x362-ft. factory at Cleveland, Ohio. Estimated cost, $80,000. Noted Mar. 23 and Apr. 6.

Plans have been prepared for the construction of a 2-story, 87x110-ft. and 31x50-ft. addition to the plant of the D. G. Hutchcraft Co., 1318 West 78th St., Cleveland, Ohio. Noted Apr. 20.

The Potter Co. has leased a site at 1600 West Superior Ave., Cleveland, Ohio, and will establish a factory for the manufacture of hardware.

The Dayton Body Co. will build a 4-story, 64x384-ft. factory at Dayton, Ohio.

The Miami Fireproof Door Co., recently organized, plans to construct a plant at Milford, Ohio.

Strob & Son will construct a garage on Main St., Montpelier, Ohio.

The Napoleon Manufacturing Co. plans to establish a factory at Napoleon, Ohio, for the manufacture of automobiles. F. M. McGraw is Gen. Mgr.

Plans are being prepared for the construction of a sheet steel plant at Niles, Ohio, for Jacob F. Waddell. Noted Apr. 13.

The Monarch Machine Co. will build an addition to its plant at Sidney, Ohio.

The Gschwind Furnace Co. plans to construct a plant at Youngstown, Ohio.

Work will soon be started on the construction of an addition to the plant of the National Car Coupler Co. at Attica, Ind. Estimated cost, $100,000. R. J. Harrison, Secy. and Geng. Mgr. Noted Mar. 23.

The contract has been awarded for the construction of a 2-story, 90x104-ft. garage at Ft. Wayne, Ind., for J. Poinsette, 1016 Maumee Ave. Noted Feb. 24.

The contract has been awarded for the construction of an addition to the plant of the Peerless Wire Goods Co. on Elizabeth St., LaFayette, Ind.

The contract has been awarded for the construction of a foundry for Gavin Ritchie & Son at Battle Creek, Mich. Estimated cost, $7,000.

Press reports state that the General Motors Co. plans to enlarge its plant at Bay City, Mich.

The contract has been awarded for the construction of a factory on Piquetts Ave., Detroit, Mich., for the Detroit Auto Crank Co.

The General Aluminum and Brass Manufacturing Co., Boulevard and St. Aubin Ave., Detroit, Mich., plans to enlarge its plant at Detroit.

The Northway Motor and Manufacturing Co., Maybury St. and Grand Trunk Ry., Detroit, Mich., plans to construct an addition to its plant at Detroit. Estimated cost, $13,000.

The Schermack Co., 1606 Kresge Bldg., Detroit, Mich., manufacturer of vending machines, has been granted a permit for the construction of a 2-story factory on Baltimore St., Detroit.

Plans are being prepared for the construction of a 2-story, 50x200-ft. factory at Grand Rapids, Mich., for the Grand Rapids Blow Pipe and Dust Arrester Co.

The Wilmarth & Norman Co., manufacturer of drill grinders, is constructing a plant at 1175 Monroe Ave., Grand Rapids, Mich. Noted Oct. 7 and Apr. 13.

Bids have been received for the construction of a plant at Horton and Leroy St., Jackson, Mich., for the Briscoe Motor Co. Estimated cost, $60,000. Noted Oct. 21.

Plans are being prepared by Fisher Bros., Arch., Fisher Bldg., Pontiac, Mich., for the construction of a 2-story, 50x208-ft. garage and salesroom for Howard Fawcett at Pontiac. Estimated cost, $20,000.

The Ford Motor Co. contemplates constructing a 1-story, 60x100-ft. addition to its factory at Saginaw, Mich. Estimated cost, $10,000. J. C. Erd is Mgr.

We have been advised that the Roesch Stove and Manufacturing Co. is building a 50x200-ft. factory at Belleville, Ill., and is in the market for sheet metal working machinery. Estimated cost, $5,000. Noted Apr. 13.

The Christopher Motor Co., 3310 Sheffield Ave., Chicago, Ill., will construct a 50x100-ft. addition to its plant at Chicago. Estimated cost, $20,000.

The contract has been awarded for the construction of a 7-story factory on Jackson Blvd., Chicago, Ill., for A. B. Dick Co., manufacturer of labor saving office devices. Estimated cost, $60,000.

The Morava Construction Co., 8431 Etewart Ave., Chicago, Ill., will build a 1-story reinforced-concrete addition to its machine shop at Chicago. Estimated cost, $5,000.

The contract has been awarded for the construction of a 2-story garage at Chicago, Ill., for Thomas P. Smith, Winnetka.

The contract has been awarded for the construction of a 1-story, 60x125-ft. garage for Gottschalk & Son, 1603 Aberdeen St., Chicago Heights, Ill. Estimated cost, $10,000.

The Buchanan Manufacturing Co., manufacturer of wire stretchers, plans to construct an addition to its plant at Eldorado, Ill.

The Geneva Foundry and Machine Co. has awarded the contract for the construction of a 1-story addition to its foundry at Geneva, Ill. Noted Jan. 6.

Plans are being prepared by Charles W. Webster, Arch., for the construction of a 1-story, 30x80-ft. addition to the plant of the Joliet Stove Works at Joliet, Ill.

The contract has been awarded for the construction of a 2-story, 75x290-ft. wire mill at Joliet, Ill., for the Syracuse Crucible Steel Co. of America. Estimated cost, $50,000.

Brown & Zimmerman plans to establish a foundry for the manufacture of stoves at Neoga, Ill. Estimated cost, $35,000.

The Junger Stove and Range Co. plans to construct an addition to its plant at Grafton, Wis.

Plans are being prepared for the construction of a garage at Merton, Wis., for the Merton Dairy Products Co.

The Badger Auto Body Co., Milwaukee, Wis., has leased a 2-story factory on Lisbon St., Milwaukee, and will remodel it for the manufacture of auto trucks.

Bids have been received for the construction of a garage on 13th St., Milwaukee, Wis., for M. Hilgendorf.

Bids are being received for the construction of a 45x125-ft. garage and repair shop for Ira Ludwig, 19th and Center St., Milwaukee, Wis.

Plans are being prepared for the construction of a 2-story, 50x120-ft. garage and machine shop at Osceola, Wis. for T. C. Nagler. Estimated cost, $12,000.

The Optenberg Iron Works, South 7th St. and Clara Ave., Sheboygan, Wis., contemplates constructing a 1-story factory at Sheboygan.

WEST OF THE MISSISSIPPI

Plans are being prepared for a factory for the McCadden Machine Works, St. Cloud, Minn.

The Omaha Van and Storage Co., 16th and Leavenworth St., Omaha, Neb., has awarded the contract for the construction of a 1-story garage. Estimated cost, $10,500.

We have been informed that the Panama Rubber Co., St. Louis, Mo., does not plan to install equipment in its plant for the manufacture of motor accessories as stated in our issue of Apr. 13.

The Houston Pneumatic Puncture Proof Wheel Co. plans to enlarge its plant at Houston, Tex.

The Traylor-Love Co., Sierra Blanca, Tex., will construct a garage and machine shop.

A foundry and machine shop for the manufacture of separators will be established by the Armstrong Steam Separator Co., Hobart, Okla., recently incorporated with $100,000 capital stock. C. Armstrong is interested.

WESTERN STATES

The Southern Pacific Co. will rebuild its machine shops at Naco, Ariz., recently destroyed by fire.

M. Randle plans to construct a garage and machine shop at Morton, Wash.

Mitchell Bros. has purchased a site on 3rd St., Spokane, Wash., and plans to construct a garage and machine shop. Estimated cost, $10,000.

R. E. Ruffschmidt and C. J. Dugan, Portland, Ore., will build a foundry at Bend, Ore.

Norris K. Davis, 400 7th Ave., San Francisco, Calif., plans to construct a 1-story addition to its machine shop at San Francisco.

The Simmons Co. has awarded the contract for the construction of a factory at North Point and Powell St., San Francisco, Calif., for the manufacture of metal beds. Estimated cost, $40,000.

The Sperry Flour Co., 332 Sansome St., San Francisco, Calif., has awarded the contract for the construction of a 1-story, 97x120-ft. garage at Greenwich and Sansome St., San Francisco. Estimated cost, $20,000. Noted Feb. 10.

The Standard Oil Co. will construct a 1-story reinforced-concrete garage on 16th Ave., San Francisco, Calif. Estimated cost, $12,000.

CANADA

Bids are being received for the construction of a foundry at Dartmouth, N. S., for Williston Steel Foundry Co. Estimated cost, $16,000.

The Springsteen & Co. will rebuild its garage at Blenheim, Ont., recently destroyed by fire with a loss of $16,00.

Bids are being received for the construction of a 2-story brick and concrete garage for Taylor Bros., Ltd., Carleton Place, Ont.

The Chalmers Motor Co., Detroit, Mich., has purchased the plant of the Tate Electric Co. at Ford City, Ont., and will install new machinery.

The Canadian Hart Wheels Co. will construct an addition to its plant on Burton St., E., Hamilton, Ont. Estimated cost, $7,000.

The British American Canners will install machinery in plant purchased at McGregor, Ont. William Wall is Mgr.

The Imperial Motor Co., 150 Albert St., Ottawa, Ont., plans to construct an addition to its plant at Ottawa. L. H. Roy is Mgr.

The Corbet Foundry and Machine Co., Owen Sound, Ont., is in the market for a heavy duty screw cutting engine lathe, 16-in. swing with 6 ft. between centers.

Plans are being prepared for rebuilding the plant of the O'Briens Munitions Co. at Renfrew, Ont., which was recently damaged by fire. Estimated cost, $75,000.

Ford & Featherstone, 55 King St., West Hamilton, Ont., for the manufacture of vaults, safes, etc.

GENERAL MANUFACTURING

NEW ENGLAND STATES

The Maine Coated Paper Co. plans to construct an addition to its plant at Rumford, Maine. Estimated cost, $200,000.

The contract has been awarded for the construction of a 3-story woolen mill for the Troy Blanket Co., Troy, N. H. Noted Apr. 13.

The Boston Duck Co. has awarded the contract for the construction of a 5-story, 130x400-ft. mill at Bondsville, Mass. Estimated cost, $275,000.

The contract has been awarded for the construction of an addition to the plant of the Massachusetts Rubber Co. at Cambridge, Mass. Estimated cost, $35,000.

The contract has been awarded for the construction of a 4-story addition to the plant of the Bay State Paper Co. at Dalton, Mass.

The Central Worsted Co. plans to construct a 2-story addition to its plant at Hartford, Conn. Estimated cost, $40,000.

MIDDLE ATLANTIC STATES

The Superior Manufacturing Co., Hoosick Falls, N. Y., manufacturer of knit goods, has awarded the contract for a 4-story addition to its plant. Estimated cost, $30,000.

The National Air Cell Co., New York, N. Y. (Borough of Brooklyn), manufacturer of asbestos for pipe covering, has acquired a site in the South Cove section of Jersey City, N. J., and will construct a reinforced-concrete factory. John A. Schawarth is Mgr.

Plans have been prepared for an addition to the plant of Thomas Oakes & Co., Bloomfield, N. J., manufacturer of woolens. Estimated cost, $15,000. Noted Apr. 20.

An addition will be built to the plant of the International Oxygen Co., Newark, N. J.

Plans have been prepared for 2 additions to the plant of Marden, Orth & Hastings, Boston, Mass., on Newark Meadows, Newark, N. J., manufacturer of oils and acids. Estimated cost, $75,000. Noted Jan. 27.

The contract has been awarded for 2 additions to the plant of the Merck Chemical Co., Rahway, N. J.

Press reports state that the Elizabeth Sash, Door and Supply Co., Roselle Park, N. J., will construct four 2-story buildings at its plant.

Bids are being received for the construction of additions to plant of Alexander Bros., 414 North 3rd St., Philadelphia, Penn., for the manufacture of leather belting.

A cold-storage plant will be constructed on Enterprise St., Pittsburgh, Penn., by the Independent Packing Co. Estimated cost, $60,000.

SOUTHERN STATES

The Richmond Cold Storage Co., Richmond, Va., will construct a 5-story reinforced-concrete plant.

C. C. Coddington and associates, Charlotte, N. C., plan to construct a factory for the manufacture of tires.

The Magnet Knitting Mills, Clinton, Tenn., plans to construct a 2-story factory. Estimated cost, $10,000. J. D. Allsup & Co., Chattanooga, Arch.

The Waller Manufacturing Co., manufacturer of furniture, has purchased a plant at Lexington, Ky., and plans to construct additions.

MIDDLE WEST

The Wovenright Knitting Co., 5815 Kinsman Rd., Cleveland, Ohio, will build a 2-story, 55x63-ft. addition to its factory at Cleveland. Estimated cost, $10,000.

The Monarch Tag Co. is constructing a 2-story, 60x135-ft. factory on East 5th St., Dayton, Ohio. Estimated cost, $35,000. Noted Mar. 23.

The Emmerson Sash and Door Co., recently incorporated, plans to construct an addition to its plant at Marion, Ohio.

The Cincinnati Can Co. contemplates the construction of a 1-story factory at St. Bernard, Ohio. Estimated cost, $20,000. G. F. Edwards, Eggleston Ave. and 4th St., St. Bernard, is Supt.

The contract has been awarded for the construction of a 2-story, 76x130-ft. factory at Toledo, Ohio, for the Hettrick Bros. Co., manufacturer of awnings, tents and canvas beltings. Estimated cost, $20,000.

The G. I. Sellers & Son Co., manufacturer of kitchen cabinets, plans to construct additions to its plant on North 13th St., Elwood, Ind.

The contract has been awarded for the construction of a 3-story, 38x60-ft. addition to the plant of the Wabash Cabinet Co. at Wabash, Ind. Noted Mar. 16.

Plans are being prepared for the construction of a 3-story, 50x100-ft. factory at Detroit, Mich., for the Detroit Cabinet Co. Estimated cost, $90,000. Frank Clipper, 988 Riopelle St., Secy.

The Globe Knitting Works contemplates constructing an addition to its factory on Commerce Ave., S. W., Grand Rapids, Mich.

The contract has been awarded for the construction of an addition to the plant of the Hawthorne Paper Co. at Kalamazoo, Mich. Estimated cost, $35,000. Noted Jan. 13.

The American Shoe Stock Co. has awarded the contract for the construction of a 2-story, 52x100-ft. factory at Centralia, Ill.

The Patent Novelty Co. has awarded the contract for the construction of a factory at Fulton, Ill.

The Chicago Rubber Clothing Co. has awarded the contract for the construction of a 1-story, 60x125-ft. factory at Racine, Wis.

Bids will soon be received for the construction of a 4-story, 80x144-ft. factory at Sheboygan, Wis., for the John C. Nicholas Harness Co., Janesvile. Estimated cost, $25,000. Noted Feb. 3 and 17.

WEST OF THE MISSISSIPPI

Plans are being prepared by J. Webster, Arch., for a packing plant for George Rath & Son, Dubuque, Iowa.

The contract has been awarded for the construction of a 2-story factory for the Hugo Manufacturing Co., 310 West 2nd St., Duluth, Minn., manufacturer of specialties. Estimated cost, $25,000. Noted Apr. 20.

The Daniel Shoe Co., 415 South St., Wichita, Kan., has awarded the contract for a 2-story addition to its plant. Estimated cost, $15,000. Noted Apr. 6.

The Du Pont Powder Co. will build a powder mill at Dawson, Mont. W. J. Laird, Dawson, Arch.

F. C. Bretsnyder, of Bell Oil Co., St. Louis, Mo., and others are interested in the construction of an oil refinery at St. Louis. The company is in the market for machinery.

The plant of the Interstate Compress Co., Hobart, Ark., recently destroyed by fire will be rebuilt.

WESTERN STATES

H. W. Etz, J. A. Gumm and C. E. Goetz plans to construct a canning plant at Benson, Ariz. Estimated cost, $10,000.

Plans have been prepared for the construction of a 2-story, 50x72-ft. cold-storage plant at North Yakima, Wash., for the Yakima County Horticultural Union. Estimated cost, $25,000.

The Standard Furniture Co. has purchased a site at 4th Ave., S. and Walker St., Seattle, Wash., and will build a factory.

The Inland Empire Paper Co. has awarded the contract for the construction of a sulphite mill at Spokane, Wash.

Plans have been prepared for the construction of a 2-story addition to the plant of the Hood River Canning Co., Hood River, Ore.

CANADA

The Acme Rubber Co. will build a factory at Brampton, Ont. Estimated cost, $30,000. F. D. Law, 471 Yonge St., Brampton, is interested.

The Waddell Preserving Co. will build a factory at Brantford, Ont., and install machinery. J. A. Waddell is Secy.

The Mitchell Woollen Mills Co. will construct an addition to its plant at Mitchell, Ont., and install new machinery.

Classified Advertising

The Classified Advertising section appears on pages 156, 157, 158, of this issue and will in future appear in the same relative position in the paper.

American Machinist

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CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormay processes, protected by United States patents issued June 22, 1915, and Apr. 18, 1916.

NUMBER OF COPIES PRINTED THIS ISSUE, 23,750
This includes the English Edition. None sent free regularly, no returns from news companies, no back numbers.

Two kinds of advertising the American Machinist does not want:

Advertising of machine tools made for "export only"—

Advertising of any equipment that will not stand the light of Truth—about which the truth cannot be and is not told.

Only reliable products can be continuously advertised.

Manufacturing British 8-In. Shells in 4½ Hours--I*

By Fred H. Colvin

SYNOPSIS—The necessity for lifting shells by mechanical means introduces a new factor and one that adds much to the handling time. The illustrations show several forms of hooks and clamps, special lathes, heavy boring tools, single- and double-tooling for lathe carriages and formers or cams for both turning and boring. While there are no startling innovations, the methods have all been carefully worked out and are giving good results, as will be seen by the operation times.

The manufacture of the 8-in. shells involves several problems not presented by shells of smaller caliber, the first noticeable difference being in the handling. Owing to the greatly increased weight over the smaller sizes, tackle is required for putting the shells into and taking them out of the machine. This lifting is done in various ways, as will be seen in the different illustrations as well as in the different forms of handling devices grouped together in Fig. 3.

The necessity for these aids will be made clear when we realize that the blanks or rough forgings weigh 250 lb. each, while the finished shell weighs 177 lb. This figure, however, includes the adapter plug, which is screwed into the base, as shown in Fig. 1. The plant illustrated has been built especially for making these shells and consists of a one-story building 88x128 ft., divided into four 22-ft. saw-tooth bays running lengthwise of the building. The shop is divided into eight 16-ft. sections by columns and roof-beams running in the other direction, giving post centers 22x16 ft.

Raw material comes in from the cars at one corner and traverses in regular order up and down the different bays, as shown in Fig. 2, receiving its final baking, after being varnished, at the same end, but on the opposite side, from which it started. From here it goes to the bonded warehouse in charge of the British inspectors.

The shell itself is illustrated in detail in Fig. 1, with all principal dimensions. It ordinarily consists of but two parts—the body and the adapter plug, which screws into the base. There is also a provision by which any shell that is too large in the nose to pass inspection may be rebored and a special adapter screwed into it. The dimensions of this adapter are also given.

Coming in from the forge shop, the shells are handled by the type of hook seen at A, Fig. 3, this being so balanced that it hangs with the open end lower than the nose, so as to avoid all danger of accidentally slipping off and injuring a workman.

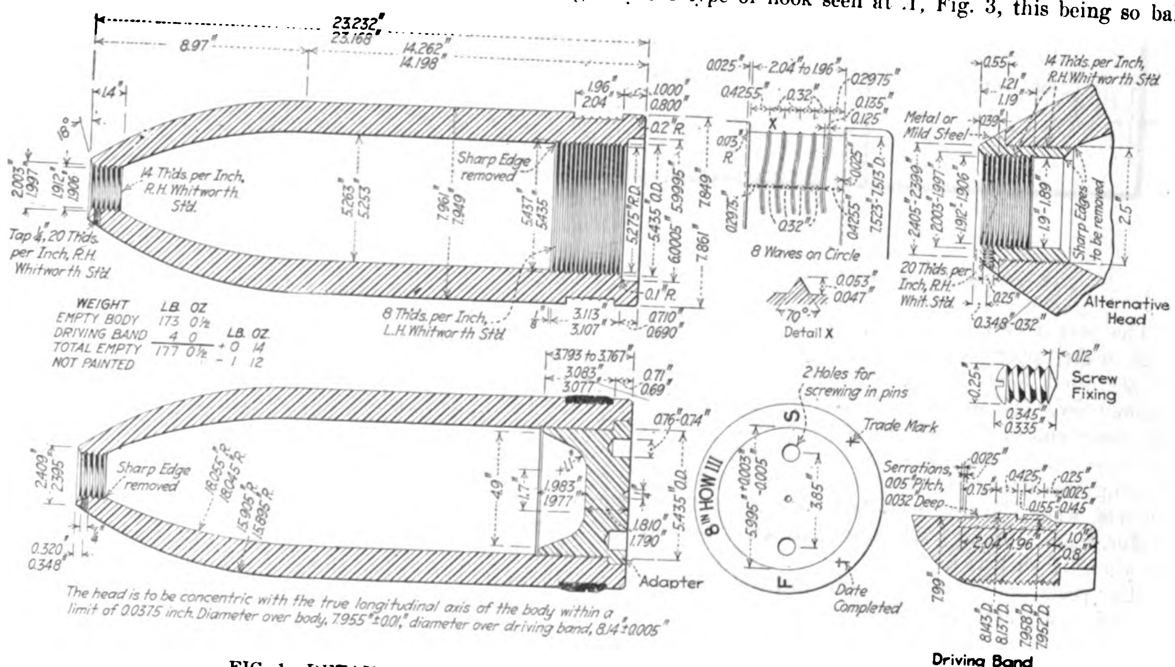


FIG. 1. DETAILS OF THE 8-IN. HIGH-EXPLOSIVE HOWITZER SHELL

The First Operation—Drilling the Nose

The first operation is the drilling of a hole in the nose, which is done on a W. F. & John Barnes drilling machine that happens to be available. A special drilling fixture of the turntable variety carries two mandrels, as in Fig. 4. These mandrels have a ring A at the upper end, which fits inside the bore of the shell near the nose, so as to center the shell from the inside, but at the same time leaves plenty of room for the nose drill to break through without interfering with the mandrel. Details of these mandrels appear in Fig. 5, only one spindle being given.

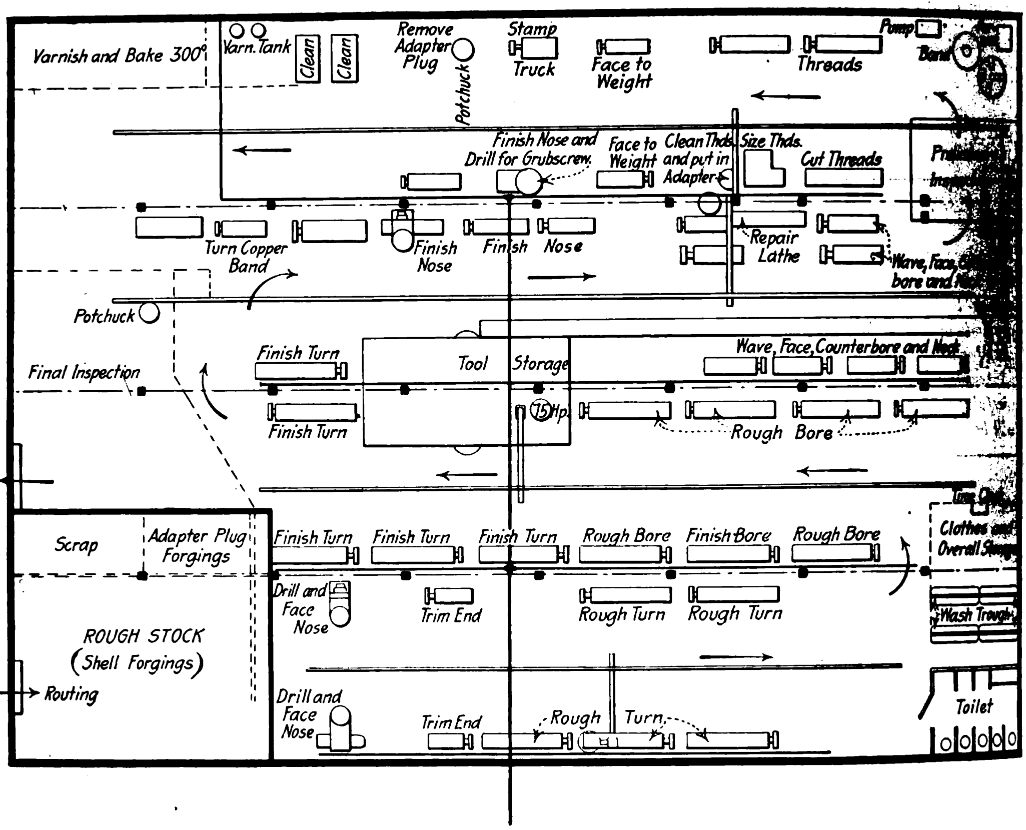


FIG. 2. FLOOR PLAN AND LAYOUT OF MACHINERY FOR MAKING 1,000 8-IN. SHELLS PER WEEK

The post A carries the centering plunger B, which is kept in the upper position by the spring C. The weight of the shell forces the plunger B down, so that the tapered lower end forces out the three fingers D to center the lower end of the shell while the collar on B centers the upper end. The shell is centered by the hole in the forging, it being easier to take care of eccentricity on the outside, where turning tools and carriages can be made stiffer, than in boring. The spring E throws the finger D in when the shell is removed.

The posts are mounted on the turntable F, which is carried on a central ball bearing H and has two indexing positions. The base G carries the indexing pin J operated by the lever I and is also provided with a raised edge to retain the lubrication. Stepping on the lever I withdraws the indexing pin J and also throws the ball bearing into action, making it easy to turn the table F. Releasing the lever allows the table to rest on the large and substantial annular bearing of the base.

This drilling fixture has a swinging plate C, which centers itself over the shell to be drilled and also carries the drill bushing. It can be swung in either direction, so that only one drill bushing is required for both mandrels, as can be seen in Fig. 4. The facing cutter is shown at D.

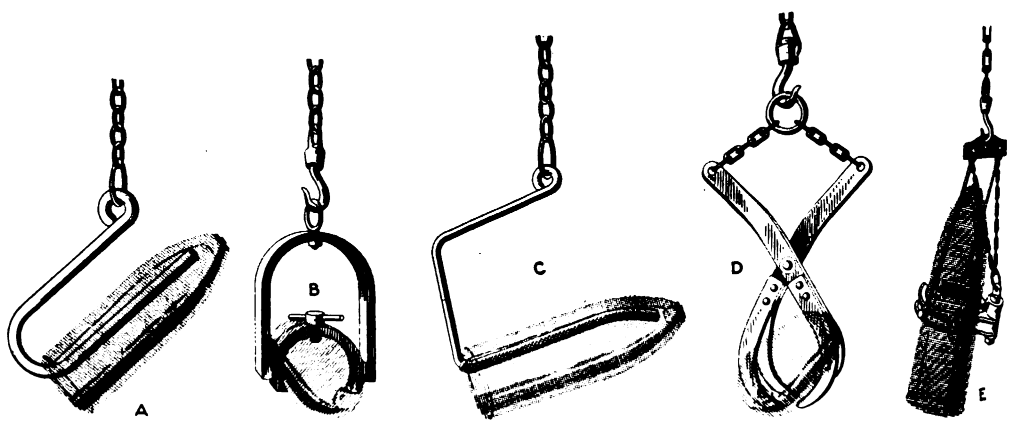


FIG. 3. TYPES OF HOOKS AND CLAMPS USED IN HANDLING 8-IN. SHELLS FOR THE VARIOUS OPERATIONS

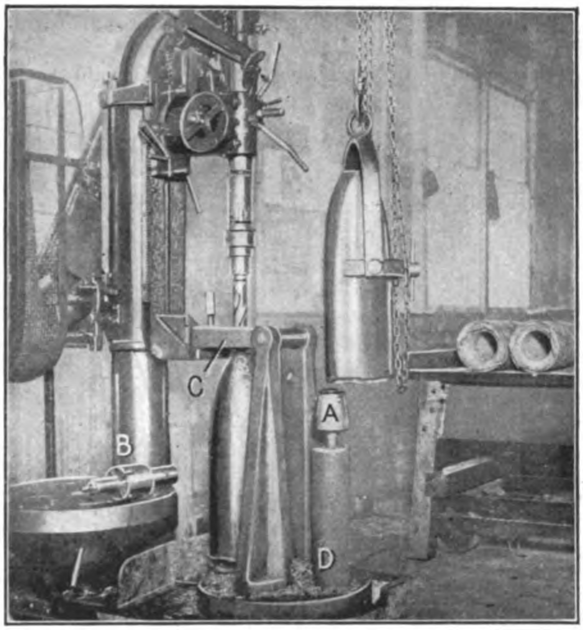


FIG. 4. OPERATION 1: DRILLING NOSE, $1\frac{11}{16}$-IN. DRILL
Machine Used—W. F. & John Barnes vertical drilling machine.
Fixtures—Revolving stand with drill bushings.
Gages—None.
Production—8 min. each.

After the hole is drilled, the shell goes to a special Root & Van Dervoort cutting-off machine, Fig. 6, with a spindle large enough for the shell to be slipped inside and held by three substantial screws. This places the shell inside the main bearing and avoids all overhang, permitting a cutting speed of from 35 to 40 ft. per min. with a heavy feed. In order to assist in centering the shell so that the ends shall be square with the bore, there is a tapered stop or plug on the inside of the spindle, which enters the hole already drilled in the nose and centers that end of the shell, while the outer end is clamped by the three screws in the chuck previously referred to. This stop also locates the shell for cutting off to length.

After this cutting-off operation the heat number, which had previously been stamped on the body of the shell, is transferred to the end, to prevent its being lost in the turning operation.

Rough-turning comes next, Fig. 7, the shell being tested at the point to see if it will true up to the required size. In case the point is somewhat eccentric, it can be coaxed over a limited amount by means of special brass cups A, of varying thickness, which are placed over the ends of one or more of the locating and holding points in the work-holding mandrel. These mandrels, illustrated in Fig. 8, are operated by air chucks. The shell is set by the bent gage, Fig. 7-B, so as to conform to the location of the cam at the back of the lathe. This gages from the flange of the shell mandrel to the point of the shell.

A rough sizing gage for the nose is shown at B, Fig. 8. It is turned on the outside so that it will slip easily into the $1\frac{11}{16}$-in. hole already drilled, while the hole through the gage is a loose fit over the end of the shell mandrel. The looseness of this fit on the mandrel shows how much the shell can be jockeyed on the mandrel and still clean up on the inside. As long as this rough gage will go over the end of the work mandrel and into the shell nose, the bore of the shell has not been thrown out of center too much to be cleaned up. This instrument also serves another purpose, as the outside is used as a gage for setting the turning tool. It also avoids inconvenient calipering on the rounded nose and allows the operator to set his tool for the cut almost at random, as he cannot well set it to cut smaller than the outside of the nose piece.

Two Tools for Rough-Turning

Two tools are used in the rough-turning—one starting at the nose and the other about midway of the shell. They are held in independent tool slides on the carriage. One slide—the one with the nose tool—is controlled by the forming cam at the back of the lathe, as can be seen in the view in Fig. 7, which is taken looking straight down on the lathe.

This operation is also performed on a Root & Van Dervoort special lathe having the same type of headstock as the cutting-off machine. The main bearing in each case is 14 in. in diameter by $7\frac{5}{8}$ in. long, the rear bearing being 7 in. in diameter by $7\frac{1}{2}$ in. long. The same lathe

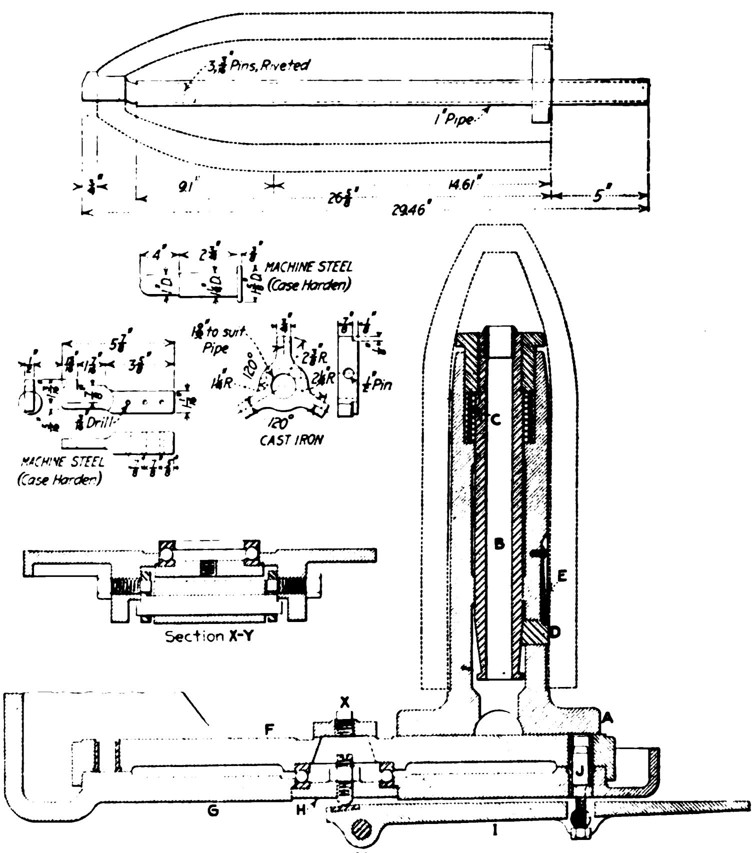


FIG. 5. DETAILS OF DRILLING FIXTURE AND GAGES

head is used for both the turning and the boring lathe, a special mandrel, Fig. 8, being bolted to the end of the hollow lathe spindle for the outside operations. The lathes for the internal work are fitted with special steel draw-in collets operated by air and fitting the turned shell.

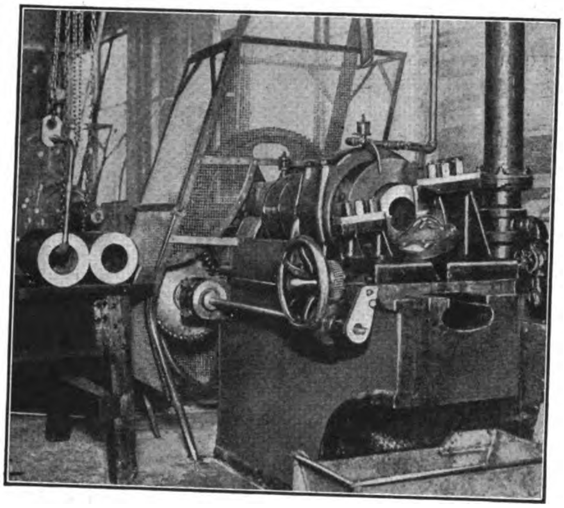


FIG. 6. OPERATION 2: CUTTING OFF OPEN END
Machine Used—Root & Van Dervoort special.
Fixtures—Chuck length stop and handling truck.
Gages—Length.
Cutting Speed—35 to 45 ft. per min.
Production—8 min. each.

Rough-boring comes next, the shell fitting inside the lathe spindle as in cutting off. A heavy boring bar made of a steel casting is used for this work, being guided for contour by the slotted cam at the back of the lathe bed. It is shown in Fig. 9, while details of the boring bar itself will be found in Fig. 10. Finish-boring is done in a similar manner on an adjoining lathe, the work progressing from one machine to the next, in order to reduce handling to a minimum, this being important on heavy shells.

Finish-turning is performed by a single round tool, Fig. 11, that is held stationary and turned only when it is desirable to present a fresh cutting edge to the work. This method gives a fairly broad contact and leaves a

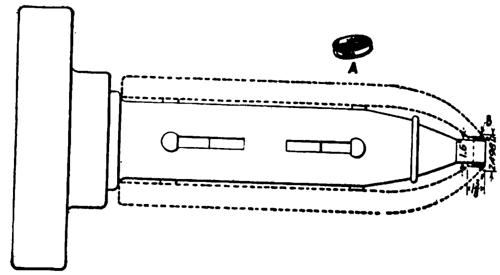


FIG. 8. DRIVING MANDREL FOR SHELL

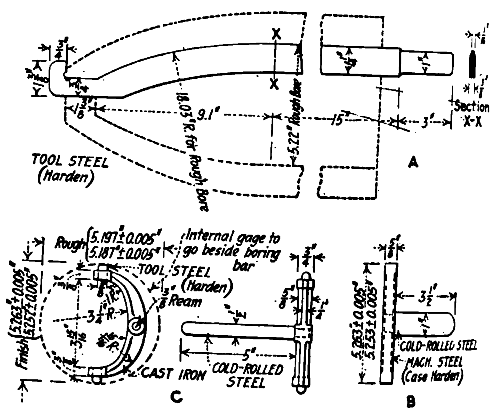


FIG. 9-B. GAGES FOR OPERATIONS 4 AND 5

smooth finish on the work. After the finish-turning, the heat number is stamped on the nose of the shell, so as to preserve it when the outer end has been faced off to length and to secure the specified weight.

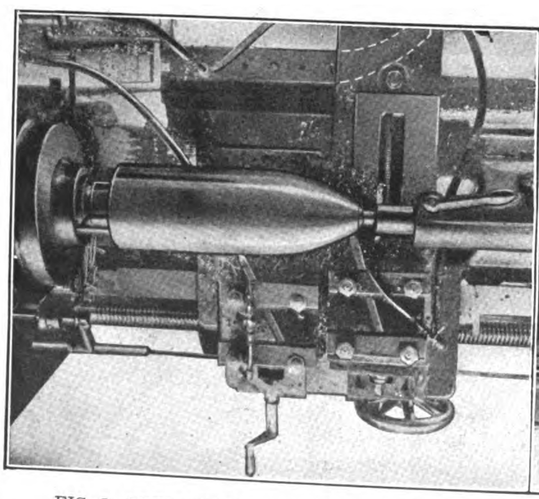


FIG. 7. OPERATION 3: ROUGH TURN OUTSIDE
Machine Used—Root & Van Dervoort special lathe.
Fixtures—Mandrel and forming cam for tool slides.
Gages—Snap for outside diameter; nose gage.
Cutting Speed—55 ft. per min.
Production—35 min.; expect to reduce to 25.

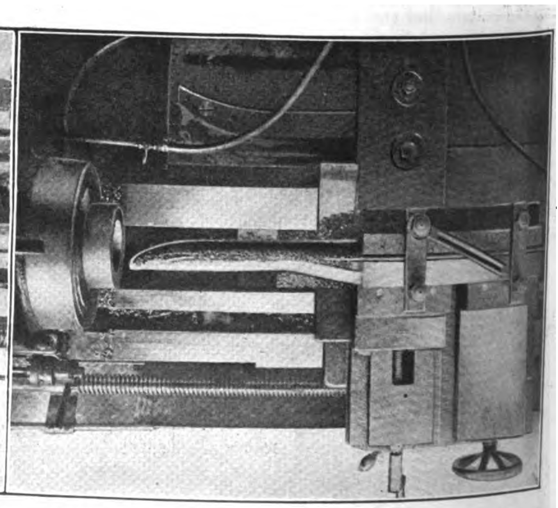


FIG. 9. OPERATIONS 4 AND 5: ROUGH AND FINISH BORE
Machine Used—Root & Van Dervoort special.
Fixtures and Tools—Boring bars and formers.
Gages—Diameter and contour.
Cutting Speed—55 ft. per min.
Production—25 min. roughing, 20 min. finish.

Boring and tapping the nose for the fuse were first accomplished in a special lathe having a similar headstock and a two-position cross-slide—one for the nose reamer and the other for the collapsing tap, as shown in Fig. 12—but are now being done under a Baker vertical drilling machine by changing the reamer and tap by means of a magic chuck.

Drilling and tapping for the fixing or grub screw comprise one of the vexatious operations on a shell of this kind. In the beginning a portable pneumatic drill was used, while the shell was held in the pot chuck, Fig. 13. The drilling bushing was held in the fixture shown at the top, and in detail at *A*, Fig. 14, the threaded plug screwing into the nose after locating the hole the right distance from the end of the shell. The details of the pot chuck for holding shells vertically are also shown. It can be used for holding the shell either end up, the ring *B*, bored to the proper curvature, forming a seat for the shell nose when the large end is up for screwing in the adapter plug. This prevents bruising the nose.

This method was a slow and unsatisfactory proposition and has been replaced by a sensitive vertical bench drill, the shells being rolled along until they come under the drill. This procedure is proving much more satisfactory, both for drilling and tapping, and has reduced the time and broken taps to a considerable extent. Continuous benches are used as much as possible throughout the shop, so that the shells can be rolled from one operation to the next. This has been used as an alternative to the trucking system in use in some shops and about which

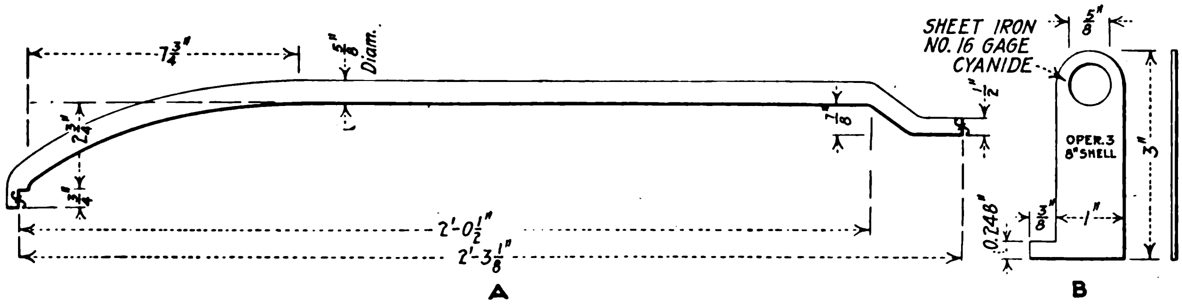


FIG. 7-B. A—GAGE FOR SETTING SHELL FOR ROUGH-TURNING, OPERATION 3; B—THICKNESS OF NOSE

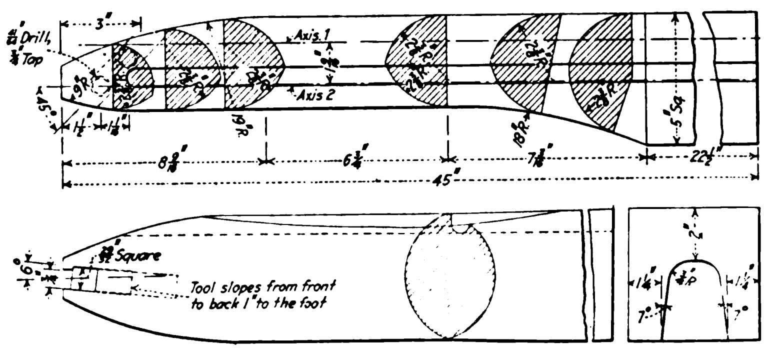


FIG. 10. DETAILS OF CAST-STEEL BORING BAR

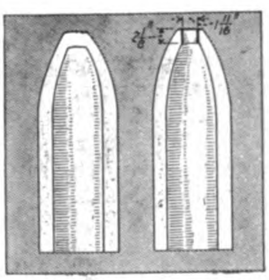


FIG. 4-A. OPERATION 1

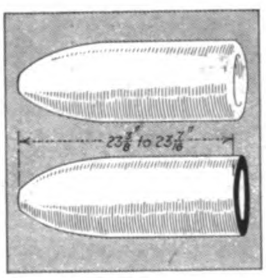


FIG. 6-A. OPERATION 2

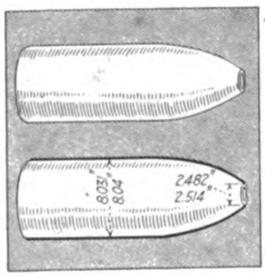


FIG. 7-A. OPERATION 3

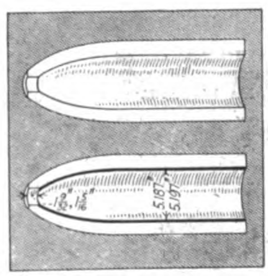


FIG. 8-A. OPERATION 4

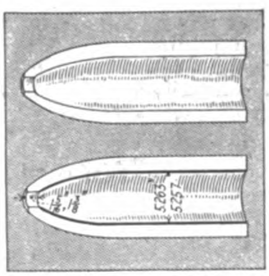


FIG. 9-A. OPERATION 5

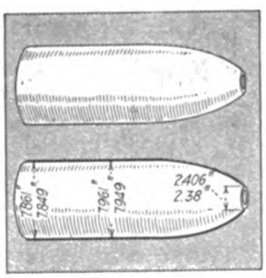


FIG. 11-A. OPERATION 6

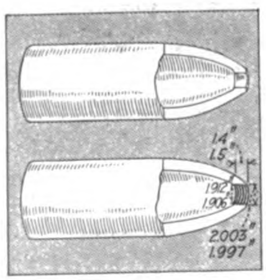


FIG. 12-A. OPERATION 7

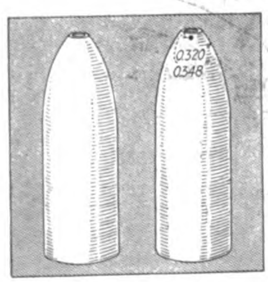


FIG. 13-A. OPERATION 8

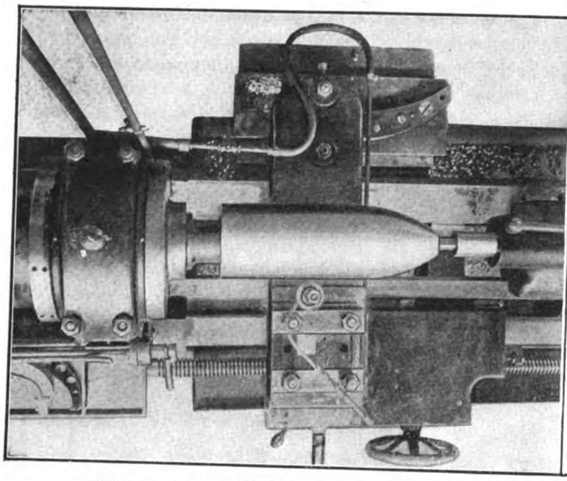


FIG. 11. OPERATION 6: FINISH TURN
Machine Used—Root & Van Dervoort special.
Fixtures and Tools—Mandrel, one round tool former.
Gages—Diameter and contour.
Production—30 min. each.

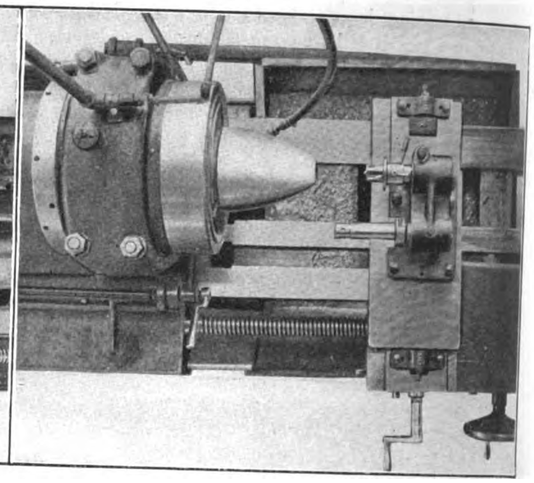


FIG. 12. OPERATION 7: BORE AND FACE NOSE
Machines Used—Root & Van Dervoort special, Boker drilling machine.
Fixtures and Tools—Collet chuck, Kelley reamer Murchey tap.
Gages—Diameter, thread and bevel surface.
Production—6 min. each.

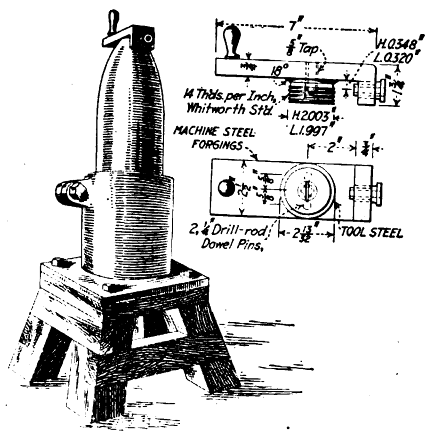


FIG. 13. OPERATION 8: DRILL AND TAP FOR GRUB SCREW
Machines Used—Portable drill and bench drill.
Fixtures and Tools—Pot chuck, drilling jig, drill and tap.
Gages—Location of holes, diameter and thread.
Production—3 to 6 min.

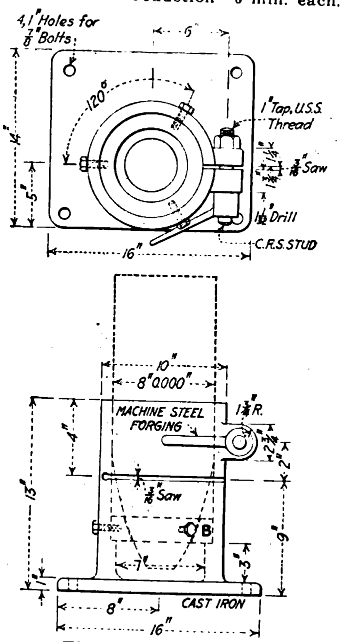


FIG. 14 DETAILS OF POT CHUCK

there is quite a difference of opinion. With lighter shells the truck system is probably the best, but with shells weighing approximately 200 lb. each, rolling saves considerable handling. And when handling means the clamping or placing of hooks or tongs, and then lifting the shell by mechanical means, the time required is by no means a negligible quantity. In fact the matter of handling 250,000 lb. of shells a week, and not only once but between every one of the many operations, is quite a problem in itself.

Special frames were made to hold these on the trucks, with divisions to keep them on end and separate. These were, however, abandoned in favor of the bench system. It saves considerable lifting at various stations and has proved very satisfactory.

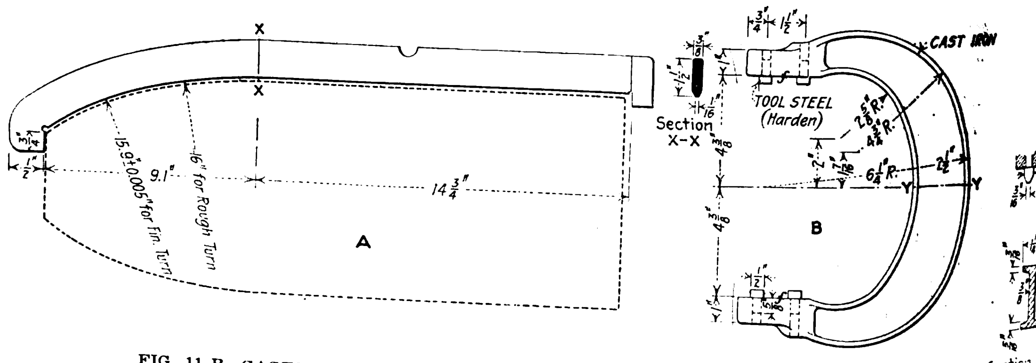


FIG. 11-B. GAGES FOR OPERATION 6, FINISH-TURNING THE OUTSIDE OF THE SHELL

Using Skill for Capital in the Small Shop

By John H. Van Deventer

SYNOPSIS—Doing what other people cannot do is one of the surest ways to success in the small-shop field. This article tells of a New England die-sinking shop that is making good on a line of work that requires a high degree of skill. How large-shop experience helps the small-shop owner to operate on sound and systematic lines becomes evident.

When you go into a successful small shop, you are often struck with the resemblance it has to a well-managed department of a large shop. Evidently there are certain earmarks of good practice that apply to small and large shops alike. Some of them, such as a clean floor, orderly and convenient arrangement of machines, proper cupboards for small equipment and tools, may be classified, inventoried and written down in plain figures; others are more vague and elusive, but can nevertheless be quite plainly felt by a shopman's sixth sense. Among these is the perception that the work is being handled to advantage, from both the customer's and the shop owner's viewpoints. Time study would paint this picture after a month or two—the sixth sense will do it instantaneously, like a "snapshot" photograph.

The small-shop owner who has had a part of his training in a large shop is somewhat ahead of the game, having obtained his education in an institution richly enough endowed to be able to find better ways of doing things by experimentation, as distinguished from the small-shop man "brung up" in the small shop, who must cut his eye teeth without the aid of a dentist. And so when the ex-large-shop man starts a small shop he is apt to carry in his mind the memory of the large-shop department and its way of doing business.

The large-shop idea is evident in the small shop of Hollander & Johnson, Worcester, Mass., who specialize in drop-forge die sinking. At present some seventeen men are employed in this shop, which is a rather rapid growth from a two-man beginning made three years ago. To some extent the demand for drop-forge dies for munition making has been responsible for this enlargement; but the start in the right direction was independent of this condition, and it is the start that will interest other small shops having a large capital of skill and a small capital of cash.

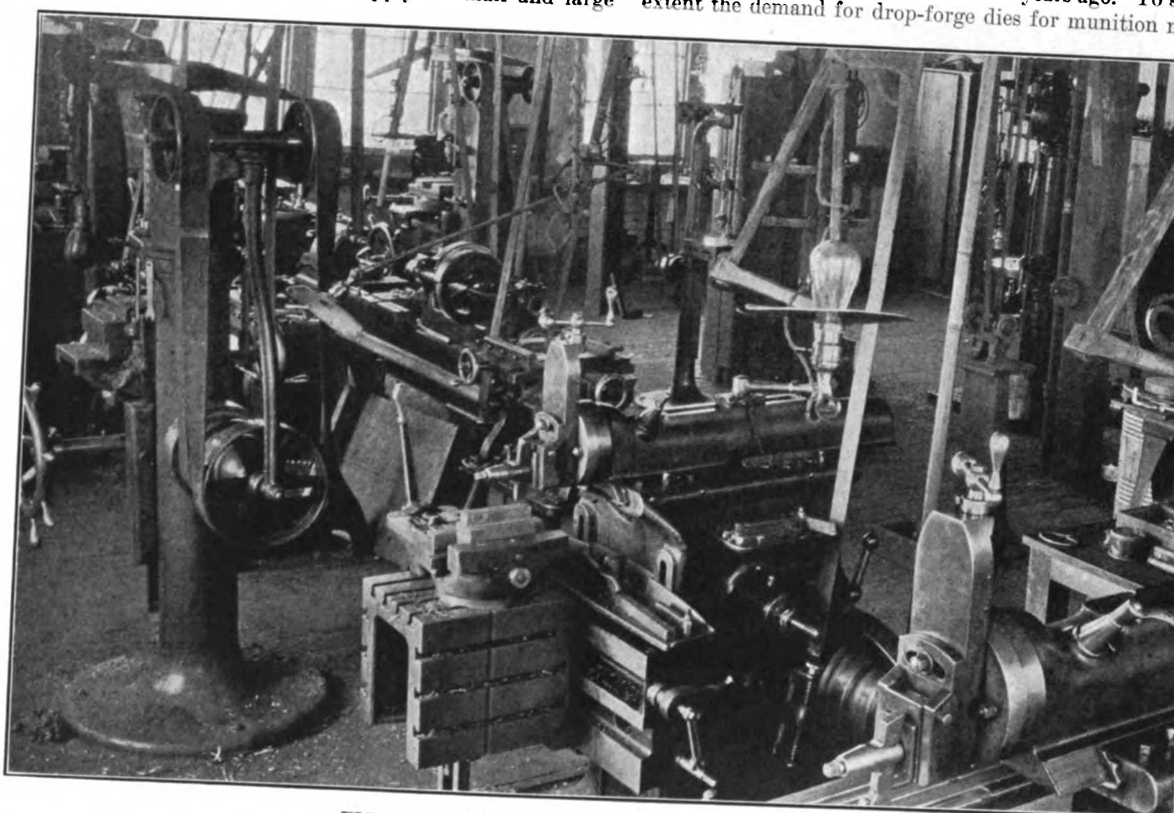


FIG. 1. A THREE-YEAR-OLD DIE-SINKING SHOP

A shop struggling for a start cannot pick and choose the class of work that it does. Often the crucial test comes in the shape of an order for work that is apparently unsuited to the machine tools at hand. In this case it was an order for 450 sets of molds for making rubber shoe-soles. There were two machines available for this work—a shaper and a die sinker—in fact, with the addition of a lathe they comprised the entire shop equipment. Taking

The order for these 450 molds for delivery in 6 weeks took both nerve and hard work; but the task was accomplished by operating night and day, and doing it put the small shop on its feet—one might say a pair of rubber-soled ones!

S. G. Hollander obtained his large-shop experience in drop-forge dies at the United Shoe Machinery Co.'s plant

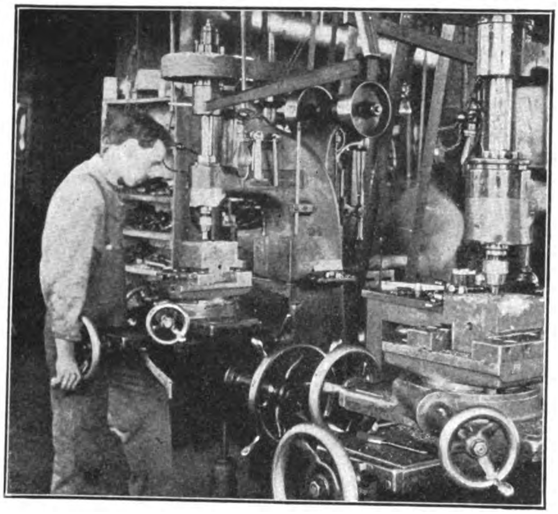


FIG. 2. SINKING RIFLE BOLT DIES

at Beverly, Mass., where he had charge of this class of work, both as to making the dies and using them. He has retained one very important large-shop feature in the making of such things—the division of labor according to the degree of skill required. Some small die-making shops are run on the old toolroom basis, one skilled man traveling about from machine to machine and taking care of the job from start to finish. The large-shop method is to pass the work from one man to another, each one a specialist on his own machine or bench, and this scheme is applied in the small shop to good advantage in both time and money.

The properly run small shop can take work requiring a high grade of skill at very nearly the cost-to-make in

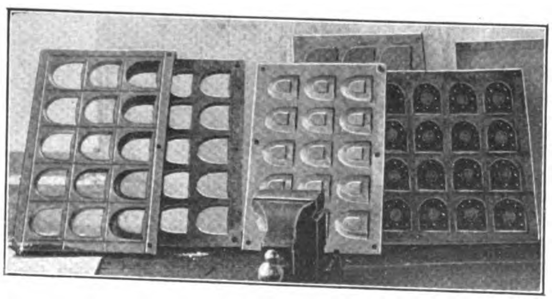


FIG. 3. MOLDS FOR MAKING RUBBER HEELS

the big-shop toolroom and come out with a profit. Here lies one of the big weapons of the small shop in hunting for business, and it is due to the low overhead expense as compared with the high one in the big plant. A shop of fifteen to twenty men, in which the owner is superintendent and manager, correspondent and time clerk, as well as on frequent occasions a die maker or tool maker, will show up an overhead of from 15 to 25 per cent., as compared with the 100 to 150 per cent. of the big shop. If this fact is thoroughly mastered, it will open up new business for the small-shop man who grasps it and uses it as a selling argument.

Another feature that will result in business is to relieve the large shop of responsibility and detail. Some people cannot get enough responsibility to suit them, but the real big fellows have a habit of placing it on other shoulders than their own when they make sure that these shoulders are broad enough to carry it. The small-shop man with small views is apt to pin the responsibility as closely to his customer as he can, living up strictly to his blueprint. The small-shop man with big views goes at it another way, saying: "Show me the piece you want made and the machine on which you want to make it and leave the rest to me. I will be responsible for the result." It

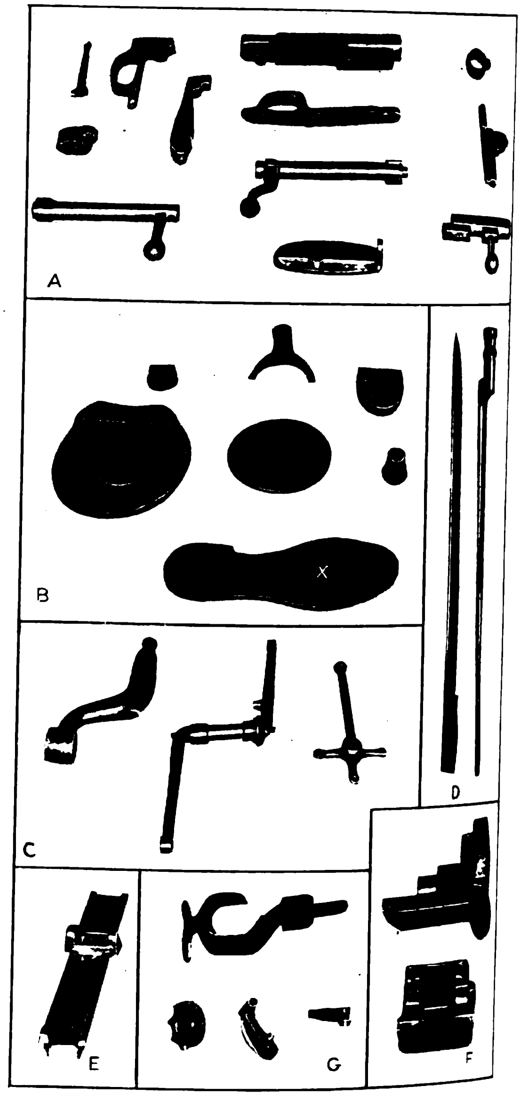


FIG. 4. ARTICLES PRODUCED IN SMALL-SHOP MADE DIES

A—Military rifle forgings; B—Rubber die products; C—Auto and bicycle forgings; D—Bayonet forgings; E and F—Machine-gun forgings; G—Miscellaneous

is unnecessary to say that this is a strong argument with a busy executive who is buried up to his chin in responsibility and who is glad to place some of it elsewhere on favorable terms.

The illustrations reproduced on these pages show what progress a two-man three-machine small shop can make in three years. It was done by hard work and skill and with no outside capital and should encourage other small-shop owners who have plenty of the former and not much of the latter.

Steel Famine in Japan and Its Effect on Shipbuilding

By a Japanese Engineer

Since the war in Europe broke out, industry in Japan has expanded wonderfully, though not so much as in the United States. This is especially true in shipbuilding. As an example, the Osaka Iron Works have orders in hand at present for a tonnage exceeding that of all the ships which they have built during the last 35 years, or since they started in that kind of business. Besides, all sorts of engineering works, for both peace and war, are in full swing and being extended. This situation makes it interesting to study the question of raw material—namely, iron and steel—for these works.

When the war began, the supply of steel from England was affected to some extent, and this condition became more serious when the Munitions Act in that country went into force. Later on, the greater activity of the submarines in the Mediterranean Sea made it worse. Beside that, the declaration last fall, of the American Steel Trust that it would not accept any new orders until further notice was a great blow to many engineering works. This fact is shown by the following table of steel material ordered from abroad. The amount, even for shipbuilding alone, allotted for vessels to be completed during 1916 is estimated to be 75 per cent. of the whole weight, 50 per cent. of this proportion being from the United States.

The steel for shipbuilding, for ships to be completed during 1916, is estimated as follows:

Ordered from	Tons	Approximate Percentage
British Isles	22,690	25
United States	44,880	50
Home	23,704	25
Total	91,274	100

Of these orders the material from Great Britain is mostly bars and section, while that from the United States is in plates. According to the latest news from England, the mills are busy drawing bars for munition works, the result being the suspension of output of bars and sections for Japanese shipbuilding, though it is said that it will be possible to resume this work in the near future.

Production of Japanese Steel Works

Such being the case at present, it is quite natural that all users of iron here go to the home steel works, asking for more and more turn-out, though at the same time they do not neglect any means for getting steel from abroad as well. The capacity of the home mills is as follows, the Government steel works being the largest one in this country and all private firms being quite small:

	Tons per Year
Rolled-Steel Capacity:	
Government steel works	290,000
Tanaka Steel Works, Kamaishi	30,000
Total	320,000
Pig-Iron Capacity:	
Tanaka Steel Works, Kamaishi	40,000
Wanishi Steel Works, Hokkaido	20,000
Honkeiko, Manchuria	40,000
Total	100,000

On the other hand, the imports of raw material during the past three years have been as follows:

	Tons 1912	1913	1914
Pig iron, spiegel iron, ferromanganese, ingots, blooms, etc.	238,400	279,817	178,639
Bars, sections, plates, wire tubes and pipes, building material	612,409	548,172	436,113
Nails, anchors, chains, wire rope	54,903	29,842	18,301
Total	905,712	857,831	633,053

Taking the amount in 1912, which is the highest figure, and comparing it with the largest turn-out of the Government steel works—227,300 tons—which was in 1914 (the output in 1912 and in 1913 being 204,005 tons and 212,816 tons respectively), we get:

	Imports, 1912, Tons	Turn-Out of Government Steel Works, 1914, Tons
Plates, including checkered plates, corrugated plates, galvanized sheeets and plates, tin plates	155,548	47,505
Sections and the like	185,000	68,064
Rails	59,100	68,732
Nails and wire, including bands and hoops, wire rope, galvanized wire and railway nails	45,672	29,216
Others	84,680	13,783
Total	530,000	227,300

The item of imported plates in 1912 included:

	Tons
Corrugated plates	220
Galvanized plates and sheets	34,000
Tin plates	26,500
Total	60,720

These products cannot be made in Japan at all. Deducting this amount from 155,548 tons, it leaves 94,828 tons, which is approximately twice the capacity of the Government steel works—47,505 tons. The rails are the only item in which the amount imported is less than the home product. The turn-out of the Tanaka Steel Works was not taken into account in the summary given, as their exact figures are not available. Since that plant makes miscellaneous varieties, this omission will not affect the comparison to any large extent.

Comparing Past and Present Imports of Pig Iron

Pig iron was imported to the amount of 270,000 tons in 1912, this being 27 times the home product of 100,000 tons. These figures of comparison of the past, combined with the present crisis brought about by the shortage of steel and iron, naturally induced many new firms to start in business and caused the extension of existing firms. These projects number about 18 up to the present. Figures obtainable are as follows:

1. Government Steel Works—An addition in course of construction during the past few years will be completed early this year. The total capacity will be increased to 350,000 tons per year. Besides, a program will be submitted to congress in a few weeks, asking for an extension to cost 36,000,000 yen (2 yens = \$1, approximately) and to be finished in five years, beginning in April of

this year. An additional capacity of 300,000 tons per year will thus be provided, bringing the total to 650,000 tons per annum. If congress approves, the extension will be executed in such a manner as to add 50,000 tons' capacity at the end of the first year and another 50,000 tons at the end of the second year, for the purpose of relieving the urgent demand. At the end of the fifth year the total additional capacity of 300,000 tons will be reached.

2. The Tanaka Steel Works, the Lumitomo Steel Works (Osaka), the Kobe Steel Works and the Kanasaki Shipyard (Kobe), the Nippon Steel Tube Co. (Kanasaki), the Nippon Steel Works (Hokkaido), the Kuhara's Steel Works, the Kinjiho Steel Works (Chosen), etc., are contemplating extensions, or new plants. I estimate that when this construction work is completed—in perhaps four or five years—about 100,000 tons will be turned out by these firms.

3. The Honkeiko Iron Works report that they will treble their capacity of pig iron after a few years, adding, say, 80,000 tons to their present capacity.

Estimated Output in Five Years

So after four or five years the total product of rolled-steel material will be 880,000 tons, as compared with a consumption of 757,300 tons—the total of the imports of 1912 and the home turn-out of 1914.

Pig iron will reach to about 200,000 tons, compared with a consuming power of 370,000 tons. Thus, it is seen that there will still be a great shortage of iron and steel material in Japan. In view of the naturally great demand for steel building and machinery, I wonder if it is not a chance for American steel makers, who must be thinking of what they are going to do when the great European War comes to an end.

Turning again to the shipbuilding problem of Japan at present, we find such facts as that a ship 35 years old was recently sold at a price of 130 yen per ton. Last year the ownership of a 3,200-ton steamer that was to be completed in February, 1916, was transferred into other hands at a price of 70,000 yen, while she was still on the shipway. Moreover, a similar vessel, which is to be finished in April of this year, was sold at a price of 150,000 yen. These incidents show how scarce ships are in Japan just as everywhere else.

The whole number of ships with a tonnage of over 1,000 tons now in the shipyards of Japan is 88—a total of 481,000 tons and 292,680 i.h.p., including 20 stock boats of 172,800 tons total. Of these 88 ships, 40 (totaling 160,000 tons) will be finished during this year, while most of the remaining 48 ships are intended to be delivered during next year; but it all depends upon whether the supply of steel necessary from abroad comes in time or not.

It is interesting to notice that the net weight of the ships when turned out from the shipyard, without water and consuming material (usually called light displacement), is about 60 per cent. (strictly speaking, a little less in a pure cargo boat). As the cargo-carrying capacity of a ship is slightly less than twice the gross tonnage, it may be said that one ton of ship will be able to carry about three tons of cargo. In other words, every ton of ship that costs approximately 300 yen will earn about 450 yen interest per year at present rates.

The Imperial Government Railway, which controls nearly all railroad lines in Japan, used to get 100,000 tons of steel per annum from the Government Steel Works, including rails, nails, etc., besides the greater amount obtained from abroad. Lately the railway office has demanded a supply of 70,000 tons as a minimum quantity for this year. The Government Steel Works, however, have declined to supply more than 40,000 tons, which means the practical stoppage of any new work, as well as the use of wood in place of steel, wherever possible. This will delay the introduction of steel cars on Japanese railways.

The engineers' society at Osaka is proposing to the Government Steel Works to buy a great amount of steel material of several varieties from the United States, as stock, but it is doubtful whether this will be done.

The First Cleveland Automatic and Its Development

Special Correspondence

An interesting contrast, which indicates the development of one of the best-known automatic screw machines in this country, is illustrated herewith. The first machine shown was built in the toolroom of the White Sewing Machine Co., Cleveland, Ohio, 28 years ago. It was designed for producing brass washers for sewing-machine bobbins, its only work being confined to forming, as the drilling of the washers was a separate operation. The tools for forming the washers were mounted on an

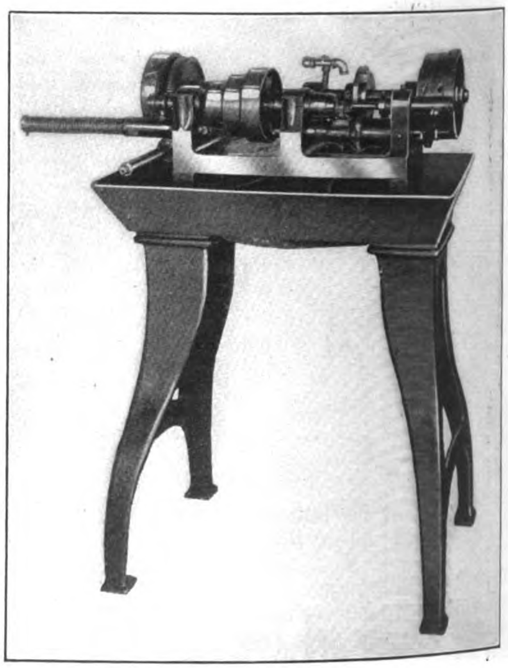


FIG. 1. THE FIRST CLEVELAND AUTOMATIC

oscillating tool post, which swung forward for the forming tool and swung back for the cutting off.

The regulation three-step cone was used on the main spindle, which means that only one speed was available without moving the belt by hand. The mechanism on the inside of the cone for opening and closing the chuck would be considered old-fashioned and bothersome today.

on account of the large number of parts liable to be disarranged. Considering the fact, however, that this machine was built 28 years ago, it worked quite satisfactorily.

Its success was responsible for continuing with the automatic idea, and this machine was in reality the foundation of the Cleveland Automatic Machine Co. of today, which built it with no thought of ever going into the machine-building business. Six of these automatics

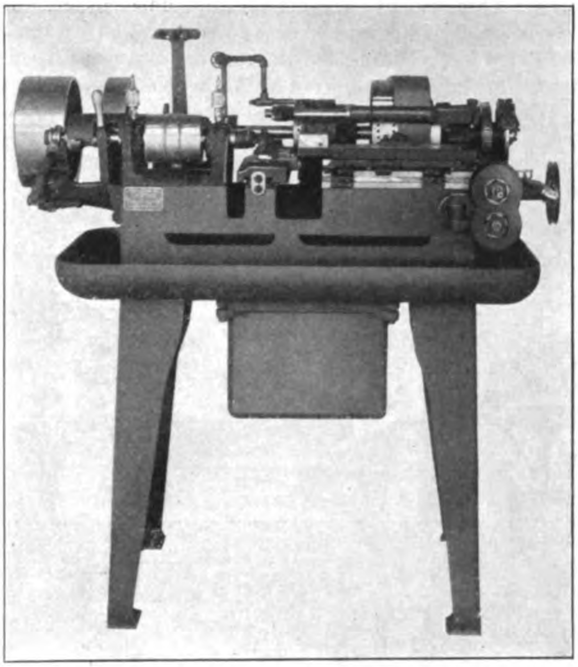


FIG. 2. THE DEVELOPMENT OF 28 YEARS

were first built—of ⅝-in. capacity—as a beginning of the automatic-machine business, about 26 years ago.

It is interesting to notice both the difference and the similarity between the original and the present machine, the most striking difference being that the speed of the camshaft can now be changed for various kinds of materials and jobs by means of changed gears. A series of tools can be mounted on the longitudinal slide so as to produce several shoulders. The gage stop is separate and independent. Independent cutoffs and the use of double cross-slides enable interesting operations to be performed on a plain automatic, which was not originally the case. The real similarity ends with the appearance, as while the old machine was designed for forming the simplest kind of machine parts, the other is suitable for the many operations demanded of a modern machine.

Sponges That Only Absorb

By John R. Godfrey

They say it takes all kinds of people to make a world, but my own opinion is that we have a plentiful supply of several kinds for some years to come. One of these is the sort of sponge that is perfectly willing to absorb all the information he can find, but refuses on one pretext or other to give up any in return. There aren't so very many of this breed, but they still exist.

My friend Bill Johnson, got into the shell game pretty early and had all kinds of trouble, till he got on to a lot of the curves of both the shells and the inspections. He didn't make any bones of it either and naturally felt a bit proud when he'd found the bugs and killed 'em.

Bill was traveling not long ago and ran on to another fellow from out in the Middle West, who was just starting in the same game and was having his troubles, same as most of 'em do. Well, Bill opened up and told him how he'd crawled under some difficulties and climbed over others; and as the Middle Westerner was going to be near his town, Bill asked him to come over and see things.

Mr. Middle Westerner comes all right and spent a day, Bill giving him as much time as he could and letting him nose around by his lonesome the rest. Oh, but he was grateful—any time Bill wanted any dope in M. W.'s line, all Bill had to do was to holler, and a lot more taffy that Bill set down to natural exuberance or such.

Now it so happened that Bill went West not so very long after and thought he would blow in on Mr. M. W. and see how he was getting on. Bill dropped a line to say he'd be in on the 2:15 train and kinder half thought Mr. M. W. might be there with his car to drive him out. But the M. W. wasn't, and that isn't all. Bill found his way out to the place, way backside of nowhere, with dirt roads and no sidewalks. He caught a glimpse of the M. W. when the latter didn't know it and so was a bit surprised to be told he wasn't in. But Bill nailed him at last and was rewarded with the information that it was strictly against the rules for anyone to go into the shop. Sorry, but he couldn't make any exceptions and other bunk.

I'd like to write what Bill said to Mr. M. W. when he got over the shock, but the censors would stop the edition, even if the editor shut his eyes when it went by.

But after passing the M. W. a few complimentary remarks about being a hypocritical, ungrateful cuss in general, Bill read the riot act on the principle of the whole thing. He pointed out in polite but forcible language that he had given a lot of his time, all his experience and saved M. W. a barrel of money in experimenting. Then he showed that man what a low-down, lop-sided sort of a hound he was to grab all he could from others and not give back to the general fund of mechanical knowledge.

Then Bill spotted the *American Machinist* reprints on shrapnel and high-explosive shells, and he broke out in a fresh spot. Showed how such information was made available because most manufacturers were openminded enough to realize that the whole advance in mechanics was due to an interchange of ideas—that the fellow who didn't give out his mite was reniging in the game and had a soul about the size of a plugged nickel. Said that if M. W. wouldn't add his bit of real dope he ought to be man enough not to use the other fellow's stuff and that there ought to be some way whereby he could be prevented from buying any of the papers which give other methods.

Bill came home mad clear through—wouldn't have hurt him so much if it had been somewhere else besides the "open-hearted West"—that's what got his goat the most, and it isn't altogether strange is it?

As Bill says, he don't blame anyone in the war game for not saying much till he gets what orders he needs; but when he's got things cinched, he sure ought to give up for the general good.

I'm wondering if Bill's scheme for an embargo to prevent the *American Machinist* from reaching men who won't give up their end of the game isn't a good thing.

Jigs Used for Machining Parts of a Press Feeder

By Robert Mawson

SYNOPSIS—Because of the high speed at which the feeder operates and the necessity for interchangeable manufacture, these parts must be accurately machined. In most cases when the part is milled the drilling operation is the next in sequence. This routine enables the part to be either located or placed on finished surfaces.

The two-sheet rotary printing press illustrated on page 58 is manufactured by the United Printing Machinery Co., Woonsocket, R. I. Several articles have already appeared, showing and describing examples of jigs and fixtures employed in machining elements used on the press. These tools were examples of economical and successful small-tool construction, and equally well designed tools used in machining five other parts used on the feeder for the press form the subject of this article.

Where rough surfaces are used for locating, adjustable means, such as screws, are provided so that the locator may be easily changed as conditions demand. The operations on all of the parts consist of drilling and reaming.

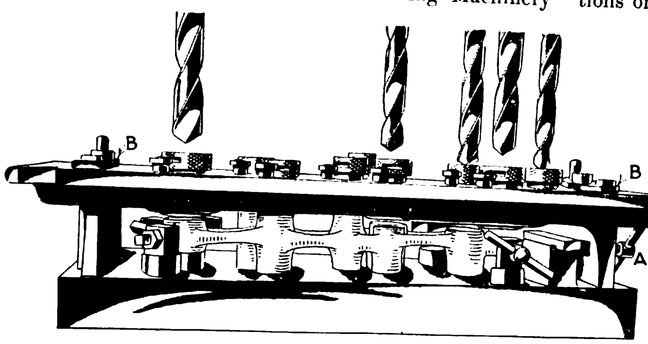


FIG. 2

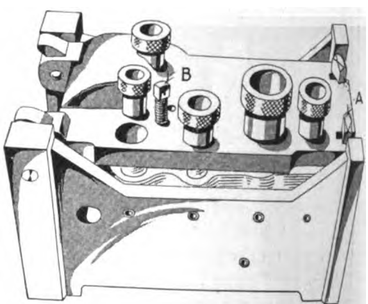


FIG 6

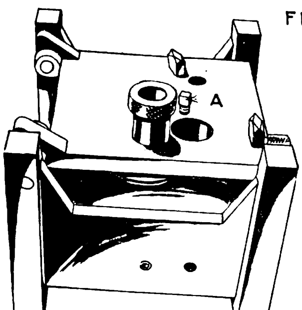


FIG. 4

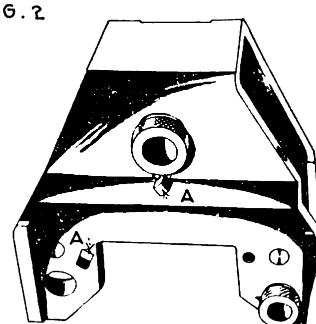


FIG. 8

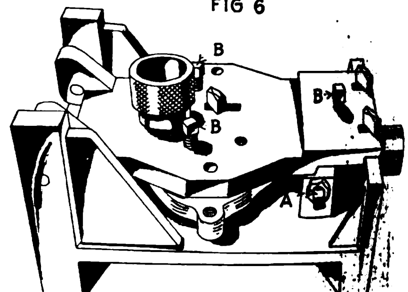


FIG. 10

JIGS USED IN MACHINING PRESS-FEEDER PARTS, WITH WORK SHOWN IN POSITION

FIGS. 2 AND 2-A

Operations—Drilling and reaming upper center bearing, Fig. 1. The milled casting is located against two pins, being forced back with knurled-head screws, as A. The cover is then dropped down and held with the three thumb-screws shown. The three screws B are then tightened down and hold the casting in position.

Holes Machined—One $1\frac{15}{64}$-in. drilled and reamed $1\frac{1}{4}$ in., one $\frac{63}{64}$-in. drilled and reamed 1 in., three $\frac{47}{64}$-in. drilled and reamed $\frac{3}{4}$ in., one $\frac{31}{64}$-in. drilled and reamed $\frac{1}{2}$ in., three $1\frac{7}{64}$-in. drilled and reamed $1\frac{1}{8}$ in., one $\frac{55}{64}$-in. drilled and reamed $\frac{7}{8}$ in.

FIGS. 4 AND 4-A

Operations—Drilling and reaming pile drag carriage bracket, Fig. 3. The milled casting is located by ears which are set on the inside of the machined surface of the fork end. It is forced back with a knurled-head screw at the opposite end. The cover is then dropped down and fastened with the thumb-screws A. The setscrew B is tightened down on the casting and holds it securely.

Holes machined—One $\frac{55}{64}$-in. drilled and reamed $\frac{7}{8}$ in., one $\frac{49}{64}$-in. drilled and reamed $\frac{5}{8}$ in., one $\frac{63}{64}$-in. drilled and reamed 1 in., one $\frac{5}{16}$-in. drilled and one $\frac{3}{16}$-in. drilled.

FIGS. 6 AND 6-A

Operations—Drilling and reaming lower conveyor bracket, Fig. 5. The rough casting is located by a V-block inside of which the circular boss of the part is forced, with a setscrew at the opposite end. A setscrew on the under side forces back the piece against locating pins.

Holes Machined—Four $\frac{39}{64}$-in. drilled and reamed $\frac{5}{8}$ in., two $\frac{47}{64}$-in. drilled and reamed $\frac{3}{4}$ in., one $\frac{63}{64}$-in. drilled and reamed 1 in., one $\frac{3}{16}$-in. drilled and two No. 9 drilled.

FIGS. 8 AND 8-A

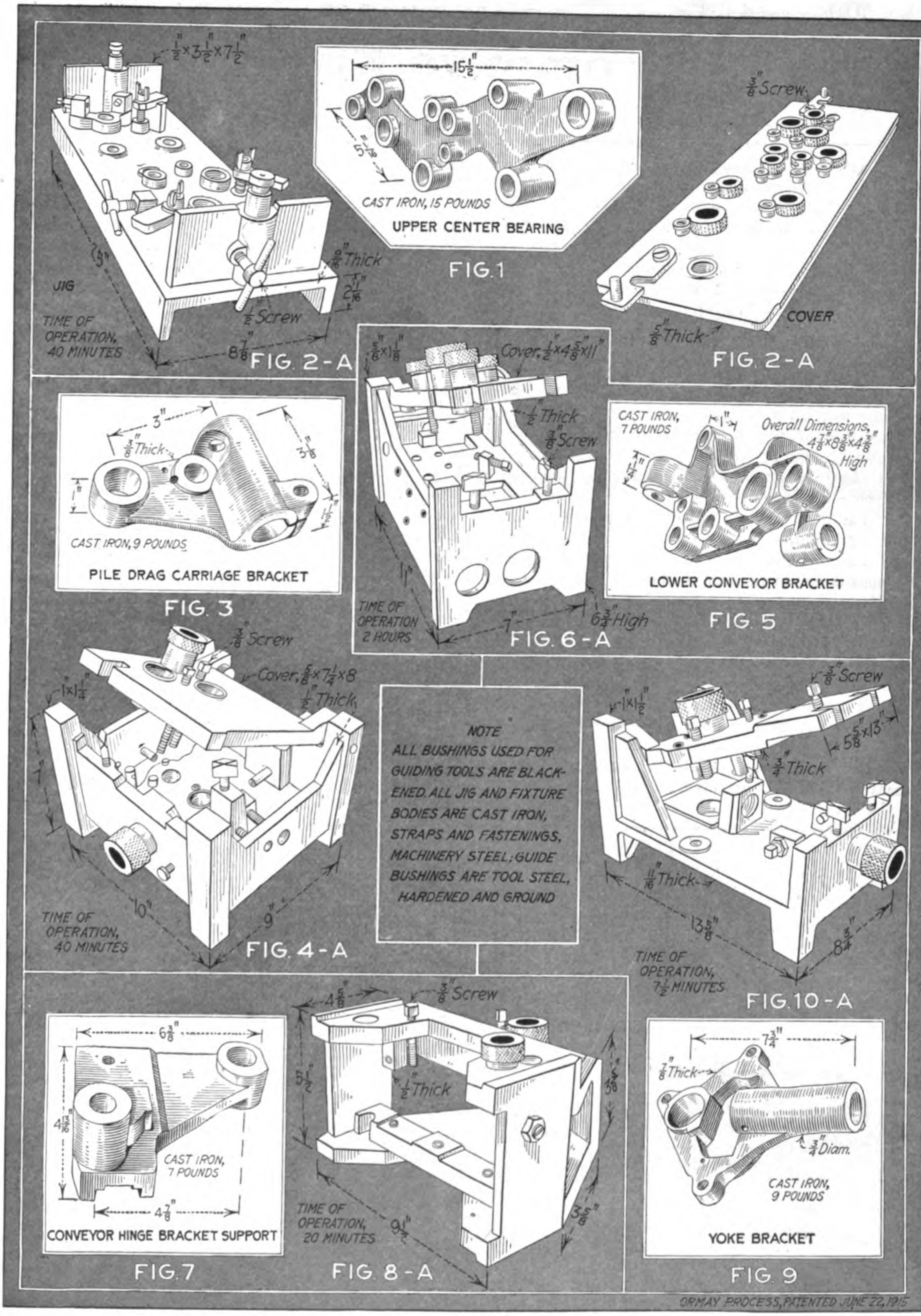
Operations—Drilling and reaming conveyor hinge bracket support, Fig. 7. The milled casting is located over a machined block and forced into the correct position determined by the adjustable setscrew A with another screw. The cover is then dropped down and fastened with the thumb-screw, as shown.

Holes Machined—One $\frac{55}{64}$-in. drilled and reamed $\frac{7}{8}$ in., one $\frac{39}{64}$-in. drilled and reamed $\frac{5}{8}$ in. and two $\frac{5}{16}$-in. drilled.

FIGS. 10 AND 10-A

Operations—Drilling and reaming yoke bracket, Fig. 9. The milled casting is located by a stop pin at one end and forced against the adjustable setscrew A with a screw at the other end. The cover is then dropped down, fastened with the three thumb-screws, and the setscrews B are tightened on the casting, thus holding it securely.

Holes Machined—Two $1\frac{15}{64}$-in. drilled and reamed $1\frac{1}{4}$ in. and three $\frac{7}{16}$-in. drilled.



DETAILS OF JIGS USED IN MACHINING PRINTING-PRESS FEEDER PARTS

A Plant for Conversion From Rifle to Locomotive Building

EDITORIAL CORRESPONDENCE

SYNOPSIS—The main interesting feature of this plant is the fact that it was designed primarily for building locomotives and is yet capable of being temporarily converted to the manufacture of rifles. The wide difference in products and in methods makes such a building construction of unusual interest. The completeness of the oil-reclaiming plant, covering as it does both chip and waste, is also unusual in size and equipment. It reclaims both the oil and the waste.

It is decidedly unusual to speak of a huge manufacturing plant as a byproduct, and yet that is exactly the character of the new buildings of the Baldwin Locomotive Works at Eddystone, Penn. Several years ago the company purchased a large tract of land, with the purpose of ultimately moving its huge locomotive works from the heart of Philadelphia to the new site, and a few buildings were erected as the beginning of the change. In common with many other unexpected developments due to the war the need of manufacturing plants for immediate use furnished the opportunity of preparing buildings for practically the entire plant at most advantageous terms.

A contract was entered into with the Remington Arms Co. of Delaware for the erection of these huge shops and their use during the manufacture of large orders of rifles for the contending armies. Plans were made so that the buildings erected should be eminently suited for the manufacture of locomotives, but should temporarily be converted into shops for rifle manufacture. These conditions developed a type of buildings, as illustrated in Fig. 1, that are capable of considerable interior modification, either temporarily or permanently, to adapt them for various kinds of work.

There is nothing temporary about the construction of the buildings themselves, which are of the most modern type, laid out to secure the best use of the land available.

The flooring arrangement has been put in with a special view to the manufacturer of rifles, but can be readily altered at any future time or even entirely removed from the central bays in shops where the nature of the work may make it seem desirable to do so. The general construction may be said to be of tile and steel, with a view to making the plant thoroughly fireproof.

The plant covers 15 acres of ground and was erected in record-breaking time—about 3 months. The main building is 1,040 ft. long by 816 ft. at the widest part. The buildings, with the temporary flooring, give a total floor area of nearly 38 acres. The main building has 13 aisles and 341 bays, each 24x80 ft. Four towers, 80x48 ft. and 74 ft. high, provide spaces for three hydraulic motors in each, when locomotive boilers are to be made. Three cranes will go in each tower to handle the boilers being riveted.

Every effort is made to secure a maximum amount of light, and in addition to the light from glass in the roof the outer walls have as large windows as are possible. To conserve still further the effective lighting, the sections with one or two auxiliary floors are alternated with single-floor bays.

It will be noticed that the building is not of uniform ground plan, but that the width increases in steps. This

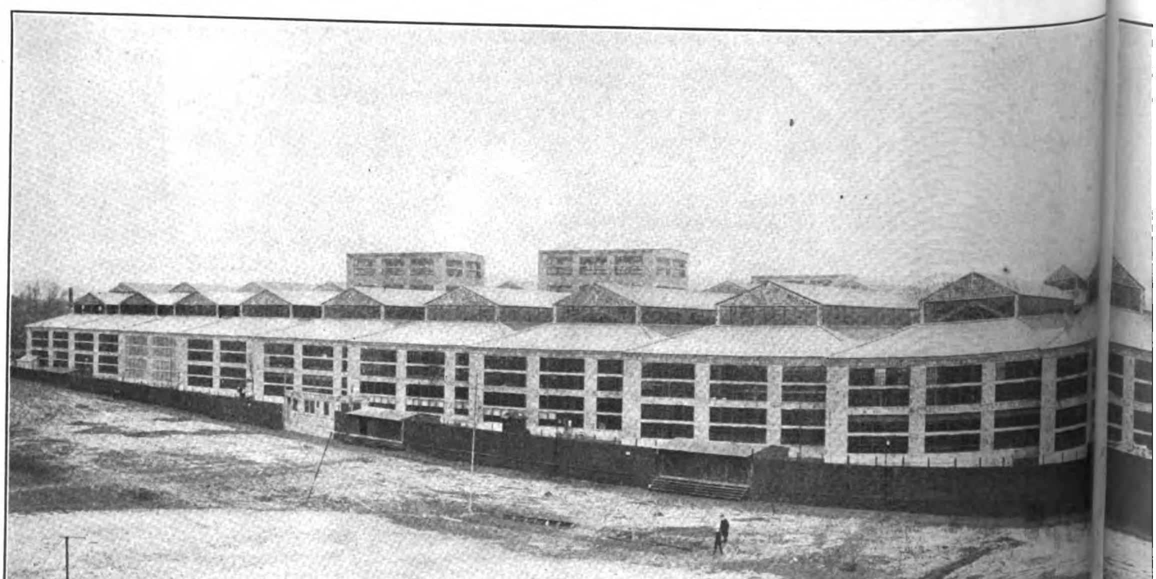


FIG. 1. A GENERAL VIEW OF THE NEW SHOPS ERECTED FOR THE ULTIMATE USE OF THE BALDWIN LO

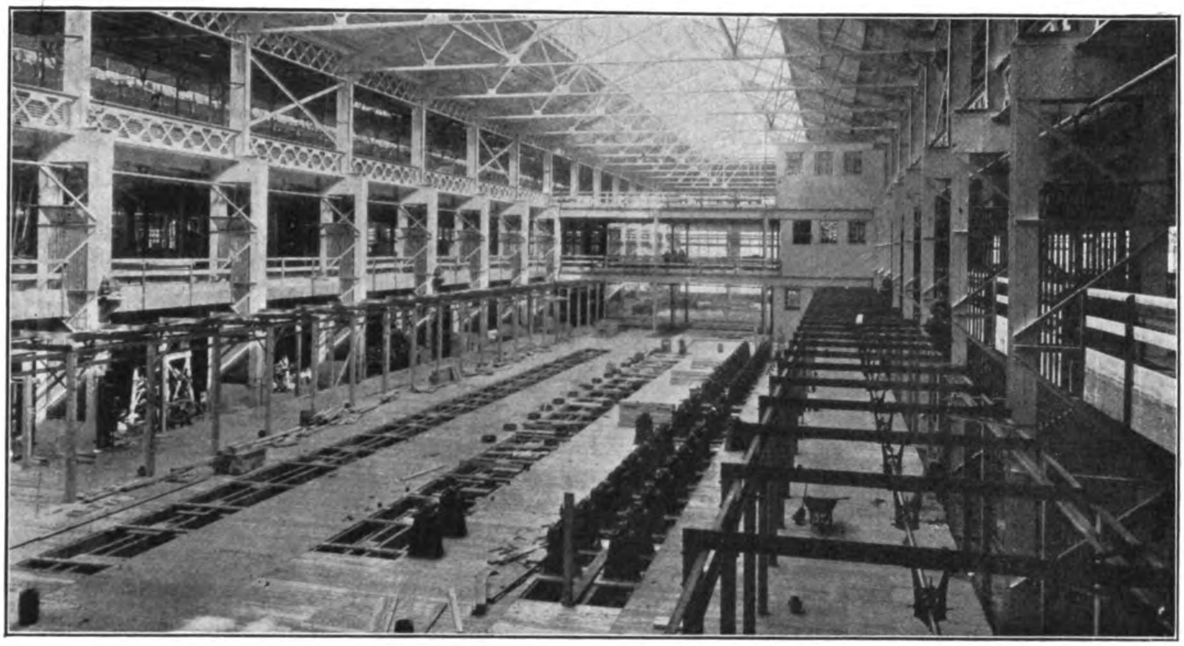


FIG. 2. A BAY WITH NO TEMPORARY FLOORING

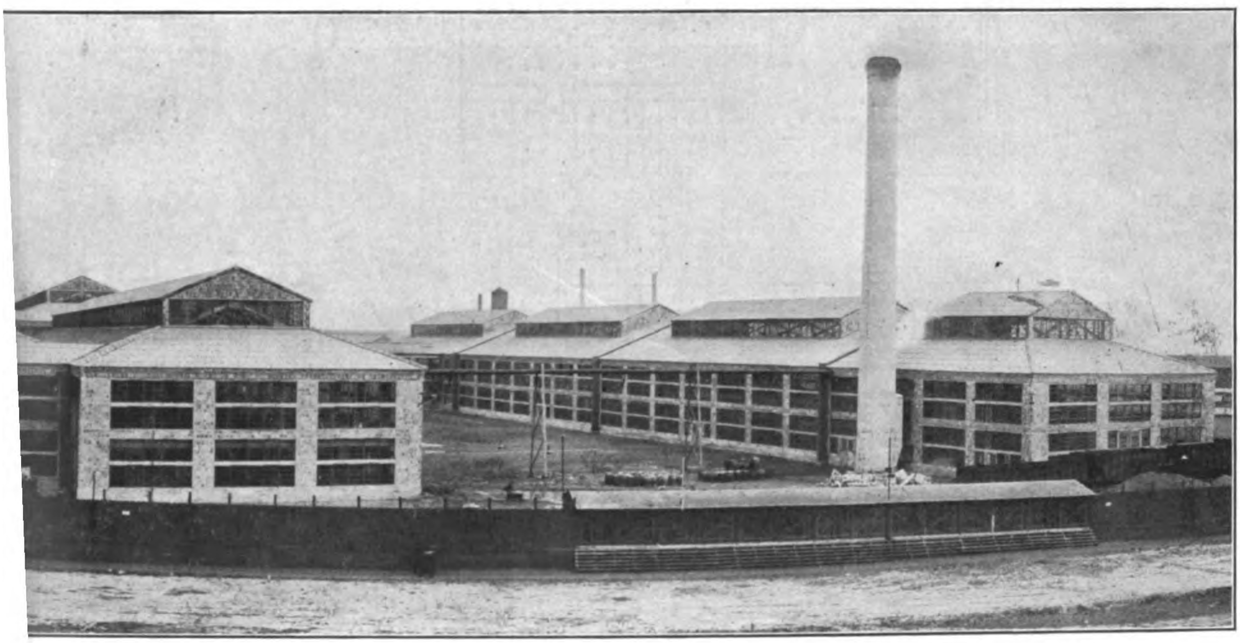
arrangement gives entrance for a track at each step on each side of the building and allows all material to enter and leave at the sides, being transferred by traveling cranes wherever needed.

Power comes from the Philadelphia Electric Co. at 13,000 volts and is handled in three transformer houses that deliver it at 440 volts, 3 phase, 60 cycles. Five thousand kilowatts will be used.

The size of the work made a blanket contract out of the question, and the unit plan was adopted. The McClintock-Marshall Co. took the steelwork and employed all its own facilities in addition to subletting a portion to the Fort Pitt Bridge Co. The grading, foundation and concrete work was given to one firm, and other items were handled in the same way.

Fig. 3 shows a ground plan of the plant layout and gives some idea of the immense area covered by it. Only a few of the principal dimensions are given, but these will serve to show the size of the plant.

Figs. 2 and 6 are different interior views of the plant, the first giving a good idea of one of the bays that has been left free from intermediate flooring. The temporary line and countershaft structure is shown at each side, while a row of grinding machines occupies a



OMOTIVE WORKS AT EDDYSTONE, PENN., NOW BEING USED BY THE REMINGTON ARMS CO. OF DELAWARE

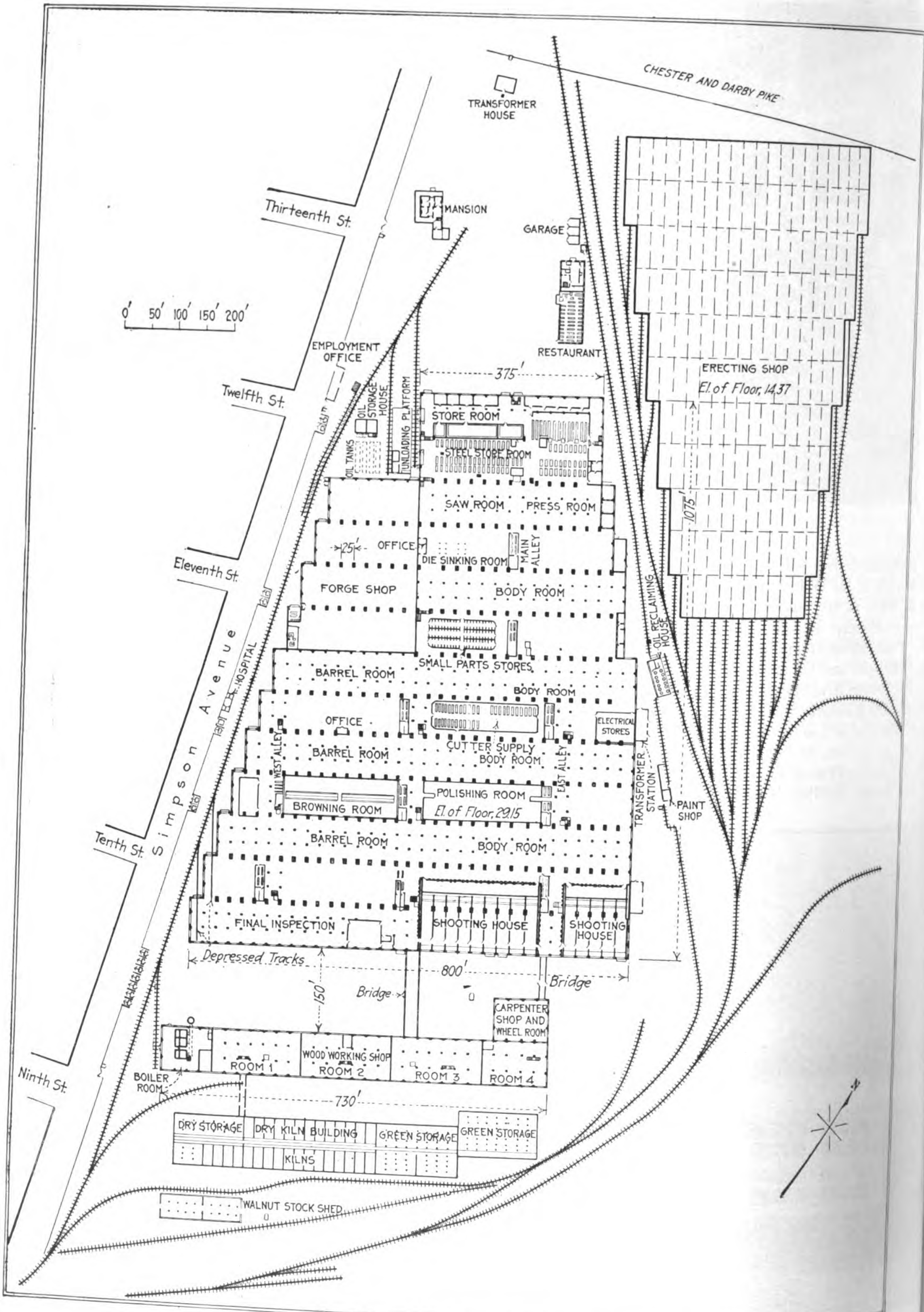


FIG. 3. GROUND PLAN, SHOWING DETAILS OF PLANT LAYOUT

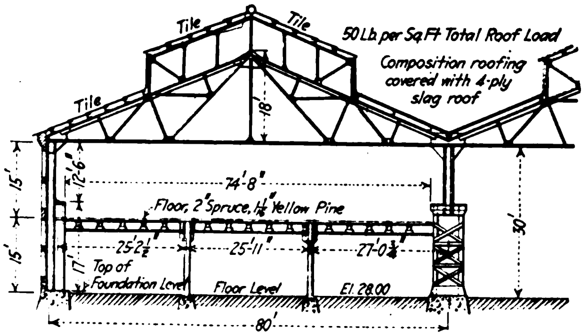


FIG. 4. DETAILS OF SINGLE FLOORING

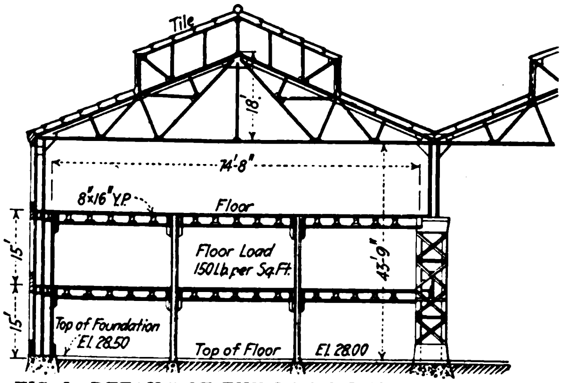


FIG. 5. DETAILS OF THE DOUBLE-FLOOR INSERTION

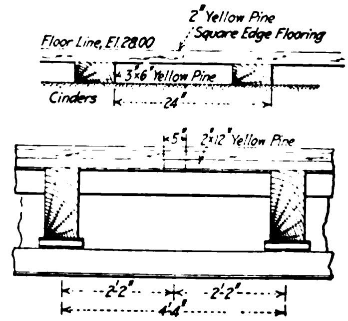


FIG. 6. FLOORING DETAIL

prominent place near-by. They are driven by shafting beneath the floor, the belt coming up inside the grinder column, as in modern practice.

Figs. 4 and 5 illustrate sections of the 80-ft. bays with the flooring in place. As will be seen, there are two styles—one being 43 ft. 9 in. to the bottom of the roof girder and carrying two floors with a headroom of nearly 14 ft. and intermediate columns that give practically a 25-ft. column spacing. The lattice girders supporting the ends of the roof trusses will carry rails for craneways, if the floors are removed and the shops used for handling large work. A portion of the buildings is only 30 ft. to the bottom of the roof girders. These sections are used with but one temporary flooring in place, but are otherwise very similar to the construction shown in the other view. A construction detail is shown in Fig. 6.

A view in the drop-forging plant is seen in Fig. 7, where numerous furnaces are shown in the foreground; the drop hammers are in the adjoining bay. This illustration also gives a good idea of the general building construction, particularly the lattice columns that support the roof and will eventually carry the rails for the craneway.

One of the most interesting features is the oil-reclaiming plant, which was designed by the plant engineer, B. T. Converse. Although this oil-reclaiming plant occupies a comparatively insignificant area as compared with the whole, it is in reality quite a fair-sized structure, about 26x70 ft. and approximately 20 ft. high. This building is of reinforced concrete throughout, with standard fireproof doors in every case, the window sash being of steel fitted with wire glass. In other words, it has been made as nearly fireproof as possible.

The object of installing this house is to remove from the main building all oil-soaked waste and oil-soaked chips, both for the purpose of reclaiming the oil and

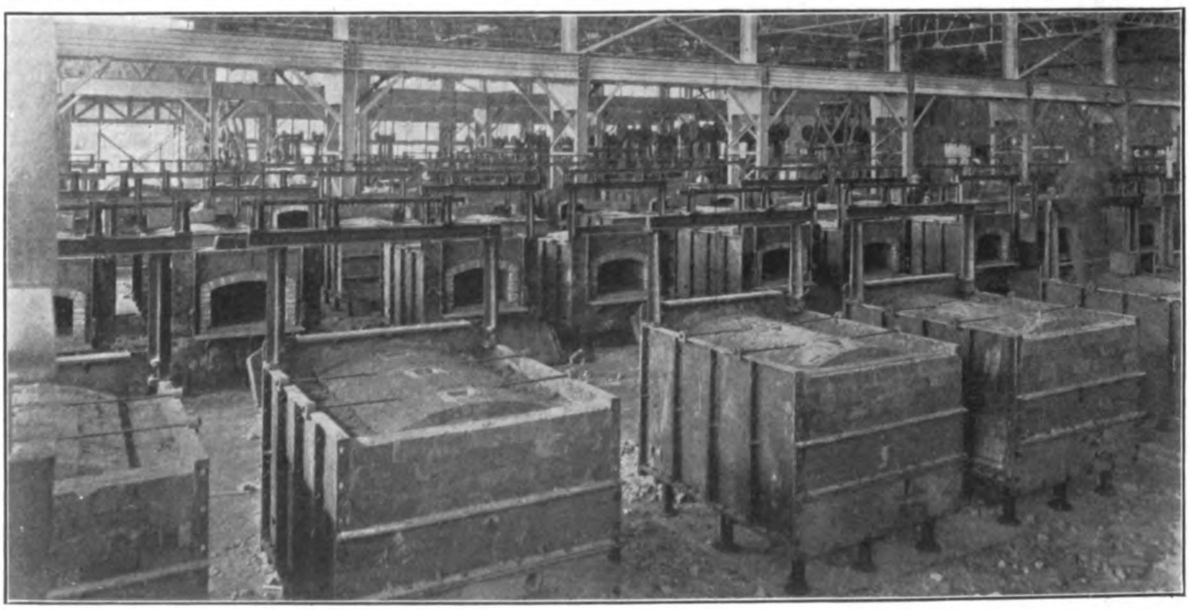


FIG. 7. THE DROP-FORGE PLANT; FURNACES IN THE FOREGROUND AND DROP HAMMERS BACK OF COLUMNS

the waste and also for reducing the fire hazard of the shop itself. The waste is washed, dried and issued again for use. The chips are run through an oil-separating machine and are then dumped directly into the cars in which they are to be shipped away.

The present equipment, as can be seen in Fig. 8, is five steam-turbine waste-washing machines on one side of the building, with foundations and pipe connections for a sixth machine, should this become necessary. On the other side of the building are six oil-separating machines, driven by quarter-turned belts from line shafting and suitable countershafts, the motive power being a 25-hp. 440-volt 3-phase 60-cycle motor, which runs at 950 r.p.m. under full load. The reclaimed oil is piped to the sediment-extracting oil tank and goes from there to the steam-turbine oil filters, shown in the room at the right. Then it goes to a suitable storage tank, which is located underground.

A better idea of the appearance and exact location of both the waste-washing machine and the oil separators can be had from the sectional view, Fig. 9, which also shows the sediment tank, the live-steam hot-water heater and the centrifugal oil filters, as well as the construction of the building itself. This shows the upper and lower floor and the gallery, all of concrete.

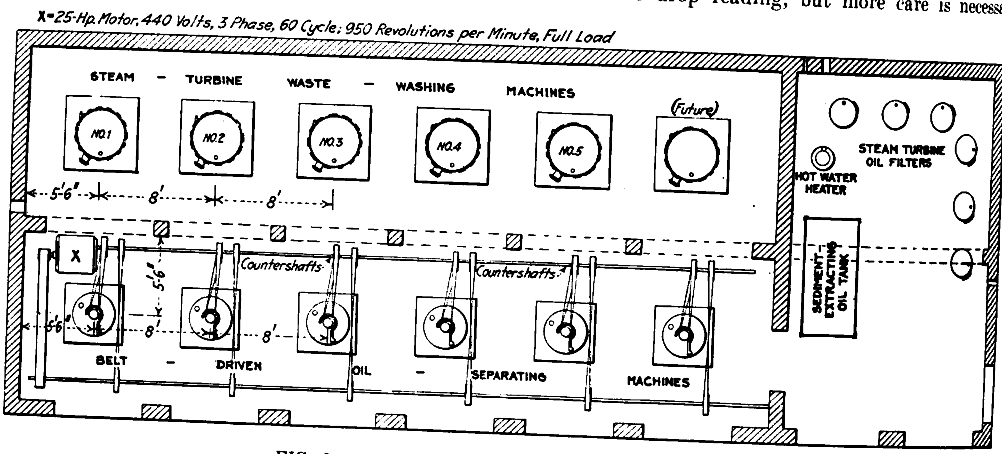


FIG. 8. PLAN VIEW OF OIL-RECLAIMING PLANT

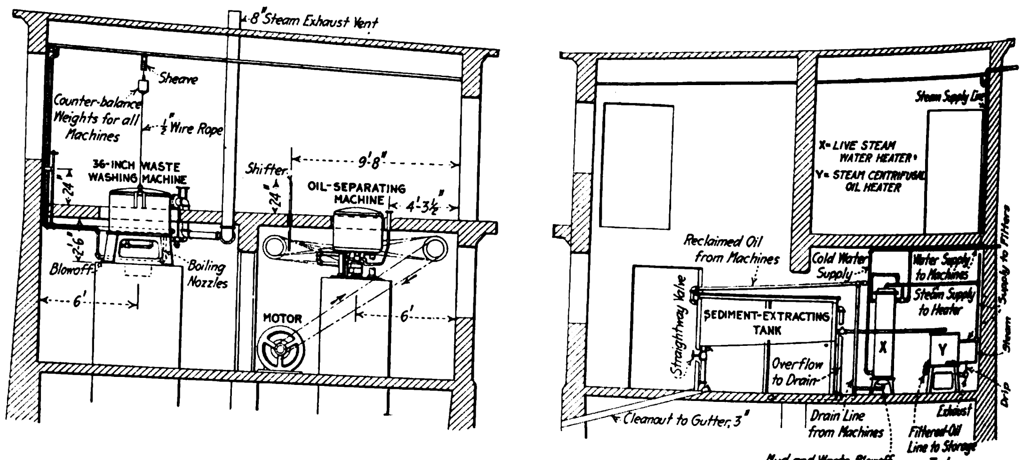


FIG. 9. CROSS-SECTIONAL ELEVATIONS, SHOWING PRODUCERS

Water Flow Through Pipe Orifices

In a paper presented at the spring meeting of the American Society of Mechanical Engineers Horace Judd derived the following conclusions: (1) A thin plate orifice inserted in a pipe is as reliable for flow measurement as the thin plate, or frictionless orifice, as used ordinarily. (2) The shape of the pressure drop curves indicates a maximum point at about ½ pipe diameter from the diaphragm, which would seem to indicate a zone of maximum velocity of flow. (3) The eccentric and segmental diaphragms are advantageous in that they increase the drop reading, but more care is necessary in making the pressure connections, especially on the upstream side of the diaphragm. (4) The best point for the pressure connection is not less than ½ pipe diameter from the diaphragm on the downstream side, and not less than 1 pipe diameter from the diaphragm on the upstream side of the pipe. (5) The 80 per cent. diameter size of diaphragm should not be exceeded to secure uniform flow conditions and to insure steady pressure drop readings. (6) The average coefficient of discharge for a 5-in. pipe diaphragm agrees very closely with the average coefficient of discharge for the 5-in. pipe cap orifice.

Empirical Formulas for the Proportions of Lathes

By A. Lewis Jenkins*

SYNOPSIS—The results of a study of the proportions of 393 American-built lathes, including practically every standard machine made in the country. The formulas cover 40 features of design. They are unquestionably the result of the most detailed study ever made of American lathes.

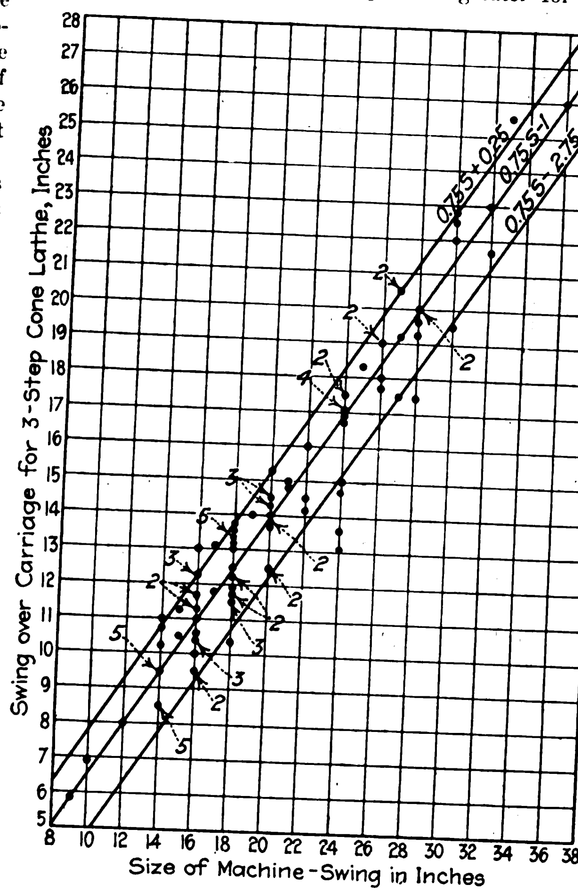
The paper presented by Mr. Alford before the National Machine Tool Builders' Association, on the "Standardization of Machine Tools," and published in Vol. 35, page 725, of the *American Machinist* created an incentive among those interested in machine tools to study the proportions of various machines from the standpoint of the principles he outlined. The results of such a study of American-built lathes is herewith presented, showing the average and limiting values used for the most important proportions.

The data used in this work consist of the specifications given for 393 lathes, and this number practically includes every standard lathe built in this country. The data were tabulated on tracing cloth, from which blueprints were made. These blueprints were gummed, then cut horizontally into strips, giving the data for each lathe on a single strip. The strips were sorted, and the data for the three-step cone, four-step cone, five-step cone and all-geared head machines were collected and arranged in the order of their sizes and mounted on large sheets of paper. This resulted in having all the data for each size and type conveniently collected for comparing and averaging. Each proportion for each type was then plotted against the size of the machine, requiring about 170 sheets of cross-section paper and the plotting of something like 14,000 points. With the exception of only one make the data used in this analysis are more complete than those given in catalogs.

In order to condense the information given by the 170 graphs, empirical formulas were derived for curves or lines through the maximum, average and minimum values. These formulas are given in Table 1. Here S denotes the nominal size of the machine, which is approximately equal to the largest diameter that will swing over the bed. No distinction was made between the light, medium, heavy and toolroom lathes. Many of the data are equally applicable to all and some merely moved from one size to the next, such as results from putting a 16-in. headstock on an 18-in. bed. These variations are accounted for in Table 1 by the maximum and minimum values.

Fig. 1 shows the data for the "swing over carriage" for the three-step cone lathe, and the lines give the maximum, average and minimum values. Great care and my best judgment were exercised in drawing these curves. The maximum and mean values were not drawn through the most extreme point when there were a few extending considerably beyond the range; but enough points, from two to ten, depending upon their position, were considered as being due to error or accident. The maximum and minimum values obtained in this way are not freaks or absurdities and have sufficient practical applications to justify their use. The fields of all graphs, with the exception of those for the highest and lowest feeds and a few others, show a remarkable consistency. Perhaps the most varied or apparently inconsistent are the graphs for the countershaft speeds. In addition to the information given in Table 1 the following conclusions and comments are worthy of mention:

Swing Over Shear—The swing over the shear is practically the same for all cone types and greater for the



PLOTTED DATA FOR SWING OVER CARRIAGE

geared. There is apparently no reason why the swing over the shears should not be standard and equal to $S + 1$, which gives ½-in. clearance between the large faceplate having a diameter equal to the nominal size of the machine and the V's on the bed. The maximum values for the three-step cone and geared types are about a size larger than the average for those types.

Swing Over Carriage—The minimum values for the swing over the carriage show a greater variation from the average than is shown for the swing over the shear. This is probably due to the increased size of the carriage on some of the heavy models.

*Associate Professor of Mechanical Engineering, University of Cincinnati.

TABLE 1. EMPIRICAL FORMULAS FOR PROPORTIONS OF LATHES*

Type of Lathe		Swing Over Shear (Diameter)	Swing Over Carriage (Diameter)	Swing Over Rest (Diameter)	Length of Bed Minus Maximum Distance Between Centers	Travel of Tailstock Spindle	Diameter of Tailstock Spindle	Taper of Centers (Morse)	Length of Front Bearing	Diameter of Front Bearing	Length of Rear Bearing	Diameter of Rear Bearing	Diameter of Hole Through Spindle	Length of Spindle Nose	Diameter of Thread on Spindle Nose	Threads per Inch on Spindle Nose	Diameter of Smallest Step on Cone Pulley	Diameter of Largest Step on Cone Pulley	Width of Belt on Cone Pulley or Driving Belt	Maximum or Last Spindle Speed, L
3-step cone, double back gear	Maximum	S+2.5	0.75S+0.25	0.66S+3	3S—2	0.575S—1.5	0.14S	0.28S	0.37S	0.22S	0.25S +3	0.14S +1.5	0.08S+0.5	0.13S +0.3	0.15S+0.6	125/S	0.45S+1	0.66S+2	0.25S	8,200/S
	Average	S+1	0.75S—1	0.75S—2.5	2.5S	0.5S—1	0.12S	0.21S	0.28S	0.17S	0.25S —1.25	0.14S —0.5	0.08S+0.1	0.13S	0.15S	125/S —1.1	0.44S	0.66S	0.20S	6,250/S
	Minimum	S	0.75S—2.75	0.75S—5.5	2.1S+1	0.3S+0.5	0.1S	0.16S	0.16S	0.15S	0.25S —3.5	0.14S —2	0.08S—0.25	0.13S —0.5	0.15S—0.3	125/S —2.1	0.45S—2	0.66S—2	0.15S	6,250/(S+6)
4-step cone, single back gear	Maximum	S+2.25	0.75S+0.5	0.66S+2	3S	0.45S+1.5	0.14S	0.33S	0.34S	0.20S	0.20S +1	0.13S +1	0.06S+1	0.13S +0.25	0.14S+0.5	125/S	0.40S	0.66S+1.5	0.16S+0.5	7,200/S +100
	Average	S+1	0.75S—1.5	0.66S—1.5	2.5S+2	0.45S	0.13S	0.20S	0.30S	0.17S	0.20S	0.13S	0.06S+0.5	0.13S	0.14S+0.25	125/S —1.1	0.30S	0.66S	0.16S	7,200/S
	Minimum	S+0.25	0.75S—3	0.66S—3	2.5S—2	0.45S—1	0.11S	0.16S	0.24S	0.15S	0.20S —1	0.13S —0.75	0.06S+0.1	0.13S —0.25	0.14S—0.25	125/S —2.1	0.25S	0.66S—1.5	0.16S—0.75	7,200/S —100
5-step cone, single back gear	Maximum	S+2	0.75S+0.25	0.66S+0.5	2.4S+10	0.5S	0.12S+0.5	0.26S	0.33S	0.18S	0.23S	0.13S +0.5	0.08S+0.2	0.14S +0.25	0.15S+0.25	125/S	0.25S+1	0.64S+1.5	0.13S+0.75	8,600/S +40
	Average	S+1	0.75S—1	0.66S—0.5	2.4S+4	0.45S	0.12S	0.20S	0.27S	0.16S	0.20S	0.13S	0.08S	0.13S+ 0.25	0.15S	125/S —1.1	0.25S	0.64S	0.13S+0.25	8,600/S
	Minimum	S+0.25	0.75S—2.5	0.66S—1.5	2S+6	0.33S	0.12S—0.5	0.15S	0.25S	0.14S	0.15S	0.13S —0.5	0.08S—0.2	0.13S —0.25	0.15S—0.5	125/S —2.1	0.25S—1	0.64S—1.5	0.13S—0.25	8,600/S —60
Geared Head	Maximum	1.03S+2.5	0.75S	0.7S+1	3.2S—2	0.45S+2	0.14S	0.25S	0.35S	0.22S	0.20S +1	0.13S+ 0.75	0.06S+1	0.13S+ 0.75	0.15S+0.5	125/S	....	0.5S+4	0.27S	14,000/(S+15)
	Average	1.03S+1	0.75S—1	0.7S—1	2.8S—1	0.45S	0.13S	0.20S	0.28S	0.19S	0.20S+ 0.25	0.13S	0.06S+0.6	0.13S +0.1	0.15S+0.1	125/S —1.1	....	0.5S+2	0.22S	7,200/S
	Minimum	1.03S+0.5	0.75S—2	0.7S—3	2.4S	0.45S—1	0.11S	0.16S	0.24S	0.15S	0.20S —0.5	0.13S —0.5	0.06S+0.1	0.13S— 0.25	0.15S—0.5	125/S —2.1	....	0.5S	0.11S+1.25	5,200/S

Type of Lathe		Minimum or First Spindle Speed, A	Ratio of Last to First Spindle Speed, R	Diameter of Countershaft Pulley	Width of Countershaft Pulley	Fast Countershaft Speed	Slow Countershaft Speed	Smallest Feed, in Turns per Inch	Largest Feed in Turns per Inch	Diameter of Lead Screw	Pitch of Lead Screw: Size of Lathes, In.	Pitch of Lead Screw: Pitch	Size of Tool	Weight of Bed per Foot	Diameter of Faceplate	Length of Carriage	Depth of Bed	Width of Top of Bed	Constant Multiplier or Geometric Ratio of Spindle Speeds, r		Number of Feed Changes	Number of Thread Changes	Largest Thread in Turns per Inch	Smallest Thread, in Turns per Inch
																			18 Speeds	9 Speeds				
3-step cone, double back gear	Maximum	278/S	....	0.5S +6	0.23S+1	6,000/S	....	450	200/S	0.05S +0.75	10 to 16	6		13S—50	S+2	1.4S+3	0.75S	S+1	1.3	1.8	50	50	4	1,250/S
	Average	212/S	29.5	0.42S +5	0.23S+0.25	4,170/S	3,380/S	180	150/S	0.05S +0.6	14 to 26	4	S/27 × 2S/27	13S—100	S also 0.3S +5	1.4S+1	0.7S	S-2	1.22	1.5	32	32	1 or 2	700/S
	Minimum	212/(S+6)	....	0.38S +4	0.16S+0.25	2,500/S	....	80	120/S	0.05S +0.4	18 to 36	2	......	13S—150	S—2	1.4S—3	0.6S	S—5	1.16	1.4	18	18	0.5	400/S
																			16 Speeds	8 Speeds				
4-step cone, single back gear	Maximum	141/S +2	....	0.5S +6	0.125S+3	4,800/S				0.05S +0.75	10 to 18	6		15S—100	S+1.75	1.3S+4	...	S—1	1.35	1.85	54	54	4	1,000/S
	Average	141/S	51	0.5S +4	0.125S+2	3,180/S	2,420/S	2,200/S	125/S	0.05S+ +0.6	14 to 26	4	S/27 × 2S/27	15S—150	S	1.3S+2	0.7S	0.7S+1	1.3	1.69	46 and 48	45 and 48	1 or 2	900/S
	Minimum	141/S —2	....	0.5S +2	0.125S+1	...	....	....	...	0.05S +0.4	18 to 26	2	......	15S—200	S—1	1.3S—2	...	0.6S+1	1.24	1.6	32	32	0.5	560/S
																			20 Speeds	10 Speeds				
5-step cone, single back gear	Maximum	107.5/S + 0.5	....	0.5S +5	0.27S	3,500/S				0.05S +0.6	14 to 16	6	¾x1¼ in. for 18 to 32 in.	15S—100	S	1.5S	0.7S +1	0.7S+5.5	1.3	1.64	54	54	4	60
	Average	107.5/S	80	0.5S +3	0.23S	2,850/S	2,280/S	4,000/S	150/S	0.05S +0.4	14 to 30	4	1x2 in. for 24 to 42 in.	15S—150	S	1.3S	0.7S	0.7S+3.5	1.23	1.58	46	46	1, 2 or 3	30 to 45
	Minimum	107.5/S —0.75	....	0.5S +1	0.1S+0.6	...	....	...	...	0.05S +0.2	22 to 54	2	¾x1.25 in. for 14 to 22 in.	15S—200	S	0.8S+10	0.7S —2	0.7S—1.5	1.24	1.27	28	32	0.5	15
																			8 Speeds, 12 Speeds	16 Speeds, 18 Speeds				
Geared Head	Maximum	490/(S+15)	....	0.33S +11	0.33S+2	...	....	7,500/S	190/S	0.08S +0.1	12 to 20	6		15S—100	S+1	1.4S+4	0.75S	S	1.66, 1.46	1.29, 1.26	50	50	1.5	1,250/S
	Average	225/S	32	0.33S +8	0.33S+1	...	....	6,000/S	150/S	0.05S +0.4	14 to 30	4	S/30 × 2S/30	15S—150	S also S/2	1.4S	0.7S	S—2	1.58, 1.36	1.26, 1.23	45 and 48	45 and 48	1 or 1.5	1,000/S
	Minimum	96/S	....	0.33S +6	0.25S+0.5	...		3,600/S	80/S	0.05S +0.2	18 to 36	2		15S—200	S—0.5	1.4S—5	0.6S	S—4	1.45, 1.27	1.23, 1.2	32 and 12	32	2	850/S

* S = nominal size of lathe, which is equal to about twice the height of centers; all dimensions are expressed in inches, weights in pounds.

Length of Bed Minus the Distance Between Centers—This shows the length of bed occupied by the headstocks and tailstocks. This value taken from the length of bed gives the maximum distance between centers. The minimum values for this proportion are apparently small. This is due to the fact that the actual lengths of some beds are greater than specified; for example, the actual length of an 8-ft. bed may be 8 ft. 6 in. in some instances, although it is not generally so made.

Taper of Centers—With very few exceptions the Morse tapers are used exclusively. The relation of the size of the taper to the size of machine may be expressed as follows: No. 2 is used on 10-in. to 12-in. lathes; No. 3 on 12-in. to 16-in.; No. 4 on 14-in. to 24-in.; No. 5 on 14-in. to 30-in.; No. 6 on 24-in. and greater. In view of these data the range could be satisfactorily covered by the three sizes Nos. 2, 4 and 6, although there are about as many Nos. 3 and 5 used as Nos. 4 and 6.

Bearings—The lengths and diameters of bearings on machines built in this country are greater than the values given by Nicolson and Smith in their book, "Lathe Design," which is based on examples of British design.

Belts—The values for the width of belt do not vary as much as might be expected for the cone-type machines, but there is a considerable variation in the widths used on the geared heads.

TABLE 2. RATIOS FOR GEOMETRIC SERIES OF LATHE SPINDLE SPEEDS*

Number of Steps on Cone	Number of Countershaft Speeds	Number of Back Gears	Number of Spindle Speeds	Constant Multiplier, r	Values of Back-Gear Ratios W_1	W_2	W_3	Values of Cone-Pulley Ratios (Duplicate Cones) U_1	U_2	U_3	U_4	U_5
3	1	2	9	$\left(\frac{L}{A}\right)^{\frac{1}{8}}$	r^3	r^6	...	r	1	$\frac{1}{r}$	...	...
3	2	2	18	$\left(\frac{L}{A}\right)^{\frac{1}{17}}$	r^6	r^{12}	...	r^2	1	$\frac{1}{r^2}$	...	...
3	1	3	12	$\left(\frac{L}{A}\right)^{\frac{1}{11}}$	r^3	r^6	r^9	r	1	$\frac{1}{r}$	.	...
3	2	3	24	$\left(\frac{L}{A}\right)^{\frac{1}{23}}$	r^6	r^{12}	r^{18}	r^2	1	$\frac{1}{r^2}$	.	.
4	1	1	8	$\left(\frac{L}{A}\right)^{\frac{1}{7}}$	r^4	...	...	$r^{1.5}$	$r^{0.5}$	$\frac{1}{r^{0.5}}$	$\frac{1}{r^{1.5}}$	.
4	2	1	16	$\left(\frac{L}{A}\right)^{\frac{1}{15}}$	r^8	..	...	r^3	r	$\frac{1}{r}$	$\frac{1}{r^3}$	.
4	1	2	12	$\left(\frac{L}{A}\right)^{\frac{1}{11}}$	r^4	r^8	.	$r^{1.5}$	$r^{0.5}$	$\frac{1}{r^{0.5}}$	$\frac{1}{r^{1.5}}$	.
4	2	2	24	$\left(\frac{L}{A}\right)^{\frac{1}{23}}$	r^8	r^{16}	.	r^3	r	$\frac{1}{r}$	$\frac{1}{r^3}$	.
5	1	1	10	$\left(\frac{L}{A}\right)^{\frac{1}{9}}$	r^5	..	.	r^2	r	1	$\frac{1}{r}$	$\frac{1}{r^2}$
5	2	1	20	$\left(\frac{L}{A}\right)^{\frac{1}{19}}$	r^{10}	.	.	r^4	r^2	1	$\frac{1}{r^2}$	$\frac{1}{r^4}$

*A = first spindle speed; L = last spindle speed; ratio of first and second countershaft speeds = r.

Pitch of Lead Screws—Considerable variation exists in the pitch of the lead screws. More than half of all the machines are fitted with a four-pitch lead screw. The ranges are as follows:

Sizes of Machines, in Inches	Pitch of Lead Screw, or Threads per Inch
14 to 16	6.0
14 to 36	4.0
18 to 54	2.0
30 to 42	1.5
30 to 36	1.0

Seven machines have a 0.5-pitch screw and seven have a 1.5-pitch screw.

Feeds—Where quick-change gear boxes are employed for cutting threads, they are also used for changing the feed. The values of the feeds are from $\frac{1}{12}$ to ½ the threads, the values of ¼ and ⅕ being the most common. Nicolson and Smith state that four feeds are sufficient, and these should equal $\frac{214}{S}$, $\frac{320}{S}$, $\frac{480}{S}$, and $\frac{720}{S}$ per inch, in a geometric series with constant ratio of 1.5.

It is seen that the average American practice is to use smaller minimum and larger maximum values, thereby increasing the range in both directions. It is also average American practice to provide a lathe with about 50 feed changes when a quick-change gear box is used. Lathes not intended for screw cutting have about eight feed changes when geared and either three or six when belted. The smallest feeds on three-step cone lathes do not seem to bear any relation to the size of the machine and vary from 80 to 450, with an average of about 180 turns per inch when a gear box is used.

Threads—The minimum number of threads per inch or the largest threads that lathes will cut are limited to the values of 0.5, 1, 1.5, 2, 3 and 4. Only a comparatively few cut 3 threads per inch. The values for the smallest threads are represented in Table 1.

Countershaft Speeds—The ratio of countershaft speeds must be equal to r the constant multiplier in the geometric series, in order to produce spindle speeds in a geometric series. In many instances the ratio of the countershaft speeds does not check with the value of r obtained from the maximum and minimum spindle speeds or from the cone-pulley ratios.

The countershaft speeds are quite variable. The values given for the averages meet the requirements of the geometric series, based on the value of r computed from the highest and lowest spindle speeds, with the exception of the four-step cone machines that are larger than 24 in. For the four-step cone double back-geared lathes having two countershaft speeds the average values are as follows: $r = 1.27$; maximum spindle speed $= \frac{7,800}{S}$ r.p.m.; diameter of largest step on cone $= 0.68S$ in.; diameter of smallest step on cone $= 0.298S$ in.; fast countershaft speed $= \frac{3,750}{S}$ r.p.m.; slow countershaft speed $= \frac{2,950}{S}$ r.p.m.

Spindle Speeds—Considerable variation is found to exist in the speeds given by lathes of the same type and size and designed for the same class of work. It is not uncommon to find a variation of as much as 50 per cent. in two lathes of the same size and duty, built by two different concerns of equal reputation. The values of the geometric ratios, ratios of back gears, countershaft speeds and diameters of steps on cones give evidences of the existence of several important considerations that have been taken into account by the designers. The four most important of these are: (1) The maintenance of a constant geometric ratio on all sizes; (2) the slowest spindle speed such as will give a constant cutting speed on a diameter equal to the nominal size of the machine or faceplate diameter; (3) large back-gear ratios; (4) maximum belt velocities.

Constant Geometric Ratio—The value of the geometric ratio may be considered as constant for each type of American-built lathe, such as three-step cone, double back geared, but varies with the type and number of speeds given by a single type, such as an all-geared head. There is considerable variation in this value when based on the highest and the lowest spindle speeds, but this is largely due to the fact that many machines do not give a geometric series of spindle speeds. The relation of the geometric ratio r to the highest and lowest speeds, back-gear ratios and cone-pulley ratios are given in Table 2. This shows that the back-gear and cone-pulley ratios are entirely dependent upon the value of r.

Constant Cutting Speed on Faceplate Diameter—The slowest speed for a given type of lathe may be found by considering a constant cutting speed either on a diameter equal to the nominal swing of the machine or on the largest diameter that will swing between centers and over the carriage. This, together with the constant value of r for each type of lathe, results in a constant ratio R, of the highest and lowest spindle speed for each type.

Nicolson and Smith give the same highest and lowest spindle speeds for all cone-type lathes for the same duty, the highest and lowest speeds on a three-step cone, double back-geared lathe being the same as for a five-step cone, single back-geared lathe. This causes the value of the geometric ratio to vary not only for the type, depending upon the number of speeds, but also for each size of a given type. It also gives different values for the geometric ratio for every possible lathe, whereas the average American practice is to make the ratio constant for each type.

Large Back-Gear Ratio—A large back-gear ratio has been looked upon by some as being a desirable feature. This will of course increase the available spindle torque on the slow spindle speeds by merely decreasing the speeds below those in the geometric series, but does not increase the available power for the first, second, third, etc., speeds, which is dependent entirely upon the belt velocity and efficiency of the machine. The available power for the first three speeds for a three-step cone lathe cannot be altered by changing the back-gear ratio. However, there is more available power at the third speed than at the first in any cone-type machine; and if the back-gear ratio is large enough to lower these speeds considerably, the lathe will have a greater power for a given diameter of work and cutting speed. The large back-gear ratio increases the belt velocity for a given revolution per minute of the spindle, which is desirable in making more power available at the tool.

TABLE 3. BACK-GEAR AND CONE-PULLEY RATIOS AND CONE-PULLEY DIAMETERS FOR LATHES

Number of Steps on Cone, p	Number of Countershaft Speeds, c	Number of Back-Gear Changes, b	Number of Spindle Speeds, T	Constant Multiplier, r	Ratio of Last to First Speeds, $R = \frac{L}{A}$	Back-Gear Ratios W_1	W_2	W_3	Cone-Pulley Ratios (Duplicate Cones) U_1	U_2	U_3	U_4	U_5	Cone-Pulley Diameters; Values of $K = \frac{\text{Diameter}}{S}$ Z	Y	X	W	V
3	1	2	9	1.562	35.5	3.82	14.6	....	1.56	1.0	$\frac{1}{1.56}$	....	....	0.66	0.54	0.42		
				1.414	16.0	2.82	8.0	....	1.414	1.0	$\frac{1}{1.414}$	....	....	0.66	0.56	0.46	....	
3	2	2	18	1.25	44.0	3.82	14.6	....	1.56	1.0	$\frac{1}{1.56}$	....	....	0.66	0.54	0.42	....	
				1.189	19.0	2.82	8.0	....	1.414	1.0	$\frac{1}{1.414}$	....	....	0.66	0.56	0.46	....	
				1.22	29.5	3.20	10.9	....	1.49	1.0	$\frac{1}{1.49}$	....	....	0.66	0.55	0.44	....	
3	1	3	12	1.25	11.7	1.95	3.82	7.45	1.25	1.0	$\frac{1}{1.25}$	....	....	0.66	0.59	0.52	....	
				1.562	135.0	3.82	14.6	55.5	1.56	1.0	$\frac{1}{1.56}$	....	....	0.66	0.54	0.42	....	
				1.189	6.7	1.38	2.83	4.75	1.189	1.0	$\frac{1}{1.189}$	....	....	0.66	0.55	0.35	....	
				1.414	45.0	2.82	8.0	22.7	1.414	1.0	$\frac{1}{1.414}$	....	....	0.66	0.56	0.46	....	
3	2	3	24	1.25	170.0	3.82	14.6	55.5	1.56	1.0	$\frac{1}{1.56}$	....	....	0.66	0.54	0.42	....	
				1.189	54.0	2.83	8.0	22.7	1.414	1.0	$\frac{1}{1.414}$	....	....	0.66	0.56	0.46	....	
4	1	1	8	1.562	22.7	5.95	....	....	1.95	1.25	$\frac{1}{1.25}$	$\frac{1}{1.95}$	....	0.66	0.55	0.45	0.34	....
				1.414	11.3	2.0	....	....	1.68	1.189	$\frac{1}{1.189}$	$\frac{1}{1.68}$	....	0.66	0.57	0.48	0.39	....
				1.682	38.0	8.0	....	....	2.18	1.207	$\frac{1}{1.297}$	$\frac{1}{2.18}$	....	0.66	0.54	0.42	0.30	
4	2	1	16	1.25	28.5	5.95	....	....	1.95	1.25	$\frac{1}{1.25}$	$\frac{1}{1.95}$	....	0.66	0.55	0.45	0.34	....
				1.180	13.4	4.0	....	....	1.68	1.189	$\frac{1}{1.189}$	$\frac{1}{1.68}$	....	0.66	0.57	0.48	0.39	
				1.3	51.0	8.15	....	....	2.2	1.3	$\frac{1}{1.3}$	$\frac{1}{2.2}$	....	0.66	0.54	0.42	0.30	
				•1.27	36.0	6.75	....	....	2.05	1.27	$\frac{1}{1.27}$	$\frac{1}{2.05}$	....	0.60	0.49	0.39	0.29	
4	1	2	12	1.25	11.7	2.44	5.95	....	1.4	1.12	$\frac{1}{1.12}$	$\frac{1}{1.4}$	....	0.66	0.59	0.53	0.47	
				1.562	135.0	5.95	35.4	....	1.95	1.25	$\frac{1}{1.25}$	$\frac{1}{1.95}$	....	0.66	0.55	0.46	0.34	
				1.189	6.70	2.0	4.0	....	1.29	1.09	$\frac{1}{1.09}$	$\frac{1}{1.29}$	....	0.66	0.61	0.56	0.51	
				1.414	45.0	4.0	16.0	....	1.68	1.25	$\frac{1}{1.25}$	$\frac{1}{1.68}$	....	0.66	0.57	0.48	0.39	
4	2	2	24	1.25	170.0	5.95	35.4	....	1.95	1.25	$\frac{1}{1.25}$	$\frac{1}{1.95}$	....	0.66	0.55	0.45	0.34	
				1.180	54.0	4.0	16.0	....	1.68	1.9	$\frac{1}{1.9}$	$\frac{1}{1.68}$	....	0.66	0.57	0.48	0.39	
5	1	1	10	1.56	55.5	9.35	....	....	2.44	1.56	1	$\frac{1}{1.56}$	$\frac{1}{2.44}$	0.64	0.55	0.44	0.35	0.26
				1.414	22.6	5.64	....	....	2.0	1.414	1	$\frac{1}{1.41}$	$\frac{1}{2}$	0.64	0.56	0.48	0.40	0.32
5	2	1	20	1.25	69.0	9.35	....	....	2.44	1.56	1	$\frac{1}{1.56}$	$\frac{1}{2.44}$	0.64	0.55	0.44	0.35	0.26
				1.189	26.7	5.64	....	....	2.0	1.41	1	$\frac{1}{1.41}$	$\frac{1}{2}$	0.64	0.56	0.48	0.40	0.32
				1.26	81.0	10.1	....	....	2.52	1.59	1	$\frac{1}{1.59}$	$\frac{1}{2.52}$	0.64	0.54	0.44	0.34	0.25

The average value of the second back-gear ratio for a three-step cone lathe is 10.9, based on the value of a geometric ratio equal to 1.22 computed from the average values of the highest and lowest spindle speeds on the assumption that the speeds are in geometrical progression. This ratio may be increased to 14.6 by making the geometric ratio equal to 1.25 and $R = 44.5$ instead of 29.5; and by properly changing the cone-pulley ratios the speeds will be in a geometric series without the large gap caused by increasing the back-gear ratios without correcting the cones. Hence, it is possible to make the back-gear ratios much greater than the average and maintain a geometric series of speeds; but the ratio R may become undesirably great, and the small step on the cone becomes undesirably small.

High Belt Velocity—The available power is proportional to the belt velocity and varies with the diameters of the steps on the countershaft cone or with the speeds of the cone on the machine. On the five-step cone machine with diameters of steps ranging from 6 in. to 18 in. the available power and belt velocity at the highest speed of the driven cone are three times as great as for the slowest speed. When the cone is on the spindle, high spindle speeds result from high belt velocities. The lower spindle speeds may be reduced by increasing the back-gear ratio, but this gives a gap in the spindle speeds. Hence, higher powers and belt velocities are best obtained by having the cone off the spindle or by using an all-geared head with a single pulley drive.

Table 3 shows the values of the back-gear ratios, cone-pulley ratios and cone-pulley diameters that give speeds in geometrical progression for practically all cone-type mechanisms used in this country in the design of lathes. The values given for the geometric ratio, or constant multiplier r, are those found to be the average for the various types and those suggested by Carl G. Barth.

Mr. Barth suggested (*American Machinist*, Vol. 36, page 52) that one of the two values $\sqrt[4]{2} = 1.189$ and $\sqrt{2} = 1.414$ might be used in the design of any lathe. Averaging the values of r given for the 8-, 9- and 10-speed machines gives 1.58, and for the 16-, 18- and 20-speed machines gives 1.25. These values, approximately equal to $\sqrt[3]{4}$ and $\sqrt[6]{4} = \sqrt[3]{2}$, come nearer to the values actually used on lathes than those suggested by Mr. Barth.

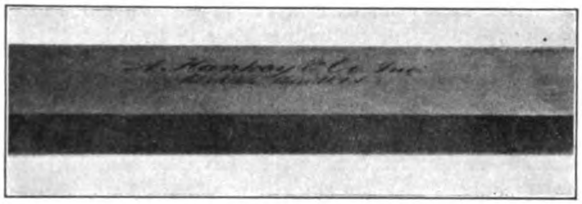
Etching Names on Steel

The accompanying illustration shows a very good example of deep etching by A. Hankey & Co., Rochdale, Mass. This process is used for etching names on both high-speed and carbon-steel hardened blades and straightedges and requires but a few moments.

It is necessary to have a raised impression of the name on a steel plate. This is used as a master impression and resembles the raised characters on a rubber stamp, except that it is direct, not reversed, and is raised only a slight amount.

Beeswax and lampblack are boiled in turpentine to the consistency of soft putty and well worked by the fingers, so that all lumps and hard spots are removed. This mixture is warmed and then rubbed over the master impression, filling the spaces between the letters. Transfer paper, known as the G. B. etching tissue, made by C. H. Dexter & Sons, Windsor Locks, Conn., is applied over the wax on the master impression. It is rubbed down into close contact with the surface of the letters. The tissue paper is then stripped from the master impression and brings with it a coating of the wax and a reversed impression of the lettering, similar to a stencil in wax, backed by tissue paper.

This transfer is applied face down to the steel that is to be etched, which must be ground very smooth and



NAME ETCHED BY ACID PROCESS

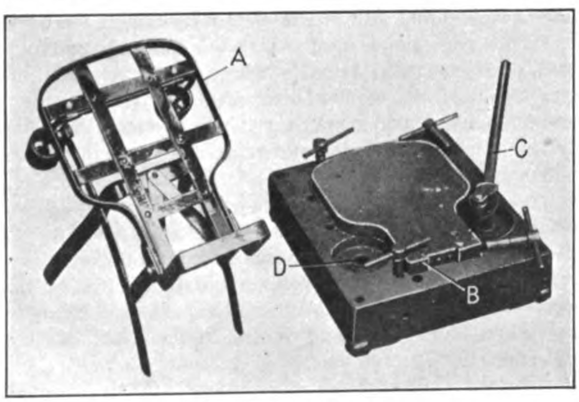
polished with emery cloth. It is rubbed into contact with the steel by a rubber roll. The paper is then removed by moistening it with water and rubbing it off with a finger. Sometimes it is necessary to retouch the waxed steel, in order to fill small pin holes and the like, which is also done with the finger.

The etching acid consists of a mixture of two-thirds muriatic and one-third nitric, being diluted with water in the proportion of 1 to 2. It is applied to the work by means of a glass tube, only sufficient being used to cover the letters. The acid is allowed to remain upon the steel, a length of time depending on the depth of etching desired, after which it is washed off and its action neutralized by a few drops of potash solution consisting of a small amount of potash dissolved in water. The results of this process are superior to those secured by a number of so-called secret processes that are kept religiously guarded.

A Bending Fixture

The frames of the tandem seats used on Henderson motorcycles are made of heavy band iron. The outer frame is bent to shape in the fixture shown. One of the completed seats, without the cushion, is shown at the left and the part that is bent in the fixture is indicated at A.

The method of using the bending fixture is first to remove all pins and the radius lever. The end of the piece of iron is then placed at B and a pin inserted in



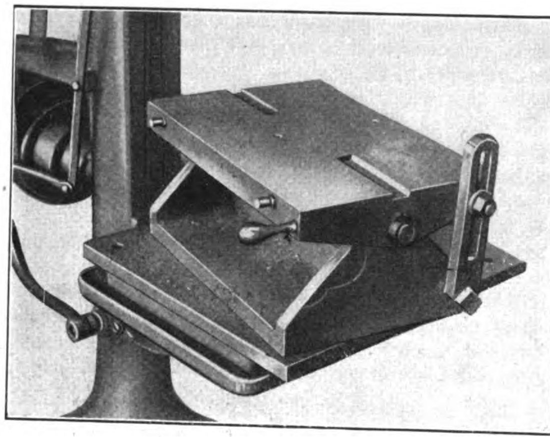
A BENDING FIXTURE

the hole just in front of it. The corner bend is then made, bending the iron in far enough so that the radius lever *C* can be placed in the hole *D*. By turning this lever the roller end forces the iron into the form. The iron is now bent around the form, using pins to hold it wherever necessary until the position is reached where the radius lever has to be used again, when the end of the iron is brought around to meet the other end. The main parts of the form and base are made of cast iron, but steel pieces are inserted at the corners and a steel bushing is used for the radius lever to turn in.

Handy Tilting Table

The illustration shows a handy tilting table used in the shop of the Millholland Machine Co., Indianapolis. Ind. For drilling holes at an angle it is unusually convenient; and constructed in the way it is, it is rigid.

The work table is 12 in. wide, 18 in. long and 1⅝ in. thick. The trunnion is made of a piece of 1-in. bar. The



A HANDY FITTING TABLE

table is about 8 in. high. The pins shown in front and the grooves in the table are for locating some special work, but any ordinary work may be easily clamped to the table when desired.

Shell Inspection Incident

Some of the manufacturers of munitions have had interesting experiences with the inspectors from foreign governments. Many of these incidents are amusing, others vexing and still others even worse. For the most part, however, the inspectors are fine fellows, generally well posted and amenable to reason so far as their instructions permit. Few of them were accustomed to our methods, and many knew only the practice of the older arsenals, which is not always modern, to put it mildly. One experience with a shell inspector is of interest.

The first hundred shells had been made to see what could be done and to have them looked over before going ahead with the job. The inspector found some little discrepancy—the outside diameter was a trifle large by his gage—so with all his authority, plus a good-sized hammer, he proceeded to strike and dent each shell that did not pass muster.

Now the maker was a fine mechanic, with as much ingenuity as any man I have ever known; and it hurt him to see good work bruised beyond repair without knowing the reason why, for the inspector had maintained a silence that would put the sphinx to shame. When he swatted the tenth shell, the maker decided to call a halt. So he talked to the inspector after this manner:

"Let's have a better understanding about this, my friend, but don't think I want to put over on you anything that isn't right. Just remember those are *my* shells now. I bought the steel and paid for all the work. If they aren't right, I don't want you to take them. But I do want to know what's wrong with them.

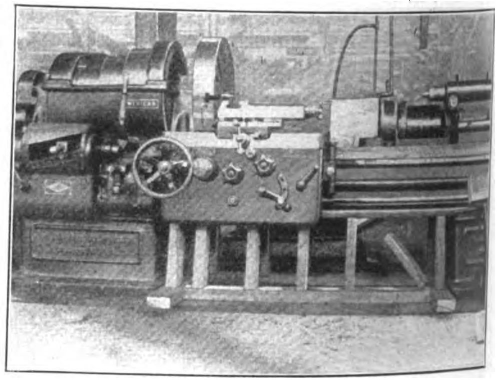
"These 90 shells are *mine;* those you've spoiled so I can't fix 'em are *yours.* Any more you spoil are yours—and must be paid for. If I spoil them, I pay for them, of course.

"Let's just understand this game right from the start. Tell me what's wrong, and I'll make it right or make new shells. But don't go destroying my shells with your hammer. If you do, you pay for 'em or we don't make another shell."

The inspector saw the point, for he was a decent sort of chap. He'd been trained wrong, that's all. They had no further trouble and became quite chummy before the contract was finished.

Bracing Lathe Beds To Prevent Distortion in Transit

The bracing shown has been made to avoid disappointment and delay to customers, owing to lathe beds being sprung out of shape by strains set up in shipping. This



BRACING LATHE BED AGAINST DISTORTION

photograph was taken just as the lathe-bed braces were being knocked out of the way. The braces are short struts set in between the skids and the lathe bed. They are fitted both at the front and the back of the bed, as shown.

Low-Grade Fuels in Producers—It is pointed out in a paper recently published by the Bureau of Mines that within the past five or six years marked progress has been made in Europe in the utilization of various kinds of refuse material not ordinarily given much consideration. The manufacturers of gas producers report the successful use of a large variety of fuels, including wood shavings, wood blocks, sawdust, excelsior, coffee husks, rice husks, cocoanut shells, straw and spent tan bark. The figures on fuel consumption reported by the manufacturers are about as follows: With reasonably dry wood (say mixed oak, ash and elm) the consumption has been as low as 2 lb. per b.hp.-hr.; with sawdust the consumption averages 3½ lb. per b.hp.-hr.; and with spent tan bark containing 50 per cent. moisture it is about 4½ lb.

Machining Automobile Parts

EDITORIAL CORRESPONDENCE

SYNOPSIS—The machines described have been specially designed to perform certain operations and have been provided with means for both hand and machine feed. The tool for machining the valve-guide holes has two spindle speeds. This is advisable, as the holes are small in comparison with the larger surfaces, which are beveled and faced in the second operation.

The Dile Motor Car Co., Reading, Penn., has designed and built several special machines for manufacturing automobile-motor parts. In Fig. 1 is shown the machine for boring and reaming the cylinders.

The casting is located by two bars *A*, against which the bosses on the cylinder rest. The holes are first bored with heads *B*, which are fitted with two inserted cutters. The heads are then removed, the reamers inserted, as shown, and the holes reamed to size. The various tools are guided through bushings in the flange *C* of the fixture. A view of the driving side of the machine is given in Fig. 2. The table carrying the cylinder is fed up against the revolving cutters by a worm and wormwheel, and the screw shown at the rear is operated by the pulley *A*.

When it is desired to lower the casting for replacing with another cylinder, the clutch *B* is thrown out of contact with the foot-operated lever *C*. The handwheel *D* is revolved, operating the screw that lowers the table and casting. The average time required to bore and ream a cylinder is 10 min.

The machine for drilling, reaming and facing the valve-guide holes and valve faces is shown in Fig. 3. The casting is located by two plugs that fit into reamed bolt holes in the flange, while the cylinder is held in position by the two clamps *A*. The valve-guide holes are drilled with the tools shown, which are placed the correct distance apart. The drills are driven through a worm and wormwheels by the pulley *B*.

The table carrying the cylinder is fed by a screw operating a nut that is revolved by the wormwheel *C* and gears *D*. It will be observed that the machine is provided with two rates of table feed. The upper gear may also be slid on a spline attached to the shaft into a neutral position between the gears.

The table may be fed by hand by the handwheel *E*. After the holes have been drilled, combination facing, beveling and reaming tools are placed on the spindles. The holes are reamed, faced and beveled with the machine operated in a similar manner to that described.

Two speeds of the spindles are obtained by gears placed in mesh by clutches controlled by the handle *F*. It moves the shaft, which in turn slides the clutches into the required positions. The time taken to machine the valve guide is 15 min.

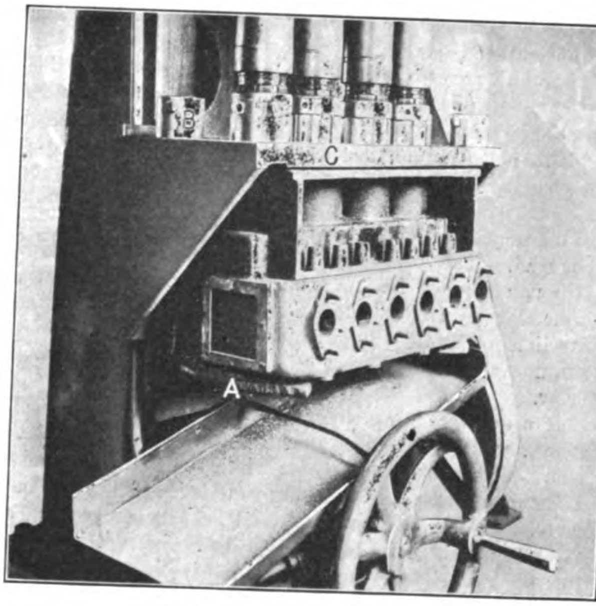


FIG. 1. MACHINING CYLINDERS

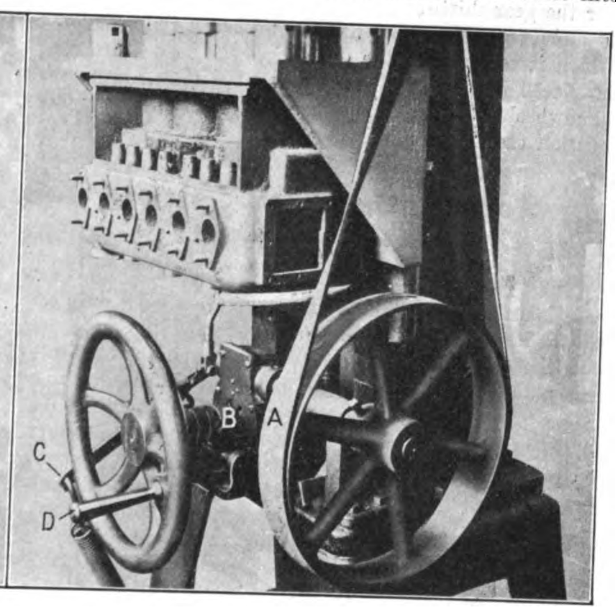


FIG. 2. DRIVE SIDE OF MACHINE

The machine for boring and facing the differential housing is illustrated in Fig. 4. The casting has the axle holes drilled in a previous operation, and the arbors *A* are inserted in the machined holes. The screws in the clamp *B* are tightened against the casting to hold it securely in position. The boring bar and facing tool are revolved by the pulley *C*.

A belt placed on the shaft end *D* drives the pulley *E*, which feeds up the table and casting by a worm and wormwheel that operates the screw shown at the rear. This screw fits into a nut attached to the work-holding table. When it is desired to feed the table by hand, the power of the pulley *E* is thrown out of mesh by a clutch, so that the table may be operated by the pulley *F*. The time necessary for this operation is 8 min.

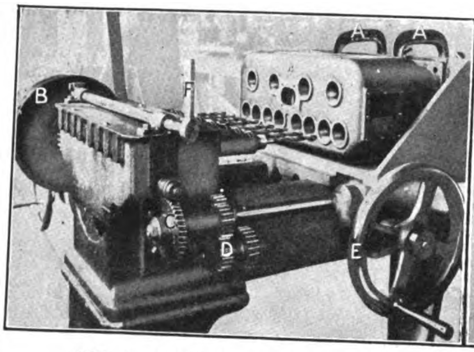


FIG. 3. DRILLING, REAMING AND FACING THE VALVE GUIDE HOLES

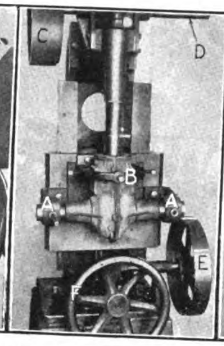


FIG. 4. BORING THE DIFFERENTIAL HOUSING

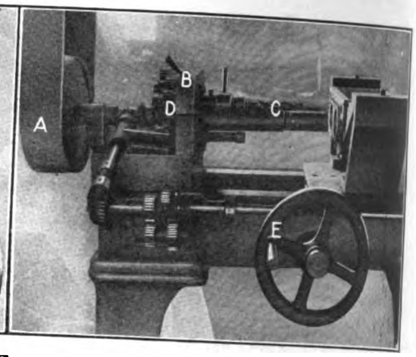


FIG. 5. METHOD OF MACHINING TRANSMISSION CASES

The machine for boring the transmission cases is shown in Fig. 5. The casting is located on dowels that fit into previously machined holes. The various tools are revolved through gearing by the pulley *A*.

Feed to the table is obtained by a screw through gears and the worm and wormwheel shown. The two positions for the gear-shifting lever holes are obtained by the pin *B* and two positions of the sleeve carrying the drill *C*, which is revolved on the gears *D*. The feed gears may be placed in a neutral position and the table fed by the handwheel *F*. The average time for machining a transmission case is 30 min.

Secrecy in Rate Setting Not Desirable

By John Bailey

It is an axiom of shop management that rates once set should never be cut. How does this affect the employee and the employer? In considering the individual rate this plan is very satisfactory to the employee; but if a rate is set on a somewhat similar piece, he is still at the mercy of a dishonest rate setter. It is also satisfactory to the employer, unless the rate is set too high through error or other cause. Then it is an injustice to the employer not to be able to correct the mistake.

When a new method of doing a piecework job is adopted, there is always a chance for ill-feeling. It is certainly just that the rate should be changed if a faster method of doing the work is discovered by the management. This fact, I believe, will be admitted by any fair-minded mechanic. In practice, however, it often leads to trouble, as there is nothing to prevent a dishonest rate setter from cutting a rate 25 per cent. because of an improvement that may save 5 per cent. of the time. In other words, there is nothing to prevent the management from adopting a minor change of method in order to have an excuse to cut a rate.

I think everybody will admit that standard piece rates are not as satisfactory as they might be. In their place I would suggest a standard method of rate setting for each plant, understood by the workmen and never to be changed. The four items entering into the setting of rates are:

1. The time consumed by the machine on all the operations—that is, the time taken to make a cut on a lathe from the moment the feed is thrown in until it is thrown out again.

2. The time consumed by the operator on all operations—that is, the time taken to throw out a feed, swing the turret, throw in the next and handle the piece.

3. The allowance made for resting or other purposes.

4. The amount the operator will earn, provided he does his work in the set time. This sum should be at least 25 per cent. more than for daywork. The amount will of course be larger if he uses his rest periods or becomes more proficient and betters the time allowed under 2.

I would suggest that the operator be taught the method of rate setting and that time allowances under 3 and 4 should be guaranteed standard and not subject to change.

This policy would then leave us only two items subject to change. If a new tool steel is purchased that will stand a higher speed or feed, the time allowance under 1 would be shortened, but the other three items would remain unchanged. The rate would be lowered; but the man, although doing a few more pieces, would still make the same wages. It would entail a little additional physical exertion to handle a larger number of pieces, but a man running a machine is very seldom bothered by the actual labor.

If a quicker-acting chuck that saves time is designed, item 2 would be changed and the other three be left intact. This result is just, for while the man will make a few more pieces, his chucking time is shortened on each piece. He does no more work and gets the same pay.

When a change is made at the suggestion of the operator, the rate should be set so as to give him the benefit of at least 50 per cent. of the time saved.

I have set quite a few rates at one time and another. I always show the operator just what time he takes on each operation and how I figure his rate. In fact, I do it with the operator looking right over my shoulder. I have never had any dissatisfaction over a rate and have always credited this success to being open with the men and not making a mystery of time setting.

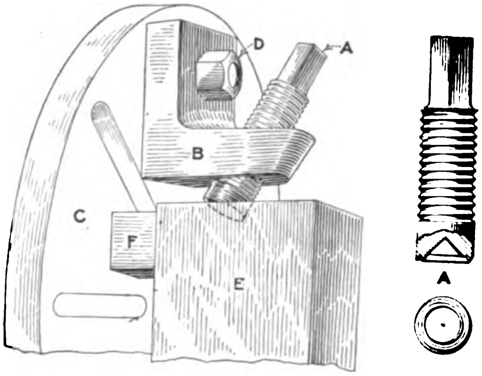
I have never tried on a large scale the system here outlined, but I believe it will work just as well and that secrecy does more than anything else to cause dissatisfaction with the setting of rates under scientific management.

To Remove Grease from Parts of Machinery the following method has been substituted in Germany for the use of gasoline and other light oils because of the scarcity of the latter: Boil the parts in soda-lye, then brush while the lye is still hot. Caustic soda is recommended as better than ordinary soda, since it causes the fat or grease to dissolve more quickly.

Letters from Practical Men

A Faceplate Dog

The illustration shows a dog for holding on the faceplate work that is to be machined. It consists of a steel screw *A* housed in the angle block *B*, which is bolted to the faceplate *C* by the nut and bolt *D*. The piece to



A FACEPLATE DOG

be machined is shown at *E*. A parallel block *F* is between *C* and *E*. The point of the screw *A* is made in the form of a spiral thread.

The rear of *A* is made square to fit the socket wrench. The function of the screw is to hold the piece *E* securely centrally and to draw it down solidly on the block *F*, thus insuring a parallel job.

G. L. JOHNSON.

McKeesport, Penn.

Sizes of Tap Drills for Varying Conditions of Work

The table of tap-drill sizes for machine screws shown herewith was derived from a series of exhaustive tests made to determine the size of drill best suited for tapping different materials of various thicknesses, or depths of hole, under ordinary manufacturing conditions. This study included the consideration of the minimum amount of tap breakage and at the same time the production of a thread of sufficient depth to serve the purpose for which it is intended.

The sizes given will not allow enough stock for a full thread, but take into consideration the strength of the tap and the amount of metal it can remove without breaking, as well as the strength of the screw itself; that is, a fine-pitch tap of a given size will be able to cut a relatively greater percentage of the full thread than a coarse-pitch tap of the same diameter.

Let us take for illustration a No. 8-32 tapped hole in a brass casting, where the depth of hole equals twice the diameter of tap, or more, this being considered as thick metal.

Referring to the table, we find that a No. 27 drill is recommended, which will give us approximately 50 per cent. of the total depth of thread. This is sufficient when we consider the root diameter, or strength of the screw. Under these conditions the screw will break before the threads can strip.

If we wish to tap this same casting for a No. 8 screw having 40 threads per inch, instead of 32, we find from the table that this also requires a No. 27 drill, which gives us approximately two-thirds of a full thread instead of 50 per cent., as will the other screw. But we have a greater root diameter in the latter than in the former

TAP DRILLS FOR VARYING DEPTHS OF BRASS AND STEEL

Standard Screw Gage Diameter	Gage No., Threads per Inch	Outside Diameter of Tap	Root Diameter of Tap	Pitch Diameter of Tap	Double Depth of Thread (U.S.S.)	Size of Tap Drill — Brass — Thin	Brass — Medium	Brass — Thick	Mild Steel — Thin	Mild Steel — Medium	Mild Steel — Thick
0.0578	0-80	0.060	0.044	0.052	0.016	56	55	54	55	54	54
	1-56	0.074	0.051	0.063	0.023	53	52	52	52	52	51
0.071	1-64	0.074	0.054	0.064	0.020	53	52	52	52	52	51
	1-72	0.074	0.056	0.065	0.018	53	52	52	52	52	51
	2-48	0.088	0.061	0.075	0.027	49	48	47	48	47	47
0.084	2-56	0.088	0.065	0.077	0.023	49	48	47	48	47	47
	2-64	0.088	0.068	0.078	0.020	49	48	47	48	47	47
	3-40	0.101	0.069	0.085	0.032	45	44	43	44	43	43
0.097	3-48	0.101	0.074	0.087	0.027	45	44	43	44	43	43
	3-56	0.101	0.078	0.089	0.023	45	44	43	44	43	43
	4-32	0.113	0.073	0.093	0.040	42	40	39	40	39	38
0.110	4-36	0.113	0.077	0.095	0.036	42	40	39	40	39	38
	4-40	0.113	0.081	0.097	0.032	42	40	39	40	39	38
	4-48	0.113	0.086	0.099	0.027	42	40	39	40	39	38
0.124	5-32	0.127	0.087	0.107	0.040	36	35	34	35	34	33
	5-40	0.127	0.095	0.111	0.032	36	35	34	35	34	33
	6-32	0.141	0.101	0.121	0.040	32	31	31	31	[illegible]	30
0.137	6-36	0.141	0.105	0.123	0.036	32	31	31	31	[illegible]	30
	6-40	0.141	0.109	0.125	0.032	32	31	31	31	[illegible]	30
	7-28	0.154	0.108	0.131	0.046	30	30	29	30	29	28
0.150	7-32	0.154	0.114	0.134	0.040	30	30	29	30	29	28
	7-36	0.154	0.118	0.136	0.036	30	30	29	30	29	28
	8-24	0.166	0.112	0.139	0.054	29	28	27	28	27	26
	8-28	0.166	0.120	0.143	0.046	29	28	27	28	27	26
0.163	8-32	0.166	0.126	0.146	0.040	29	28	27	28	27	26
	8-36	0.166	0.130	0.148	0.036	28	27	27	28	27	26
	8-40	0.166	0.134	0.150	0.032	28	27	27	28	27	26
	9-24	0.179	0.125	0.152	0.054	25	23	22	23	22	21
0.176	9-28	0.179	0.133	0.156	0.046	25	23	22	23	22	21
	9-32	0.179	0.139	0.159	0.040	25	23	22	23	22	21
	10-24	0.194	0.140	0.167	0.054	21	19	18	19	18	17
0.189	10-28	0.194	0.148	0.171	0.046	21	19	18	19	18	17
	10-32	0.194	0.154	0.174	0.040	20	19	18	19	18	17
	10-36	0.194	0.158	0.176	0.036	20	19	18	19	18	17
0.203	11-24	0.208	0.154	0.181	0.054	17	16	15	16	15	14
	11-28	0.208	0.162	0.185	0.046	17	16	15	16	15	14
	12-20	0.221	0.156	0.189	0.065	13	12	11	12	11	9
0.216	12-24	0.221	0.167	0.194	0.054	13	12	11	12	11	9
	12-28	0.221	0.175	0.198	0.046	13	11	10	12	11	9
	12-32	0.221	0.181	0.201	0.040	12	11	10	12	11	9
0.229	13-20	0.234	0.169	0.202	0.065	9	8	6	8	7	6
	13-24	0.234	0.180	0.207	0.054	9	8	6	8	7	6
	14-20	0.246	0.181	0.214	0.065	5	4	3	4	3	2
0.242	14-24	0.246	0.192	0.219	0.054	5	4	3	4	3	2
	14-28	0.246	0.200	0.223	0.046	4	3	3	4	3	2
	14-32	0.246	0.206	0.226	0.040	4	3	3	4	3	2
0.255	15-18	0.258	0.186	0.222	0.072	3	7/32	2	7/32	2	1
	15-20	0.258	0.193	0.226	0.065	3	7/32	2	7/32	2	1
	16-16	0.271	0.191	0.231	0.080	2	1	A	1	A	B
0.268	16-18	0.271	0.199	0.235	0.072	2	1	A	1	A	B
	16-20	0.271	0.206	0.239	0.065	2	1	A	1	A	B
0.282	17-16	0.285	0.205	0.245	0.080	A	C	D	C	D	E
	17-18	0.285	0.213	0.249	0.072	A	C	D	C	D	E
	18-16	0.298	0.218	0.258	0.080	E	F	G	F	G	H
0.295	18-18	0.298	0.226	0.262	0.072	E	F	G	F	G	H
	18-20	0.298	0.233	0.266	0.065	E	F	G	F	G	H
	19-16	0.312	0.232	0.272	0.080	G	H	I	H	I	J
0.308	19-18	0.312	0.240	0.276	0.072	G	H	I	H	I	J
	19-20	0.312	0.247	0.280	0.065	G	H	I	H	I	J
	20-16	0.325	0.245	0.285	0.080	J	K	L	K	L	L
0.321	20-18	0.325	0.253	0.289	0.072	J	K	L	K	L	L
	20-20	0.325	0.260	0.293	0.065	J	K	L	K	L	L

case and therefore have greater strength in the tap. We have of course a stronger screw, but to compensate for this we have a greater percentage of thread to resist stripping.

Numerous tables of tap drills are available, but they all differ more or less; and in most cases the sizes recommended are too small for general manufacturing purposes, thereby causing a large amount of tap breakage, which must be added to the manufacturing cost. Anyone having large quantities of holes to tap will find this table very

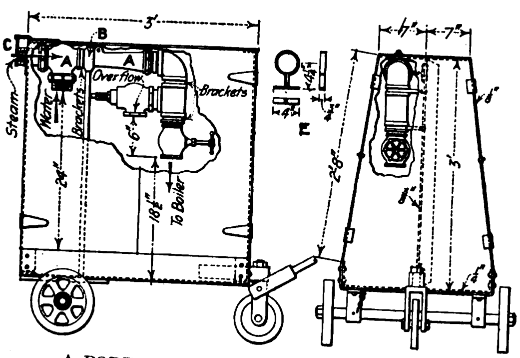
valuable as a reference. It must be remembered that, while some of these drills seem to leave very little thread, even a sharp tap forces up some metal and that a dull tap will greatly increase the amount of thread in the hole.

Indianapolis, Ind. O. R. KLEPPER.

Boiler-Washing Outfit

The boiler wash-wagon shown herewith is handy, because it can be easily hauled around the shop or engine house for one locomotive or another. The bottom end plates and one top of the box are of ¼-in. boiler iron. The center or partition plate is ⅜ in., flanged and riveted to the end plates, which are flanged at top and bottom and, of course, riveted.

A nice thing about this wagon is that there are doors on each side, hinged at the end plates and meeting in the center. They are provided with hasp, staple and lock,



A PORTABLE BOILER-WASHING OUTFIT

so no one can "borrow" the hose. One side is entirely for hose, and both sides are closed and locked when not in use.

The ejector is shown at *A*. The other fittings are ordinary, an overflow being provided as indicated. *B* is a kickoff with a pipe leading toward the floor. Hose is attached to the overflow and leads to the pit on the sewer.

A washer or plate *C* is placed over the steam end, to prevent dirt from getting into the ejector tubes. The ejector and fittings are held to the center sheet by means of four small brackets *E*. All connections can be easily made, the doors, of course, being open when in use.

Renovo, Penn. JOSEPH K. LONG.

Clearing Chips from Deep Holes

A case where a little ingenuity saved a shop a good many dollars in both drills and time was recently brought to my attention. The work consisted of a series of manganese-steel forgings, in which a number of holes were to be drilled for bolts and for oil leads. These holes were of small diameter and ranged from 4 to 7 in. in depth, depending upon the thickness of the material at the point drilled. For the first 2 or 3 in. the drills would work well and clear satisfactorily; but as the holes deepened, the chips would jam against the walls of the hole, the bit would seize and in many cases break off before the operator was aware that trouble was brewing. Compressed air was tried for blowing out the chips, but was found to lose its effectiveness at a point but little below that where the fluting of the drill served to remove the chips.

The trouble became so bad that the drill-shop foreman figured one-half of the time spent in drilling the pieces was wasted in trying to clear the holes. The number of drills broken mounted so high that profits began to disappear before being really earned. Finally, as a last resort, the inner winding was taken from an induction coil belonging to an old motor car stored in the shop's pattern loft. This coil was fastened to one end of a steel rod having a diameter slightly less than the smallest of the holes to be drilled and the coil connected to it through a push-button switch and heavy insulated wires, then to a set of six dry cells on the floor beneath the drill press. The work was carried out experimentally by drilling 1 in. and then inserting the magnet into the hole and switching the current on. The magnet was withdrawn, bringing most of the chips with it, and the circuit was broken by releasing the switch. The chips dropped as the bar became demagnetized. The magnet was then used as a probe a second time, to remove the remainder of the chips.

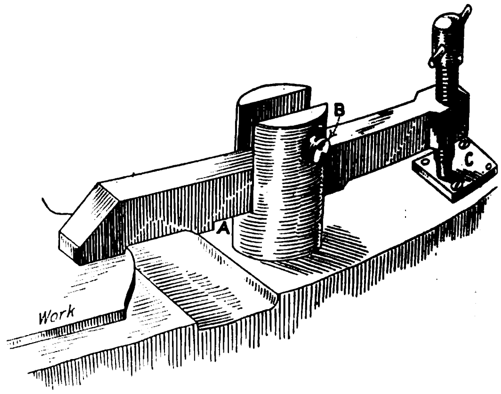
Contrary to the predictions of some of the shopmen, the chips did not show any great attachment for the sides of the hole, but instead adhered closely to the magnet bar. After a few trials it was found that the magnet, on account of its being of steel, retained a part of its magnetism and therefore refused to part with the chips readily. A soft cast-iron rod was machined to the proper size and used as a magnet pole with satisfactory results. The experimental magnet was so successful and required so little time for its operation that one was provided for each drill press. The job was finally turned out at a profit instead of the large loss feared when the trouble made its appearance.

Pittsburgh, Penn. CHARLES C. LYNDE.

A Notched Clamp

The illustration shows a simple clamp that I have not yet noticed in print. It is notched at *A* instead of having the usual elongated hole through it. The hinge pin *B* is above the clamp.

When the screw is released, the clamp drops away from the pin *B* and is easily slid back. The screw point slides



A NOTCHED CLAMP

on the hardened block *C*. The notch *A* must be long enough to allow the clamp to slide away from the work. Clamps of this type have been found strong.

Milford, Conn. CHARLES W. OVIATT.

Spherical-Seat Boring Bar

This boring bar has been designed for boring the spherical seat of the grinding spindle head shown in Fig. 1. After a straight hole has been bored in the piece, the bar is inserted with the cutters in the farthest position to the right.

The bar *A* fits into the spindle of a horizontal boring machine. It is slotted, as shown, to provide two chambers for the cutters *B* and a guide for the link *D*. The two cutters are hinged on pins *C* and are stepped to take the cut in two chips. The star wheel *F* acts as a nut on the screw *E*, which pulls on the link *D*. This star wheel is so shaped that it will allow the screw to deviate from the central line of the bar with the motion of the cutters. The piece *G* supports the screw and is provided with a curved seat for the nut *F*. A spring *G*, bearing against a curved washer *K*, keeps the nut in place. P. P. FENAUX.

Newtownville, Mass.

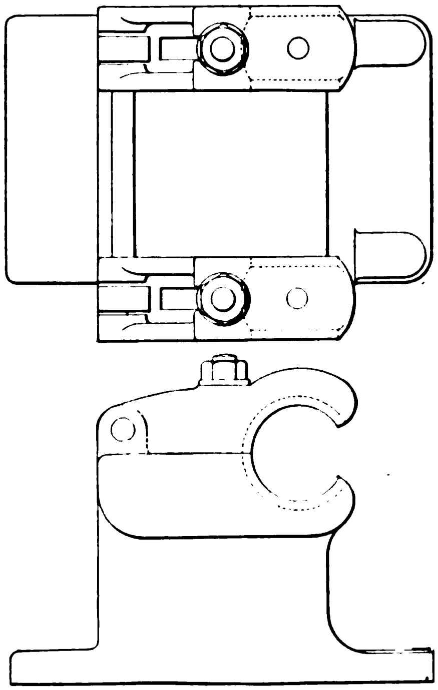


FIG. 1. SPHERICAL BEARING SEATS IN GRINDER HEAD

Is the Evening Trade School Worth While?

The ordinary citizens who give the matter of evening trade schools a thought must view them as places of inspiration and advancement for the ambitious young mechanic. To them it must seem that a person who has the energy and ambition to rush home at the close of a hard day's work, gulp his evening meal and hurry to the school must have all the qualifications that go toward success and must therefore be deserving of a goodly portion of the taxpayers' money in the support of such institutions. And it is for the ambitious that the evening trade school is maintained.

The principles underlying the foundation and maintenance of the school coincide with the ideals of the citizen. Theoretically, it gives the pupils a supplementary training in the evening that will aid them in taking the next step forward in their daily work.

School supporters in general realize that men in factories are not hired with any idea of helping them to advance by trade training, but for their immediate power of productiveness. To assist worthy mechanics to a better development in a knowledge of their trade, the taxpayer approves a considerable appropriation. The idea of the taxpayer is not to get any financial return to the city for its investment, but so to better the training of workmen that their added wage and intelligence will count toward civic betterment. Is the taxpayer getting his money's worth?

Being an instructor in evening trade-school work, my knowledge of the situation as I see it from the inside may be of interest. Experience shows that, while many register, a very large number drop out as the term advances. Those who drop out with but a rudimentary knowledge

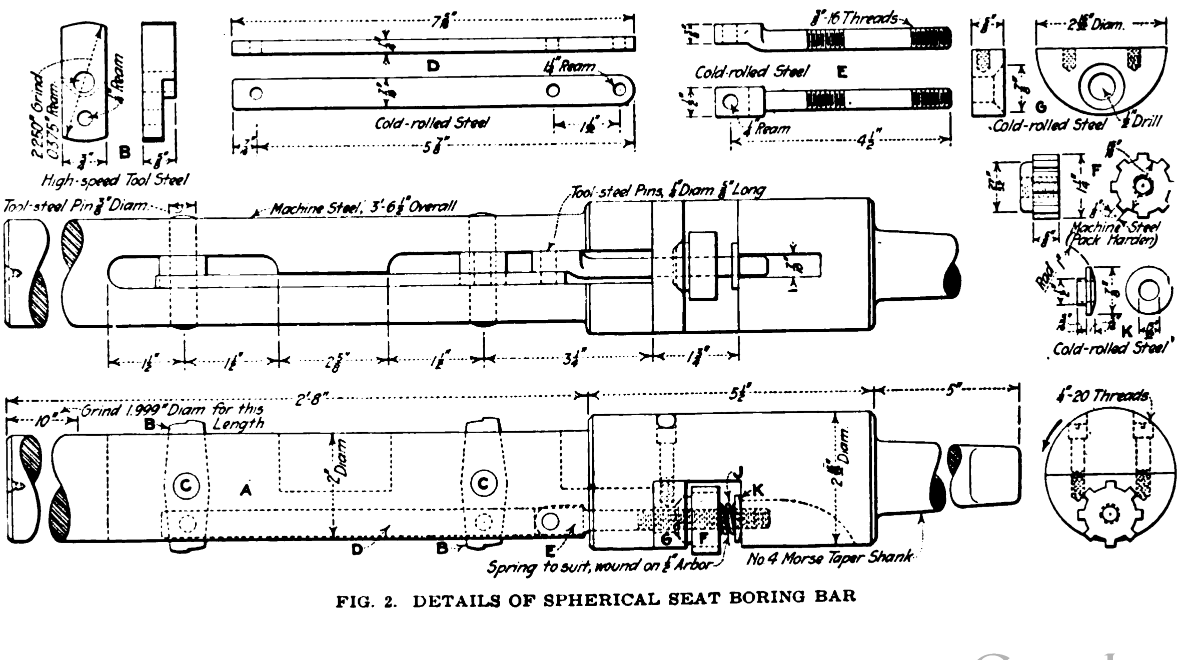


FIG. 2. DETAILS OF SPHERICAL SEAT BORING BAR

of the operation of a machine are really a menace. The school simply gives them a basis for bluffing. When they leave the school, they too often pose as competent operators and start on their career of spoiling work and getting fired until they really become skilled through the experience gained in different shops. But the manufacturer pays for this sort of training in the work spoiled, the entire fraternity of machinists loses and the school loses much in reputation.

It is discouraging to the instructor to attempt to take the interest he should in a floating group. The general belief in the type of men who take advantage of evening trade-school instruction will bear revision. It is by no means a seleced group of men having promotional capacity. Some (but these are the decided minority) are naturally bright and are a delight to the instructor. The prospect of training them toward a specific goal is always pleasing. The majority, however, who require more repetitive work than the limited number of evenings justifies, show little inherent ability to grasp or absorb instructions, to say nothing of ever being able to advance on their own initiative. Their record shows a considerable shifting about from place to place and from job to job, and no amount of training will get them much more than their initial wage. There are of course some exceptions who have ability enough in a way, but they direct it toward using the evening school as one of the stages in the evolution of "picking up" a trade.

Some pupils attending evening schools are, to an increasing degree, too recently of such different foreign environment that they cannot profit by the instruction sufficiently to warrant their seeking work in the trades. Their entrance into a shop under the guise of a skilled workman would tend to lower conditions in the factory. To me the word "machinist" should express the qualifications and experience which the name implies, and I always feel averse to lowering in any way the dignity of the calling. Perhaps this is what has led me to write this article.

On the other hand, when the taxpayers' money is considered, it may be reasonable to suppose that the public is willing to spend money on evening trade-school work for the sake of the minority whom it helps toward advancement. The public always has in mind an ideal. A single Edison would justify an enormous expenditure. The promotion of one evening trade-school graduate to a shop superintendency would sink into oblivion all other failures.

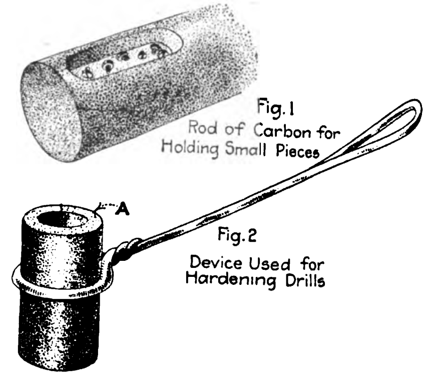
And of course there is always in mind the small proportion of men being trained in evening schools as compared to the whole number employed in the industry throughout the country. In Massachusetts the 7,000 students under evening trade-school instruction at present is but 1 per cent. of the whole number of employed adults.

Looking the situation over carefully from my point of view, I would make a few suggestions: Let the supplementary trade training be given to the skilled to make them more skilled, not to the unskilled—at present at least; establish a better measure of the ability of the applicant to profit by the instruction; consider a man's attitude toward his work, as shown by his record; and place more emphasis on the fact that the aim of the school is to open the way to future advancement in the trade along the usual channels and not by any tempting short-cut.

Worcester, Mass. ROBERT J. SPENCE.

Hardening Small Pieces

For hardening small drills or screws, pieces of arc-lamp carbon may be drilled or scooped out, as shown in Fig. 1, and used for holding the pieces while heating. It was necessary to drill several hundred holes 0.0135 in. in diameter for a number of small spring collets. The drills were not hard enough for the purpose, so they were hardened in a cup made by drilling a hole in a piece of



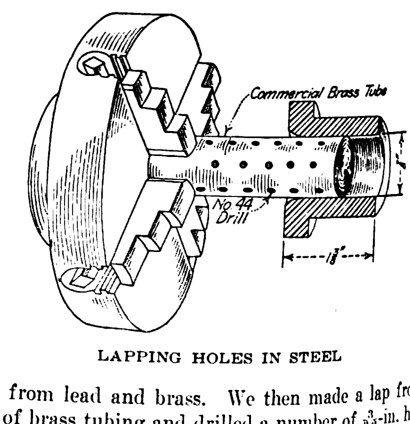
HARDENING SMALL PIECES

carbon and attaching a piece of wire, as in Fig. 2. If these small drills had been hardened in the open flame, an even heat would have been difficult to obtain and the danger of burning would have been great. The drills were heated in the cup A to the desired extent and dumped vertically into a pot of sperm oil. The results were satisfactory.

Newark, N. J. GUSTAVE A. REMACLE.

Lapping Holes in Steel

Some time ago we had a number of pack-hardened steel bushings with a ⅞-in. hole 1⅜ in. long to be lapped out. About 0.0015 in. of metal was to be removed. The holes were from 0.001 to 0.002 in. out of round after trying laps



LAPPING HOLES IN STEEL

made from lead and brass. We then made a lap from a piece of brass tubing and drilled a number of $\frac{3}{32}$-in. holes, staggered as shown, and found we gained about 50 per cent. in time.

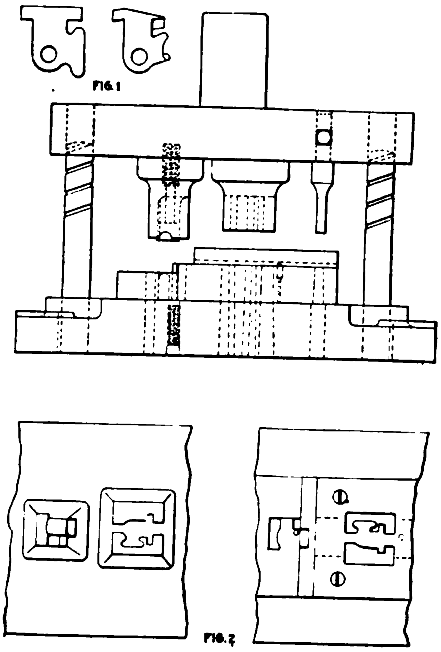
We used a mixture of turpentine and No. 00 powdered emery mixed to a liquid paste. The lapping compound was fed in from the hole in the tube and gradually worked itself out of the small holes. N. J. MIANO.

Norfolk, Va.

Discussion of Previous Question

A Simple Hand-Operated Bending Tool

On page 513 Mr. Breitschmid illustrates and describes a bending fixture for forming the small-sheet steel stamping shown in Fig. 1, which is first blanked and perforated on a power press. Although this bending fixture may suggest ideas in other lines of work, I cannot understand why it was necessary to go to this expense in order to form the stamping shown. The addition of simple forming parts to his blanking and perforating die would enable Mr. Breitschmid to complete this article in



PIERCING, FORMING AND BLANKING DIE

one operation. Even if made in very small quantities, a one-operation die of the progressive type, Fig. 2, would have cost much less than the blanking and perforating die plus the bending fixture.

Mr. Breitschmid states that fixtures of this character are of more than usual interest at this time on account of the great amount of work being required of power tools. This may be true in other lines of work, but in his case the addition of forming parts would not decrease the production in the operation of his blanking and perforating die, if the die was properly designed; and I fail to comprehend his meaning when he states that the hand-operated bending fixture requires only unskilled labor. Surely the operation of a small power press requires no better class of labor than that of hand-operated bending fixtures.

The die shown would eliminate the slow hand operation entirely. We have a great many dies of this type in service, some of which produce stampings very similar to the one Mr. Breitschmid illustrates. Others blank and form in a much more complicated manner by the use of cam-operated die parts, and nearly all of these dies will operate as rapidly as plain blanking dies, on an inclinable press.

If Mr. Breitschmid has many more of these parts to make, a die similar to the one shown would perhaps pay for itself.

A. J. CHAMBERLAIN.

South Bend, Ind.

Why Not Give the Applicant a Square Deal?

Reading Thomas B. Bracey's article on page 564, Vol. 43, reminds me of an experience of my own. Some time ago I answered an advertisement for a toolroom foreman. It required applicants to state age, nationality of parents, experience in full, names of last two employers, salary expected and to address XYZ office.

I replied, giving my family history, business experience and all other information asked for. Three weeks later I received a notice to call at the labor department of an out-of-town concern between 11 and 12 o'clock the next day. So 11:05 found me in the office in a more or less skeptical frame of mind, with three applicants for work ahead of me who, I learned later, were applying for the same position. After waiting a few minutes while the three clerks and the office boy gave me the "once over," I was handed an application blank designed to get a man's pedigree from the cradle up. Then my eyes fell on a framed notice that read, "Applicants not giving information asked for will not be considered."

In an hour and a half my turn came for an interview, which amounted to a cross-examination almost rivaling that to which a criminal suspect is subjected. After being ushered into a private office, I was seated between two men, one of whom I presume was Mr. Hiring Agent, the other the works manager. This is only a presumption, as neither introduced himself. However, I was not yet comfortably seated when they began to fire away—one putting the questions, the other cross-examining as to my truthfulness regarding the statements in my letter and application, which they had before them—and meanwhile writing down their impressions. They finally summed up by asking me how soon I could report in case they decided to hire me.

Up to this point I seemed to make a fair impression; but as I had begun to consider the situation seriously, I felt that I was entitled to know something of my prospective employers too. So I asked permission to put a few questions, at which they acted somewhat surprised, but consented. They balked, however, at my questions, which were: "Is this a new department; if not, why do you need a new foreman? Was the previous foreman promoted? Did he leave or was he discharged? Why? What was his salary?"

They decided I would not suit, whereupon I demanded the record they had obtained. They flatly refused to

surrender this, saying that it was to be filed away for future reference.

Has any business concern any right—legal, moral or otherwise—to keep a record, which in some instances is very personal, of a man who is not, never was and is never likely to be in their employ? WALTER HURLEMAN.

Philadelphia, Penn.

Over-Safetyized Machines

On page 371 Mr. McDermid discusses over-safetyized machines. This brings to mind an incident that happened in one of the Government navy yards.

When the fever of placing guards on machines struck the metal shop, all moving parts, approaches to punches and guards were painted a glaring red. Over each machine was hung a huge red and white sign, telling what to do and what not to do. It seemed impossible for a workman to be injured, unless he were blind or one of the "safety-signs" fell upon him. And that is what actually did happen. This accident was due to no fault of the operator nor yet to unprotected machines, but to "over-safetyization." The sign had been insecurely fastened.

The incident caused considerable joking among the men in the shop and about the yard, and the statement went around that the only way to get hurt in that shop was by a safety sign itself. CARL G. PLANCK.

Charleston, S. C.

Wanted--A Lighting Gage

I read with much interest your editorial on page 654, dealing with the lighting of factories.

I was at one time engaged by the largest rubber-producing corporation in the world in the attempt to reduce or abolish certain wastes of time, material and power that were taking place in its largest plant. The indifferent mental qualities of some of the laborers made it a difficult matter to impress upon them the importance of eliminating the waste, for instance, of lighting current, although this waste became an important factor when spread over the entire plant.

I suggested that the heliostat used in the automatic buoys common in our waters be adapted as a unit to cut in and out the lighting for whole floors or sections of floors where the average light requirements were the same. I even went so far as to consult with the engineers of the firm making these buoys and was told that, while the idea was new to them and they had no such apparatus ready for the market, there was no reason why the plan would not work.

It was planned to put one of these light-sensitive units at such a point that the minimum daylight necessary for the proper handling of the work would control the lighting circuit for that section. As soon as it became sufficiently cloudy or late in the day, the unit would automatically throw into circuit the lights or ring a bell as a signal to the proper person, whose duty it would be to attend to it. If good judgment were used in locating this unit, there would always be available current for lighting use; but it would not be possible for a careless employeee to leave his drop burning in full daylight. Since these units in buoy service are sufficiently sensitive to operate when the sun is suddenly obscured by a cloud or a fog, it is easy to see that they would be sensitive enough for factory service, especially if, as probable, a special adaptation were made.

The foregoing suggestion does not, of course, dispose of the cases where a special drop is used to examine work in process, but such conditions are nowadays carefully avoided by efficient superintendents and lighting engineers. ROBERT G. PILKINGTON.

Chicago, Ill.

Side Shields for Emery Wheels

W. B. Greenleaf states on page 606 that there is nothing in the composition of the wheel to prevent side grinding. This is true, but from my experience covering several years as a grinding-wheel salesman I am convinced that it is poor practice habitually to use the side of the wheel. It is a recognized fact among grinding-wheel manufacturers that a wheel for side grinding should be considerably softer, speed for speed, than one used for peripheral grinding.

Let it be assumed that we are using a tool-grinding wheel 12 in. in diameter, running at the correct speed for this size. For the dry grinding of general tools N grade is usually considered to give good results. When we grind on the side of the wheel, it glazes readily owing to the fact that the speed is far too high for this kind of grinding. Then we true the wheel at frequent intervals, which soon wears it out of shape, as the dresser cannot be brought very close to the collar. The result is a taper-sided wheel with its periphery half cut away from frequent truings. Such a wheel is a poor compromise, to say the least.

If the wheel was of a soft enough grade to do side grinding in a satisfactory manner, the periphery would be too soft. In other words, it is almost impossible to strike a happy medium. To be sure, if the workman exercises care, satisfactory results can sometimes be obtained. This in all probability was Mr. Greenleaf's experience. Where there is any amount of work that requires grinding on the side of the wheel, it is the best accepted practice to order cup wheels in a suitable grade for this purpose. With this type of wheel the dresser can be passed clear over the rim of the wheel, thus preserving a true surface. This plan not only insures good work, but it is the most economical practice in the end. The only excuse for grinding on the side of the wheel is where the shop refuses to purchase a cup wheel or a disk grinder. Many do not seem to realize that it is false economy to save the cost of one wheel at the expense of another. Moral: Don't expect too much of one wheel. F. B. JACOBS.

Indianapolis, Ind.

Who Can Make This Nail?

It is not so very long ago—before wire nails came into general use—that all malleable-iron plants made their own nails for flask boards and for general shop purposes. Why not cast the nail (referred to on page 604) of a good grade of malleable iron? A suitable molding-machine plate could be made for less than \$100, whereby one molder could easily produce 125,000 of these nails per day. A. E. HOLADAY.

Naugatuck, Conn.

Industrial Preparedness from the Engineer's Viewpoint

SYNOPSIS—A continuation of the discussion brought out at the New Orleans meeting of the American Society of Mechanical Engineers in which many practical pointers are made in connection with the manufacturing side of munition work.

Listing Engineers According to Previous Experience

By George R. Henderson

The point brought out by Mr. Miller that for each man at the front three are needed at home to prepare munitions of war is a most interesting fact. This is especially significant to those who through age or physical disability are prevented from entering the trenches or submarines, and it seems to me that in organizing for industrial preparedness the engineer who may not be directly connected with a manufacturing plant should not be overlooked. There are in the membership list of this society many who act in a consulting capacity, whose technical services would probably be of greater advantage to the national Government than digging trenches or shouldering a rifle. I believe these men should be listed, with their professional records, so that the very best use might be made of their services in the navy yards, arsenals and other plants where mechanical skill is of the highest importance.

I would suggest to the American Society of Mechanical Engineers representatives on the Naval Consulting Board that they consider this feature as well as that of mobilizing factories with their men and machines, so that all patriotic citizens would have the opportunity to serve their country in time of need in a manner which would insure the greatest efficiency of the organization as a whole and which would permit those who could not stand the rigors of active service to furnish their quota of usefulness by preparing ships, machines, etc., for those whose duty it might be to fight them.

Redesign Munitions To Reduce Cost of Manufacture

By Bernard M. Fine

The subject of industrial preparedness, while falling within the engineer's scope, should interest us also as citizens. As citizens we will have to meet the cost, and one good way to reduce it is to apply consolidated engineering experience to this problem and endeavor to put the design and construction of war material upon a basis similar to that customary in the commercial field.

In order to get production on the foreign contracts the limits had to be changed. This is too much like swapping horses in midstream. The time to do that is now, and it is really within the range of the American Society of Mechanical Engineers' work to assist the war office in modifying its standards.

To store in times of peace an amount of material equal to the needs of war would not be wise, but in times of peace let us educate ourselves to be adequate to meet this need. In war as now waged the industrial force plays as important a part as the fighting force. The industrial force must be officered by men trained in the peculiarities of munitions manufacture. This is the work of engineers, and the American Society of Mechanical Engineers should make the organizing of these men its business under an ordnance section and keep alive the work by requesting the presentation of papers on the subject at our meetings.

The delay that was occasioned in starting on foreign war orders was due to the fact that the contractor accepted orders for which his machine-tool equipment was inadequate, and the abnormal demand could not be met. As a result many, in order to escape penalties, pressed into service anything that resembled a machine tool, adaptable or otherwise, then improvised crude fixtures—all at great expense and delay. We can avoid this deplorable condition by means of Mr. Miller's system of cataloging adaptable equipment. We will then be sure that a contractor gets orders for only such component parts as his equipment will handle and in that way obviate the confusion and loss of time the foreign contracts caused. A central assembling plant, or a number of them, and an efficient inspection and supervisory force are necessary; but if we start now and line up the men adapted for this work, or even if we can get the war office to take these steps, we will have rendered the nation an invaluable service.

We have appointed a Publicity Committee to bring the work of the engineer into public view. Here is a chance for the committee to get busy and for the society to do work that will act as its own press agent.

I also wish to call attention to the fact that, with few exceptions, our munition plants are concentrated on the Atlantic Coast. This is in itself a danger, and steps should be taken so that in an emergency the work could be shifted to any section. Here is another instance where the ordnance section of the American Society of Mechanical Engineers would render invaluable assistance to the nation.

Preparation for Manufacture of Military Rifles

By Fred E. Rogers

A very large munitions plant would be required to run steadily for a year to turn out the shells fired by the Allies' guns in one day on the western battle-front. To provide the millions of shells used by them has required the united efforts of thousands of manufacturing plants. But these plants had to be provided with drawings, tools, gages, jigs and fixtures and plans of operations before they could begin to produce. It has been due to their lack that Great Britain has been so slow in getting ready.

Take, for example, the manufacture of military rifles: This is a complex process requiring special skill and experience. With the exception of our Government arsenals, there was at the outbreak of the present war perhaps not one plant in the United States properly equipped and manned for manufacturing military arms that would pass the rigid test prescribed by Government inspectors. There are about 800 principal machine operations involved in making the parts of the simplest military arm, including the wooden stock and hand guard. Many of these operations require special machinery, and practically all the parts must be held in jigs or fixtures during the machining operations.

When we consider the fact that, to provide for an army of 1,000,000 men, from 2,000,000 to 3,000,000 rifles are required, the size of the task of equipping an army of a million with shoulder guns alone becomes apparent. What the condition of this country would be in a sudden emergency, we can only guess. Judging from the experience of some of our ill-advised manufacturers who undertook to make shells, it would be one of great confusion and enormous waste.

Nothing can be left to guesswork. Every machine operation must be specified and the types of machines and tools; the production per hour is given and the number of machines that each man operates, etc. But no data are given of the jigs, the limit gages, the inspection or assembling. Several hundred jigs are required for each unit of a plant producing 200 rifles daily, and the same applies to the gages. All these data must be prepared by experts, but considerable experiment is always required before satisfactory results can be obtained. That such elaborate plans pay is known from the fact that a rifle, complete with strap, bayonet and scabbard, can be produced with about 20 man-hours' labor. Thus, while it is true that the means of production of munitions are in our machine shops, mills and factories, they must be supplemented by the drawings, specifications, jigs, fixtures, tools and plans of operations. These latter can be made ready for immediate distribution to the plants selected for each specific product.

Comprehensive plans should be prepared for the manufacture of shrapnel, high-explosive shells, cartridge cases, rifles, field guns and all the varied equipment of war. Every step of the operations should be laid down, specifying in each

instance the tool and the machine on which the work should be done and the limits of accuracy required, including an estimate of the possible production. It will be a great undertaking, but how much better it will be to spend a few million dollars working out plans to provide means for industrial mobilization and rapid production than to run the risk of a complete smash-up in time of stress. Perhaps in some cases selected plants should be required to produce some parts, even though only a few are made. When these parts have been actually produced, there will be in that plant a knowledge of the conditions and methods that should not be speedily forgotten.

It is true that all plans, tools, jigs, fixtures and methods of operations will become obsolete when improvements in the means of production and arms are developed, as they certainly will be; but is it not better to face this certainty and be ready to reconstruct the means of production and keep them up to date rather than to spend several hundred million dollars in the manufacture of those munitions, which themselves become obsolete and practically worthless in a few years?

There is an argument for this sort of preparedness which should appeal to every engineer whether he is in favor of military preparedness or not. It can be made a powerful lever for improving industrial efficiency. It is unfortunately true that many of our manufacturing plants are working far below their possible efficiency. They employ penny-wise and pound-foolish methods of production; their men are not trained to understand the basic principles of interchangeable manufacturing. Gaging systems are inadequate and incomplete; data on the life of gages are wanting as well as the number required for any given unit of production. There is too a lack of the coöperative spirit so absolutely necessary to success in any great trade or military emergency. Those emergencies will surely come to the United States, though, we trust, in the trade sense only. It will be only when we have coöperation in the true industrial sense that we can face with confidence great national emergencies.

Prevent Unnecessary Waste of Materials

By Percy E. Barbour

There have been many instances of great waste. How much of this waste is avoidable? The idea that there is a good deal of unnecessary use of metals by military men through thoughtless specifications is not new. A ray of light upon this subject is found in a communication from France, in the New York "Sun":

> A weeding out of unnecessary governmental expenses takes place in the Chamber of Deputies every year when the report of the Audit Office is distributed to Parliament. Usually a score or more of conspicuous cases in which the public money has been wasted are selected by a committee which investigates them. A member of the Committee on Economy spent several hours endeavoring to find a reason why ammunition was sent to the front in zinc-lined cases. The other members of the committee and the Minister of Munitions were not able to solve the problem, so two members of the committee accompanied a box of cartridges from Vincennes to the front, to ascertain the reason for the zinc. None were forthcoming, but after numerous fruitless interviews with army officers the general in command of the Fifth Army hit upon the reason. The zinc had been used for 60 years in ammunition boxes, and no one had ever thought to take it out. As a result an order was issued doing away with the zinc lining. As the zinc in each box is worth nearly $2, the saving during the war amounts to almost $150,000 a year.

Regarding this matter the "Engineering and Mining Journal" says editorially:

> In our opinion this indicates the most effective way for the engineering societies to render assistance to the military authorities of the United States. The measures that are being taken in the excitement of the present moment are largely at sixes and sevens. They are not laid out according to any definite plan. The logical way, we think, would be something like this:
>
> "The army general staff should determine the number of men to be put into the field in the worst possible contingency. No doubt it has done that already. It should draw up a complete bill of material for the supply of such an army. Perhaps it has done that, and perhaps not. That bill of material, together with specifications, should then be referred to the United States Naval Consulting Board, representing the engineering societies, and by it should be cut up and distributed among the engineering societies—the metallurgical parts to the metallurgical engineers, the mechanical parts to the mechanical engineers, the chemical parts to the chemists and so on. Those bodies would then subdivide things among their specialists. They would scrutinize the specifications, finding out whether certain things likely to be troublesome or costly were prescribed by reason of necessity or by reason of tradition. They would suggest substitutes and improvements. Having determined what was really needed, they would formulate plans for the supply of it, making a survey of the industries, listing industrial plants, etc., and recommending steps for the filling of gaps."

Recently a lot of barbed wire for military purposes was condemned by the inspector because the galvanizing was not even and smooth. This is certainly a ludicrous refinement, which can only militate against military efficiency in every way.

Organizing Men for Munition Manufacture

By James A. Campbell

Members of the American Society of Mechanical Engineers employing collectively several thousand mechanics could get signed statements from those men who would be willing in time of war to take positions in the large shell factories or wherever machinists were required. These mechanics could be classed by their superintendents so that firms requiring men could see from the lists the experience and class of workers available. Committees could be formed for the drafting of these men so that there would be no loss of time in the production of munitions.

Value of Good Roads in War

By John Younger

A nation in arms is two vast bodies—one the fighting unit, the other the producing unit. My experience has shown the tremendous importance of a third unit, the connection between the two—the transportation unit.

The production of any country is of little value if the transportation facilities are not ample to carry it. It must be remembered that in time of war the actual munitions will in general travel one way—toward the theater of operations. In time of peace Buffalo, for example, exports by means of its railway systems to the four points of the compass. Because of economic reasons these systems are proportioned in close accordance with the volume of traffic; and actually just now, when there is an exceptionally large volume of freight passing through to eastern ports, the transportation facilities are found inadequate and freight embargoes are operative on practically every railway.

We are exporting only a small percentage of the supplies used on the European battlefields, yet our transportation has not proved equal to the task. The building of more railways in our immense territory would be at a terrible cost that would render no adequate return in times of peace. Even if they were built, their use would be of value only in very restricted areas. Germany, France and Russia had all built strategic railways leading to and paralleling their frontiers, but they did not stop at this. They also built good roads. They knew that every ton of freight carried on the railroad is sometime or other carried on a road, and they took the precaution of having the road as efficient as the railroad.

Good roads are no luxury. They are not built for the motorist, who takes a week-end spin for personal enjoyment. They should be built to link up the small villages, the communities and townships with the railway and the big city. A good road opens up new country to the farmer, who can carry his produce to market at a cheaper rate. A poor farm located on a good road is often a better investment than a good farm on a poor road. A good road is an economic investment in time of peace, and it is a sign of the times that the country is waking up to facts.

In war times the roads are the first and last links in the transportation scheme. They carry munitions to the railway, and they distribute supplies from it. Each link in the chain must be of adequate strength. It is useless having a perfect railway, if it begins and ends in a bog. It is useless having stretches of perfect roads in New York State, if they be totally unrelated and unconnected with each other.

Great Britain, France, Belgium, Russia and Italy have bought from us vast numbers of motor trucks. They have been making others themselves, by the thousands, and still the supply is not adequate. Figures are not available, but I would estimate that France alone on actual military service is probably using 50,000 motor trucks. A vast army of men is kept exceedingly busy making and repairing her roads. Actually, munitions are being put on motor trucks in the industrial centers of England and carried along the roads to the desired port; thence the truck travels by steamer and completes its journey along the roads to the base depot.

The organization of our transport demands the attention of our engineering bodies just as much as does the

mobilization of our industrial resources. The standardization of our road systems, the standardization of the controls on our locomotives and motor trucks, so that men can change from one to another with all confidence, the education and disciplining of numbers of men to the principles of transportation are all matters that can be handled by engineering executives only.

Standardizing Gages and Fixtures

By Harold V. Coes

It seems to me that one of the vital elements necessary for the proper carrying out of the plan is for the Government to construct in its own factory under its own jurisidction and in accordance with its own standards the necessary jigs, templets, gages and fixtures that are required and that are adaptable to special or standard machine-tool equipment. Then the Government should rent, lend or sell these tools to those manufacturers who are equipped, and who signify their intention, to manufacture shells, rifles and other war material of this character for the Government.

I think there is no doubt that the British Government in its present crisis would have been much farther ahead with its plans if it had been able to send necessary jigs, templets, gages and fixtures to those manufacturers in this country who are making munitions of war for the British Government. The jigs, tools and fixtures that rifle manufacturers in this country use were of practically little use when it came to making the Lee-Enfield; consequently, it would appear extremely desirable for us to profit by this lack of foresight on the part of one of the powers now engaged in the present worl cataclysm.

Co-operation and Standard Methods in Shell Making

By Ralph Flanders

There are a number of points in connection with the experience of Canada which I think would be useful in our own situation. The first point noticeable was the difficulty of getting gages, and this difficulty was serious. It was necessary to try to get the shells out in a few weeks, but usually several months were required. A larger number of gage-making machines had to be undertaken than was reckoned with at first.

Another difficulty met with in the manufacture of Canadian shells was the lack of means for furnishing the material and supplies. It would be the same as if in a manufacturing establishment one department should get way ahead of another department. For instance, if the makers of the shells are many months ahead of the makers of the fuses, there is delay; and sometimes a fuse is held up for a small screw. There should be some committee to attend to such factors as that—what you might call routing of the work, to make sure that each department gets through with the work on time and to put all the energy possible behind the departments falling behind.

Another exceedingly favorable feature in the Canadian manufacture of munitions was the publicity and the co-operation shown there. There were absolutely no secrets in the shops of the Canadian manufacturers. That was made a requirement of the shops—that everyone who desired to engage in the manufacture of munitions was privileged to see what everyone else was doing. While the whole country was ignorant of, and unprepared for, the making of munitions, yet in a remarkably short time everyone was able to know what everyone else knew. In regard to that matter I think that we are in a somewhat bad condition in this country, or we should be if similar conditions were brought about. As a natural thing where ammunition is manufactured in private plants, we find that the processes of manufacture are kept quite secret and visitors are not allowed. This is the case at the present time at the plant in Philadelphia, unless conditions have changed in the last few months, and it is a bad state of affairs. It is not necessary that an arsenal should be thrown open to everyone, but it is necessary that everyone who may be called upon to manufacture shells may use whatever the Government arsenal has to offer.

Another thing to be noticed in Canada is the impracticability of standardizing methods. I am speaking of shrapnel and high explosives. I do not think the same statement applies to small arms. The demand for machine tools is so tremendous that it is impossible to approach the problem from an ideal standpoint. It is a question of adapting processes to machines that can be used and have to be used, and different kinds of tools have to serve in the different machines. For instance, take the operation of finishing the inside of the shell. That has been done on a lathe, on an automatic turning lathe, on standard machines, on drill presses and on special machines made for that purpose. It would be folly to confine the method of doing that work to any one machine and leave the resources of other machines untouched. So I am inclined to think that we should go a little slow in the matter of standardizing too finely the process of making shells, as thereby we should cut down the rate of production.

Another interesting point is the improvement in design and manufacture. This is a subject to which there are two sides. I think that a manufacturer or a machine-shop man who undertakes ordnance or munition work is beset by a large number of foolish provisions and unnecessary requirements regarding methods of manufacture. He is likely to find after he investigates the matter a little further, however, that they are not entirely foolish. They look foolish to him because he does not understand all the necessities of the case. There are a few instances, however, where it is possible for the ordnance designer to come more into line with the manufacturer, as in the case where the manufacturer has to swing into line making ordnance.

One point that I might mention is when the shell shall be treated. The method now followed in the average arsenal is to treat the shell in the blank immediately before the forging is done. It has been found, so far as the English shell is concerned, under pressure brought to bear on the manufacturers that it is possible to leave the heat-treating of the shell until the final finishing operation on the outside; and it would be well for the United States Government to provide for this, if it has not already done so, because it means an increase in the production of shells.

There are rumors of bad management in Canada, from the standpoint of excessive profits to certain firms and individuals. Such a condition might be true in our country and might be discovered more quickly than it was in Canada. So some such provision as is suggested by Mr. Miller would be necessary; and this would necessitate something in the line of a standard method of accounting, having some way of defining the various details of manufacture and the methods of manufacture. Depreciation should be reckoned, and the various items that go into the overhead should be calculated. The requirements should be quite simple and should be readily taken care of.

Pressures Used in Drawing Cartridge Cases

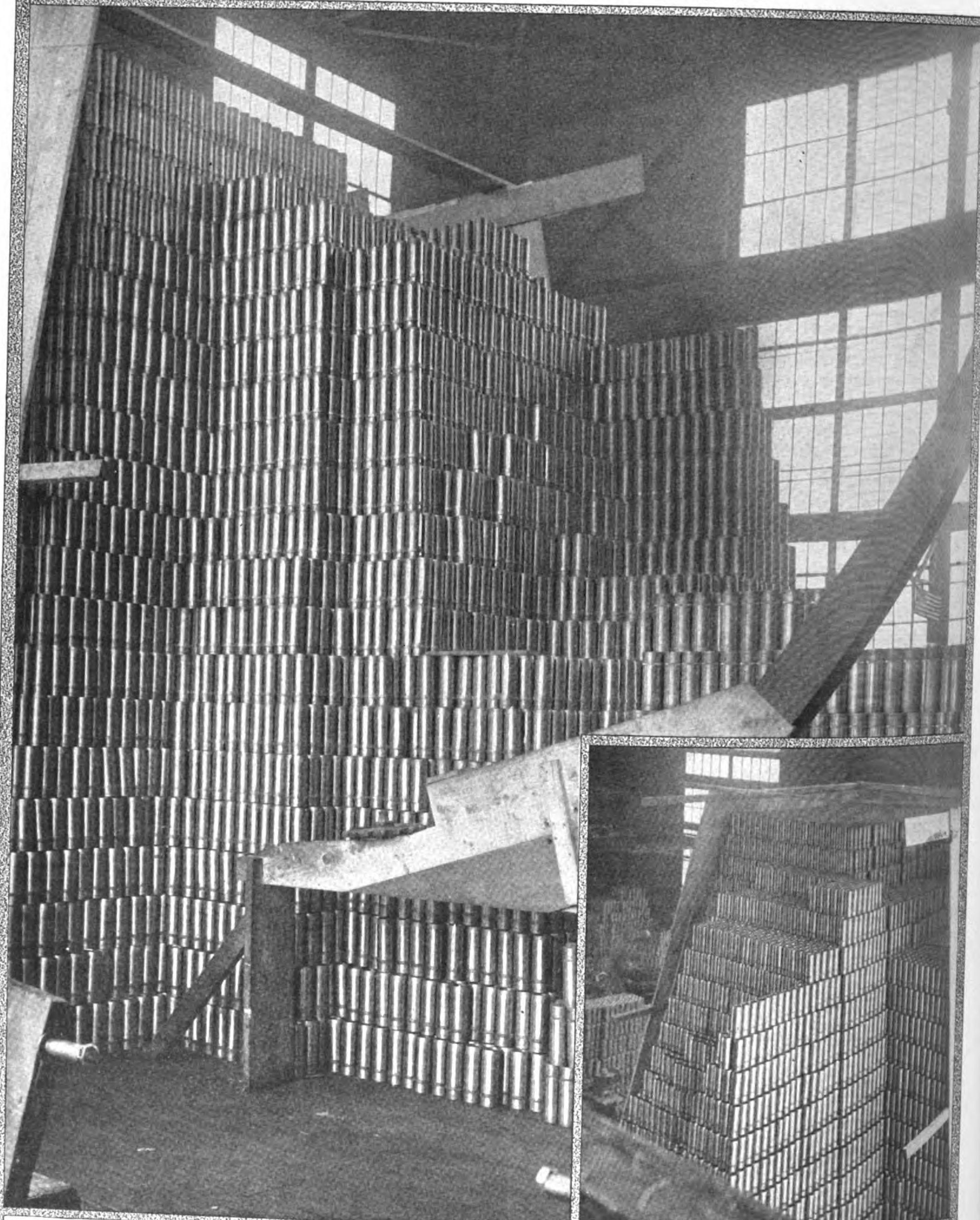
By Oberlin Smith

One very important class of machine tools was no. ...entioned in the paper by Mr. Miller—the presses with which cartridge cases are made, the brass cases up to 6 or 8 in. in diameter. The most important size is known as 3-in., or as the 75-mm. shell in France. More of those are used, probably, than of any other kind, and a great many American presses have been built for making the British 18-pounder—about the same size.

The cases are drawn in from six to nine operations, the 3-in. in presses giving 100 tons' pressure at first. They cut the blanks from sheet brass, usually about ⅝ in. thick, draw them into cups, by successive draws, down to an edge $\frac{1}{16}$ in. thick. Millions of these cases are being made, and thousands are spread over the battlefield of Europe every day. The operations are usually with 100 tons' pressure until the cases reach full length, and then they require 1,000 to 1,300 tons' pressure to squeeze the head, which is left full thickness, into the same shape as the small cartridge. The cases are almost all being made in presses already standardized. The presses themselves are almost exactly the same as have been made for years by the different press makers for all sorts of drawing work and all work of that nature.

Besides the presses for making cases there are some used for punching and drawing the steel shells, although a great many of the latter are cut from solid bars. The last drawing operations on the brass cases is often done in hydraulic presses, but lately sizes up to 3, 4 and 5 in. have been made chiefly in mechanical presses. The presses for long strokes also have their place.

Twenty Thousand Shells Waiting For Fuse Sockets



In shops producing thousands of shells daily the shortage of one component part causes a delay and accumulation that run into money.

Editorials

Delays That Mean Money

The accumulation of shells shown in the illustration on the opposite page is due to the shortage of a small component part, which is a few days' late in its arrival at the factory. Anyone can see at a glance that an accumulation of this kind means men, machines and money tied up—a disruption of organized effort that becomes serious in a very short time. It means a dangerous condition unless promptly acted upon by the company's officials.

Invisible dangers are much more to be feared than visible ones. In a shell-producing plant where shells form the exclusive product a condition of this kind cannot escape attention. The slightest interruption of regular routine or a shortage of component-part supply calls attention to itself immediately. There is but one main consideration—shells; there is a shortage of but one part—in this case, fuse sockets; the result is accumulation and congestion that begin to be seen in a few hours and continue to grow until they assume mountainlike proportions unless the cause is removed.

The shop that is not working on shells, but has a large variety of products, encounters this danger in a more insidious form. Shortages do not make their results apparent in such a striking manner, although their total effect, distributed over the many products made, may tie up just as much money. It is hard to grasp this fact, because the human mind cannot conceive the meaning of an immense variety of unlike objects and parts, as it can easily do with a quantity of exactly similar pieces, such as shells.

The average shop doing a great variety of work is marked by the large accumulation of product parts, and one having a clean floor is an exception. There is but one unit by means of which this accumulation can be translated into a realizable total, and that unit is the dollar. Plants that have a running inventory of work in process have a gage which will indicate the effect of delays quickly and accurately. Those that have not should study the illustration of this accumulation of shells and draw a profitable conclusion from it.

Avoiding Costly Errors in Indexing Work

The problem of accurate and reliable indexing on millers is a serious one in manufacturing products that require uniform spacing. Gear cutting is of course done by automatic indexing, but such work as reamers, milling cutters, etc., is not usually indexed in that way. The dividing head as applied to a modern miller, with its gearing for compound and differential indexing, works out admirably in the toolroom, but seems to leave some things to be desired when it is used in regular manufacturing work.

As an illustration we may cite an instance of an operator running four machines, each doing a different kind of work. The indexing varied from four to fourteen divisions of the work. With the geared dividing head this meant a different number of turns, in addition to the different fractions included between the fingers of the sector, although this feature should not be confusing. The main trouble comes from the varying number of turns for each dividing head.

With four heads to attend to, all with different indexing, together with the desire to do the indexing as quickly as possible and so reduce the idle time of the machine, it is small wonder that mistakes occur. Few of us could probably do much better in the long run, day after day; it is so easy to make one turn too few or too many. But the loss of nearly $900, covering a period of only 30 weeks in one particular shop, due to errors in the milling department, makes us feel that some sort of remedy should be forthcoming at an early day.

Two solutions seem to present themselves, aside from the question of automatic indexing, which might not be considered feasible in many cases. One, which seems to be the most practical, is to use direct indexing for such work. This can be easily accomplished on some dividing heads by dropping the worm out of mesh and using an index plate on the spindle, as with plain indexing centers. This plan would obviate any difficulty as to counting turns, the movement of the index pin between the sector fingers being all that is required, which could hardly be confusing.

Another solution, which is neither as simple nor as easy of accomplishment in most cases, would be so to plan the work that the same operator need not index different divisions. This arrangement is not easy, yet it might be possible in some instances where the dividing heads were incapable of being used for direct indexing; for $900 would pay for considerable readjusting of machines and work and is well worth considerable effort to save. And where no other way seems to be at hand, there can be no doubt that the work should be so arranged that a man does not have to make widely varying movements in indexing, with the ever present opportunity for error thus presented.

Special index plates, or at least plates that permit direct indexing by means of the sector, seem the most practical method of solution.

Some Changes Needed in the Consular Service

As American manufacturers are seriously engaged in reaching out for export trade, it is appropriate to suggest needed changes in the consular service in order to make it an efficient aid in business getting. The changes here suggested are inspired by questions asked by American manufacturers in response to circular letters sent out by the *American Machinist* and *Engineering News*, asking if specific information of any kind was desired on South American conditions. The inquiries in re-

ply came from all sections of the United States and Canada, showing that there was no section of the country more conversant with foreign-trade conditions than another. Extracts from these letters follow:

Is it necessary for a representative to have a knowledge of the Spanish language in order to do business there?

Please peruse our catalogs and tell us with what success these machines can be used in that country.

Please send us a list of reliable agents in each country.

What is your opinion of the possibility of selling friction clutches, friction-clutch pulleys and small friction-driven hoists there?

Please send us a list of users of our product.

My competitors are shipping at lower than publicly quoted freight rates. How do they do it?

What kinds of tools are principally used in the machine shops?

In what kind of manufacturing are ball bearings used?

We have had numerous inquiries from South America, but have been unable to sell. What is the trouble?

Is there a market for our machinery?

We are without authoritative information concerning trade conditions in South America. Can you enable us to enter this field successfully?

How much belt-hook business is there in South America?

Is there any market for gears there? Are any gears manufactured there and in what amounts?

What percentage of drills, reamers, cutters and tools of this character is of American manufacture?

Can sales to railroads and large industrial users be handled to advantage direct from this country?

Can we sell second-hand equipment there?

What kind of belting is used there; where made?

Are quality goods used, or is price the most important feature?

What about credits there?

What are the best means of marketing our products?

What are the future possibilities of that market?

What are the expenses for traveling?

Are factories equipped with bolt-threading machinery?

What is the buying procedure?

Would it be better to wait until war is over to go after that business?

What fields now developing present possibilities for the sale of our machinery, and whom may we approach regarding it?

How can I quote a delivered price under present conditions?

We have orders on hand held up by high freights. Is there any way around this?

On what class of work are they using turret machinery?

Send us specific information of the number of machine shops, classified as to kind, number of employees, etc.

What are the best methods of getting our product before consumers there?

Our lines comprise engines and boilers, 3 to 60 hp. mostly, also hydraulic turbines. Help us increase our business.

What are the terms of payment for water-purification plants, when bought by municipalities and individuals?

We would like to know whether our customers are worthy of credit.

Send us all available information regarding irrigation and drainage work and marketing of pipe at present time.

Please recommend reliable forwarding agents for handling shipments to this address.

What railroad developments or irrigation and drainage projects are under way?

We have an order on our books which has passed through two hands, each of them probably taking a commission. How is this usually handled?

What is the best way of forwarding small shipments?

Please send our catalog to the chief engineer.

What kinds of flare lights are used?

What are the legal requirements with respect to cast-iron pipe for house drainage, water-works, etc.?

Is concrete curbing used in South America; and if so, where and under control of what public officers? Are curb guards used?

To what extent is concrete-base or concrete pavement laid?

Is there a field for derailing devices there?

To what extent are creosoted materials used?

What classes of business use standard railroad-type shovels, small revolving-type shovels, drag-line excavators, dipper dredges, elevator dredges, hydraulic dredges?

The wide range of these inquiries suggests that the Government should consolidate its commercial forces so as to present accurate specific data in reply to any questions, American manufacturers may have available at all times industrial information to promptly meet the inquiries.

This implies a complete canvass of the manufacturers, merchants and consumers in every market of the world every five years or less. Every item of information that could be used by a manufacturer to increase his business should be noted. Complete details of the nature of equipment used in mechanical plants and factories should be given. Anything that will guide a manufacturer in the problem of increasing his business should be included. What a manufacturer wants is *practical* information, credit ratings, etc. Such information cannot be obtained in any other way than through inquiries on the ground. Dependence cannot be placed upon city and telephone directories and classified lists, as may be seen from the fact that the six largest machine shops in Rio de Janeiro are not in either directory.

The objection of the Government that a consul should not criticize can be overcome by putting his comments in the form of quotations from various authorities whose names need not be mentioned in the reports. A diplomatic representative is really handicapped by the courtesy expected of him, so that the consuls come nearer the actual consumers. Therefore, the bulk of this work should be handled by the Consular Service.

The pay should be higher than at present, to attract a better class of men, and they should be furnished with capable heads for the various trade departments. The weaker members now in the service should be transferred to other departments where their activities are not so closely connected with American prosperity.

Conditions are certainly ready for improvement when one of the largest manufacturers in the United States writes to the *American Machinist:* "We are without authoritative information concerning trade conditions in South America. Can you enable us to enter this field successfully?"

Duncan N. Hood, the representative of the *American Machinist* in South America, reports that he entered the United States consulate in a city of 120,000 inhabitants and asked, "How many machine shops are there here?" An aged Englishman who was in charge (the consul was on leave and the vice-consul had not yet reached the office) replied: "There is only one. It has a concession covering all repair work here." Mr. Hood found within four blocks of the consulate two machine shops working full blast, and there were eight in the city. One of them is larger than the shop the consular officer thought was the only one.

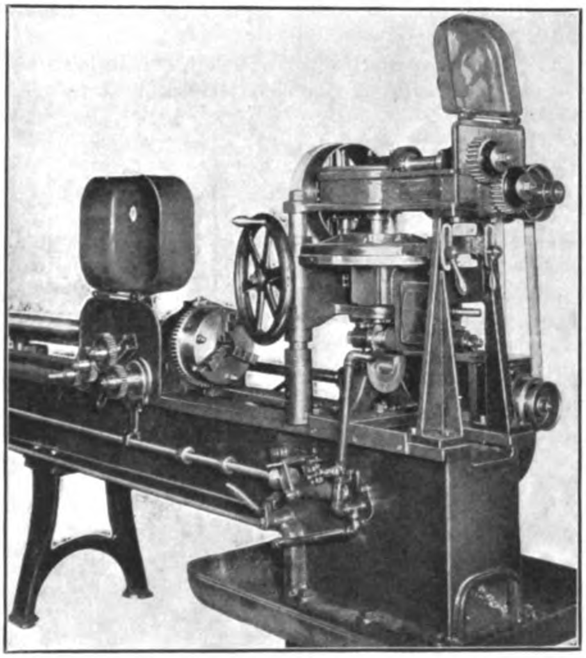
Intelligent and aggressive coöperation between the Consular Service and the technical press is highly desirable. The technical press knows by many years of experience just what information is needed and the best methods of acquiring and presenting it for the use of the busy manufacturer, while the Consular Service has the machinery for obtaining the facts. The start should be made now.

A correspondent of the *American Machinist* sent a clipping from the letterhead of a manufacturing firm and emphasizes this statement, "Makers of Special Tools—Tools of More Than 100 per Cent. Efficiency." He also adds this comment, "Some of us must be asleep." The *American Machinist* agrees with the comment, but dislikes to say just who is slumbering among dreams of something from nothing.

Shop Equipment News

A Thread Miller

The illustration shows a thread miller built by Edwin Harrington, Son & Co., Inc., Philadelphia, Penn., designed for a general range of work of milling screws, threads, slots and spiral gears, either right or left hand, of fine or coarse lead, either single or multiple. It will also mill keyways in shafts, flue rolls and perform many other similar operations. The work is gripped in a



THREAD MILLER

chuck at one end and is supported in a steadyrest directly under the cutter, thus avoiding the disadvantages of cutting work on centers.

The cutter head is mounted above the work, allowing full inspection of the cut at all times, and rotates 180 deg. on its vertical trunnions. The spindle is driven by helical gears and generated-tooth bevel gears. The drive to the machine is from a single pulley on the top frame, with six changes of cutter speed by slip gears.

The lead screw is large and mounted in direct line with the work, which is gripped in a chuck mounted on the end of the lead screw. The pitch of thread to be cut on the work is regulated by change gears on the carriage controlling the relative speeds of two worm gears, one revolving the nut and the other the chuck and screw. Indexing for multiple threads is accomplished by a special method that avoids errors of spacing and the use of special index plates. A wide feed range is provided by a system of belt cones and quickly operated sliding gears in a box. Any desired feed can be obtained from 19 in. per min. on the periphery of ½-in. work to 0.75 in. per min. on 4-in. work. When grooving straight or long spirals on rolls, the lineal feed along the axis of the work is from 0.015 in. to 3 in. per min. For this special class of work the machines can be furnished with special gearing to allow a faster feed.

Power-operated quick return is a part of the regular equipment. An indicator is also provided for picking up the thread after the carriage has been returned by hand with the nut open. Automatic trips are provided for both the feed and the power return.

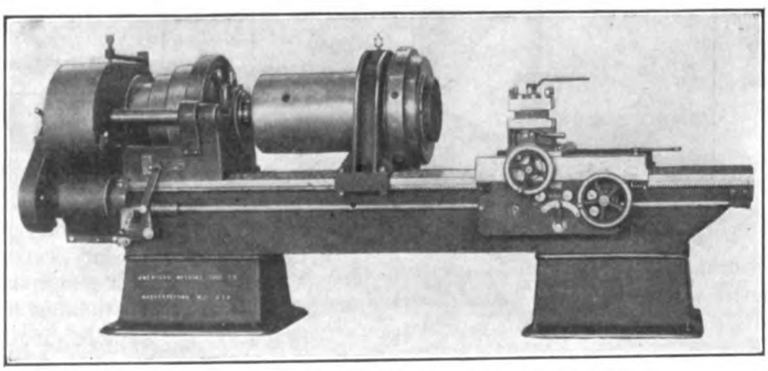
The bed is one continuous casting and is provided with a large drip pan and a settling tank for catching the chips and cutting lubricant.

The regular equipment includes an overhead countershaft, six cutter speed-change gears, fifteen lead-change gears, two steadyrest bodies, two steadyrest bushings, a heavy three-jaw chuck, a full set of wrenches and charts for change gears and multiple-thread indexing.

Heavy-Duty Single-Purpose Engine Lathe

While the lathe shown was planned to be specially adapted for turning and facing back ends of 12-in. shells, the requirements of a general-purpose lathe were kept in mind during its design and construction. It is claimed therefore that only a few slight changes will be necessary to adapt the machine to meet the more general requirements of lathe duty.

The headstock is of English design, in which the gears are placed in front of the spindle instead of at the back. A lever at the top of the gear case operates a pair of sliding gears running on a feathered sleeve that is attached to the cone pulley, providing two changes of spindle speeds. The form of the gear box eliminates the



HEAVY-DUTY SINGLE-PURPOSE ENGINE LATHE

Swing, 24 in.; spindle diameter, 5½ in.; hole through spindle, 2⅛ in.; length of carriage on ways, 31 in.; width at right angles to ways, 29$\frac{11}{16}$ in.; weight 7,570 lb.; length of bed, 11 ft.

need of a clutch. The hand lever is easily shifted to any one of its four positions. The lever moves a special key constructed with a heavy spring in a keyway under it, which is designed to insure the key's springing into proper contact. Hardened-steel rings placed between the gears cause the key to be pressed down below the surface of the shaft and pass readily from one set of gears to the other. With this arrangement four changes of feed—0.01525, 0.02343, 0.0325 and 0.0625 in. per revolution of spindle—are provided.

The bed is braced internally by four channel-shaped girts. The back side of the bed is flat; no V is put on it, except a small supplementary one to permit the fitting of a tailstock. At the front there is a special-shaped V planed to angles of 22 and 68 deg.

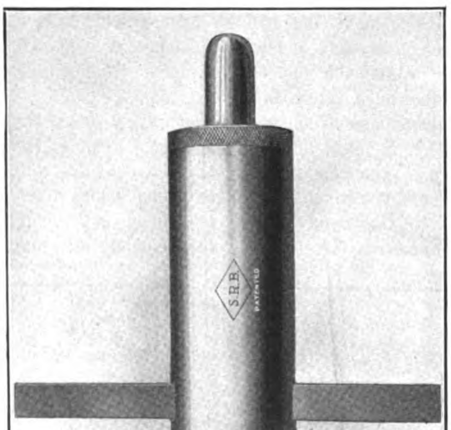
The power crossfeed is operated by throwing the lever in the apron to the neutral position and then pushing the knobbed shaft on the crossfeed shaft in as far as possible. This puts the crossfeed gears in mesh and throws out the rack gear.

On the carriage is mounted a standard-type 8-in. square turret. The revolving tool holder, having four slots, revolves on a steel tapered pin and has six locking spaces, thus allowing the operator to put his tools on a tangent or angle, if necessary. The locking arrangement is rigid, and the locking bolt can be adjusted to take up wear by means of a taper gib.

The machine is a recent product of the American Machine Tool Co., 50 Church St., New York City.

Portable Brinell-Method Hardness Tester

The growing demand for real knowledge regarding the hardness of metals has developed several instruments for that purpose, the latest being a simple portable device



BRINELL PORTABLE TESTER

Contains Brinell meter, 6 bars of standard hardness, 12 standard 10-mm. tools, 2 special scales, set of direct-reading tables, key for inserting new lots, instructions, leather carrying case 9¼x6¼ in.; weight, 6½ lb.

that utilizes the well-known Brinell method. This feature allows the instrument to be taken to the work and to be used on thin metal sheets that are apt to be penetrated when tested in the regular Brinell machine.

The simplicity of the device is apparent from the illustration. A standard 10-mm. ball is held loosely in the end of the body. Above it is a standard bar of square section, having a known degree of hardness. The ball is placed on the spot to be tested, and the plunger at the upper end is struck with a hammer of any convenient weight. By means of a special scale furnished with the instrument the diameter of the depression is then compared with the one made in the standard bar.

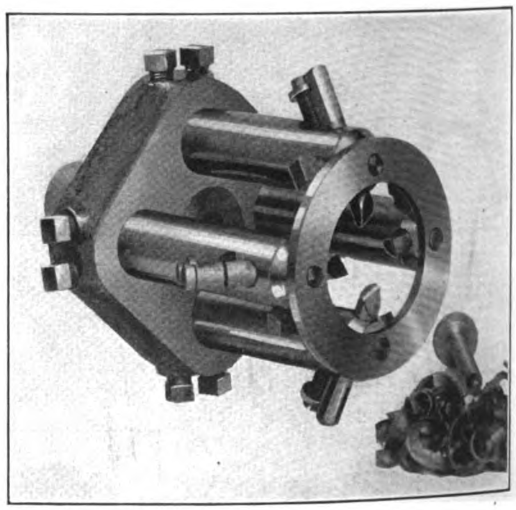
If the indentation is the same as that in the standard bar, the hardness of the material is evidently identical with that of the bar. Should it differ from the standard, a direct-reading table gives the hardness in Brinell values.

It will be seen that neither the weight of the hammer nor the blow struck is important, so long as a readable depression is secured. For thin metal sheets a light hammer is used and a softer standard bar inserted above the ball.

The device has much to commend it, and its distribution is in the hands of Herman A. Holz, 50 Church St., New York City.

Screw-Machine Box Tool

The main base of the body of the open-type screw-machine box tool shown is made of cast steel; the bars supporting the cutters, of machine steel; the cutters, of high-speed steel. The cutters are adjustable to varying diameters by the small collar and setscrew feeding in the cutting tool proper. The rake of the tool can be changed



SCREW-MACHINE BOX TOOL

by releasing one of the capscrews in the shank of the cutter holder and tightening the other.

The open-type construction permits free lubrication and chip clearance. Four cutting tools are provided, and the chip clearance, as well as the ease of lubrication, permits running at higher speeds and coarser feeds.

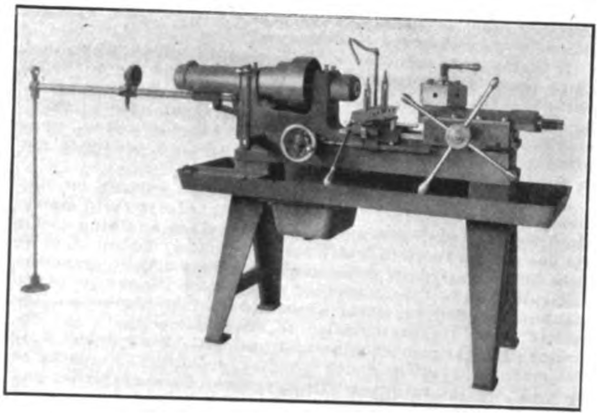
The elimination of the roller or block backrest is calculated to minimize friction, and four tools cutting at one time have the same effect as a roller backrest, insuring concentric work. The locking feature is positive, and the main tool adjustment is easily and quickly made. The main tool

holders are graduated for adjustment for varying diameters.

This tool is manufactured by the Watson Manufacturing Co., Toledo, Ohio.

Hand Screw Machine

It will be observed that the hand screw machine illustrated is of the conventional design. The manufacturer—the Loisy-Patton Co., Cleveland, Ohio—emphasizes the heavy headstock construction, intended to insure rigidity, and its dished base. The base is slotted so that the oil that drops from the bearings flows through to the drip pan instead of over the headstock sides.



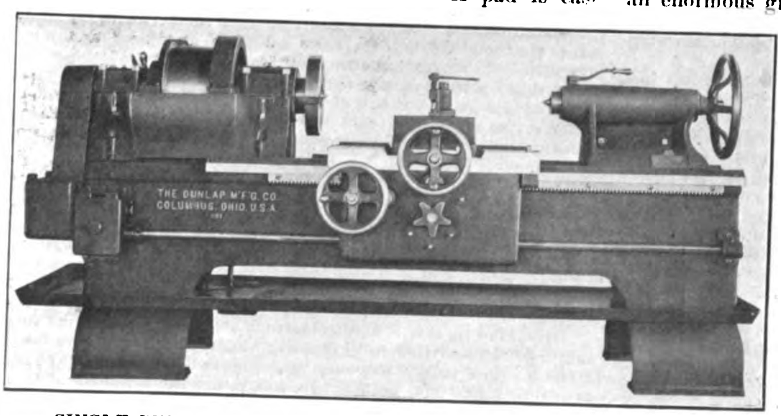
HAND SCREW MACHINE

Capacity, 1 in. rounds; length of turned stock, 6 in.; swing over bed, 14 in.; swing over cut-off slide, 6 in.; maximum distance from end of spindle to face of turret, 14 in.; hexagon turret, 1 in. holes; three-step cone drive, 3-in. belt

Heavy-Duty Back-Geared Engine Lathe

The illustration shows a heavy-duty single-purpose back-geared engine lathe built by the Dunlap Manufacturing Co., Columbus, Ohio.

The bed is cast from so-called semisteel that is cast iron with an admixture of mild steel. A pad is cast at the back of the bed and planed for the reception of taper, or forming, attachments. The headstock bearings are provided with ring oilers.



SINGLE-PURPOSE HEAVY-DUTY BACK-GEARED ENGINE LATHE

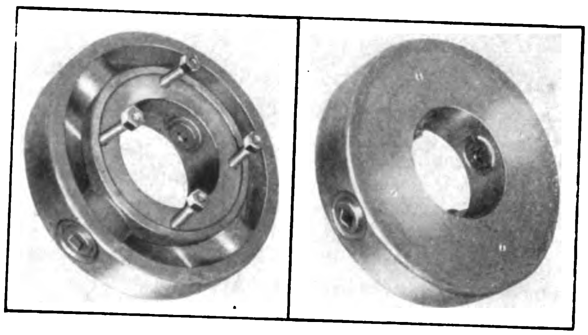
Swing, 21 in.; swing over carriage, 14 in.; distance between centers, 37 in.; driving pulley, 14 in. in diameter for 6-in. belt; bed, 8 ft.; weight, 6,000 lb.

The tailstock is a single casting. The clamping bolts are both in the center. The spindle is of forged steel. The end thrust is taken by steel and bronze collars. The carriage is cast from steel mixture and provided with taper gib to take up wear. The apron is of the double-wall type.

Seven feeds provided are from 0.012 to 0.112 in. per revolution. The feed gears are of steel, 8-pitch. The pan is of sheet steel. The cut lubricant pump is mounted on the rear of the bed. A two-speed countershaft is furnished.

Extra-Heavy Four-Jaw Chuck

The chuck shown in front and rear views in Figs. 1 and 2 and in detail in Fig. 3 is made in several sizes by the Mann Corporation, Chicago, Ill. It was designed to meet the requirements for an independent four-jaw direct-screw chuck with large hole and small range of jaw travel and is especially good for use on heavy cutting-off machines and for gripping shrapnel or high-explosive shells of all sizes during machining operations. From the construction it will be seen that an operator can get an enormous grip on the work with comparatively little exertion on his part, and when properly tightened the work will positively not slip under the heaviest cuts.



FIGS. 1 AND 2. EXTRA-HEAVY INDEPENDENT-JAW CHUCK

Specifications—Made in three sizes, as follows: No. 3, rated size, 12 in.; diameter of center hole, 4⅛ in.; diameter of faceplate seat, 5¾ in. No. 6, rated size, 18 in.; diameter of center hole, 6¾ in.; diameter of faceplate seat, 12 in. No. 9, rated size, 24 in.; diameter of center hole, 10¼ in.; diameter of faceplate seat, 15 in.; weight, 350 lb.

The body of the chuck is bored out quartering to receive shouldered sleeves pressed in from the inside. These sleeves are of large diameter and are threaded near the outer end for the reception of an eight-lead nut operating the jaw that slides in the inner part of the sleeve. A small key prevents the jaw from rotating as the nut is turned. The large diameter of the nut with its comparatively small lead, gives an enormous leverage when the wrench is applied for tightening. All parts are made of suitable material and properly proportioned for the hardest kind of service. It will be noticed that the hole through the chuck for the passage of work is very large when compared with the outside diameter of the body of

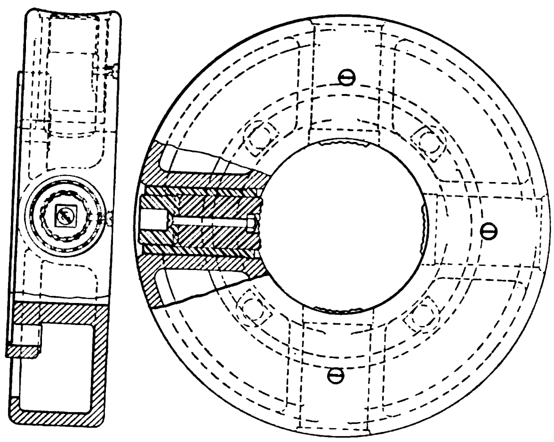


FIG. 3. DETAILS OF INDEPENDENT JAW CLUTCH

the chuck. This feature adapts the chuck for use for many other purposes besides the production of shrapnel and high-explosive shells.

Convention of National Metal Trades Association

The eighteenth annual convention of the National Metal Trades Association, on Apr. 27 and 28, was well attended. The first day was devoted to the regular business of the association, including reports of officers and of standing committees. These included Industrial Education, F. A. Geier, chairman; Apprenticeship, W. A. Viall, chairman; Membership, John W. O'Leary, chairman; and Prevention of Industrial Accidents, W. H. Van Dervoort, chairman. The afternoon was devoted to an experience meeting of members.

One of the interesting features of the morning session was the result of a referendum on the proposed legislation to compel the use of the metric system. The vote was 238 against to 37 for. The following resolution was unanimously adopted:

Whereas, The system of weights and measures long established in the United States and in all English-speaking countries has been attacked by numerous parties who are desirous of imposing upon American industry the metric system, and

Whereas, The Director of the Bureau of Standards has issued a report on the "Metric System in Export Trade," published as Senate Document No. 241, which gives an erroneous idea of the necessity of fostering the use of the metric system because of our participation in foreign trade, and

Whereas, Several bills have been introduced in Congress purporting to promote uniformity in weights and measures, but inimical to the long-established system, and

Whereas, The engineering industry comprising the membership of the National Metal Trades Association is vitally concerned in the conservation of the existing system and realizes that the fostering of any foreign standards means confusion to industry instead of promoting uniformity, and

Whereas, The several engineering societies participating in an intersociety committee to consider the feasibility of the adoption of the metric system following an agitation promoted by scientists and others not fully appreciating the vital importance of this question in its industrial aspects as well as in the habits of people; it is hereby

Resolved, The National Metal Trades Association in convention assembled deplores the continued agitation of a subject which would deprive American industry of a substantial uniformity heretofore enjoyed in its use of weights and measures and points with pride to a great foreign trade already secured by the ready adaptation of our products to the needs of the foreign buyer without any legal enactment or Government supervision, and be it

Resolved, The efforts of Government either through statutory enactment or through administrative action should be the promotion of uniformity on the basis of present universally used units instead of the encouragement of any new units, and be it further

Resolved, The sense of this convention be conveyed to the members of the Interengineering Society Committee, to the Committees of the House and Senate on Coinage, Weights and Measures, to the Secretaries of the Department of the Treasury and of Commerce and to the press.

F. A. Halsey then spoke as follows:

Superficially, the metric system is the most plausible thing on earth, and one must go below the surface to see its fallacies. One man wants it because he "believes in anything decimal"; another wants it for "uniformity," and another thinks it "necessary for export trade."

It is through such superficial generalitites as these that many make their decisions. The chief racket now being worked is the export-trade racket, as expressed by Hon. James L. Slayden, member of the House Committee on Coinage, Weights and Measures, at a recent hearing of that committee: "If we do business in South America, we have got to do it on that system."

Before this audience it is superfluous to enlarge on this topic, as you gentlemen know that your products go to metric countries where no one knows, asks or cares anything about the units of measure to which they are made. You may, however, be interested in some new facts that I take from the latest number of the "American Machinist." Many are aware that shortly after the outbreak of the war the "American Machinist" sent a representative to South America in the interests of American machine-tool builders. That representative made a circuit of South America, spending 18 months at the task; and he returned with a census of the personnel and equipment of South American machine shops, of which there are more than most people believe. This census shows that of the machine tools in South America 39.3 per cent. are of American, 43.2 per cent. of English and the remaining 17.5 per cent. of German, Belgian and French production, the total being 82.5 per cent. made to English and 17.5 per cent. to metric measure. We are always told that the countries of South America are solidly metric, the only exception being British Guiana. They have the markets of the world from which to buy, and no one in this audience will claim that German machine tools are not good tools. Nevertheless, these metric countries buy machine tools made to English measures, in preference to those made to metric measures, in the ratio of nearly six to one. We have here in brief the contemptible littleness of the export-trade argument.

But how plausible the argument sounds! This surface plausibility is characteristic of every claim made, and therein lies the danger. Yet prick these claims with commonsense, and every one of them collapses like a soap bubble, just like this one. There is no reason whatever for the adoption of the system; there is every reason for having as little to do with it as possible. The facts are all against the system, and they have been widely published. They are so conclusive that no one who knows anything worth knowing about the subject can possibly favor the system. But does this make any difference? Not the slightest. The metric party simply ignores all we say except when they add insult to injury and claim that our arguments have all been answered and our difficulties shown to have no foundation.

Of this I will give you a few examples, which are not the result of a search, but are simply expressions that have come under my eye during recent weeks when reading new metric literature. First, we have this choice example from Secretary of Commerce Redfield:

Recent practical experience has disproved so much that has been written against it that I venture to say that the Bureau of Standards is now in an excellent position to represent the enlightened opinion on both sides of the question.

Again, we have from Dr. Stratton's report on the "Metric System in Export Trade":

In the textile industry, for example, one outspoken writer —not a manufacturer—speaks disparagingly of the metric system.

Of course, you will recognize that Dr. Stratton is a manufacturer and entitled to cast a slur upon anyone who is not. More to the point, however, this is Dr. Statton's way of brushing aside Mr. Dale's overwhelming facts showing the utter failure of the metric system in the textile industries of metric Europe and the infinite harm that has come from the attempt to introduce it. Again in the same report Dr. Stratton says:

Some well-meaning men have urged that English measures were working well enough and that a change would be all but impossible. Yet the very firms concerned are using the metric system for their own profit. No more can be asked.

Again you see how easily be brushes aside our whole case. Mr. Sharpe is a "well-meaning man" who has "urged

that a change would be all but impossible"; but he makes metric micrometers, gages, reamers and other tools for sale abroad, and he has thus shown that his difficulties are imaginary.

Again we have from Dr. Stratton in a recent hearing before the House Committee on Coinage, Weights and Measures:

The objection to it came largely through ignorance, and I will use that word qualifiedly—I mean people who are not familiar with the system. They would be very intelligent otherwise. When I came to Washington, I remember a series of very interesting hearings in this roon on the metric system.

"The objection to it came largely through ignorance." Here you have again the insufferable Phariseeism of these people. You are "ignorant" of your own business, but Dr. Stratton is all-wise. He knows your business and all others. And the man who says this does not know factory measurements. He knows nothing of what this change means.

But Dr. Stratton "remembers a series of very interesting hearings." That is the net result of your tremendous efforts in filling that committee room for two years when you overwhelmed the committee on Coinage, Weights and Measures and destroyed Dr. Stratton's case. Evasion, concealment and downright misrepresentation, with the slogan "Claim everything," make up the metric case.

The situation is comic or tragic, according to the viewpoint. Another adverse fundamental condition that we have to fight arises from the misleading comparisons which are constantly made with our decimal currency. Did you ever make a table of our coins? I presume not, and so I will give it, as follows:

5 cents make a nickel
2 nickels make a dime
2½ dimes make a quarter
2 quarters make a half-dollar
2 half-dollars make a dollar.

In this table every denomination that can be divided by two without a remainder is so divided. As it appears on the ledger or invoice, our currency is purely decimal; but when we make coins for the actual measurement of values, we get as far from decimals as we can. There is no better illustration of the limitations and inadequacy of decimals. Because we write it decimally, our currency is constantly made to serve as an argument for the metric system; and this argument is as plausible and as hollow as all the rest.

Finally, we have to recognize that the national Bureau of Standards, with an appropriation of $800,000 a year, is a giant engine for the promulgation of the metric system.

Two other resolutions were also passed, one dealing with time study and premiums and the other on coöperation for national defence. The first of these resolutions reads:

Whereas, There is now pending in Congress, House Bill 8665, known as the Tavenner Bill, to regulate the method of directing the work of the Government employees, the object of which is to prohibit at the Government arsenals what are known as time studies and premium payments, and

Whereas, This association fully agrees with the facts and request set forth by the Hon. Newton D. Baker, Secretary of War, in a letter to the Speaker of the House of Representatives under date of Apr. 20, 1916, therefore be it

Resolved, That this association notify the Committee on Military Affairs of its disapproval of said H. R. Bill 8665 and that our members do all in their power to help the defeat of this bill and to strengthen the hands of the Secretary of War.

The second resolution follows:

Whereas, The Naval Consulting Board composed of foremost inventors and engineers has been created to assist the Government in the making of plans for national defense,

Whereas, The coöperation of the nation's industries in achieving adequate defense undertakings is of the utmost importance to the country contemplating the vast supplies needed in time of national peril, and

Whereas, The several engineering societies are coöperating to furnish an inventory of industries which may be available as sources of supply in time of the nation's need, committees of engineering having been appointed in various states to direct the making of such an inventory,

Be It Therefore Resolved, The National Metal Trades Association in convention assembled heartily endorses the making of an inventory of industries as a most important feature in industrial preparedness, which not only should result in a better knowledge of sources of supply for the Government, but also will assist our own members to a better realization of the possibilities of their own manufacturing plants, and be it

Resolved, The several members of the association are urged to heartily coöperate with their own state committees in furnishing desired information which will make the industrial inventory possible.

The new officers are: W. H. Van Dervoort, president (Root & Van Dervoort Engineering Co.); George Mesta, first vice-president (Mesta Machine Co.); J. W. Higgins, second vice-president (Worcester Pressed Steel Co.); F. C. Caldwell, treasurer (H. W. Caldwell & Sons Co.); John D. Hibbard, commissioner; Homer D. Sayre, secretary. The councilors for 1917 remain as before, except that Herbert H. Rice, the retiring president, replaces J. W. Higgins, the new second vice-president. The new councilors for two years are Theodore O. Vilter, Milwaukee, Wis.; B. F. Tobin, Detroit, Mich.; H. N. Covell, New York; Murray Shipley, Cincinnati, Ohio; R. H. Jeffrey, Columbus, Ohio; and H. B. Kennedy, New Haven, Conn.

PERSONALS

James E. Mills, formerly connected with Gilbert & Barker, has become sales manager for the Bellevue Industrial Furnace Co., Detroit, Mich.

J. J. de Boxes has severed his connection with the Century Steel Co. in order to form the Apex Steel Corporation, 50 Church St., New York, N. Y., of which he will be president.

Paul Kendig, vice-president of the Seneca Falls Manufacturing Co., Seneca Falls, N. Y., has resigned. Mr. Kendig will devote his entire time to other interests with which he has been connected.

James P. Farrell, resigned his position as chief engineer of the Garrison Machine Works, Dayton, Ohio, to become associated with the Dayton Stamping and Tool Co., Dayton, Ohio, in a similar capacity.

W. B. Gardiner, until recently production superintendent of the Modern Tool Co., Erie, Penn., has joined the Remington Arms plant in Bridgeport where he will act in the capacity of chief inspector of the factory.

W. L. Schellenbach, formerly chief engineer of the Lodge & Shipley Machine Tool Co., Cincinnati, Ohio, has established an office in the First National Bank Building, Cincinnati, where he will practice consulting engineering, especially that covering machine design.

Henry Cave, president of the Cave Welding and Manufacturing Co., which has acted as the New England agency of the Davis-Bournonville Co. for many years, has become directly connected with the latter company for which he will be in charge of the research department.

BUSINESS ITEMS

The Bellevue Industrial Furnace Company, Detroit, Michigan, has acquired the Krentler Bros. buildings at 1315 Bellevue Avenue. This gives them an additional floor space of 6,000 sq.ft.

M. A. Palmer Co., 469 Atlantic Ave., Boston, Mass., has just moved into larger quarters at this address, where they will handle tool steel, forgings and die blocks, crucible and openhearth steels.

The International Machine Tool Company, Indianapolis, Ind., has contracteed for the erection of an addition to their plant which will provide additional 15,000 sq.ft. in which new equipment will be installed.

TRADE CATALOGS

C. J. Jackson, Easton, Penn. Circular. "Peerless" 1916 all steel stfety shaft hanger. Illustrated.

Henry Disston & Sons, Inc., Philadelphia, Penn. Pamphlet. "Why a Saw Cuts." Illustrated, 12 pp., 6x9 in.

Canton Foundry and Machine Co., Canton, Ohio. Catalog. Portable floor crane and hoist. Illustrated, 4x7½ in.

Link-Belt Co., Chicago, Ill. Booklet No. 267. "Moving Material Indian File." Illustrated, 24 pp., 3½x6½ in.

C & C Electric & Mfg. Co., Garwood, N. J. Bulletin No. 102-X. Type "IB" motors with commutating poles. Illustrated, 8 pp., 8x10½ in.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	Apr. 28, 1916	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$15.00	$15.00	$9.50
No. 2 X Northern Foundry, New York	20.75	20.50	14.25
No. 2 Northern Foundry, Chicago	19.00	19.00	13.00
Bessemer, Pittsburgh	21.95	21.95	14.55
Basic, Pittsburgh	18.95	19.20	13.45
No. 2 X, Philadelphia	20.50	20.25	14.25
No. 2, Valley	18.50	18.50	12.75
No. 2, Southern Cincinnati	17.90	17.90	12.40
Basic, Eastern Pennsylvania	20.50	20.00	13.25
Gray forge, Pittsburgh	18.70	18.45	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger from jobbers' warehouse at the places named:

	New York				
	Apr. 28, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Steel angles, base	3.25	3.10	1.85	3.25	3.10
Steel T's, base	3.30	3.15	1.90	3.25	3.10
Machinery steel (bessemer)	3.25	3.10	1.80	3.25	3.10

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse at the places named:

	New York				
	Apr. 28, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
No. 28 black	3.65	3.50	2.60	3.20	3.20
No. 26 black	3.55	3.40	2.50	3.10	3.10
Nos. 22 and 24 black	3.50	3.35	2.45	3.05	3.05
Nos. 18 and 20 black	3.45	3.30	2.40	3.00	3.00
No. 16 blue annealed	4.45	4.30	2.35	3.70	3.60
No. 14 blue annealed	4.40	4.20	2.25	3.60	3.50
No. 12 blue annealed	4.30	4.15	2.20	3.50	3.45
No. 28 galvanized	5.65	5.65	4.00	5.50	5.50
No. 26 galvanized	5.35	5.35	3.75	5.20	5.20
No. 24 galvanized	5.20	5.20	3.55	5.05	5.05

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot for carload lots f.o.b. mill:

	Black		Galvanized	
	Apr. 28, 1916	One Yr. Ago	Apr. 28, 1916	One Yr. Ago
¾ to 2 in. steel butt welded	70%	80%	52½%	69½%
2½ to 6 in. steel lap welded	68%	79%	48½%	68½%
Diameter, In.				
¾	3.45	2.30	5.46	3.51
1	5.10	3.40	8.08	5.19
1¼	6.90	4.60	10.93	7.02
1½	8.25	5.50	13.06	8.39
2	11.10	7.40	17.58	11.29
2½	18.72	12.29	30.13	18.43
3	24.48	16.07	39.40	24.10
4	34.88	22.89	56.14	34.34
5	47.36	31.08	76.22	46.62
6	62.44	40.32	98.88	60.48

From New York stock the following discounts hold:

	Black	Galvanized
3½ to 6 in. steel lap welded	61%	36%
¾ to 3 in. steel butt welded	64%	42%

Malleable fittings, Class B and C, from New York stock sell at 30 and 5% from list price. Cast iron, standard sizes, 54%.

Bar Iron—Prices are as follows in cents per pound at the places named:

	Apr. 28, 1916	One Month Ago
Pittsburgh, mill	2.50	2.45
Warehouse, New York	3.15	3.10
Warehouse, Cleveland	3.25	3.25
Warehouse, Chicago	3.10	3.10

Bar Steel sells at $3.25 per 100 lb. from warehouse, New York.

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-size lots, the following quotations hold:

	Apr. 28, 1916	One Month Ago
New York	List price plus 20%	List price plus 10%
Cleveland	List price plus 20%	List price plus 20%
Chicago	List price plus 10%	List price

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York Today	New York One Year Ago		
$5.50	$3.75@4.00	Cleveland... $5.80	Chicago... $4.25

In coils an advance of 50c. is usually charged.

High Speed Tool Steel containing from 10 to 18% tungsten sells as follows per pound in New York:

Billets ....$2.35   Bars $3.00

METALS

Miscellaneous Metals—The present quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	New York		
	Apr. 28, 1916	One Month Ago	One Year Ago
Copper, electrolytic (carload lots)	*30.50	27.00	19.00
Tin	50.00	49.00	41.00
Lead	7.50	8.50	4.20
Spelter	18.12½	17.62½	14.00
ST. LOUIS			
Lead	7.37½	8.40	...
Spelter	18.00	17.50	...

*Quotations are nominal as follows: Delivery May and June, 30c.; July, 29½c.; August, 29c.; September, 28¾c.

At the places named, the following prices in cents per pound prevail:

	New York				
	Apr. 28, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Copper sheets, base	36.50	35.50	24.00	37.50	36.00
lots)	36.50	35.50	20.00	34.50	36.50
Brass rods, base	44.00	37.50	20.25	36.00	38.00
Brass pipe, base	44.50	41.50	21.00	43.00	46.00
Brass sheets	43.00	37.50	20.50	36.00	38.00
lots)	30.75	30.75	20.00	35.50	35.50

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York		Cleveland	
	Apr. 28, 1916	One Month Ago	Apr. 28, 1916	One Month Ago
Copper, heavy and crucible	25.00	23.00	25.00	22.00
Copper, heavy and wire	24.50	22.00	24.00	21.00
Copper, light and bottoms	22.00	19.00	24.00	18.00
Lead, heavy	6.00	6.00	7.00	6.50
Lead, tea	5.50	5.50	6.00	5.50
Brass, heavy	14.50	14.00	20.00	18.00
Brass, light	12.50	12.00	13.00	12.00
No. 1 yellow rod brass turnings	15.25	15.00	14.50	16.25
Zinc	13.00	13.00	16.00	14.50

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	31.50	32.00	32.50	33.00	36.00
¼ to 5/16	31.25	31.75	32.25	32.75	35.75
⅜ to 1⅞	31.00	31.50	32.00	32.50	35.50
1 15/16 to 2⅞	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3 7/16	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3½ to 3 15/16	32.25	32.75	33.25	35.75	36.75
Squares					
3 1/16 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4 15/16	33.00	33.50	36.00	36.50	37.50
5 to 6 15/16	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Antimony—Chinese and Japanese brands are quoted in cents per pound for spot delivery, duty paid:

	Apr. 28, 1916	One Month Ago
New York	39.00	45.00
Cleveland	50.00	50.00
Chicago	45.00	44.75

Copper Bars from warehouse sell as follows in cents per pound:

	Apr. 28, 1916	One Month Ago
New York	42.00	40.00
Cleveland	31.50	39.00
Chicago	....	38.00

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places named:

	New York	Cleveland	Chicago
Best grade	60.00@65.00	58.00	58.00@60.00
Commercial	30.00@35.00	22.00	25.00@30.00

Copper Sheets—In New York hot rolled 16 oz. (large lots) base per lb. is 36.50c.; cold rolled 14 oz. and heavier add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

SHOP SUPPLIES

Nuts—From warehouses at the places named, on fair sized orders the following amount is deducted from list:

	New York Apr. 28, 1916	New York One Month Ago	Cleveland Apr. 28, 1916	Cleveland One Month Ago	Chicago Apr. 28, 1916	Chicago One Month Ago
Hot pressed square	$2.50	$3.00	$3.25	$3.75	$3.25	$3.70
Hot pressed hexagon	2.50	3.20	3.50	3.75	3.25	3.80
Cold punched square	2.00	3.00	3.00	3.00	3.00	3.50
Cold punched hexagon	2.50	3.75	3.50	3.75	3.50	4.25

Semifinished nuts sell at the following discounts from list price:

New York... 50-10% Cleveland... 65-10% Chicago... 70%

Carriage Bolts—From warehouses at the places named the following discounts from list price are in effect:

	New York	Cleveland	Chicago
⅜ by 6 in.	45 and 5%	60 and 5%	60 and 5%
Larger and longer	35%	50 and 5%	50%

At this rate the net prices are as follows:

Length, In.	New York ¼	New York ½	New York ¾	Cleveland ¼	Cleveland ½	Cleveland ¾	Chicago ¼	Chicago ½	Chicago ¾
1½	$0.53	...	...	$0.38	...	...	$0.38	...	...
2	.58	...	...	.42	...	...	.42	...	...
2½	.53	$2.12	$5.53	.46	$1.64	$4.04	.46	$1.63	$4.25
3	.68	2.30	5.85	.50	1.67	4.28	.50	1.77	4.50
3½	.73	2.48	6.18	.54	1.81	4.52	.54	1.91	4.75

Machine Bolts—From warehouses at the places named the following discounts hold:

	New York	Cleveland	Chicago
⅜ by 4 in. and smaller	50%	65%	60 and 10%
Larger and longer up to 1 in. by 30 in.	40%	50 and 15%	50 and 10%

At this rate the net prices per 100 follow:

Length In.	New York ¼	New York ½	New York 1	Cleveland ¼	Cleveland ½	Cleveland 1	Chicago ¼	Chicago ⅝	Chicago 1
2	$0.89	$2.32	$9.60	$0.63	$1.64	$6.80	$0.64	$1.74	$7.20
2½	.93	2.48	10.14	.65	1.75	7.19	.67	1.85	7.60
3	.97	2.63	10.68	.68	1.87	7.57	.70	1.97	8.00
3½	1.01	2.79	11.22	.71	1.98	7.95	.73	2.08	8.40

Wrought Washers—From warehouses at the places named the following amount is deducted from list price:

New York.... $4.00 Cleveland.... $6.00 Chicago.... $6.30

At this rate, the net prices follows:

Diameter, In.	New York	Cleveland	Chicago
5/16	$10.00	$8.00	$7.70
¾	8.20	6.20	5.90
⅞	7.40	5.40	5.10
1	6.50	4.50	4.20
1¼	5.70	3.80	3.50
1⅜	5.20	3.40	3.10
1½	5.10	3.30	3.00
1¾	5.00	3.20	2.90
2, 2¼, 2½, 2¾	5.00	3.10	2.80
3, 3¼	5.00	3.00	2.70
3½, 3¾	5.20	3.00	2.90
4, 4¼, 4½	5.50	3.20	3.20

For cast-iron washers the base price per 100 lb. is as follows:

New York.... $2.50 Cleveland.... $2.00 Chicago.... $2.00

Rivets—The following quotations are allowed for fair sized orders from warehouse:

	New York	Cleveland	Chicago
Steel 7/16 and smaller	45%	60—10%	52½%
Tinned	45%	60—10%	52½%

Button heads ¾, ⅞, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.:

Ne wYork.... $5.25 Cleveland.... $3.60 Chicago.... $3.50

Cone heads, same sizes:

New York.... $5.35 Cleveland.... $3.70 Chicago.... $3.60

For the following sizes, the extras over the above prices in cents per 100 lb. are as follows:

1¼ to 1¾ in. long, all diameters	$0.25
⅝ in. diameter	0.15
½ in. diameter	0.50
1 in. long and shorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

Copper Rivets and Burs sell at the following rate for orders 100 lb. and over:

	Rivets	Burs
Cleveland	List price	List price
Chicago	List price	List price
New York	20% from list price	List price

Nails—Wire nails f.o.b. Pittsburgh sell at $2.40; galvanized, 1 in. and longer, $4.40, and shorter, $4.90. These prices are to regular customers and delivery is made at the mill's convenience. From warehouse wire and cut nails sell as follows:

	New York	Cleveland	Chicago
Wire	2.90	2.95	2.70
Cut	2.90	2.85	2.70

Bolt Ends—Fair-sized orders of bolt ends with hot-pressed nuts, from warehouses at the places named, sell at the following discount from list price:

New York.. 40% Cleveland.. 50—5% Chicago.. 50—10%

MISCELLANEOUS

Seamless Drawn Tubing—The base price in cents per pound from warehouse is as follows:

	New York	Cleveland	Chicago
Brass	42.50	45.50	42.00
Copper	45.00	44.50	43.00

For immediate stock shipment the following quotations hold:

Diameter, In.	Copper New York Apr. 28, 1916	Copper New York One Year Ago	Copper Cleveland	Brass New York Apr. 28, 1916	Brass New York One Year Ago	Brass Cleveland
¾ to 2½	48.00	45.50	44.50	45.50	43.50	45.50
3	48.00	45.50	44.50	45.50	43.50	45.50
3½	49.00	46.50	44.50	46.50	45.00	45.50
4	50.00	47.50	45.50	47.50	46.00	46.50
4½	52.00	49.50	47.50	49.50	48.00	48.50
5	54.00	51.50	49.50	51.50	50.00	50.50
6	55.00	52.50	51.50	52.50	51.00	52.50
7	57.00	54.50	51.50	54.50	53.00	52.00
8	59.00	56.50	55.50	56.50	55.10	56.50

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire

⅜, 11/32, 5/16, ¼, 7/32, 3/16	8.50
No. 8, 5/32 and No. 10	9.25
⅛	10.00
No. 12	11.00
3/32, No. 14 and 1/16	12.00
No. 18	14.00
No. 20	16.00

Special Welding Steel

⅛	33.00
5/32	30.00
3/16	28.00

Cast-Iron Welding Rods

¼ by 19 in. long	22.00
3/16 by 12 in. long	26.00
⅜ by 19 in. long	20.00
½ by 21 in. long	20.00

Vanadium Wire in Coils or Sticks

1/16	15.50
3/32	15.00
⅛	14.00
5/32	12.00
3/16 and larger	11.00

Tin Plates—The following prices are in effect from warehouses at the places named:

			New York Apr. 28, 1916	New York One Month Ago	Cleveland Apr. 28, 1916	Cleveland One Month Ago	Chicago Apr. 28, 1916	Chicago One Month Ago
Coke tin plate, 14x20:								
100 lb.			$6.00	$5.00	$5.40	$4.87½	$5.60	$4.75
I. C. 107 lb.			6.15	5.15	5.55	5.05	5.75	4.90
Terne plate, 20x28:								
Base Wgt.	Net Wgt.	Coat-ing						
100 lb.	200	8	$10.00	$9.00	$9.10	$8.60	$8.90	$8.30
I. C.	214	8	10.30	9.30	9.35	8.90	9.25	8.80
I. X.	270	8	12.30	11.30	11.60	11.10	11.40	10.55
I. C.	218	12	12.00	12.00	10.50	10.10	10.75	10.30
I. C.	221	15	13.00	13.00	10.50	10.90	11.60	11.25
I. C.	226	20	13.50	13.50	12.50	12.20	12.50	12.05
I. C.	231	25	14.25	14.25	13.50	13.40	13.75	13.30
I. C.	236	30	15.50	15.50	14.50	12.40	14.75	14.30
I. C.	241	35	17.00	17.00	15.75	15.60	15.85	15.25
I. C.	246	40	19.00	19.00	16.75	16.60	17.10	16.55

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Apr. 8	Apr. 15	Apr. 22	Apr. 29
Prompt furnace	$2.75@3.00	$2.75@3.00	$3.00	$2.25
Prompt foundry	3.75	3.75@4.00	3.75@4.00	3.75

Sponge Cloths (Wiping Towels) sell as follows per dozen: 16x18 in., 30c.; 18x20 in., 35c.; 18x22 in., 38c.

Cotton Waste—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	11.00@13.00	11.00@14.00	11.00@13.50
Colored mixed	8.00@10.00	7.50@11.00	8.00@10.50

Sal Soda sells as follows per 100 lb.:

New York.............. $1.90 Cleveland.............. $2.25 Chicago.............. $1.90

Roll Sulphur in 360-lb. bbl. sells as follows per 100 lb.

New York.... $2.25 Cleveland.... $2.75 Chicago.... $2.85

Foundry and Fire Clay in New York sells at $2 per lot of 300 lb. This does not include delivery charges.

Zinc Sheets—The following prices in cents per pound prevail:

Carload lots, f.o.b. mill................................ 25.00

	New York	Cleveland	Chicago
In casks	26.00	26.00	26.50
Broken lots	26.50	26.50	27.00

Linseed Oil—These prices are per gallon:

	New York	Cleveland	Chicago
Raw in barrels	$0.81	$0.80	$0.83
5-gal. cans	.91	.90	.91

Boiled, it is 1c. per gal. higher.

White and Red Lead, in cents per pound, sell as follows:

	Red Dry	Red In Oil	White Dry and In Oil
100-lb. keg	10.50	11.00	10.50
25- and 50-lb. kegs	10.75	11.25	10.75
12½-lb. keg	11.00	11.50	11.00
1- to 5-lb. cans	12.50	12.50	12.50

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

The contract has been awarded for the construction of a 1-story, 85x125-ft. garage for M. J. Gallagher, Arlington, Mass. Estimated cost, $19,000.

Plans are being prepared for the construction of a 1-story, 65x165-ft. garage for Arthur G. Jones, 568 Columbia Rd., Boston, Mass. Estimated cost, $35,000.

The contract has been awarded for the construction of an addition to the garage of the St. Joseph's Parochial School at Brighton, Boston, Mass. Estimated cost, $10,000.

William Johnson has purchased a site on Ashland St., North Adams, Mass., and plans to construct a foundry and machine shop.

The contract has been awarded for an addition to the foundry of the Davis & Furber Machine Co., North Andover, Mass.

A. J. Booth plans to construct a 1-story, 55x107-ft. addition to its garage on Richmond Ave., Worcester, Mass.

The contract has been awarded for the construction of an addition to the plant of the American Chain Co., Bridgeport, Conn.

The contract has been awarded for the construction of a factory for the American Graphophone Co., Bridgeport, Conn.

Plans are being prepared for the construction of a plant at Bridgeport, Conn., for the Canadian Car and Foundry Co.

The contract has been awarded for the construction of a 1-story, 50x150-ft. garage at New Haven, Conn., for the Beecher Realty Co., 831 Chapel St. Estimated cost, $20,000.

The contract has been awarded for the construction of an addition to the Winchester Ave. forge shop and for a new forge shop for the Winchester Repeating Arms Co., New Haven, Conn.

The contract has been awarded for the construction of a 1-story, 40x80-ft. garage for A. B. Collins, 569 Bank St., New London, Conn. Estimated cost, $15,000.

The Connecticut Brass Co. has awarded the contract for the construction of a 1-story, 38x140-ft. and 38x40-ft. addition to its plant at West Cheshire, Conn. Estimated cost, $10,000. Noted Apr. 13.

MIDDLE ATLANTIC STATES

The contract has been awarded for the construction of a 1-story manufacturing building at Colonie, N. Y., for the Ludlum Steel Spring Co.

The Buffalo Bolt Co., Ironton, N. Y., plans to construct an addition to its plant.

A 2-story factory is being constructed at Stewart Ave. and Harrison Pl., New York, N. Y. (Borough of Brooklyn), by the Peelle Co., manufacturer of fire doors and elevator safety appliances.

The Rochester Stamping Co., manufacturer of tinware, Rochester, N. Y., is building an addition to its plant on Rochester Ave.

The contract has been awarded for the construction of a 1-story factory addition for the Syracuse Chilled Die and Casting Co., 209 Sunset Ave., Syracuse, N. Y.

The contract will soon be awarded for the construction of an addition to the turbine building of the Kerr Turbine Co., Wellsville, N. Y., manufacturer of machinery.

Plans are being prepared by Carl I. Goldberg, Arch., 437 Broadway, Bayonne, N. J., for a 3-story garage for Cohen & Grimsky, Bayonne. Estimated cost, $15,000.

The Pathe Freres Phonograph Co., Belleville, N. J., will build an addition to its plant.

The Canadian Car and Foundry Co. plans to construct several additions to its plant at Kingsland, N. J.

John F. Schrink & Son, Newark, N. J., manufacturer of jewelry, will build a 3-story addition to its plant on Emmet St.

Thomas A. Edison, Inc., Silver Lake, N. J., plans to construct an addition to its storage-battery plant.

Plans have been prepared for an addition to the Brock Garage, Trenton, N. J.

The contract has been awarded for the construction of a service building on South Cameron St. near Mulberry St., Harrisburg, Penn., for the Keystone Motor Car Co., 10th and Market St., Harrisburg.

Press reports state that the Clarke Can Co., manufacturer of druggists tinware, 1012 Passyunk Ave., Philadelphia, Penn., plans to enlarge its plant and install new machinery.

The Gomery-Schwarz Motor Car Co., Philadelphia, Penn., is having plans prepared by Charles E. Oelschlager, Arch., Philadelphia, for a 10-story building at Broad and Cherry St.

The Arsenal Garage Co., Pittsburgh, Penn., will build a 2-story garage and machine shop. Estimated cost, $15,490. J. J. Schill is Pres.

The contract has been awarded for an addition to the plant of the Carpenter Steel Co., Reading, Penn. Estimated cost, $50,000. Noted Mar. 9.

The Klauden-Welson Dyeing Machine Co., Amsterdam, N. Y., is establishing a new plant for the manufacture of special dyeing machinery at Yardley, Penn.

The Delaware Motor Sales Co., Wilmington, Del., is having revised plans prepared by L. W. Crawford, Arch., Odd Fellows Bldg., for a 2-story auto service station.

J. W. Lee, 322 Pennsylvania Ave., N. W., Washington, D. C., plans to construct a 2-story garage. Estimated cost, $10,000.

SOUTHERN STATES

The Pulaski Foundry and Machine Co., Pulaski, Va., recently incorporated will construct a foundry and machine shop.

The Wheeling Mold and Foundry Co., Wheeling, W. Va., plans to enlarge its plant in the east end.

The Seaboard Air Line Ry., Atlanta, Ga., has awarded the contract for improving its shops and yards at Howell, Ga. W. D. Faucette, Norfolk, Va., is Ch. Engr. Noted Apr. 27.

The Memphis Overland Co., Memphis, Tenn., plans to construct a garage and service building. Estimated cost, $40,000. G. M. Shaw & Co., Memphis, Arch.

The National Foundry and Machine Co., Louisville, Ky., will build a factory at 1408 West Main St.

MIDDLE WEST

Work will soon be started on the construction of a 2-story factory at Bellefontaine, Ohio, for Allie J. Miller, manufacturer of automobile bodies.

The contract has been awarded for the construction of a 5-story, 50x80-ft. factory at Cincinnati, Ohio, for the American Diamalt Co. Estimated cost, $25,000. Noted Mar. 23.

The Barrett Manufacturing Co., manufacturer of roofing materials, Illuminating Bldg., Cleveland, Ohio, has awarded the contract for the construction of a 2-story addition to its plant at Willey and Walworth Ave., Cleveland. Noted Jan. 27.

The Gravity Carburetor Co. has purchased a site at East 37th and Perkins St., Cleveland, Ohio, and plans to construct a factory.

The Ferry Cap and Screw Co. will construct an addition to its plant at 2147 Scranton Rd., Cleveland, Ohio. Estimated cost, $4,000.

The contract has been awarded for the construction of a reinforced-concrete factory at East 49th St. and Superior Ave., Cleveland, Ohio, for the National Telephone Supply Co. Estimated cost, $50,000.

The S. F. K. Steel Barrel Co., 7930 Jones Rd., Cleveland, Ohio, will build a 2-story, 64x96-ft. factory at Cleveland.

The Standard Oil Co. will construct a garage at 3041 Broadway, Cleveland, Ohio.

Fire, Apr. 24, damaged the factory of the U. S. Cast Iron Pipe Co. on West Goodale Ave., Columbus, Ohio. Loss, $1,000.

Work will soon be started on the construction of a 4-story, 64x384-ft. factory at the Miami Chapel Rd. and the Cleveland, Cincinnati, Chicago & St. Louis Ry., Edgemont, Ohio, Cincinnati post office, for the Dayton Body Co.

The contract has been awarded for the construction of a 1-story, 114x200-ft. addition to the plant of the Elmwood Castings Co., Tennessee Ave., Elmwood, Ohio, Cincinnati post office. Noted Dec. 9.

Work will soon be started on the construction of a plant at Girard, Ohio, for the Carnegie Steel Co., Youngstown. Thomas McDonald is Dist. Supt. Noted Dec. 23.

Plans are being prepared for the construction of a 3-story, 50x200-ft. garage for J. H. Blattenberg, M. D., 128 South Union St., Lima, Ohio. Estimated cost, $25,000.

The contract has been awarded for the construction of a garage at Lima, Ohio, for E. G. Leist, Kempton. Estimated cost, $15,000.

Fire recently destroyed the foundry of the Buckeye Foundry Co. at Overpeck, Ohio. Loss, $25,000.

Bids will soon be received for the construction of a 2-story, 60x130-ft. garage for C. N. Harvey, Main and 2d St., Zanesville, Ohio. Estimated cost, $18,000. Noted Nov. 11 and Apr. 20.

The contract has been awarded for the construction of a 2-story, 50x150-ft. garage at Garrett, Ind., for D. S. Johnson & Son. Estimated cost, $10,000. Noted Mar. 16.

The contract has been awarded for the construction of an addition to the plant of the United States Slicing Machine Co. on Larson St., La Porte, Ind.

The Maxwell Newcastle Manufacturing Co., manufacturer of automobile parts, will build an addition to its plant at Newcastle, Ind.

The Rich Twist Drill Co., Chicago, Ill., plans to construct a factory at Battle Creek, Mich. Estimated cost, $45,000

The Saranac Machine Works plans to construct an addition to its plant at Benton Harbor, Mich.

The Crescent Brass and Pin Co., 1150 Trumbull Ave., Detroit, Mich., plans to construct an addition to its plant at Detroit.

The Detroit Vapor Stove Co., 407 Franklin St., Detroit, Mich., has awarded the contract for the construction of a 2-story, 72x700-ft. factory at Detroit. Noted Mar. 23.

Plans have been prepared for the construction of a 2-story, 50x200-ft. factory at Grand Rapids, Mich., for the Grand Rapids Blow Pipe and Dust Arrester Co. Noted Apr. 27.

The Homer Furnace Co. is constructing an addition to its foundry at Homer, Mich. Noted Jan. 6.

The Lane Motor Truck Co. is constructing a factory at Kalamazoo, Mich. M. H. Lane is interested. Noted Mar. 23.

F. B. Hubbell will rebuild the roller mills at Milford, Mich., recently destroyed by fire.

The contract has been awarded for the construction of a 1-story, 168x272-ft. plant at Argo, Ill., for the Elgin Motor Car Corporation. Estimated cost, $50,000. Noted Mar. 9.

The Christopher Motor Co., 2310 Sheffield Ave., Chicago, Ill., has awarded the contract for the construction of a 50x100-ft. addition to its plant at Chicago. Estimated cost, $20,000.

The Continental Bolt and Iron Co. will construct an addition to its plant at 2235 West 43d St., Chicago, Ill.

Robert M. Fair has awarded the contract for the construction of a 3-story, 80x180-ft. auto service station at Chicago, Ill. Estimated cost, $100,000.

The Gage Structural Steel Co. has awarded the contract for the construction of a 1- and 2-story factory at 3125 Hoyne Ave., Chicago, Ill. Estimated cost, $20,000.

The Lasker Iron Works, 2830 South Ashland Ave., Chicago, Ill., plans to construct a factory at 3201 South Lincoln St., Chicago. Estimated cost, $25,000.

The North Shore Fireproof Storage Co. will build a repair shop and garage at Chicago, Ill.

F. W. Williams, 2525 West Taylor St., Chicago, Ill., will construct a 3-story brick factory at Chicago for the manufacture of metal specialties. Estimated cost, $15,000.

The Holt Manufacturing Co., manufacturer of traction engines, contemplates constructing a 110x180-ft. addition to its plant at Peoria, Ill.

Plans are being prepared for the construction of a plant at Peoria, Ill., for the Keystone Steel and Wire Co. Estimated cost, $1,750,000.

The Bradford Supply Co. plans to construct a machine shop at Robinson, Ill.

The P. B. Yates Machine Co., formerly the Berlin Machine Works, has awarded the contract for the construction of a two-story, 265x283-ft. machine shop at Beloit, Wis. Noted Jan. 27 and Feb. 3.

The contract ahs been awarded for the construction of a garage at Merton, Wis., for the Merton Dairy Products Co. Noted Apr. 27.

The contract has been awarded for the construction of a garage and repair shop for the Magnetic Realty Co. at 525 Jefferson St., Milwaukee, Wis. Estimated cost, $25,000.

WEST OF THE MISSISSIPPI

The Russell Grader Manufacturing Co., Minneapolis, Minn., manufacturer of road machinery, is having plans prepared for an addition to its plant.

The Northwestern Shot and Lead Co., 90 Fairfield Ave., St. Paul, Minn., plans to construct an addition to its plant. Estimated cost, $15,000.

The contract has been awarded for an addition to the car-repair shops of the Atchison, Topeka & Santa Fé Ry. at Argentine, Kan. Estimated cost, $31,100. Noted Nov. 18.

The contract has been awarded for the construction of an addition to the plant of the Montana Auto Supply Co., Dillon, Mont.

A plant for the manufacture of automatic automobile signaling devices will be equipped at Kansas City, Mo., by the Signalite Manufacturing Co., recently incorporated. W. M. Farr is interested.

C. F. Sands, Kirksville, Mo., has awarded the contract for a 2-story garage. Estimated cost, $15,000. Noted Apr. 6.

The St. Louis, Iron Mountain and Southern Ry. plans to construct a repair shop and engine house at Texarkana, Ark. E. A. Hadley, St. Louis, Mo., Ch. Engr.

The Midland Valley Railroad Co. has awarded the contract for the reconstruction of its machine shops at Muskogee, Okla. Estimated cost, $160,000. Noted Feb. 24 and Mar. 2.

WESTERN STATES

The Rosalia Auto Co. plans to construct an addition to its garage and machine shop at Rosalia, Wash.

The Oregon City Iron Works plans to improve its plant at Portland, Ore. Estimated cost, $10,000.

The Standard Gas Engine Co., 1 California St., San Francisco, Calif., plans to enlarge its plant at Oakland, Calif. Estimated cost, $200,000.

A. A. Gamble plans to construct an addition to its garage and machine shop on 7th St., Riverside, Calif. Estimated cost, $10,000.

The Joseph D. Bell Co., recently incorporated, plans to construct a factory at 264 7th St., San Francisco, Calif., for the manufacture of wall beds.

The Smith Aviation Co., Los Angeles, Calif., contemplates constructing an aëroplane manufacturing plant at Venice, Calif.

CANADA

Fire recently damaged the plant of the Smith Foundry Co. at Fredericton, N. B. Loss, $5,000.

T. McAvity & Sons plan to construct an iron and brass foundry on Marsh St., St. John, N. B.

The Calumet Zinc and Metal Co. will rebuild the section of its plant at Bryson, Que., recently destroyed by fire.

An addition will be built to the plant of the Canada Stove Co., Montreal, Que.

O. H. & N. A. Timmins, 4 Park Crescent, Westmount, Que., will construct a garage at Westmount. Estimated cost, $10,500.

A factory for the manufacture of vacuum cleaners, washers, etc., will be constructed by the Onward Manufacturing Co., Berlin, Ont. T. A. Witzel is Prop.

Plans are being prepared for the construction of an addition to the factory of the Perfect Machinery Co. at Galt, Ont. Estimated cost, $20,000. S. L. Clarke is Mgr.

W. Ellis has taken over the Maple Leaf Auto and Garage Supply Co., manufacturer of metal specialties, machinery, tools, etc., and will build a plant on Barton St., Hamilton, Ont.

The contract has been awarded for the construction of a factory at Niagara Falls, Ont., for the Dominion Safe and Vault Co., Farnham, Que. Estimated cost, $7,000.

The Chalmers Motor Co. contemplates the construction of an addition to its plant at Saskatoon, Sask. Estimated cost, $500,000.

The Saskatchewan Bridge and Iron Works, Medicine Hat, Alta., is building a plant at Medicine Hat.

An addition will be built to the plant of the Begg Motor Co., 1062 Georgia St., W., Vancouver, B. C. Estimated cost, $15,000.

GENERAL MANUFACTURING

NEW ENGLAND STATES

Fire, Apr. 21, destroyed the factories of the Canonchet Line and Twine Co. and the Union Line and Twine Co. at Canonchet, R. I. Loss, $50,000.

MIDDLE ATLANTIC STATES

The Glove Woven Belting Co., Buffalo, N. Y., plans to construct a 1-story factory at 1420 Elmwood Ave. Estimated cost, $10,000.

The Clayville Knitting Co., Clayville, N. Y., has awarded the contract for the enlargement of its plant. Estimated cost, $200,000. Noted Apr. 20.

The contract has been awarded for the construction of a new plant on Plum Point Lane, Newark, N. J., for John Campbell & Co., New York, N. Y., manufacturer of chemicals. Estimated cost, $35,000.

The Radel Leather Manufacturing Co. plans to construct an addition to its plant on Hamburg Place Rd., Newark, N. J.

Plans are being prepared by Moses, Pope & Messer, Arch., 366 5th Ave., New York, N. Y., for a plant at Newark, N. J., for the Stillwell Chemical Co., 2 Rector St., New York.

The contract has been awarded for the construction of a 4-story silk mill on Straight St., Paterson, N. J., for Dunlop Bros., 254 4th Ave., New York, N. Y. Estimated cost, $110,000. Noted Mar. 16.

The contract has been awarded for the construction of a 3-story factory on Union Ave., Paterson, N. J., for Harris Bros. Silk Co., 25 Manchester Ave., Paterson. Estimated cost, $20,000. Noted Apr. 6.

The Folding Partition Co., 200 Broadway, New York, N. Y., has acquired a site on Market St., Perth Amboy, N. J., and will establish a plant for the manufacture of its patented section-fold partitions.

The contract has been awarded for an addition to the plant of the Star Porcelain Co., Muirheid Ave., Trenton, N. J. Noted Jan. 13.

Plans are being prepared by Moses, Pope & Messer, Arch., 866 5th Ave., New York, N. Y., for an addition to the plant of the American Analine Chemical Co., West Nutley, N. J. (Newark post office). Estimated cost, $25,000.

The contract has been awarded for the construction of a chemical factory for the General Manufacturing Co., 30th and Market St., Philadelphia, Penn. Estimated cost, $10,000.

The contract has been awarded for the construction of a box factory for George W. Kugler Sons Co., 921 Market St., Philadelphia, Penn.

The contract has been awarded for the construction of a 2-story factory at 37th and Tasker St., Philadelphia, Penn., for the Nitrogenous Chemical Manufacturing Co. Noted Apr. 20.

The Security Silk Co., Morris Run, Penn., has awarded the contract for the construction of a silk mill. Noted Mar. 23.

Fire recently destroyed the Heidelberg plant of the Aetna Chemical Co., near Pittsburgh, Penn. Loss, $50,000.

The Standard Box Co., Reading, Penn., has awarded the contract for the construction of a box factory.

The Rich Woolen Mills, Woolrich, Penn., is having plans prepared for an addition to its plant.

SOUTHERN STATES

The Richmond Leather Co., 22d and Carey St., Richmond, Va., plans to construct a 2-story factory. Estimated cost, $16,200.

The Ideal Paper Box Co., Parkersburg, W. Va., plans to construct a plant.

The J and D Tire and Rubber Co., Charlotte, N. C., plans to construct a 2-story factory. Herbert O. Smith, Indianapolis, Ind., is Pres.

C. B. Armstrong will build a mill at Gastonia, N. C., for the manufacture of cotton yarns.

The National Dye and Munitions Co., New York, N. Y., has awarded the contract for the construction of a plant at Sanford, N. C. Estimated cost, $10,000,000.

The N. P. Josey Guano Co., Scotland Neck, N. C., will rebuild its fertilizer plant recently destroyed by fire. Estimated cost, $50,000.

The Buffalo Shoals Clay Manufacturing Co., Statesville, N. C., recently incorporated, plans to construct a factory.

The Wendell Knitting Mills, Wendell, N. C., plans to enlarge its plant.

The Huntley Furniture Co., Winston-Salem, N. C., has awarded the contract for a 4-story addition to its plant. Noted Apr. 6.

The Middleton Warehouse and Compress Co. plans to construct a compress at Charleston, S. C. Charles F. Middleton is Pres.

The Titus Clay Products Co., Columbia, S. C., plans to enlarge its plant.

The Southland Knitting Mills, Macon, Ga., is building a 40x100-ft. addition to its plant.

The contract has been awarded for the construction of a compress at Savannah, Ga., for the Savannah Warehouse and Compress Co.

The contract has been awarded for the construction of a knitting mill at Attalla, Ala., for W. B. Davis, Co., Chattanooga, Tenn. Estimated cost, $10,000. Noted Apr. 13.

The Opelika Cotton Mills, Birmingham, Ala., plans to enlarge its plant.

Fire recently destroyed the cotton compress of the Sheffield Cotton Co., Sheffield, Ala. Loss, $125,000.

The Lane Cotton Mills Co., New Orleans, La., plans to construct an addition to its plant.

The Chattanooga Aseptic Cotton Co., Chattanooga, Tenn., has awarded the contract for the construction of a new plant. Noted Apr. 6.

The Davis Hosiery Mills, Chattanooga, Tenn., has awarded the contract for the construction of a factory at Bristol, Tenn.

The 638 Tire and Vulcanizing Co., Memphis, Tenn., plans to construct a service station. Estimated cost, $35,000. G. M. Shaw & Co., Memphis, Arch.

The John J. Delker Carriage Co., Henderson, Ky., is building a new plant.

The Adler Manufacturing Co., Louisville, Ky., manufacturer of pianos and organs, will build an addition to its factory. Estimated cost, $15,000.

Plans being considered by the Louisville Chemical Co., 108 South 3d St., Louisville, Ky., for the enlargement of its plant.

The East London, Ky., handle factory of the Turner, Day & Woolworth Co., Louisville, Ky., recently destroyed by fire with a loss of $3,000, will be rebuilt. L. B. Murphy, East London, is Mgr.

Plans have been prepared by D. H. Jamieson, Arch., for a new plant for the Paducah Hosiery Mills, Paducah, Ky. Noted Apr. 27.

MIDDLE WEST

The Akron Airless Tire Co. will construct a plant at Akron, Ohio. Estimated cost, $150,000.

The Icy-Hot Bottle Co., 120 West 2nd St., Cincinnati, Ohio, plans to enlarge its factory at Cincinnati.

The Sayers & Scoville Co., 2247 Colerain Ave., Cincinnati, Ohio, will rebuild its carriage factory at Cincinnati, recently destroyed by fire with a loss of $200,000.

Plans are being prepared for the construction of a cold-storage plant at Lorain, Ohio, for the Amherst Supply Co.

Plans have been prepared for the construction of a 2-story, 60x150-ft. factory on Barnhart St., Marion, Ohio, for the Marion Tire and Rubber Co. Estimated cost, $15,000. Noted Apr. 6.

The Toledo Bottle Co., recently incorporated, plans to construct a plant at Toledo, Ohio. Frank O'Neill is Pres.

Plans are being prepared for the construction of a 1- and 2-story plant at Terre Haute, Ind., for the Grasselli Chemical Co. Estimated cost, $200,000. W. T. Cashman, 980 The Arcade, Cleveland, Ohio, is Asst. Secy. Noted Apr. 13.

Plans are being prepared for the construction of a gravel washing plant at West Terre Haute, Ind., for the Vandalia R.R. Co. Estimated cost, $35,000. F. T. Hatch, Syndicate Bldg., St. Louis, Mo., Ch. Engr.

The Champion Ignition Co. has awarded the contract for the construction of an addition to its plant at Flint, Mich. Noted Apr. 13.

The Pennsylvania Salt Manufacturing Co. plans to rebuild its plant at Wyandotte, Mich., which was recently destroyed by fire with a loss of $200,000.

The Fulton Saw Works, 52nd Ave. and 22nd St., Chicago, Ill., has awarded the contract for the construction of a 1- and 2-story factory at Chicago. Noted Apr. 13.

The I. Horween & Co. will construct an addition to its plant at 1051 West Division St., Chicago, Ill. Estimated cost, $20,000.

The Inter-Lake Pulp and Paper Co. contemplates constructing a 4- or 5-story mill at Appleton, Wis. W. A. Fannon is Mgr.

Plans are being prepared by Henry Auler, Arch., for the construction of a 2-story, 66x70-ft. factory at Berlin, Wis., for the Berlin Fabric Manufacturing Co. Estimated cost, $18,000.

WEST OF THE MISSISSIPPI

The Perfection Tire and Motor Co., Ft. Madison, Iowa, will erect a new plant for the manufacture of automobile tires. Estimated cost, $300,000.

The Goodyear Tire Co., Red Wing, Minn., plans to construct a factory.

W have been informed that the Ohio Oil Co., Findlay, Ohio, does not plan to construct an oil refinery at Greybull, Wyo., as stated in our issue of Apr. 20.

The Corsicana Cotton Mills, Corsicana, Tex., has awarded the contract for a 2-story addition to its plant. Estimated cost, $100,000. Noted Mar. 23.

The Farmer's Gin Co., Gonzales, Tex., will construct a cotton gin. Estimated cost, $15,000. D. Stahl, interested.

The Texas Refining Co. will construct a cotton seed oil mill at San Antonio, Tex.

The Seguin Compress Co., Seguin, Tex., will build a cotton gin. Estimated cost, $25,000.

Fire recently destroyed the plant of the Interstate Compress Co., Hobart, Okla.

According to press reports the Kingston Cotton and Oil Co., Kingston, Okla., plans to establish a cold press mill, 3 cotton gins and a boiler plant at Kingston. C. C. Chestnut, Pres. and Mgr.

J. R. Pruett, Mannsville, Okla., plans to establish a canning plant.

The Southwestern Tire Manufacturing Co. recently incorporated, Colcord Bldg., Oklahoma, Okla., plans to construct a factory. Estimated cost, $200,000. J. L. McClelland is Pres.

H. P. Anderson and associates, Tulsa, Okla., plan to construct a cold-storage plant at Tulsa. Estimated cost, $300,000.

The Enterprise Window Glass Co., Tulsa, Okla., plans to construct a plant at Mexia, Tex., for the manufacture of window glass.

A plant for the manufacture of horse collars and harness will be equipped at Woodward, Okla., by the Woodward Manufacturing Co., recently incorporated. J. E. Milby and J. D. Gray are interested.

WESTERN STATES

Press reports state that the Union Knitting Mills Co. is constructing a mill at Logan, Utah. Estimated cost, $40,000.

The Utah Canning Co. will build an addition to its plant at 29th St. and Pacific Ave., Ogden, Utah.

The E. E. Samson & Co. plans to construct a cold storage plant at North Yakima, Wash.

The Western Meat Co. plans to construct an addition to its cold-storage plant at Fresno, Calif. Estimated cost, $7,500.

The contract has been awarded for the construction of a 1-story box factory for the American Can Co., Mills Bldg., San Francisco, Calif.

CANADA

The Skedden Brush Co., 130 King St., N., Hamilton, Ont., will construct an addition to its factory at Hamilton. Estimated cost, $5,000.

Plans have been prepared for an addition to the plant of the Perfection Tire and Motor Manufacturing Co. of Ft. Madison, Iowa, at Niagara Falls, Ont. Estimated cost, $300,000.

The Simcoe Shoe Co. will construct a factory at Simcoe, Ont. Estimated cost, $15,000.

Bids are being received for the construction of a factory at Toronto, Ont., for A. R. Clarke & Co., 633 Eastern Ave., manufacturer of leather goods.

The York Knitting Mills Co., 993 Queen St., W., Toronto, Ont., is building an addition to its factory at Queen and Shaw St. Estimated cost, $70,000. Noted Apr. 6.

Classified Advertising

The Classified Advertising section appears on pages 245, 246, 247, of this issue and will in future appear in the same relative position in the paper.

American Machinist

Volume 44, No. 19
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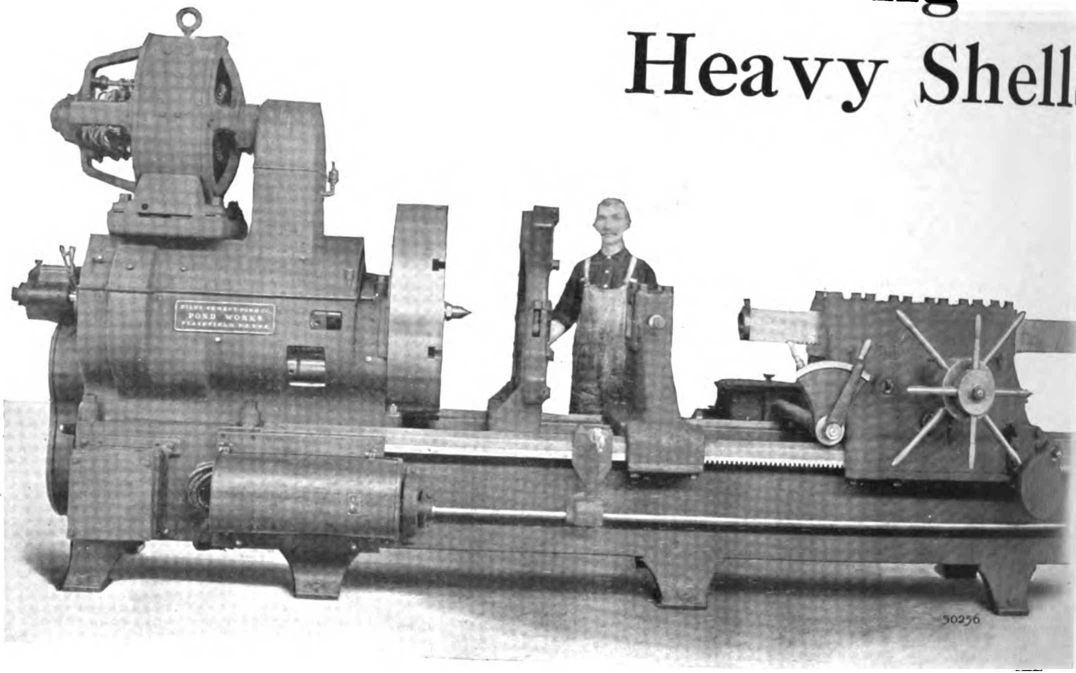
NEW YORK, MAY 11, 1916

Price, 15 Cents
Contents, First Page
Advertising Index, Last Page

Prompt Delivery

Lathes For Boring

Heavy Shells



36-In. Heavy Lathe with boring tailstock.

All Steel Gears

Lathes are equipped throughout with steel gears and are driven by 20-hp. motors. Rear end of spindle is provided with a special thrust bearing of heavy construction to take the end thrust due to boring large holes.

Boring Tailstock

The boring ram is forged steel 6-in. square, and has a very long bearing in the tailstock. The ram feed is driven from the feed shaft, at the rear of the bed, through worm and worm wheel giving a smooth motion for boring. By means of two levers four feeds can be obtained without changing any gears. These levers are attached to the tail stock and hence are always in a convenient position.

Supports for Work and Boring Ram

A steady rest is provided to support the shell or other work. There is also furnished a special rest to support the end of the boring ram. This rest moves along the bed with the ram as it feeds.

Specifications, Delivery, Prices, etc., Promptly Furnished on Request.

Niles-Bement-Pond Co.,

111 Broadway, New York City
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American Machinist

L. P. ALFORD, *Editor*

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VOLUME 44 — MAY 11, 1916 — NUMBER 19

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WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormsy processes, protected by United States patents issued June 22, 1915, and Apr. 18, 1916.

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This includes the English Edition. None sent free regularly, no returns from news companies, no back numbers.

What the Engineers are Doing

THIRTY thousand American engineers are making a card index survey of American industry so that it may be prepared for its vital part in defending the country, if need comes. The past eighteen months have taught us here in America what lack of industrial preparedness has meant to some of the countries now at war. These nations had the ships and they had the men; but when the hour struck, their factories were not able to furnish the colors with arms and shells and powder. Their factories were not prepared. And our factories are not prepared.

But it is not enough to draw a moral. In the United States five great Engineering Societies—Civil, Mining, Mechanical, Electrical and Chemical—have pledged their services to the Government of the United States, and are already working hand in hand with the Government to prepare industry for the national defense. They receive no pay and will accept no pay. All they seek is opportunity to serve their country, that she may have her industries mobilized for defense.

All elements of the nation's life—the manufacturers, the business men, and the workingmen—should support this patriotic and democratic work of the engineers, and assist them cheerfully when asked. *There can be no better national insurance against war.*

The Associated Advertising Clubs of the World, representing all advertising interests, have offered their free and hearty service to the President of the United States, in close co-operation with these five Engineering Societies, to the end that the country may know what the engineers are doing. The President has accepted the offer. The engineers have welcomed the co-operation.

This advertisement, published without cost to the United States, is the first in a nation-wide series to call the country to the duty of co-operating promptly and fully with the engineers.

NAVAL CONSULTING BOARD OF THE UNITED STATES

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ENGINEERING SOCIETIES BUILDING — 29 WEST 39th STREET, NEW YORK

Building Single-Purpose Lathes in a Single-Purpose Shop

By Ethan Viall

SYNOPSIS—The building and machine-construction methods outlined in this article constitute an unusually remarkable series of engineering achievements. The machines were made to produce shells and the plant to produce machines. A notable feature is that the building is long and narrow, the work moving across it and not lengthwise, as usual. The machines are so designed as to eliminate all the machine work possible, there being absolutely none on the main-frame casting. The comparatively few machined parts are made in quantities, all interchangeable, and then assembled with a speed that is almost incredible.

The first great demand for shell machinery and tools was for the smaller sizes. Established makers eliminated the manufacture of all machines except those which were in immediate demand and could be most easily produced. Special or single-purpose machines were designed as rapidly as possible or were improvised by leaving off the nonessentials from regular models. The average shop, however, was not fitted to produce machinery capable of machining the larger sizes of shells. Probably less than a half-dozen shops in this country had sufficient room and production machines for large work. As a consequence practically everyone concerned concentrated on machines for producing shells under 4.5 in. The demand for larger shells steadily increased, but proper machinery could not be obtained. This condition led to the formation of the Amalgamated Machinery Corporation, of Chicago.

Ignoring the overcrowded small-shell field, its efforts were directed entirely to the construction of machines for making the largest sizes of shrapnel and high-explosive shells. Shells demand accuracy. The demand for large shells was urgent. It naturally follows that machines to do the work required must be made right and be made quickly. That these conditions were successfully met will be apparent from this article.

It must be remembered, however, that market conditions were extraordinary. Otherwise, it is extremely doubtful whether anything so radically different from existing types would have been given anything like a fair trial. The fact that shell-making plants having huge batteries of these machines are constantly reordering more is proof enough of their accuracy, durability and success for the purpose for which they were designed. The machines themselves have previously been described in these columns, so this article will be mainly confined to a description of the construction, or assembling and handling, methods. However, a brief review of the main features will be given in order that the reader may follow clearly.

Someone has said that the history of machine design always shows three stages of progression—first, crude directness; second, unnecessary complexity; and third, finished simplicity. Maudsley's first lathes are said to have had triangular bars for ways, the design of course being adopted for the sake of expediency. Planers were made a number of years later, and the triangular bar in subsequent lathes was cast directly on the bed, as it could be machined to a finish where the first bars had to be hammered, chipped and filed. Started in this manner, tradition and the dislike of change have continued the triangular form of ways to this day. Any radical departure from such accepted practice would have been a losing venture at a time unfavorable to its introduction, though it is extremely probable that if Maudsley could have obtained stiff, hard, accurate bars of round stock,

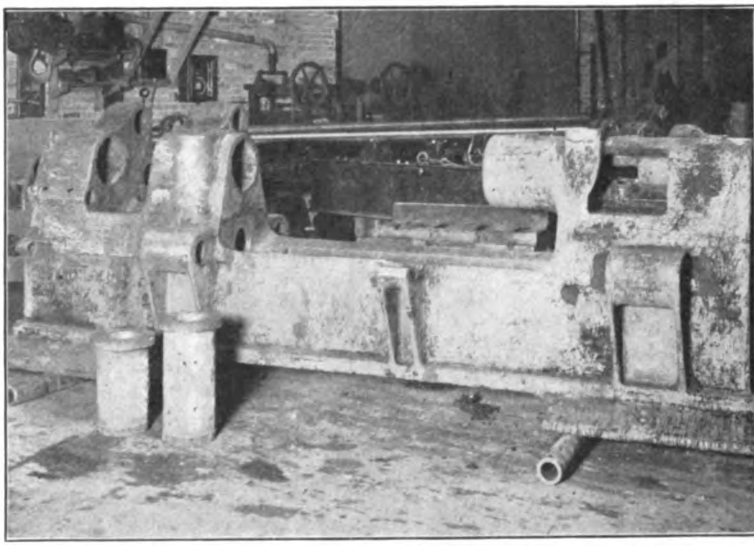


FIG. 1. FRAME CASTING AS IT APPEARS AFTER COMING FROM THE FOUNDRY

FIG. 2. METHOD OF PUTTING IN THE BUSHINGS

he would have used them in preference to the triangular ones.

In making the Amalgamated ammunition machinery the designers broke entirely away from traditional practice, unhampered by the necessity of making something adapted to manufacture with any existing equipment in any existing shop. The essentials insisted upon were that the machines should be strong, rigid, durable, capable of operation with ordinary labor, very accurate where accuracy is necessary, conveniently handled, capable of machining shells with as little tool expense and as great exactness as any other machines and with as high a rate of production. In addition, the design was to permit the use of such materials of construction as were readily obtainable in quantities sufficient for all reasonable requirements and to provide for deliveries in time and quantity that had been unheard of previously. One of the claims for the type of machine produced is: "A machine . . . having a plurality of bearing bushings, castings having recesses in which said bushings are mounted, the bushings being held in said recesses by fusible metal surrounding the bushings, and certain of the bushings forming bearings for the working parts of the machine." Such construction makes possible the use of round-steel guide ways in a manner that insures perfect alignment and at the same time requires the least possible time in the factory and the least floor space for assembly.

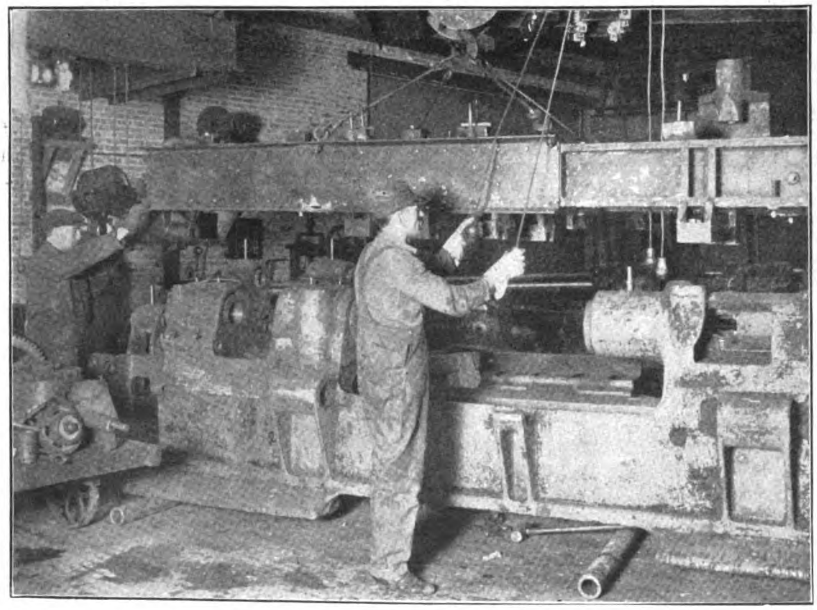


FIG. 3. LOWERING THE JIG INTO POSITION

The first machine designed along these lines was a turning lathe, with headstocks and tailstocks cast integral with the bed. It has a swing over the ways of 27½ in. and over the carriage of 13 in. It covers a floor space 4x17 ft. and weighs about 18,000 lb. This machine was made complete and tested out in 28 days from the time the drawings were started! I recently saw this same machine take a demonstrating cut on a regular 9.2-in. steel shell at 28 r.p.m., producing a chip ⅞ in. wide and ⅛ in. thick. Not the least sign of chatter or stalling developed, though no tools will stand up under such a terrific strain for any length of time. Such a cut, of course, has no place in shell-making practice, but shows conclusively the great power of the machine.

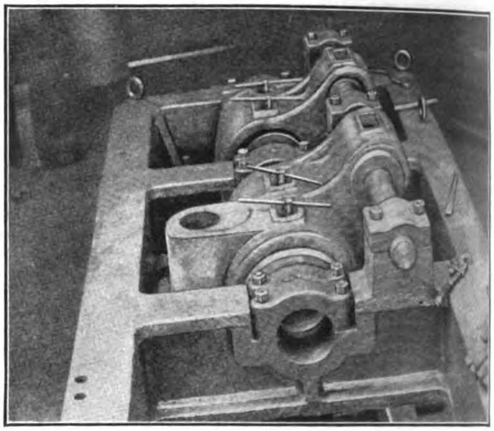


FIG. 4. VIEW OF HEADSTOCK FROM ABOVE WITH JIG IN POSITION

Though a number of sizes and models of machines are made for all kinds of shell work from 4.5 in. up, the general principle of construction is the same in all. Absolutely no machine work of any kind is done on the main frames, which go direct from the foundry to the assembling floor. For this reason examples of the assembling steps for one model will be sufficient to give a good idea of how all are constructed, though a few of another model will be used to illustrate something special. The frame of a No. 21 machine, just as it comes from the foundry, is shown in Fig. 1. On the floor in front are two bearing bushings. This type of babbitt-lined cast-iron bushing is used for all rotating shafts. The bushings are cored with dovetail grooves on the inside to anchor the babbitt, and the babbitting work is done by the National Lead Co. Every precaution is taken to obtain the best results. It is well known that each remelting of a babbitt mixture injures it, so these linings are poured direct from the original mix, which contains 85 per cent. tin, 7½ per cent. copper and 7½ per cent. antimony. About 140 lb. of babbitt is used for each machine of this size. After pouring, the bearings are bored to a uniform size and then compressed by means of a blunt rotating-pin tool and then finish-bored and fitted to the spindles. From 0.001 to 0.0015 in. is allowed between the spindle and the bearings for the oil film. The babbitted bearings include the main-spindle bearings, those for the back-gear shaft and the pulley. All others on the machine are of fine, close-

grained cast iron, no babbitt being used in any place for sliding bearings.

As the live spindle is 5$\frac{15}{16}$ in. in diameter and runs in bearings 20½ and 16 in. long, there is something like 6 per cent. more projected area of bearing than there is on the four bearings under one end of a standard 80,000-lb. capacity freight-car total!

In Fig. 2 a machine is shown with all the babbitt-lined bushings in place. The workman is just pushing a cast-iron bushing into the cored hole in the front end of the tailstock.

The next operation is to lower a huge jig down on the frame, for the purpose of correctly locating the various bushings and guide rods. This jig is illustrated in Fig. 3. It weighs in the neighborhood of 4 tons, being so made to secure rigidity and insure perfect alignment of the mandrels.

Fig. 4 is a view of the headstock and end of the jig as seen from the top after a mandrel has been thrust through the back-gear bushings, but before the spindle mandrel has been pushed through. Small cross-handled screws will be observed in the oil pockets of the spindle bearings. Each babbitted bushing is drilled and tapped with a ⅞ tap. In each tapped hole a screw is placed, as shown. After the locating mandrel has been run through the bushings, these screws are tightened so as to draw the bearing firmly against the bottom of the mandrel. This is to forestall any floating tendency on the part of the bushings when the type metal that is used to hold the bushings is poured in. The natural conclusion would be that all would float alike anyway; but in practice this is not true, as any slight obstruction would interfere. If one floated the 0.001 in. or so allowed while another did not, the alignment would be seriously affected. Arranged in this way, the alignment is correct in any case.

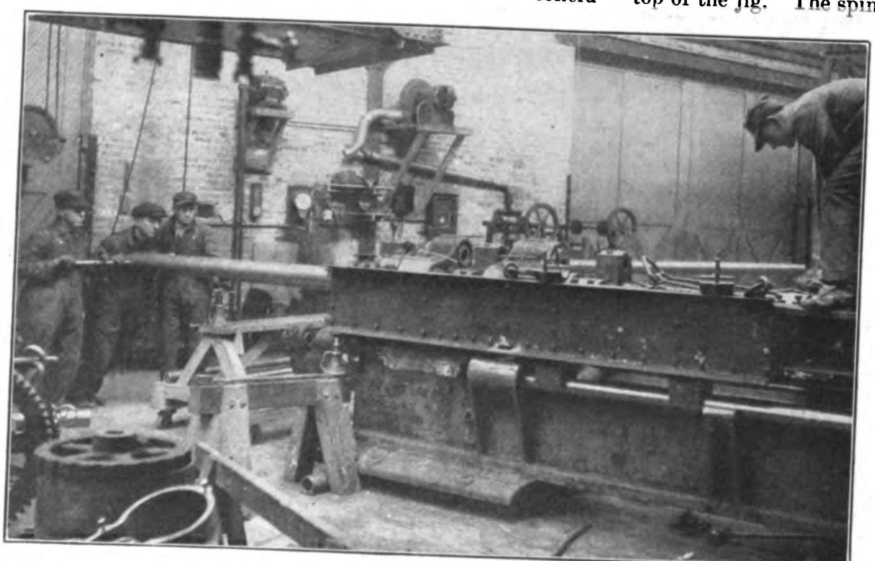


FIG. 5. PUSHING IN MAIN-SPINDLE MANDREL

Previous to any of the mandrels being run through, the jig is brought so that the various guide bushings are approximately central with the cored holes in the frame. This is done by means of screw-jacks suitably placed or by shoving one way or the other. The mandrel for the main spindle is shown being pushed into place in Fig. 5.

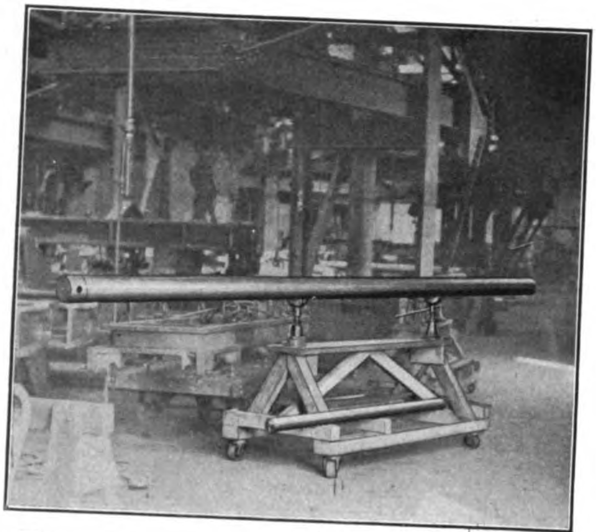


FIG. 6. TRUCK FOR HOLDING ALIGNING MANDRELS

The three men shove while the man on top juggles the bushings in the cored holes. The mandrel itself is of course guided by the bushings of the jig. One of the carriage guide rods is also seen in place in the frame. There is another similar rod at the back, and they correspond to the usual lathe ways. They are held to the jig blocks above by means of caps shown lying loose on top of the jig. The spindle mandrel is 16 ft. long, weighs 1,600 lb. and is supported in seven fully encircling bearings, set in the framework of the heavy, rigid jig. With this construction there can be no question of the perfect alignment of the bearings, since the mandrel is twisted out by hand after the type metal is poured around the bearing bushings. The slightest bind or distortion would make the removal of the mandrel extremely difficult, if not impossible. It must of course be remembered that the frames have had no machine work done on them. In consequence no scale has been removed, affecting the strains in the castings, so that the seasoning changes are far less than usual. When not in use, the various mandrels are carried on special trucks of the type illustrated in Fig. 6. The main-spindle mandrel is set on lead-padded jacks; and when it is to be used, the truck is run to the jig and the jacks run up or down until the mandrel is exactly in line with the guide bushings in the jig. It may then be pushed in as previously shown.

An end view of a No. 23 machine, with a jig and all the mandrels in place, is given in Fig. 7. The opposite end of this same machine previous to the setting on of the jig is shown in Fig. 8. Here a boring-bar carriage is seen, with the guide rods or ways in place. Bronze

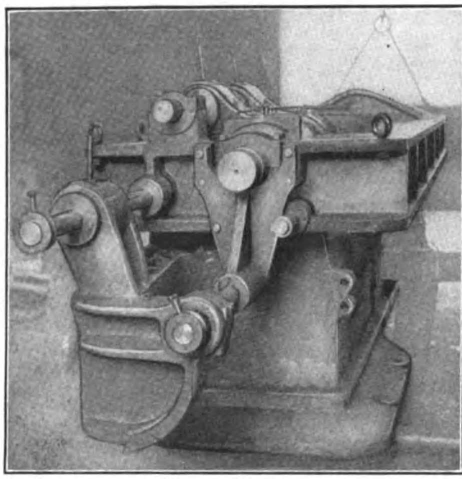


FIG. 7. END VIEW OF MANDRELS

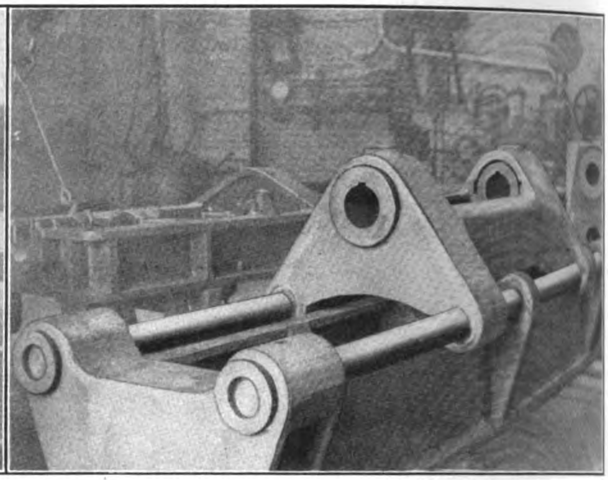


FIG. 8. BORING-BAR CARRIAGE IN PLACE

bushings are shown in the cored holes on the end of the machine bed. They are used to guide the rods through without bruising or marring them, and similar ones are used in all cases where these rods are inserted. The bushings are of course removed after they have fulfilled their mission and are laid aside for use on the next frame.

After a jig has been correctly placed, the mandrels all pushed in and the bushings located right, the various openings are luted with clay, and type metal is poured in around the bushings, setting them solidly into the cored holes of the frame. The process of pouring is shown in Fig. 9. While the men handle the ladle, another stands close with a large wad of clay ready to stop up any runs that might unexpectedly develop. Light steel ladles are used, which may be manipulated with or without a crane. This illustration also plainly shows how the guide rods or ways are held to the jig by means of caps, as previously mentioned. The clay luting may be noticed in various places. The luting clay is handled in an unusual manner. As a rule, a man simply takes a wad and rolls it up in his hands and presses it around the opening. This takes considerably more time than necessary, so here the clay is furnished the workmen in strips 1 in. square and 30 in. long. These strips are brought to the machine, laid on boards and covered with damp sheets of felt, two layers being placed on a small truck, as in Fig. 13. The advantage of this method will be seen at once by any practical man. The clay strips are made in a special power-driven machine, Fig. 15. Not only are the strips convenient to handle, but the mixture is uniform. The machine will run out two strips at a time.

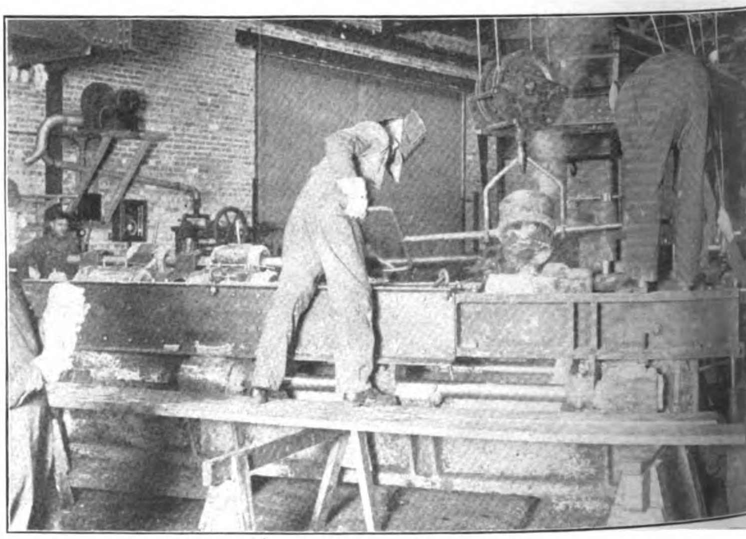


FIG. 9. POURING THE TYPE METAL AROUND THE BUSHINGS

Masks are worn by the men pouring the metal. Two of these masks are shown in Fig. 14. The face is covered with fine screen, and the neck is protected by a leather flap attached to the lower part of the mask. The ones shown were made especially to order.

About 960 lb. of type metal is used for each machine. It contains 14 per cent. of antimony, which is 1 per cent. more than the eutectic alloy of antimony and lead, the object being to allow for any loss in melting. Great care is taken in melting and bringing this special mixture to just the right temperature for pouring. A large amount of experimenting was done before any machines were built; and while the metal formula may be varied considerably, its treatment, temperature of pouring and the time of cooling are of the utmost importance. It is sufficient to say that the pouring temperature is so critical that a range of only 30 deg. F. is permitted; above that point shrinkage takes place, while below it the expansion would be great enough to result in cracking the casting retaining it.

At first thought the construction of a machine in this way would seem to be cheaper than by the time-honored designs, but a moment's consideration will disclose the error. The expense of the metal is more than enough to pay for any boring, planing and scraping that could be done on a machine of this class. The real gain is not in money, but in time and quantity of production, which could be obtained in no other way. Another thing may be mentioned here, and that is that the use of round stock is also much more expensive than it looks at first. Only 50-point carbon steel is used. It is machined and ground to size by the Cumberland Steel Co., which in addition to the regular price of the steel receives 1½c. per pound additional, which is divided into ½c. for working the high-carbon steel: ½c. for accuracy and ½c. for special inspection. The frame, with the various mandrels and the jig removed, is illustrated in Fig. 10. This view plainly shows bearing bushings in place and also the two carriage guides or ways. It will be seen that these are supported in the middle by a bracket, to eliminate all chance of springing. The tail spindle and operating mechanism are still to be put in place. The mechanism is so arranged that the holding brackets are attached to the tailstock by means of extensions or tongues, which are set down into cored holes in the casting in such a way that type metal may be flowed around to anchor them securely. The tail spindle itself moves in the cast-iron bushings, which were aligned by the bar in the big jig previously mentioned.

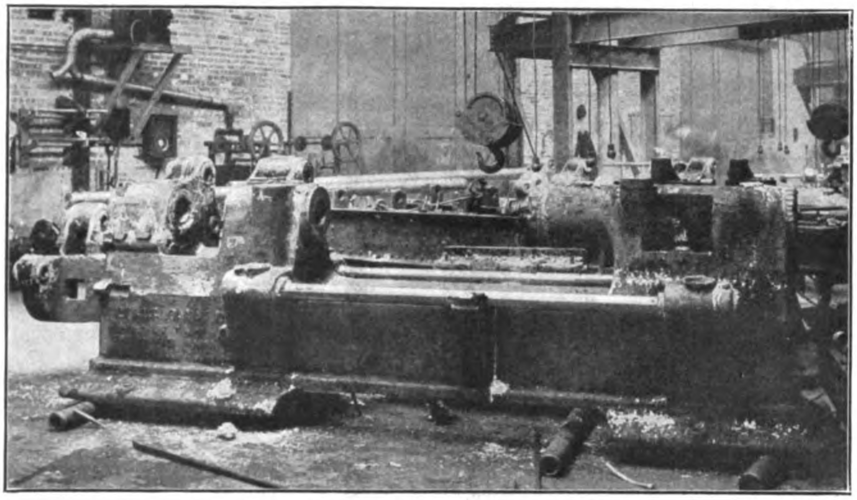


FIG. 10. FRAME WITH BUSHINGS AND GUIDE RODS IN PLACE

Fig. 11 shows the tailstock mechanism in place and the big gear being worked into position as the spindle is pushed through. This part of the assembling differs but little from that ordinarily done, except that everything is arranged for speed. Where heavy shafts or other parts are to be handled either by hand or by crane, special gripping tongs faced with leather are used. A number of these may be seen lying on a truck in Fig. 16.

The heavy flanged collar used as a faceplate is shrunk on the spindle nose. A shrinkage allowance of from 0.008 to 0.010 in. is made. A faceplate just being swung into position to be placed on the spindle nose is shown in Fig. 12. As soon as it is set in place it is cooled by water from the hose at the left. This water is caught in the tank and drains off through the hose at the right. These faceplates, finished, weigh about 220 lb. The holes in them for bolting purposes are cored in. After the faceplate has been shrunk on, it may be faced off.

FIG. 11. PUTTING IN GEARS AND SPINDLES

FIG. 12. SHRINKING ON THE FACEPLATE

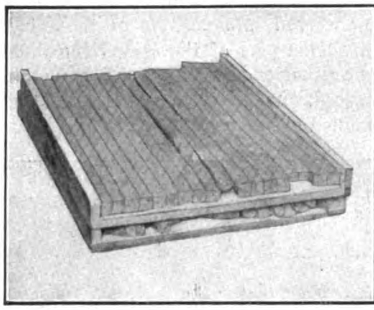


FIG. 13. TRUCK PLATFORM FULL OF CLAY LUTING STRIPS

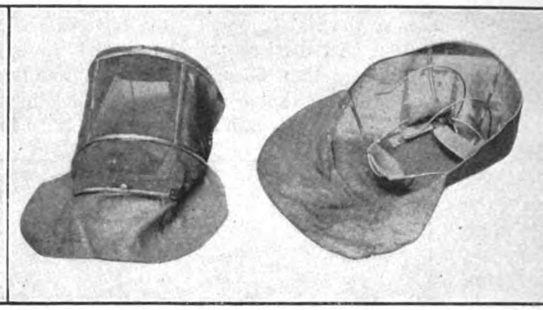


FIG. 14. THE PROTECTING MASKS FOR POURING OPERATIONS

FIG. 15. THE CLAY MIXING MACHINE

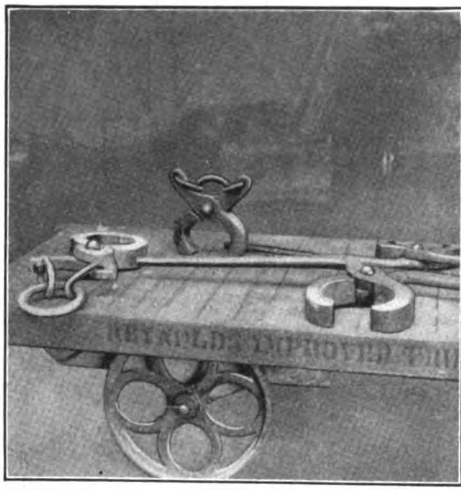


FIG. 16. MANDREL TONGS

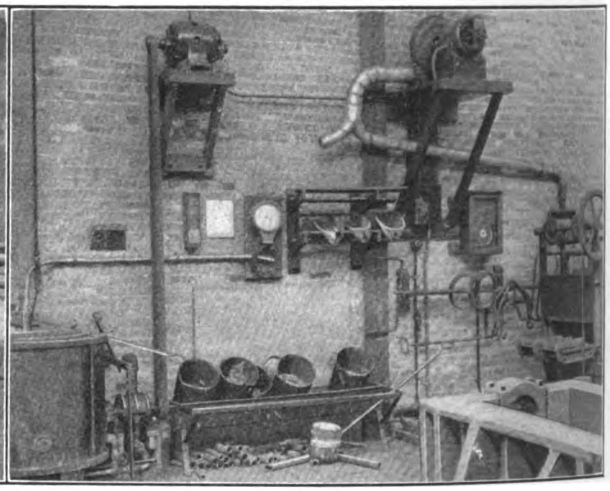


FIG. 17. ONE OF THE FURNACE SETS

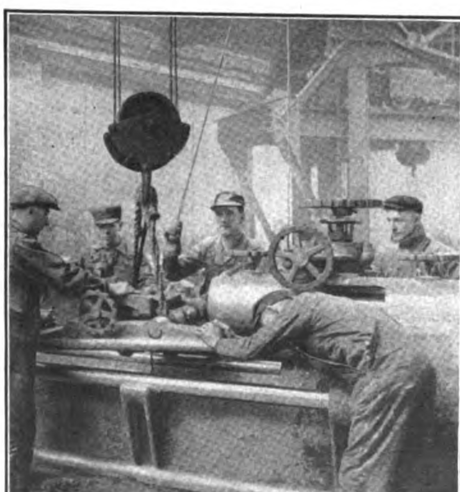


FIG. 18. LOWERING CARRIAGE ON WAYS

FIG. 19. RUNNING A TEST ON FINISHED LATHE

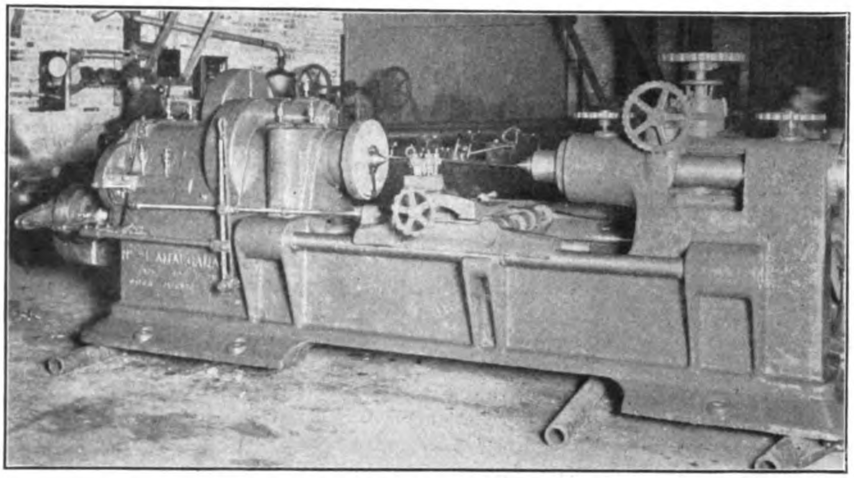


FIG. 20. COMPLETED MACHINE ALL READY TO PAINT

The shop is supplied with a number of heating sets like the one in Fig. 17. The furnace at the right heats the faceplates just described. Two little wheeled trucks may be seen just in front of the door. The faceplates are placed on these trucks and wheeled inside the furnace to heat. The weight of the faceplates makes something of this kind necessary. On the wall, next to this furnace, is shown a Bristol recording pyrometer. Farther to the left is a mask rack, at the left of which is a Bristol recording thermometer connected to the type-metal melting furnace at the extreme left. Just below the thermometer is a gas-heated rack for the metal ladles. The furnace at the left is a Stewart Special, made by

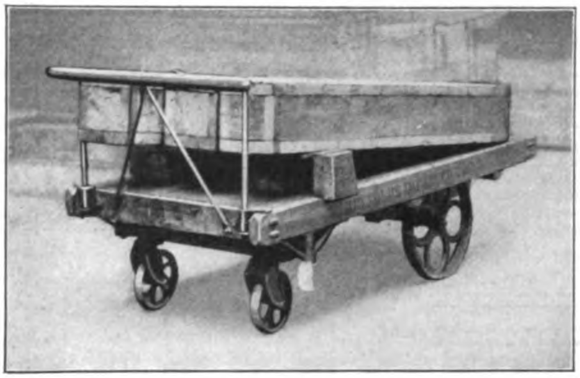


FIG. 21. BOXED SPINDLES AND SHAFTS

the Chicago Flexible Shaft Co. and capable of melting a ton of type metal an hour. The heating furnace was made by the National Machine Works, Chicago. Care must be taken to obtain the exact pouring heat of the type metal used. Hence, one man makes a specialty of this operation.

Fig. 18 illustrates a machine practically completed, with the carriage being lowered to the ways. Fig. 19 shows a running test being made with a portable apparatus. The motor used is a 3-hp. Triumph running at 1,300 r.p.m. Other tests determine the accuracy of the various parts and alignments wherever necessary. Fig. 20 shows a machine all complete, ready to be painted. The paint used is a special Sherwin-Williams mixture that will dry in an hour, and the machine may be wrapped in waterproof muslin webbed paper immediately after painting and greasing for shipment.

One of the very unusual guarantees of the company is to finish 5 per cent. of any order per day, no matter how large the order. It follows that some unusual production methods must be followed, aside from the assembling of the machines as shown. The shop is divided into units, each practically complete in itself, for the assembling of a single machine at a time. Four men constitute an assembling gang. The record for assembling a No. 21 machine is about 7½ hr. complete. A fair average seems to be 9 hr. Gears, bushings, shafts, screws and all castings are made under contract, and very little but actual assembling is done in the main shop. Except for a small room for the shafts, gears and the like, almost no storage facilities are provided. The shafts used are sent in se-

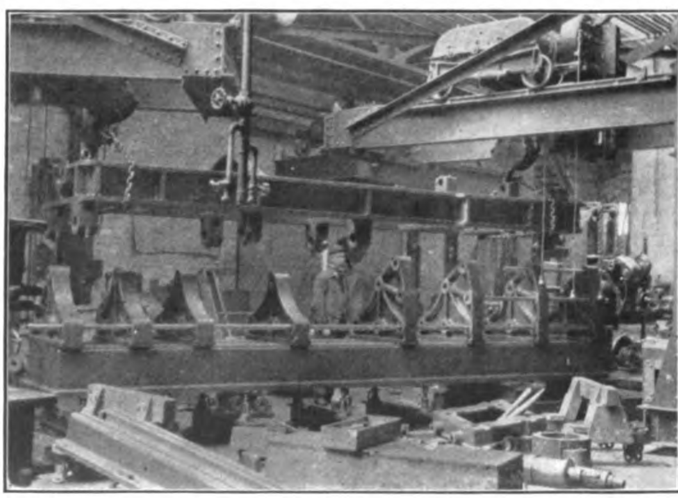


FIG. 22. VIEW OF JIG AND MASTER JIG

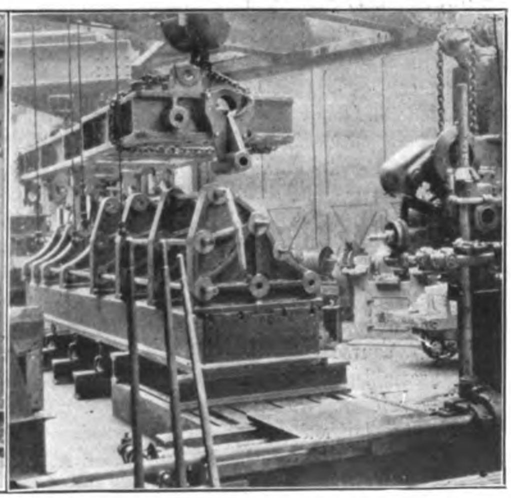


FIG. 23. ANOTHER VIEW OF MASTER JIG

curely boxed, as in Fig. 21, to prevent any damage in transit. This practice costs more money, but saves time and trouble.

In order that each working group may work independently, each is supplied with an aligning jig. These jigs weigh approximately 4 tons each and are made from a master jig. The latter is unusual in that it is composed of bushing brackets accurately made, which may be arranged on a huge grooved bed, as in Fig. 22. Suspended on crane chains just above is a jig that may be lowered to the plate and bored as desired. Another view of the master jig is seen in Fig. 23. In the foreground is a Beaman & Smith horizontal boring mill. The boring bars are connected to the machine spindle by a double universal joint, the bars themselves being guided by the steel ground bushings in the master brackets. This method is bound to produce duplicate jigs, and the parts of one machine are interchangeable with those of any other.

The size and number of castings required to supply the assembling shop when running on a large order precludes any one foundry from doing all the work or any one set of patterns from sufficing. For this reason a large number of duplicate patterns were made, requiring the work of over 100 men for two months. A three-story furniture factory furnished the necessary machinery and space. One of the sets of patterns for the No. 20 machine, with its core boxes, requires all the space in a furniture car for shipment, and all the patterns on hand would load 30 freight cars. There is another trainload of jigs. The production of 200 tons of machine tools daily means rapid handling all along the line, and in the assembly shop the work is of an extent that would be impossible unless everything had been built special.

The assembly building, known as the south shop, is 44x300 ft., and some of its main features are outlined in Fig. 24. A railroad track runs close to each side, so that castings are unloaded at a door on one side, take a diagonal course almost directly across, emerge completely assembled and are loaded on a car at the other side. By referring to the plan it will be noticed that the doors are labeled A5, B5, A6, B6 and so on. This means that the doors of the same number represent the places of entrance and exit. Two 5-ton cranes are available to serve each machine, if necessary. Ten of these cranes, each worked by two motors and capable of revolving entirely around its columns, are placed down the length of the shop. The only columns in the building are the crane columns. The trusses are supported on the wall opposite and cantilever across the columns. Water and gas are supplied at each crane, and also alternating and direct electric current. The astonishing thing is that this entire building, with its fittings, was completed in 18 days from the laying of the foundation.

The preliminary preparations for the manufacturing operations included an enormous number of details. Nothing, however small, that would assist the speed and accuracy desired was overlooked. One instance is that double-thickness pipe was obtained for rollers under the frames while in the shop. Their thickness prevented crushing, and each gang was supplied with sets already cut to the required length for convenient use. Enormous stocks of other material were purchased, and the Amalgamated owns and has in its actual possession what is probably the largest stock of steel of its special sizes in the country. No cold-rolled stock whatever is used, as it has an end grain as well as a surface tension rendering it unfit for the Amalgamated's purposes. As previously stated, only openhearth, 50-carbon steel, turned and ground to extreme limits, is employed. All other parts, such as gears, collars and the like, are made by specialists who are held to rigid inspection limits.

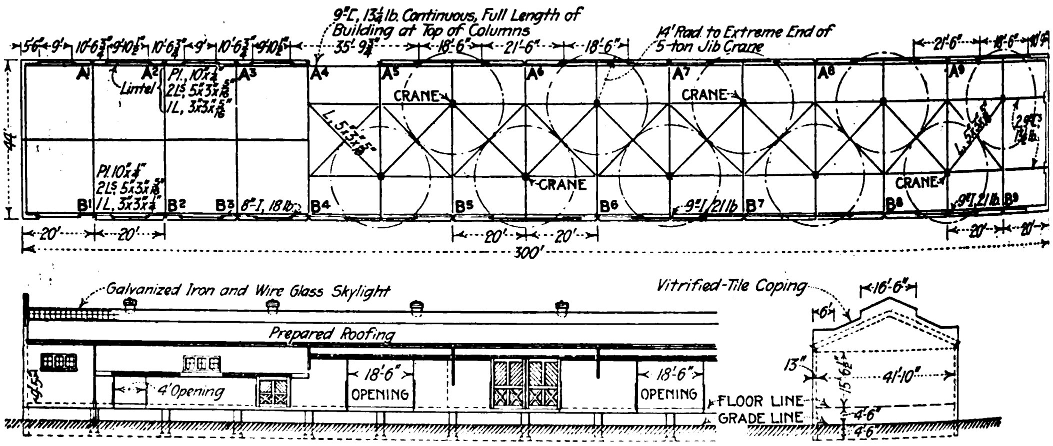


FIG. 24. SOME OF THE BUILDING DETAILS

Power Needed for Wire Drawing

Kenneth B. Lewis, in the *Blast Furnace and Steel Plant* for December, 1915, gives a formula for the horsepower required to draw wire. It is the result of some 60 motor readings made under known conditions and covering a wide range of size and quality of material. The formula is

$$Hp. = T\,(A - a)\,S\,\frac{F}{33{,}000}$$

where

T = Tensile strength of stock before the draw, expressed in pounds per square inch;
S = Speed of draw in feet per minute;
A = Area of wire before the draw, in square inches;
a = Area of wire after the draw, in square inches;
F = Factor selected from the accompanying chart.

Spring Fever in the Small Shop

By John H. Van Deventer

SYNOPSIS—This is a "Dave Hope" story, telling how the inmates of his small machine shop were afflicted with spring fever and how they were cured by inoculation.

There is a disease not mentioned in the medical books. It spreads its influence broadcast over the country each year and spares not rich nor poor, young nor old. It affects most strongly those whose occupations keep them within doors and is a disease that every machinist's apprentice and even the machinist himself suffers from each year. The germs of this disease are frozen up and harmless during the winter season; their busy time is the month of May:

When the buds begin to blossom
And the bees begin to hum;
When you feel like playing 'possum
And your job seems on the bum.

It is at this season of the year that the machinist in the large or the small shop picks out a soap box or nail keg as a resting place from which he can with the least effort observe the slow progress of the thirty-second-inch feed crawling over the surface of the work. But while his eyes are on the machine, his thoughts are elsewhere. In imagination he is feeling the warmth of the sun upon the back of a neck that has been protected from sleet and storms for many months by an upturned coat collar. He is imagining the satisfaction of indulging his five senses, individually and collectively, with the sights, sounds, smells, tastes and feelings of a rejuvenated earth. And just about the time when his imagination takes him to the crystal-clear inland lake crammed with fish as hungry as starving wolves—bang! The whole thing is punctured by the sarcastic voice of the boss: "Get rid of that hookworm and double up on your feed!"

Symptoms of Spring Fever in Dave's Shop

There were obvious signs that this spring malady had attacked Dave Hope's small shop. One convincing symptom was evident in Sandy McPherson's location out of doors, for he had moved the portable work bench from within and was doing his filing under the sky instead of under the shop roof. Reddy Burke, whose duties confined him to a close proximity to machines not so easily portable, looked rather disconsolate. As for the boy and the half-dozen other men who comprised the personnel of the shop, the evidence of the disease was unmistakably written upon them and displayed in every motion.

Dave Hope had not overlooked these indications and, in fact, felt some of the symptoms working in his own system. "This thing is going to cost us some money," he reflected, "because the trouble is sure to last for two weeks at least. During this time one after another of the boys will be taking a day off now and then, and it isn't in my disposition to tell them no, for I'll probably be doing the same thing myself." Just at this moment his eyes rested upon the magazine section of the preceding week's Sunday paper, which happened to lie open at article entitled "How Disease Is Made Harmless by Inoculation." "By George!" exclaimed Dave to himself; "I wonder if there isn't a way to inoculate against spring fever."

He read the article with considerable interest and found that the principle of inoculation is to treat the system with a dose of the disease bacillus that causes the complaint. "Looks like a case of fighting fire with fire," muttered Dave, lapsing into a period of silent reflection that lasted several moments. Then he got up, slapped the desk with his fist and ejaculated, "By George, I'll do it!"

Dave Gets Ready to Try the Inoculation

Next morning Dave did something that it was very unusual for him to do; he lined his men up and made a speech to them. Perhaps it should be called a talk rather than a speech, for there was nothing formal about it any more than about Dave himself.

"Boys, we're all coming down with a bad case of spring fever. I've got it myself, and I know that you have. And I don't blame you for it. But there are some orders here that we've got to get out—that 12x12 engine for Jones' sawmill, the road roller for the town and that duplex pump for Tim Ebbets. Now I'll tell you what we'll do—you boys pitch in and clean these up by Friday night, and we'll shut down until Monday morning, with the condition that all of us together go out for a two days' camp in the woods."

The speech of an eloquent statesman was never received with any more enthusiasm than were these few words of Dave's. All hands pitched in with a vigor that gave evidence of the success of the first inoculation.

Starting Off for the Camping Grounds

On Saturday morning at sunrise the wheels of the one-horse farm wagon creaked under the load of eight men and a boy and sundry equipment in the nature of provisions and camp material. Fishpoles were a prominent feature included in this assortment of goods, for every small-shop man is instinctively a fisherman by second nature. Dave had suggested that the party go on foot, thinking that the spring-fever inoculation would take place more rapidly under such circumstances, but compromised on a farm wagon without springs.

It was very pleasant jogging along the fresh-smelling country road, and the occasional bumps encountered by the springless farm wagon as it rolled over furrows left by recent freshets did not cause any lessening of the enjoyment, unless it was on the part of the boy, who was jolted off the back of the wagon by an unusually severe bump. As the sun grew hotter and the road grew hillier, it was necessary for the party to get out of the wagon and "spell" the horse, who seemed to be suffering from spring fever himself. Coats came off one by one, and beads of perspiration began to bathe newly acquired sunburn. Dave had chosen the road and had taken care to pick one with very little shade.

"Gee," said Tom, the boy, "I didn't think it could be as hot as this in May!"

"Hot, is it?" exclaimed Reddy Burke. "T'ink of the poor byes in Mexico—this is a rayfrigorator be comparison."

The destination of the campers was an inland stream girded by woods. It was a location seldom visited by fisherman, being 18 miles from town and 10 miles from the nearest railroad, and for this reason might be expected to furnish exciting sport and appetizing meals. The country in this neighborhood was sparsely settled, but a farmhouse was encountered some six miles distant from the creek, and Dave stopped the wagon to buy some fresh milk and to have a word in private with the farmer.

A Raid on the Commissary Department

The two days' supply of eatables in the commissary department had begun to melt under the attack of nine hungry appetites. "If you lads dinna refrain frae eatin' the noo, we will have nowt for breakfast the morn's mornin'," cautioned Sandy.

"We'll have fresh fish for breakfast anyway," replied Bill Evans; "there's a dozen breakfasts and dinners too, swimmin' in that there creek."

Upon arrival at the destination the horse was unhitched from the wagon and tethered in a shady patch of woods. Fishpoles were hurriedly sorted out from among other contraptions, Reddy Burke finding difficulty in unearthing his from beneath the big fly tent that had been brought along for sleeping quarters.

There was a rush for strategic positions on the bank of the creek. Sandy McPherson was the first to get into action, baiting his hook with a "night walker" the size of which insured an ambitious catch if any at all. Two minutes later, while Sandy was lighting his pipe, a ferocious and unexpected pull yanked the pole from his left hand. It was a steel pole, and not having the buoyance of the more common wooden kind, it disappeared beneath the surface, followed by a shower of Scotch imprecations.

"Hoot, a beastie wi' sic a pu' can be nae less than a hippopotamus," exclaimed Sandy, after he had cooled down a bit.

This experience heightened the anticipation of the rest of the party, proving as it did that there was big game in the creek. And in confirmation of this, Reddy Brooks' pole began to bend vigorously. "Begorry, I hov the baste," exclaimed Reddy, "and it's mesilf that will bring the craytur safely to terry firmmy."

Reddy Burke Catches a Big One

Then ensued a momentous struggle between an excited Irishman at one end of a fishpole and a fish of unknown species at the other. The battle waged with varying success for a half-hour, the rest of the boys dropping their poles and offering varied suggestions as to the best way of landing the catch. Finally, human skill aided by the elasticity of a fishpole conquered. "Get ready to hov a look at the biggest fish in the counthry," exclaimed Reddy, shortening up on his line. But it wasn't a fish—it was a gigantic snapping turtle.

That place seemed to be the headquarters of the snapping-turtle trust. One after another received promising bites, only to find them given by these hard-shell creatures who monopolized the stream. So many hooks were lost in this pastime that the fishermen discontinued their fishing and sought the shade of near-by trees.

The noon repast finished up most of the provisions. It was followed by a nap for all of the party but Dave, who seemed to have business back in the woods. So soothing was the outdoor air of spring that, when the amateur campers awoke, it was after 6 o'clock and they were as hungry as wolves. By unanimous consent they started for the wagon. But when they reached the clearing where it had been left, they was no sign of either horse or wagon!

Mysterious Disappearance of Board and Lodging

"Sure, 'tis a likely place for the fairies," exclaimed Reddy; "but if they bewitched the baste and the wagon, they've left tracks behint thim to indicate it." Here he pointed to unmistakable wheel and hoof prints. "Some dhirty rascal has cabbaged the commissary department!"

They succeeded in following the tracks as far as the crossroad, but here the wind had obscured the marks and the men were not enough skilled in woodcraft to detect which branch had been taken. Besides, it was growing dark, they were without shelter, and the evening breeze began to feel chilly.

"The best thing for us to do," advised Dave, "is to find some barn where we can sleep. The nearest farmhouse is six miles away, and I suggest that we follow the creek road, where we may find something nearer."

A six-mile walk without supper did not attract the rest of the boys, and it was agreed to try the creek road. It was quite dark by this time, and everyone had parted with his last bit of good nature. Tom, the boy, apparently could see in the dark better than any of the others. "There is a building over there, I think," he exclaimed, after the party had trudged a half-mile by starlight. "If you fellows will wait here a minute, I'll go over and see what it is."

He came running back in a few moments. "It looks like a good place to sleep," said he; "it's a shed with a lot of sawdust on the floor."

Reddy Burke Has a Nightmare

Reddy Burke woke up two hours later from a nightmare in which he, a morgue and a slab of ice played the principal parts. He found that he had sunk downward quite a bit in his bed of sawdust, and he was surrounded with icy cold water. "Wake up, lads," he bellowed at the top of his voice, "the creek is rising and youse will all be drownded!" Someone struck a match, and by its flicker they could see that they had gone to sleep in an icehouse!

Two hours later the moon looked down on a disconsolate party trudging back toward town. It was almost dawn when they came to the farmhouse where the milk had been obtained. "Guess I'll run in here and see if the farmer has seen anything of our horse and wagon," said Dave.

He did not have much trouble in arousing this gentleman, who led him back to the barn and the missing conveyance. "Wall, I reckon you're satisfied that I followed directions all right enough, aint ye?" said the farmer, with a sly wink as he pocketed Dave's two-dollar bill.

The horse ambled along with his load of homeward bound pilgrims, quite unconscious of the verbal abuse that was heaped upon him by men who were too tired to sleep and too angry to converse.

Sunday was spent at home in bed by the members of the camping party; and when they returned to work on Monday morning, the spring-fever inoculation was complete. Even Sandy McPherson moved his work bench back into the shop.

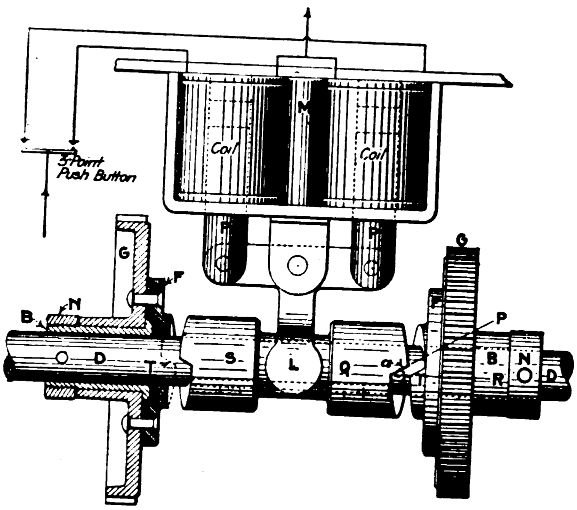
Magnetic Clutch for Machine Application

By Jan Spaander

Except for lifting purposes, electromagnets are seldom used in the machine shop. This is partly because the possibilities of the magnet are not generally understood and partly because the machine-shop man, as a rule, is not aware that a two-coil full-time magnet in four cases out of five can be installed at lower cost and in a more convenient place than a system of levers.

The two-speed mechanical-magnetic clutch shown was built to perform two operations on a drilling machine that required the full attention of the operator to obtain good work at a reasonable price. The clutch did not call for attention at all. It worked silently, and it did wonders.

The two gears *G* are idlers on the bushing *B* and, with their nuts *N*, are pinned to the driving shaft *D*. The gears are riveted to the flanges *F*, in which jaws *T* are cut. The sleeve *S* is keyed to the shaft in such a way that the



MAGNETIC CLUTCH APPLIED TO A DRILLING MACHINE

lever of the magnet *L* can slide it in either direction and thus engage one of the gears. The jaws at the ends of the sleeve correspond with those in the flanges.

The jaws slope in such a way that, if there is no current on the magnet, the axial component of the tangential force on the jaws is slightly greater than the friction of the sleeve on its keys and the sleeve is gently pressed back to its central position, disengaging the machine automatically.

The magnet is built out of a frame of flat iron, two commercial full-time coils and two iron plungers *P*. The coils receive their current from a three-point switch or push button, as shown. This contact maker is placed near the foot of the operator.

If the angle *a* of the jaws is well chosen, the friction on the keys and the axial force balance; and the energy consumed to keep the clutch in can be very small. The calculation of this angle seems formidable indeed, the friction and the forces involved being unknown quantities.

However, the angle can be found in a practical way within a couple of minutes by putting one of the two keys on a strip of the material of which the sleeve is made. By lifting one end of the strip, the key will slide at the angle of friction, and the angle of friction practically equals the angle *a* of the jaws. The points of application of the forces on the keys and on the jaws are practically equidistant from the center of rotation and therefore equal.

Blueprints Without Tracings

By A. Spalding

The popularly accepted manner of making drawings to be reproduced by blueprinting is to transfer a pencil drawing on heavy paper to tracing cloth, which means a double operation in getting the drawing on a medium suitable for blueprinting. While this practice has the advantage of giving drawings on a durable material, which may be justified in cases where many blueprints are to be made, it is nevertheless expensive, and needlessly so, for a great amount of work.

There are on the market several grades of bond paper, in different weights and suitable widths, with sufficient body for drawings. From these surfaces blueprints may be successfully made, thereby eliminating the necessity of tracing and also reducing the cost of the drawing from 25 to 50 per cent. While bond paper is most suitable for details, it may in many cases be used for complicated assemblies.

The only precautions needed in making drawings on bond paper is to use a sufficiently soft pencil to procure a dense black line—a 2-H pencil is suitable. Also, on account of the paper being thin, as compared with the usual drawing paper, it may be found necessary to fold the corners over a couple of times where the sheet is tacked to the board, in order to prevent tearing.

Where this system is adopted, it is well to file a limited number of drawings in cardboard folios that may be taken from the file for the removal of individual drawings. Thus tearing or wrinkling, due to the weight of superimposed drawings, when taking drawings out of, or replacing them in the file, is avoided.

For office reference it is preferable to use a blueprint rather than the original, although the heavier grades of paper are very strong. Acid-treated tracing paper, which is brittle and tears easily, should not be confused with the bond paper mentioned.

In addition to plain bond paper pads of 100 sheets of a ruled cross-section paper in 8½x11-in. size or thereabouts, printed if desired with a suitable heading consisting of the firm's name, space for title, drawing number and date, are found to be admirably adapted to the rapid reproduction of details. These sheets may be sketched without a scale or straight-edge, using the section lines as a substitute. With this paper it may be found preferable to use ink, to avoid possible confusion on the blueprint, because the section lines may also show faintly.

However, it has been found in many cases where the draftsman has the detail sufficiently well in mind that he can draw it (to scale if necessary) freehand by following the cross-section lines. A so-called ball-pointed pen has been found satisfactory for this work.

In making the blueprints about double the usual time of exposure is required. This item is not serious, because of the cheaper labor employed to make the prints.

Punches and Dies for Making Pepper and Salt Tops

By Robert Mawson

SYNOPSIS—In this article are shown the punches and dies used in manufacturing pepper and salt tops.

The H. O. Rogers Silver Co., Taunton, Mass., manufactures a variety of high-grade silverware. An example of this work—silver pepper and salt tops—is interesting and is here described. It will be seen that the various operations are performed at a good rate of speed, which is given. The tools are of a simple design, but they produce parts of a high-grade order. The machine for rolling the thread is shown in Fig. 10, while one of the finished parts is illustrated in Fig. 11.

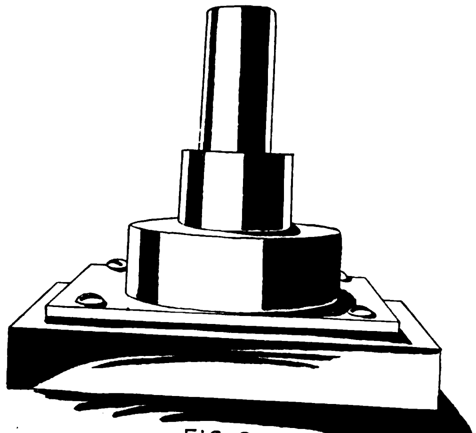


FIG. 2

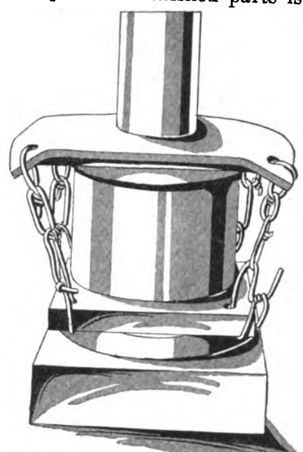


FIG. 4

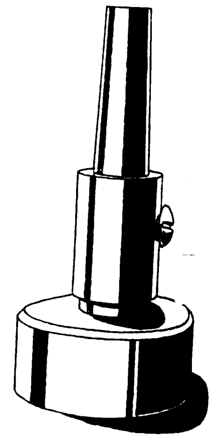


FIG. 6

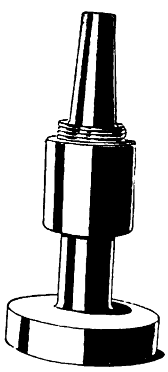


FIG. 8

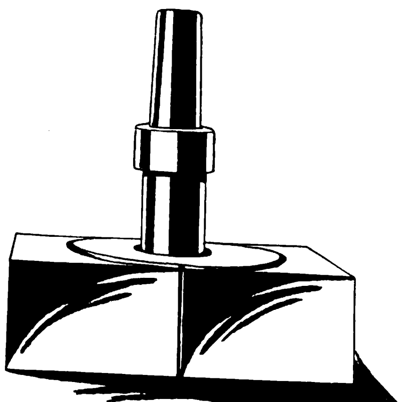


FIG. 9

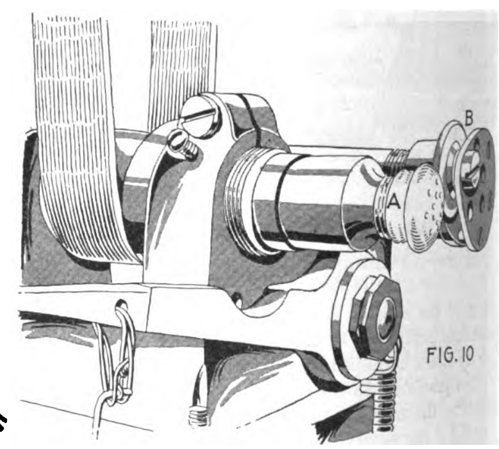


FIG. 10

PUNCHES AND DIES FOR MAKING PEPPER AND SALT SHAKER TOPS

FIGS. 2 AND 2-A

Operation—Blanking out disk, Fig. 1. The stock, which has been cut to the correct width, is fed under the stripper. As the punch descends, the disk is blanked out.

FIGS. 4 AND 4-A

Operation—Drawing the blanked disk to the shape shown in Fig. 3. The disk is placed in the recess formed in the die, and the punch is forced down. The machined projection on the punch holds the blank in position on the die. As the punch descends farther, the rubber pad is compressed and the internal punch gives the required shape to the disk.

FIGS. 6 AND 6-A

Operation—Rolling the edge to the contour seen in Fig. 5. The drawn blank is placed so that it rests on a shoulder at the lower end. The punch is moved down by the press, and the upper edge of the blank is rolled over by means of the shoulder at the upper end of the punch.

FIGS. 8 AND 8-A

Operation—Perforating the upper end, as illustrated by the detail, Fig. 7. The rolled blank is placed over the machined shank of the die, which is a good fit. The punch, which is provided with steel punches of the size and number to suit the part to be produced, is forced down by the press, and the holes are perforated in the top.

FIGS. 9 AND 9-A

Operation—Bulging the perforated top. The piece is placed between the two die elements, which are made with a similar contour to that desired for the top. A rubber plug is placed in the hole of the piece, and as the punch is forced down by the press, the rubber is compressed and the top pushed out to the same shape as the die elements.

FIG. 10

Operation—Rolling the thread. The top is slid on the threaded arbor A, and as the wheel B is fed along it with the arbor revolving, a similar thread is rolled on the top.

DETAILS OF PUNCHES AND DIES USED IN MAKING PEPPER AND SALT SHAKER TOPS

The Engineer, the Public and Economics

By A. L. Haas

In his consideration of modern progress or in his survey of industry the economist divides the past into two distinct periods, the separating point being the utilization of power by the introduction of steam. This factor, leading to improvement in textile machinery, together with the invention of the lathe slide rest, forms the keystone that sustains all recent progress. Antiquity offers evidence of huge works accomplished—the pyramids are one example—but such work was in the main apart from economic consideration altogether.

An engineer may be defined as one who guides, directs, controls or takes advantage of natural forces to serve utilitarian ends. In a modern sense the necessary qualification is that the results achieved must lessen cost. Much of the work of the past served no utilitarian end, nor was it of direct commercial benefit to the community at large. Modern effort is alone commercially communal and can be considered upon the ground of direct utility.

Much criticism has been passed upon engineering work as inartistic and unbeautiful. The correct reply is to insist upon its commercial benefit rather than its infraction of the canons of art. The question of beauty versus utility will always be arguable and find reason to back both points of view. Where, as in some large work, the two opposing factors can be combined (as they have successfully been at times), there is agreement in place of opposition.

Engineer—The Tool-Using Superman

Man is separated from all other life by one clear distinction. He uses tools. The engineer is separated from other men in that his tools are of supersize. He is the tool-using superman. If merit rests in the first distinction, then obviously greater merit rests in the second.

The functions of the engineer are purely economic, his ends frankly utilitarian. He will harness a picturesque waterfall to the basest of power uses without his conscience feeling in the least uneasy. He will alter natural features by schemes of irrigation and transit. He is the true evolutionist of the modern era, and nothing he does is devoid of use or service to the community. Apart from engineering effort modern wealth would not exist. In more senses than one he creates wealth as does no other section of mankind. He conserves energy and renders practical the otherwise impossible of achievement. Today he wages war and in at most a few short years will certainly render war impossible.

He takes the bare results of scientific discovery and adapts them to universal benefit. He renders time-wasting and cumbrous methods obsolete, gives improved means to effect the laborious and the menial work of the world and dignifies manual labor by removing its worst features. Simple muscular work is rapidly passing away, and skill is being placed in front of mere muscle—all because of engineering effort. Those professions most in the public view are largely those whose stock in trade consists of words. The engineer's busy doings are inarticulate, and he remains more or less a mystery to the public at large.

As an organizer and economist of front rank no other member of the community has the engineer's opportunity of acquiring the same vital experience. He combines the human and the material as does no other man. In spite of this, or perhaps because of it, his place in public affairs has in the past been a minor or a secondary one. This is to be lamented and it is hoped, will soon be remedied. As a servant of the community at large the engineer's efforts have been second to none. He is therefore qualified to take a place in public affairs as are few others in the nation.

It may be on account of the inherent modesty of genius, or because his time is occupied and his life a satisfying one—perhaps it is because he does not yet realize that the qualified technical man is the equal of those in any other profession extant—that his voice is more or less silent in public affairs. Whatever the reason, it is to be regretted.

Were the public at large more acquainted with the engineer's value and worth, it would certainly welcome his guidance in problems already solved in manufacturing, but which seem beyond the capacity of those vested with elective authority.

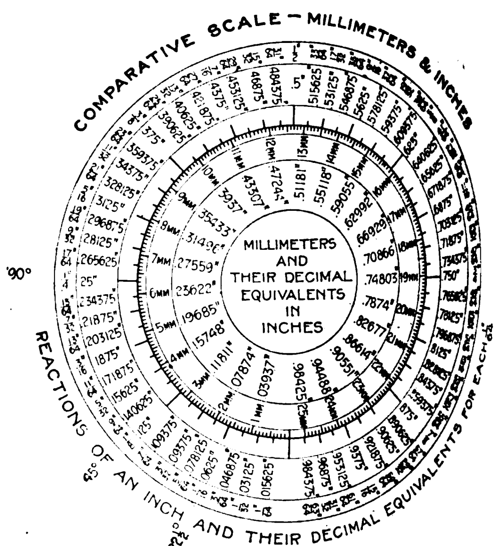
Handy Metric and Decimal-Equivalent Scale

By Norman V. Christensen

There is hardly a shop but what uses the metric system at least occasionally; and this tendency is on the increase, largely owing to the present conflict in Europe.

The accompanying scale is practically self-descriptive, but a little explanation will be helpful.

The circumference of the heavy circle represents 1 in., and as will be seen, the outer ring of figures indicates



HANDY METRIC AND DECIMAL EQUIVALENT SCALE

the fractional parts of an inch and their decimal equivalents. It will be observed that there is little chance for confusion.

The millimeters are marked off on the inside of the circle and show at a glance what any number (under 25) equals in inches. For example, take 13.5 mm. and it will be seen that it is just $\frac{17}{32}$ in.

Manufacturing British 8-In. Shells in 4½ Hr.--II*

By Fred H. Colvin

SYNOPSIS—The method of cutting the wave groove is interesting, special tooling being used. Using taps and dies of nearly 5½ in. in diameter on long threads in fairly high-carbon steel is unusual enough to be of special interest, especially when an 8-thread is cut at the rate of 1 in. advance per min. The shells are varnished by flooding. The instructions for inspection are also noteworthy.

The wave groove for the band is the succeeding, or eighth, operation, for which another Root & Van Dervoort machine is made to serve by using a special turret and a bolt and then turns the turret. This arrangement gives a particularly convenient mode of operating tool-post turrets of this kind. Then comes the first government inspection for the operations as far as they have proceeded.

Banding is done on the West hydraulic machine, the band being heated in a Stewart gas-burning furnace. Considerable experimenting was necessary to secure entire satisfaction in this operation, as it is a large band to force into place so as to fill completely the undercut at the side of the band groove.

After trying various heats running as high as 1,400 deg. F., it has been found that 1,150 deg. F. gives the best results with about 2,400 lb. pressure, there being three squeezes in order to seat the ring properly in every way.

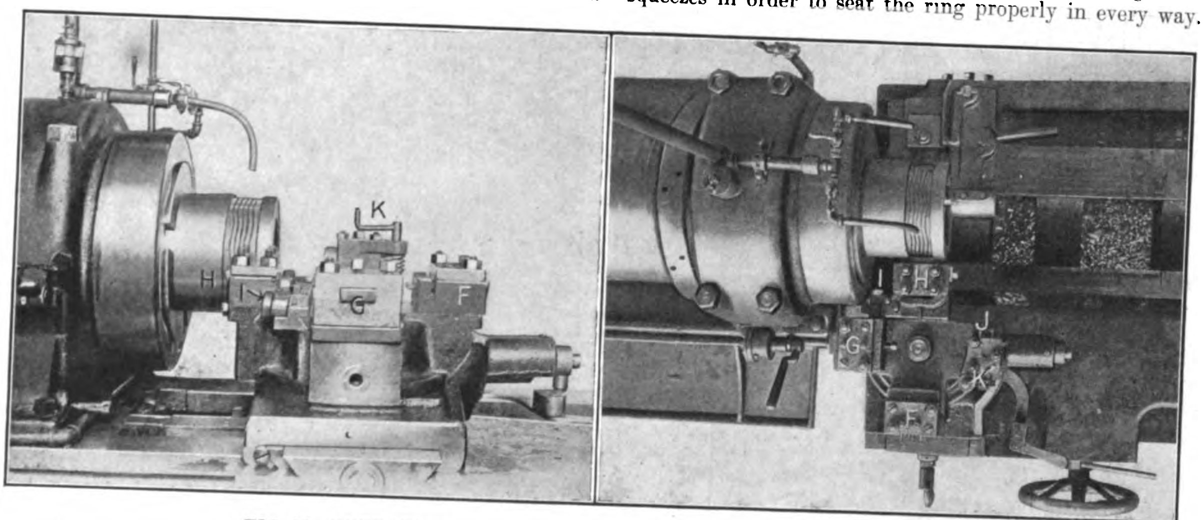


FIG. 15. OPERATION 9: CUTTING WAVE GROOVE—SIX SUBOPERATIONS

Machine Used—Root & Van Dervoort special.
Fixture and Tools—See Fig. 16.
Gages—Diameter, width, wave and undercut.
Production—20 min. each.

cross-slide, Fig. 15. They are shown in detail in Fig. 16. There are six suboperations in making this wave groove. First, two parting tools *A*, Fig. 16, come in from the back and cut down the side of the groove. Then a tool block *B* is swung in from the pivot *C*. It carries the tool which chamfers the end of the shell and faces it square with the groove for the banding operation. The tool was originally used to undercut for the thread in the base, but this work is now provided for in a later operation.

Then six grooves are cut in the band space by a gang of parting tools *F*, to break up the width of the chip, which would be about 2 in. wide. The metal that is left is faced down with the flat cutter *G*. The waves are then cut with the formed cutter *H* by means of the wave cam on the face of the chuck and the roller *I*. The sides of the groove are undercut by two tools *J* moving at the proper angle and controlled by the handle *K*, which operates through a worm and racks on the back of the tools. The indexing is by the side handle, which first withdraws the

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It was also found that the width of the ring plays quite an important part in having it fill the undercut. Best results are secured by turning the ring to $^1/_{64}$ in. less than the minimum width of the groove when cold. This means that a slight shaving takes place from the ring when it is forced into place, but it insures enough metal at the bottom of the band groove to flow nicely into the corners of the undercut. Fig. 17-A gives the band dimensions. Production time, 3 min. each.

Next come the counterboring and threading for the adapter plug and for the open end of the shell, Fig. 18-A. The threading operation and the plug itself are both interesting. The shell is held in the same type of lathe as for cutting off in the second operation. The tools consist of a boring bar and a Murchey tap, mounted in a specially heavy turret. When the toughness of the steel is considered and also the fact that this thread is 5.435 in. in outside diameter with an 8-pitch, left-handed Whitworth thread, it will be seen that considerable metal must be removed at each tapping operation. The shells are bored, counterbored at the end of the thread and the tap run in at 10 r.p.m., making exceptionally fast threading for this

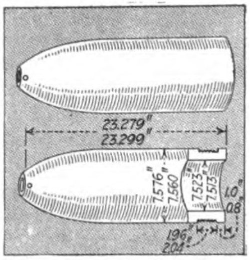


Fig. 15-A. Operation 9

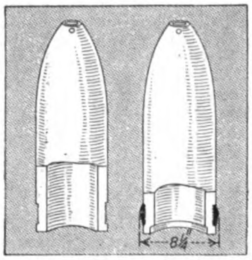


Fig. 17-A. Operation 10

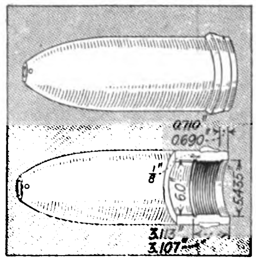


Fig. 18-A. Operation 11

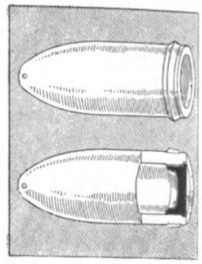


Fig. 19-A. Operation 12

FOUR OF THE OPERATION SHEETS FOR 8-IN. SHELLS

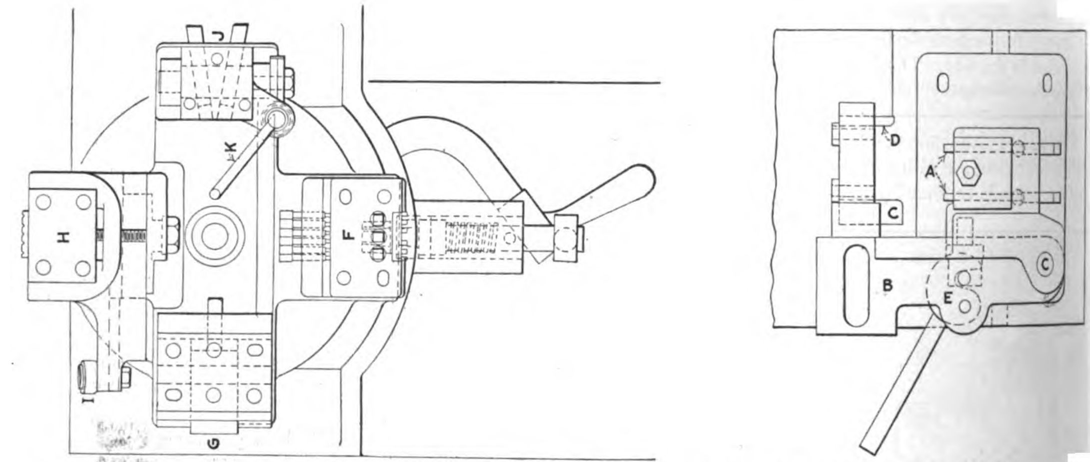


FIG. 16. TURRET FOR WAVE GROOVING AND BACK-GROOVING TOOLS ON SAME CARRIAGE

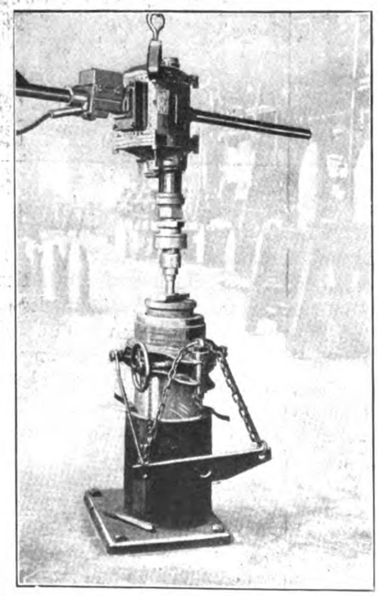


FIG. 19. OPERATION 12: SCREWING IN ADAPTER PLUG
Machine Used—None.
Fixtures and Tools—Pot chuck and pin wrench.
Production—5 min. each.

diameter. A finishing tap is also used, in order to maintain the thread size. Production time, 15 min. each.

The thread is then cleaned out with a brush and an air jet, and the adapter, which has been previously made, is screwed into place, as in Fig. 19. The shell is held in a clamping stand, Fig. 14, for this, the eleventh, operation.

With the adapter screwed in place, the large end of the shell must be faced to weight on the lathe shown in Fig. 20. The shell is held in a regular draw-in chuck.

Over this lathe is a jib crane that carries a beam scale, as can be seen. Suspended from it are the chain hoist and shell clamp. The shell is first weighed, then placed in the chuck, and the proper amount is faced off according to a table that is hung up in plain sight at A. A few of the main equivalents are shown herewith, from which it will be seen that facing off $\frac{1}{32}$ in. of both shell and adapter plug reduces the weight 6¾ oz., while $\frac{3}{32}$ in. gives 1 lb. 4 oz.; and ¼ in., 3 lb. 5¾ oz. This system

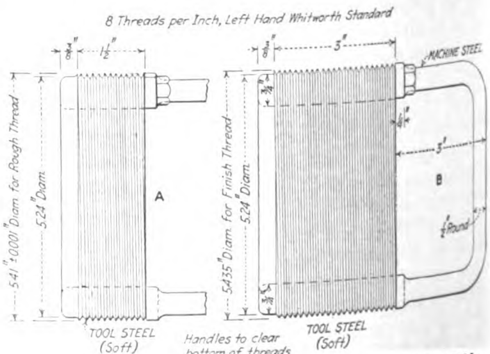


FIG. 18-B. THREAD GAGE FOR BACK END OF SHELL

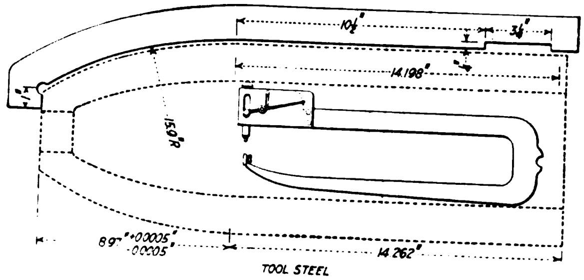


FIG. 20-B. GAGES FOR LENGTH AND WALL THICKNESS

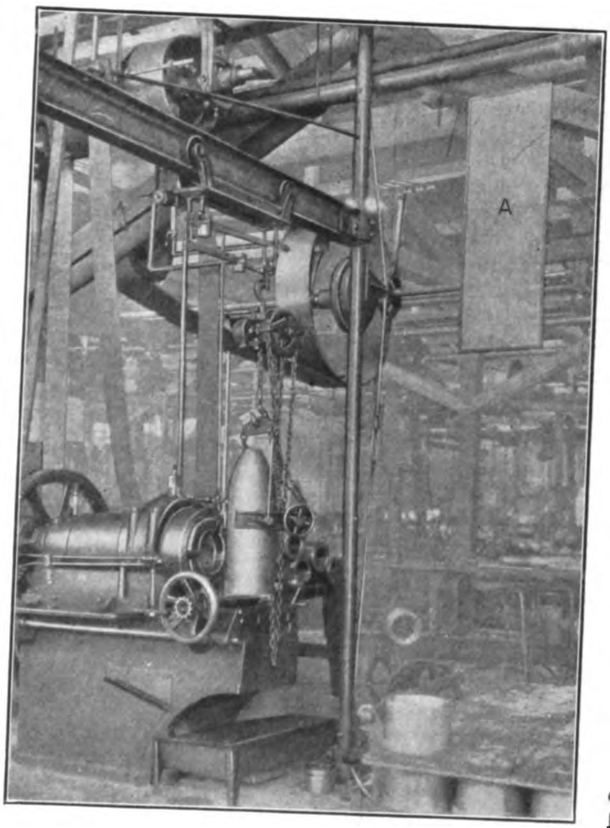


FIG. 20. OPERATION 13: FACE TO WEIGHT
Machine Used—Root & Van Dervoort special.
Fixtures—Scales and clamp.
Gages—See Fig. 20-B.
Production Time—15 min. each.

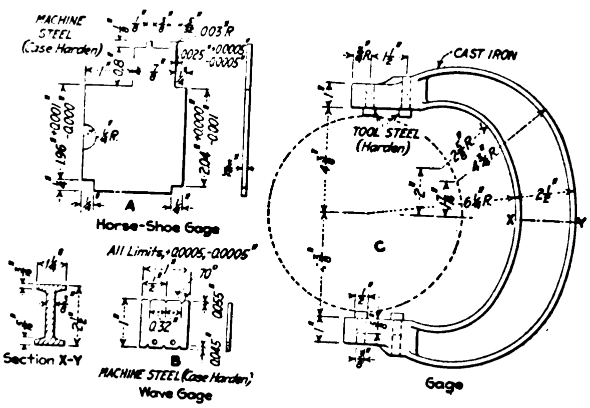


FIG. 15-B. GAGES FOR OPERATION 9

makes it easy to bring the shells to proper weight very quickly and with a degree of accuracy that largely reduces the cut-and-try plan.

After facing to weight, the end is again stamped with the heat number and other symbols, as in Fig. 21-A, this work being done by hand through a specially made guiding plate. The adapter plug is removed for cleaning the inside and varnishing, an electrically driven drill properly geared down serving for this purpose. The way in which this is done is shown in Fig. 19, the motor being suspended and counterweighted for easy handling.

The shells are cleaned with hot soda and water by the arrangement shown in Fig. 22. It consists of a framework *A*, built up of wood and steel, into which the shells are set point down. The whole framework is then lowered into the tank of hot soda water, where it remains as long as necessary. The shells are next washed in plain water, after which they are ready for varnishing.

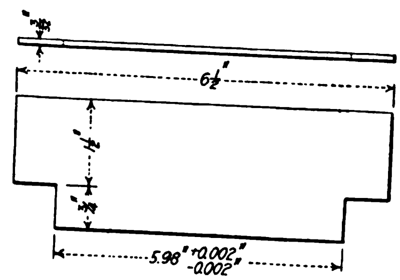


FIG. 18-B. GAGE FOR OPEN END OF SHELL

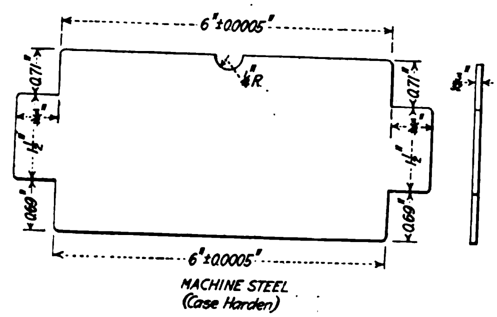


FIG. 18-C. LIMIT GAGE FOR OPEN END OF SHELL

The varnishing is done by a different method than usually employed. For this purpose special trucks, Fig. 23, have been made, the upper part consisting of a framework that carries 12 shells, nose down, in a cast-iron frame. The construction of this frame is given in Fig. 24, a bronze collar with the same curve as the nose of the shell being placed in the lower section to hold the shell firmly without bruising.

The truck with its load of shells is run beside the varnishing tanks, which are shown in outline in Fig. 25. One of the elbows, seen in place on the truck, is screwed into the nose of a shell, completely covering the threaded portion and thereby preventing varnish from getting into it. The elbow is then connected to a hose running to the varnish tank. Manipulating the three-way cock allows pressure from the air tank to force varnish up into the shell, which is stopped when the height reaches the recess below the adapter-plug thread. The air is then shut off, and the varnish returns by gravity to its tank, allowing just enough to adhere to cover the inside of the

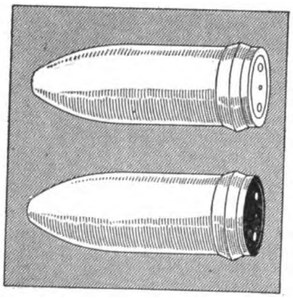


FIG. 20-A. OPERATION 13: FACE TO WEIGHT

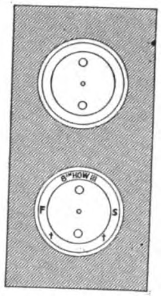


FIG. 21-A. OPERATION 14: STAMP END OF SHELL

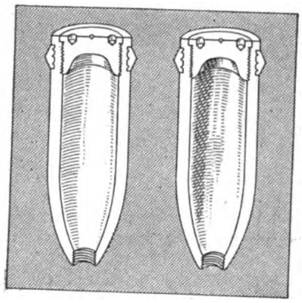


FIG. 22-A. OPERATION 17: VARNISHING INSIDE OF SHELLS

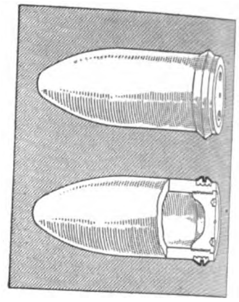


FIG. 26-A. OPERATION 18: TURN COPPER BAND

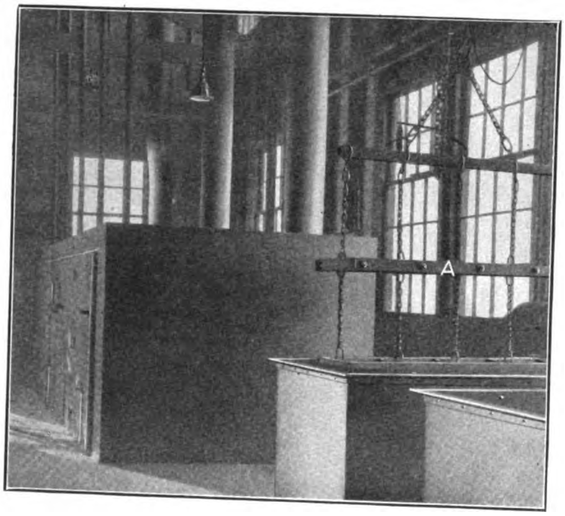


FIG. 22. SODA TANK AND OVENS

shell. With the elbow left in place, to prevent the varnish from running down into the thread, the truck load of shells is run into the baking oven, Fig. 22, where they are held at a temperature of 300 to 325 deg. for a sufficient period thoroughly to bake the varnish.

The bands are next turned on a short-bed Root & Van Dervoort lathe by means of two formed tools. The front tool merely roughs out the band to the approximate shape, while the rear undercutting or shaving tool gives it the final form, including the proper serrations at the point.

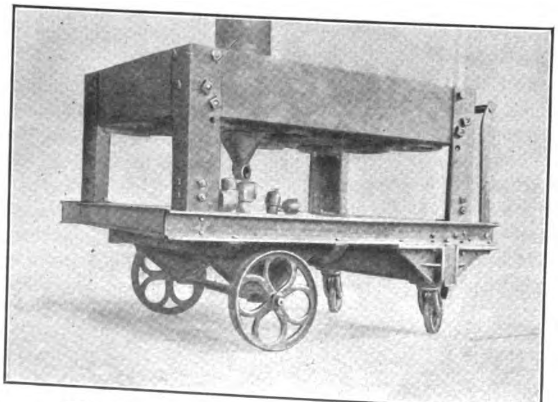


FIG. 23. SPECIAL TRUCK FOR VARNISHING

Final inspection comes next, after which the grommet or endless-rope band is slipped over the shell close up to the front of the upper band as in Fig. 27. The grommet remains on the shell, as it affords protection to the band, both in handling and in shipping. Then the plug is screwed into the body, and the shells are boxed for shipment, one shell in a box.

The adapter plug, which screws into the base of the shell, is made from a forging weighing 30 lb. The first operation, Fig. 28-A, is to face and rough-turn the head on a large Potter & Johnston machine, the regular tool equipment being used for this purpose. Next comes

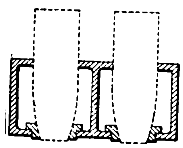


FIG. 24. SECTION OF TRUCK

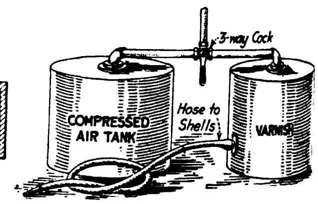


FIG. 25. THE VARNISHING TANKS

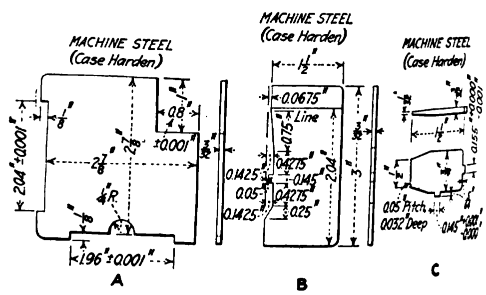


FIG. 26. GAGES FOR BAND, OPERATION 18

the drilling of the two ¾-in. holes for the pin wrench and also for holding in some of the future operations.

This operation is shown in Fig. 29-A and the drilling fixture in Fig. 30. The piece is chucked by the head and rough-turned on the outside, while the curved contour is also roughed out by flat cutters approximating the correct form. Both a Potter & Johnston machine with sweep cutters and a Root and Van Dervoort shell machine are employed. Special cutters are used with a hydraulic feed.

The plug is driven by two pins fitting into the wrench holes, while the plug itself it held by three chuck jaws. The holder *A*, Fig. 31, bolts against the face of the chuck and allows the jaws to act in the three slots shown, the driving stress being carried by the two steel pins.

Then the outside is finish-turned and the curved contour swept out to shape, the undercut for the thread being made at the same time, either on a Root & Van Dervoort or on a Potter & Johnston machine.

The thread is then cut under a Baker vertical heavy-duty drilling machine, Fig. 32, furnished with a Murchey self-opening die and a special knock-out that has been arranged particularly for this work. It consists of two fingers of small section, which go down between two of the chasers, opening the die when they strike the head.

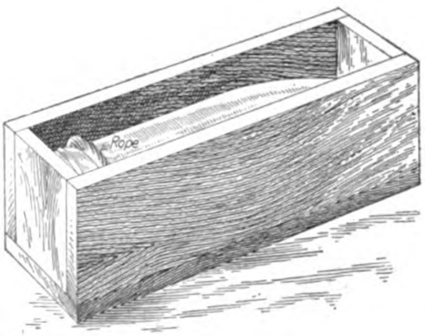


FIG. 27. GROMMET IN PLACE

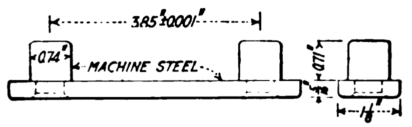


FIG. 29-B. GAGE FOR HOLES IN PLUG

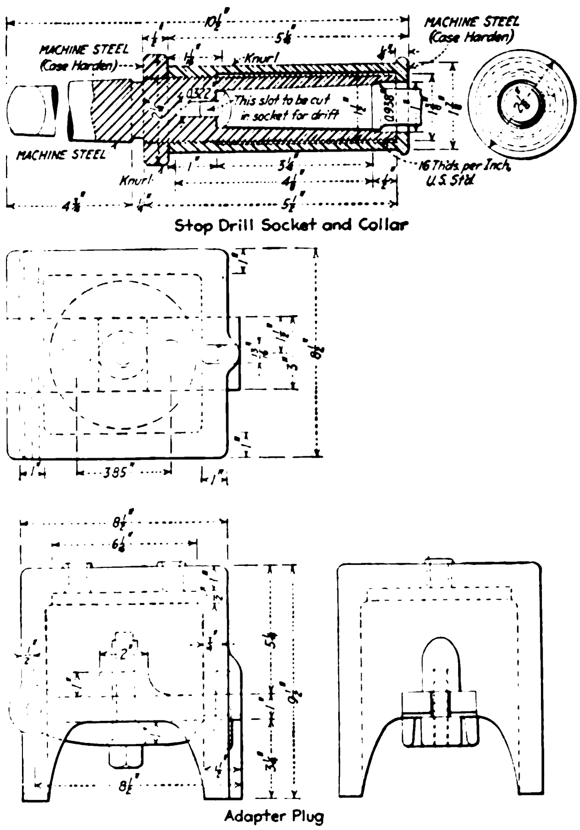


FIG. 30. DRILLING FIXTURE FOR PLUG

The thread is an 8 to the inch, of Whitworth form and left-handed, and the cutting is done at 8 r.p.m., using for a lubricant Sol-cut with a trace of tri-sodium phosphate added to it. It has proved much more satisfactory than the cutting oil that was first tried, as it leaves a better finish on the work and is apparently easier on the die.

The plug is held for threading by simply placing the two wrench holes over dowels in the holding fixture on the drilling table. The operator makes a small punch mark to show which way the plug was placed on the fixture for the first threading.

The feed is geared so as to lead the die at its proper rate, and the punch mark allows the plug to be replaced for the finish threading without difficulty. By bringing the die head down on a distance block before throwing in the feed, the proper lead is maintained, and there is no trouble experienced in catching threads. The finishing die removes $^1/_{64}$ in. and leaves a good thread on the plug. The roughing cut is taken at the rate of 8 r.p.m., while the finish cut is speeded up to 12 r.p.m.

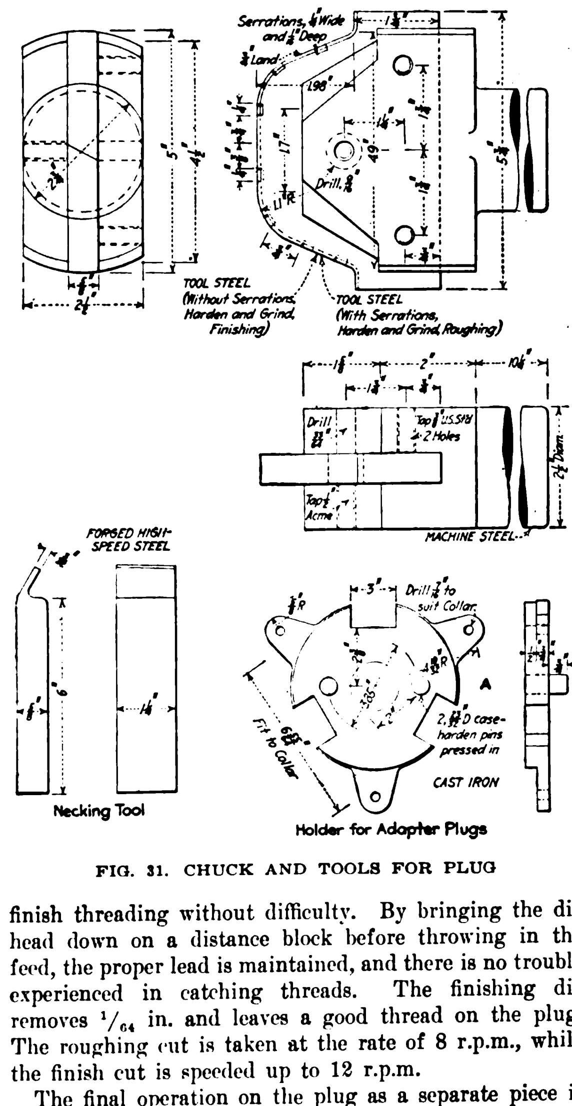


FIG. 31. CHUCK AND TOOLS FOR PLUG

The final operation on the plug as a separate piece is to screw it into a sleeve chuck, Fig. 33A, which bottoms it so as to allow the fillet to be turned and the under side of the head to be squared. The outside is then turned true with the thread, this being done on an engine lathe that happens to be available. The finished plug weighs about 19 lb.

The inspector's instructions are given, to show the special points to which they must give attention.

INSPECTION INSTRUCTION

Inspection of Rough Forging—The rough forging is examined for heat number and for the two acceptance marks. If the heat number should come directly on the nose of the shell, it is transferred by the inspector to the side of the nose of the shell. The shells are inspected for lengths, outside diameter and inside diameter, which is done by the use of calipers, and are also measured for concentricity by the use of a special concentricity gage.

From four to eight shells are placed on the bench by the inspector's helper, and the inspector does the measuring, carefully marking the amount of concentricity at the high point of the shell. This marking is done with a brush and yellow ochre. Shell forgings are piled so that all forgings eccentric ⅛ in. or more are in one pile, while forgings that come eccentric ⅛ in. or less are piled in another pile.

The forgings are also inspected for deep flaws or grooves. All forgings not coming up to requirements are held for the decision of the chief inspector, who in turn takes up any questions as to the availability of the forgings with the British inspector.

Operation 1: Drill and Rough-Face—The length of hole is carefully inspected by the use of gage provided. The inspector also looks through the hole in the nose of shell from the rear end, ascertaining if the hole is reasonably concentric with the bore. The inspector ascertains that there are no flaws in the hole.

Operation 2: Cut Off End—The inspector ascertains that the operator has transferred the heat number from the nose of the shell to the end which has been cut off. The length of the shell is ascertained by use of gage provided. The forging also is inspected for cracks or flaws.

Operation 3: Rough-Turn—The inspector ascertains that the outside diameter is within the limits according to special gage and also ascertains that the contour of the outside is according to the special gage. The diameter of the small end is carefully measured with a special limit gage which has not yet been made. The finish is examined, and care is taken to see that there is no step of appreciable depth in the forging, and also the whole exterior surface is carefully examined for flaws.

Operation 4: Rough-Bore—The inside diameter is checked with limit gages provided. The inside contour is checked with gage provided and the length of the hole in front carefully checked to see that same will clean up. A special gage must be provided for this. The interior surface is carefully inspected by the aid of a looking-glass and a small electric light, or other suitable means to ascertain that there are no flaws or cracks in the forging.

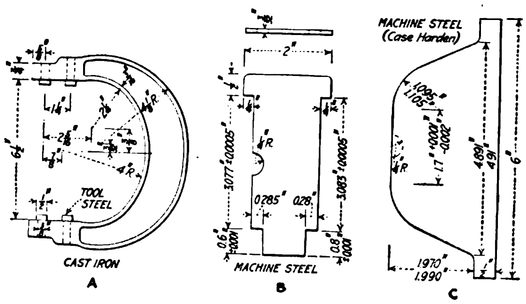


FIG. 31-B. GAGES FOR ADAPTER PLUG

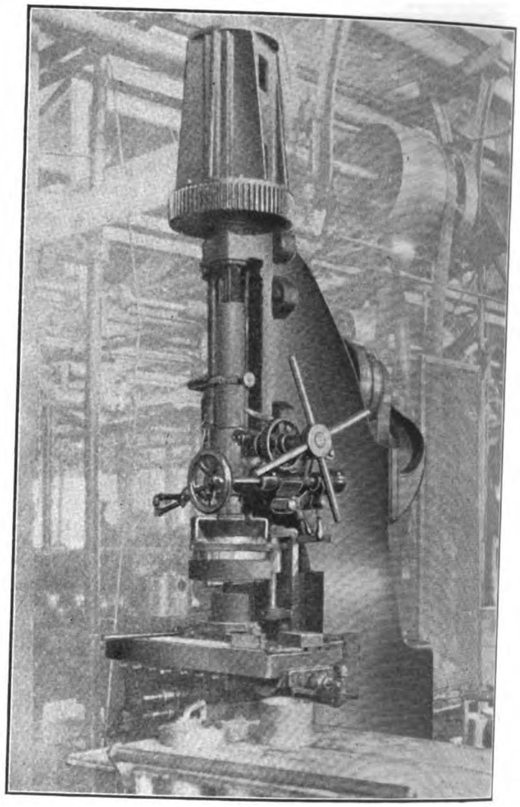


FIG. 32. ADAPTER OPERATIONS 5 AND 6: CUT THREAD WITH DIE

Machine Used—Baker heavy duty drill.
Fixture and Tools—Holder and Murchey die.
Gages—Ring thread gage.
Production—5 min. for rough, 4 min. for finish.

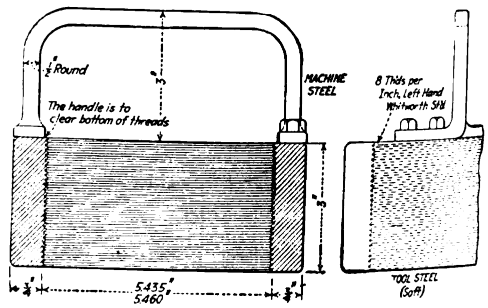


FIG. 32-B. GAGE FOR PLUG THREAD

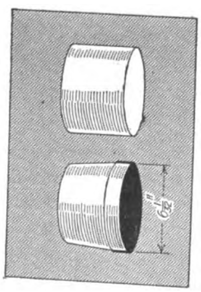


FIG. 28-A. OPERATION 1: ADAPTER PLUG FACE AND ROUGH TURN

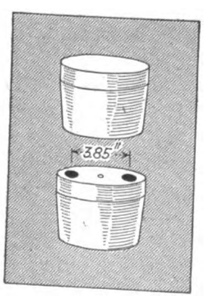


FIG. 29-A. OPERATION 2: DRILL WRENCH HOLES

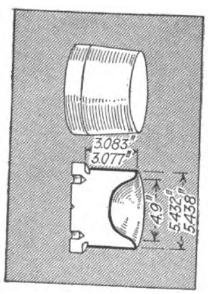


FIG. 31-A. OPERATIONS 3 AND 4: R. & F. TURN AND SWEEP

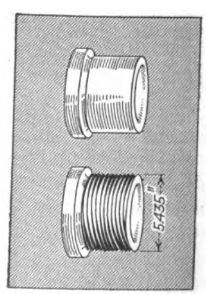


FIG. 32-A. OPERATIONS 5 AND 6: CUT THREAD WITH DIE

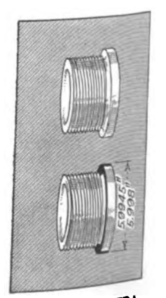


FIG. 33-A. OPERATION 7: SQUARE UNDER HEAD AND TURN

Operation 5: Finish-Bore—The inside diameter is checked according to gages. The contour of the inside is checked according to gages, and the general concentricity of the shell is ascertained by the use of callipers. The length of hole and nose is also carefully watched for, and a special gage is used which is not yet designed. Special care is taken to ascertain that the proper finish is obtained in the bore, any irregularities being cause for the rejection or holding for correction of the work. The shell is also inspected for flaws.

Operation 6: Bore and Thread Nose—The final stamping of the heat number on the rounded part of the outside of the shell is ascertained. The outside diameter in front of the copper band is checked with gages provided. The diameter of the sides below the copper band is checked with gages provided. The diameter of the face of the nose is also carefully checked, and a gage must be made for this. The outside finish is inspected and must be as good or better than the sample, which must be made.

The diameter of the side of the hole is carefully ascertained by the use of limit gages provided, and the diameter

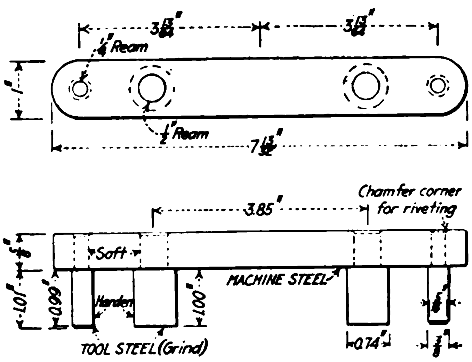


FIG. 32-C. GAGE FOR HEAD OF PLUG

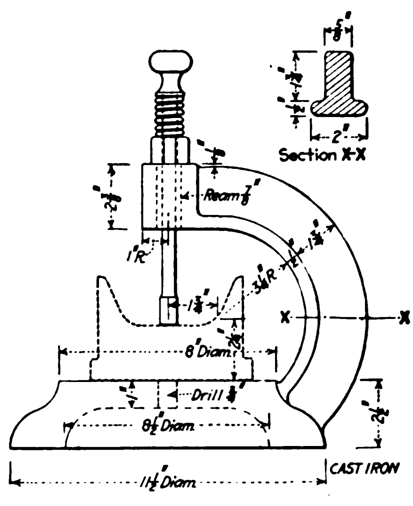


FIG. 32-D. MEASURING THICKNESS OF HEAD

and angle of facing are carefully checked. The finish of the thread is carefully inspected and is also inspected for flaws or chipping out in this thread.

Operation 7: Drill and Tap for Grub Screw—The distance of the hole from the face is ascertained, and size of the thread is tried with a tap used as a plug gage. The appearance of the thread is carefully checked, and if the thread causes a burr on the large thread in the nose the shell body must be retapped.

Operation 8: Wave Grooves—The width of the groove, the diameter at the bottom of the groove, the diameter of the waves, the throw of the waves and the amount of undercutting are carefully checked by the use of gages provided. The finish of the waves and the groove in general is carefully checked.

Operation 9: Bands—All copper bands are examined before they are placed on the shell, to ascertain that no scale is on the inside of same. After the shell is banded, the inspector tests the band by the use of a very small hammer, placing his left finger on the part near where he strikes a blow, and he can readily ascertain whether the band has been properly seated. Great care is exercised at all times so that careful inspection is maintained on this point.

Operation 10: Thread and Counterbore—The forging is carefully inspected for size of counterbore, for fillet at bottom of counterbore, for smoothness of machining, for correct size of thread and depth of same in relation to necking.

Operation 11: Clean Threads—The threads are inspected to ascertain that they are perfectly clean, the operator calling on inspector before screwing in the adapter plug. The adapter plug is then screwed in, in the inspector's presence, and same must be screwed in so that the head will seat properly in the counterbore. A little vaseline mixed with gasoline is used as a lubricant.

Operation 12: Facing to Weight—The shell is examined to see that the face is smooth, to see that the radius of the fillet is correct, and is also carefully weighed to see that it comes within the limits of the weight requirements.

Operation 13: Stamp—The shells are carefully inspected to see that the proper stamping, consisting of 8-in. Howitzer—3, F & S, date of completion, trade-mark, heat number and serial numbers are stamped neatly and correctly.

Operation 14: Remove Adapter Plug—No inspection is necessary except to be sure that the operator does not damage the threads of either the shell or adapter plug in this operation.

Operation 15: Clean Shell—The shell body, especially the interior, is gone over carefully to see that shell is perfectly dry and clean.

Operation 16: Varnish—Special attention is given to this operation, as it is imperative that the coating of the varnish is absolutely smooth, free from cracks and that there is no varnish in either of the threads. The inspection can be well done with an electric light and a mirror.

Operation 17: Turn Copper Bands—The diameter and general shape, the width and depth of groove, the spacing of serrations and the shape of the band are carefully inspected by the use of gages provided. The finish according to sample must be maintained.

Preliminary and Final Inspection—The preliminary inspection consists of going over each shell body and adapter plug and ascertaining that all dimensions and conditions are according to the drawing and specifications. Gages are provided for this operation, but a scale is used in order to enable the checking of the weight of various parts, so that the weight will come out right in the end.

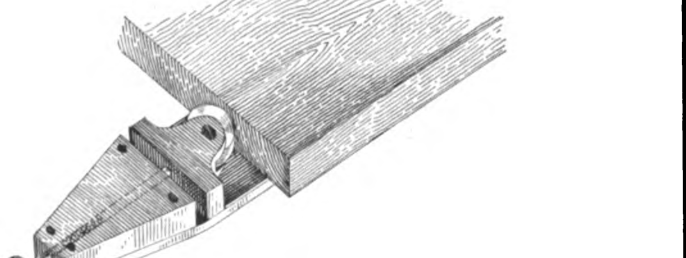
The final inspection consists of going over all inspection done prior to this operation and checking up each item to see that the shell is according to the accepted standards. The adapter-plug fit is carefully tried on each shell.

Stellite is now being used on the rough-turning, rough- and finish-boring and finish-turning operations with $\frac{1}{24}$-in. feed and 105 to 120 ft. per min. cutting speed, which makes a very satisfactory job. This alloy comes in three harnesses—Nos. 1, 2 and 3, No. 2 being found most desirable for this class of work.

Attachment for T-Squares

By J. M. Fitzgerald

The accompanying illustration shows an easily constructed and satisfactory attachment for small T-squares.



ATTACHMENT FOR SMALL T-SQUARES

Any desired tension may be obtained by means of the knurled screw, so that the board may be used at any angle and the square will stay wherever placed.

A Department of Economy*

By W. Rockwood Conover†

The organization of every large industry should include a department of economy. Even in the smaller factory some person should be definitely assigned to the work of investigating and controlling the expenditures on expense and investment accounts. The scope of this work is so broad that it does not receive adequate attention where it is divided and the responsibility assumed by busy officials or placed on the heads of manufacturing departments. The big industries and many municipal corporations are already recognizing the importance of maintaining a department specially devoted to the study and control of expense matters. Publicity is one of the most potent factors in overcoming waste and extravagance, either in public or private business, and the department of economy exerts a most valuable influence toward this end.

The economist must be a person of broad experience in his line of work. He must be a free lance in the factory, in order to pursue his duties with a good measure of success. It is his function to investigate conditions in any office or department, and in doing this he should have unrestricted authority to ask and insist upon the coöperation of the foreman or his assistants. All expense matters, whether relating to labor or material charges, come under his observation. A record of the organization of each department should be maintained for reference, and this record should be correct to date at all times. At the close of the month reports of the number of help of all classes working in each shop or office should be sent to the desk of the economist for inspection. These reports bear the signature of the foreman as certification that they are correct. All requests to supply additional expense help should also be sent to the department of economy for approval before the help is employed. By comparing the number of expense employees with the number of productive employees working each month the economist is able to judge whether the foreman is justified in asking for additional labor in the expense classes. Productive conditions, such as new orders or rush business, should receive his consideration in making decisions. The regular reports of the production department relating to apparatus on schedule, shipments, unfilled orders and new business are also of assistance to him in his work.

One of the functions of the economist's office is to issue to the head of each department a weekly budget statement of expenditures on the various expense shop orders, including manufacturing expenses and maintenance of property items. On this sheet is shown the budget allowance per week against each separate account for operating expenses. These statements are carefully scrutinized, the expenditures for the different classes of labor compared with the budget allowance and checked, whenever necessary, with the organization record showing the number of help employed in any given classification under investigation. These sheets are compiled from the payroll records immediately on the close of the roll, which enables a prompt investigation to be made while the cause for any increase in expenditure is still fresh in the foreman's mind. This system of furnishing information to department heads and making criticisms week by week exerts a wholesome influence in establishing uniform efforts toward economy and permanent methods of control.

Reports of all expense materials, such as miscellaneous shop and office supplies, lubricants, fuel oil, gas, etc., consumed in the various departments should be sent each month by the central storekeeper to the department of economy for inspection and criticism. The amounts used are in turn sent out in a detail report to each foreman, so that he may be posted on these expenditures in his individual shop. The issuing of these reports regularly has a marked effect in preventing extravagance and waste. Constant investigation by the economist also exerts a helpful influence in teaching the head of each department to keep a close watch upon these items. It opens the way for devising means of controlling the consumption more adequately than is feasible where the matter is left in the hands of the foreman.

Machinery and tool-repair accounts, miscellaneous repairs and all expenditures on maintenance of property accounts are items that should receive the attention of the economist. In like manner all purchases of office furniture, office supplies and forms, miscellaneous shop equipment and purchases in general of a special or expense nature require the consistent attention of some person equipped with the knowledge and experience to pass upon these items.

In the small factory the superintendent may find time to look into these matters with some measure of success, but in the big, modern industry his time is largely taken up with business of an executive nature, which prevents the investigation of a very large number of details usually considered of lesser importance and which are usually left to the heads of individual departments, with the result that many such items receive only indifferent attention or no attention at all. The field for economic work in these large plants is practically without limit, and the organization of such work on a systematic basis of continued, efficient effort is worthy the manager's serious consideration as a profitable feature of business.

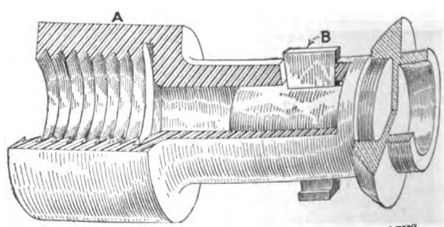
*Prepared for the author's forthcoming book on "Industrial Economics." Copyright, 1916, Hill Publishing Co.

†Factory economist, General Electric Co.

Simple Chuck for Machining Shrapnel Noses

By Fred Fruhner

The illustration shows a simple chuck for turning and threading brass noses for shrapnel shells. The chuck consists of a body *A*, which screws on the spindle. The other end is threaded to go into the work. The shank has a taper slot *B* in it, so that when the job is put on, the key is loose. By driving the wedge down, the work is ready for operation.



CHUCK FOR MACHINING SHRAPNEL NOSES

Successful Suggestion Plan

By W. J. Tewksbury*

SYNOPSIS—The reason why so many suggestion plans fail is because they are allowed to die a lingering death. Enormous energy is put into them at first, but the interest in them is allowed to dwindle. The suggestion plan described herewith is a success because the management put sufficient energy into the project to keep it alive.

Various kinds of suggestion plans have been tried and condemned as, partial, if not complete, failures by a great many manufacturing concerns in the past. I have had considerable experience during the past 15 years with a number of schemes which failed and others which at the start showed promise, but later had to be dropped through lack of satisfactory results obtained or lack of interest generally.

Some four or five years ago, however, a new attempt was made, no scheme of this character having ever previously been tried out by our company. Notices were

SUGGESTIONS

Every EMPLOYEE of this company is invited to make SUGGESTIONS.

We want your CO-OPERATION in our work.

We welcome CRITICISM.

YOU are on the job. YOU are in a position to know what is needed, in many cases, BETTER than any one else.

USE the suggestion BLANKS. Seal the SUGGESTION in the addressed envelope and place it in the suggestion BOX at the EAST or WEST entrance, or send it through the MAIL (Local service).

Each suggestion will receive my personal ATTENTION.

If you don't THINK the reason given for rejecting a suggestion is a good one, take the question up PERSONALLY with the undersigned.

If you do not receive an ACKNOWLEDGMENT for each suggestion sent in, NOTIFY the undersigned.

DO NOT expect to be advised as to the REJECTION or ACCEPTANCE of your suggestion at once. It takes TIME to investigate and to SECURE the facts before passing on its MERITS.

W. J. TEWKSBURY,
Factory Superintendent

FIG. 1. NOTICE SOLICITING SUGGESTIONS

printed and posted on the bulletin boards throughout the factory, and a quantity of printed suggestion blanks was supplied to each department. The notices asked employees to make suggestions at will, and for a while quite a number were received, many of which were worth while, saving money, improving quality, etc.; but after a number of months they began to drop off. A few of the foremen, however, took considerable pride in the matter from the first and were so enthusiastic in their efforts that it occurred to me that the solution of the problem was not so difficult a one as it appeared. The idea worked out in detail in the following manner:

First, printed cards, as in Fig. 1, were neatly framed and posted throughout the factory, most of them being placed above the drinking fountains, where they would be seen by all employees. Directly below or to one side of the framed notice was fastened a suitable box, on

SUGGESTIONS

2366

Date 8-17-15

I suggest that in packing the connector shelves, that the brace which holds down the shelf be bolted in and the lid be fastened on with screws, by adopting this method the boxes will not be destroyed and they can be returned. These boxes cost $1.97 each. We will require 600 boxes on the St. Paul alone.

Signed, G. Green Dept. No. 07

Please investigate the above suggestion and return to me with the following information:

Signed, W. J. Tewksbury
FACTORY SUPERINTENDENT

Does the suggestion involve a change in design? No

Estimated cost of machine equipment required? None

Estimated cost of new tools or fixture required? None

Probable future yearly demand? 600 boxes for St. Paul alone

Estimated saving per unit? $1.37 per box

Estimated total yearly saving? $822.00

Remarks Get estimated cost of return of boxes, subtract from total saving. You should have cost of present box, cost of new box, etc.

Signed, ______ Dept. No. ______

The Department designated shall secure above information and return to Factory Superintendent.

SUGGESTION { ~~Rejected~~ Approved

W. J. Tewksbury,
FACTORY SUPERINTENDENT.

ADDITIONAL INFORMATION OR SKETCHES CAN BE MADE ON THE BACK OF THE SHEET.

FIG. 2. FILLED-IN SUGGESTION BLANK

the front of which was lettered the word "Suggestions." In this box was put a supply of suggestion blanks similar to the filled-in blank in Fig. 2, inclosed in addressed envelopes like Fig. 3. An employee can take a blank without being required to go to the foreman's desk and ask for a blank and envelope. The average workman is found to be disinclined to do anything which in his estimation is likely to get him in wrong with the man to whom he reports. Human nature will out, and in some cases undoubtedly a jealous foreman afraid of his job might take offense at something some one of his employees suggested.

To eliminate so far as possible any chance for a feeling of this nature and to make it easier for the employee to do what he might like to do, we placed these addressed envelopes containing suggestion blanks as specified. Another change that is vital to the success of the plan now in operation consists in requiring each

*Factory Superintendent, Automatic Electric Co., Chicago, Ill.

foreman to send in a report once a week to the factory superintendent. He can make as many suggestions as he sees fit; but in case he has no idea to suggest during the week, he must before 9 a.m. of the following Tuesday send in a suggestion blank on which he writes, "No suggestion for this week," and signs his name thereto. Any foreman failing to send in at least one bonafide suggestion or a blank with the foregoing remark during the week receives at once a copy of a form memorandum, Fig. 4. A factory superintendent's instruction No. 64, dated Apr. 20, 1912, had already been sent to each department, outlining the proposition in detail, Fig. 5.

W. J. TEWKSBURY
Factory Superintendent,
DEPT. 51

FIG. 3. THE ENVELOPE

This one requirement can be said to have contributed more to the success of our plan than any other one thing.

Pride entered into the matter. A foreman, realizing that a report must be made, disliked the idea of sending in a blank with a signed statement to the effect that he could think of nothing to improve conditions in any way, shape or form in his own department or anywhere else. He well knew that this department was far from perfect, and he know that I also was aware of it, with the result that the foreman began to think. Instead of taking things for granted, he began to use his head in a new manner possibly. He began to look for ideas, and in seeking for something worth while he discovered many cases that called for investigation and improvement. He found this layout in error, a blueprint incorrect, a tool or fixture so designed as to interfere with the operator's being able to turn out the maximum output in the minimum time. He discovered that he was possibly doing work that need not be done or that could be handled in another department at a lower cost and also save a transfer. His reserve force of brain power was brought into active use and developed. He became a more forceful executive, looking at the world and at his work in particular from a different angle, and this example had its effect. As a result, thinking

Date.__________

Dept. No.________.

Your attention is called to Supt. Inst. #64 which specifies that:-

"All Shop Foremen shall make a suggestion report at least once a week to the Shop Superintendent on F-248."

"If there are no suggestions to be made, they shall send in a report in the same manner marking it "no report" and sign same."

Your report for week ending__________has not been received. Please forward same at once, and in the future arrange so that this report will be sent in and received by Dept. #51 not later than 3 o'clock Monday of each week.

____

FIG. 4. A GENTLE REMINDER

became more and more apparent, others became infected with the same desire and the plan became a success.

Of course, all was not accomplished in a day, a week or a month. Conditions changed gradually and were assisted by various schemes all working to one end, such as blotters, Figs. 6 and 7, and time cards, Fig. 8. The blotters are distributed to the office staff, foremen, engineers and draftsmen, while the daily time card is used by every factory employee for recording his time.

Lead pencils on which were stamped the company's name and the additional words, "Suggestions Wanted," were purchased and acted as a constant reminder to all employees who used pencils. In each department we placed blue or brown prints mounted on heavy cardboard and changed monthly. Problems for the month appear on this sheet and also a calendar for the month. Figs. 9, 10 and 11 are samples of the sheets mentioned. By selecting each month a new subject for the problem, such as time, thrift, save, efficiency, scheduling, trucking,

Factory Supt's Inst. #64
April 20th, 1912.

SUGGESTION REPORTS

All Shop Foremen shall make a suggestion report at least once a week to the Factory Supt. on Form F-248.

If there are no suggestions to be made they shall send in a report in the same manner marking it "no report" and sign name.

Suggestions, such as improvements in methods of manufacturing, tools, equipment, increase of efficiency, saving in the management of departments, should be reported. The reports are to be sent to the Factory Supt. (Dept. #51) in a sealed envelope, and an investigation will be made under personal instructions from his office.

Suggestion forms should specify the piece number or drawing number in each case, and explain briefly and precisely the suggestion to be considered. If a sketch is required to give the necessary information the same can be made on the reverse side of the suggestion report Form F-248.

These suggestion report forms are to be used by any employee desiring same. Forms shall be kept in a box in each department for use of employees desiring them.

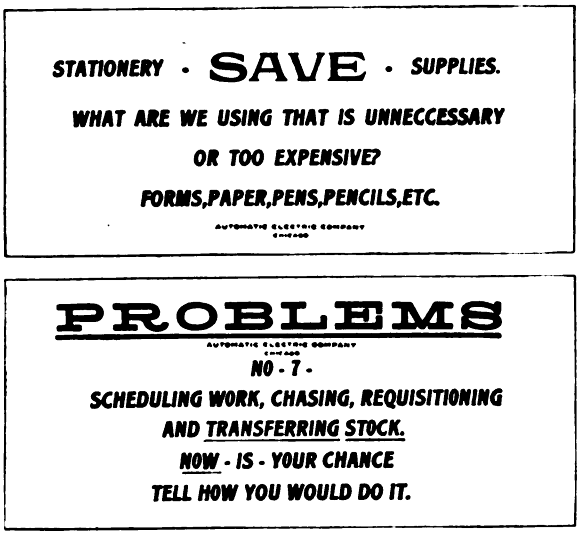
W. J. Tewksbury,
WJT/S. FACTORY SUPERINTENDENT.

FIG. 5. OUTLINE OF SYSTEM SENT TO SHOP FOREMEN

rate setting, etc., interest is maintained, and new lines of thought are developed. In addition to the blueprint problem and calendar referred to, it was my practice to send out a letter to all department heads, foremen included, in which the problem was discussed at some length.

About a year ago we began issuing monthly bulletins, printing a sufficient number so that each employee interested received one. In addition to this monthly letter a lot of local news appears in the bulletin, "doings," and has gone a great way in creating further interest in this plan, particularly with those who previously had given the matter but a small amount of consideration. The results of our first year's experience were not altogether satisfactory, and we made changes until we have what may be considered a fairly successful "Suggestion Plan," even if passed on by a biased judge.

The management realized before the end of the second year that the plan was working along the right lines, and a banquet was arranged for. Employees who had to their credit an approved suggestion during the year were given a ticket to the banquet and came as guests of the company; all other employees were required to pay. In addition certain employees, according to the value of suggestions approved, were presented by the management with gold, silver and bronze watch fobs, suitably engraved to show that they were presented by the company for valuable suggestions during 1913. The following year, 1914, was more successful as a record producer. In 1912 there had been but 41 employees, who made a total of 302 suggestions, of which we approved 147. In 1913, from 137 men and women came a total of 714 suggestions, of which there were 481 approved. In 1914 the 146 employees made 1,314 suggestions, and we approved 613 as being worth while. In 1915, the total number of employees being considerably reduced on account of business depression, there were but 135 who sent in suggestions. However, the total number made increased to 2,345, of which 1,189



FIGS. 6 AND 7. TWO FORMS OF BLOTTERS

were approved, or more than 50 per cent. In 1914 we celebrated the conclusion of the year's work by a banquet, at which we presented to those who had distinguished themselves various tokens of the company's appreciation.

The best record was made during that year by the foreman of our screw-machine department, and he received a 21-jewel gold watch. Others received 17- and 15-jewel gold watches, diamond-set knives, gold, silver and bronze watch fobs, etc. The value of the total approved suggestions made determined the class in which the individual was placed, and the value of the article presented was in accordance with the value of the suggestions received from that particular individual. There were seven classes or divisions that year, the seventh being those who had at least one approved suggestion to their credit and were therefore invited to be the guests of the company at the banquet.

In 1915 the same arrangement was made, with the addition of a dance after the banquet. The tokens for 1915 consisted of all the articles used in previous years, with the addition of three classes of rings. In class No. 1 the rings were set with ten diamonds, one in each of the finger holes of the dial of the automatic phone, as on each ring was engraved a facsimile of the dial. Class No. 2 rings were set with one diamond, and class No. 3 were plain, all, however, being engraved with the dial, as in case of classes No. 1 and No. 2. The banquet was attended by 700 of our employees, which was just double the number attending the first banquet in 1913. We have received suggestions from office boys, clerks and stenographers. Everybody is thinking, and the fever is catching.

We bar all employees above the rank of foreman from competing, but do not of course bar them from making

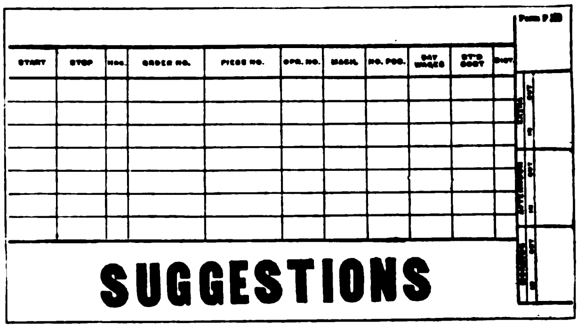


FIG. 8. THE TIME CARD

suggestions. The greatest saving which any one suggestion has made during a single year is $6,700. We have had several instances where the total value of all the suggestions made during the year by one employee reached $1,000 or more. There have been hundreds of approved suggestions on which no money value could be figured, and many cases where adopting the suggestion has meant a higher manufacturing cost and the expenditure of a considerable sum of money for tools,

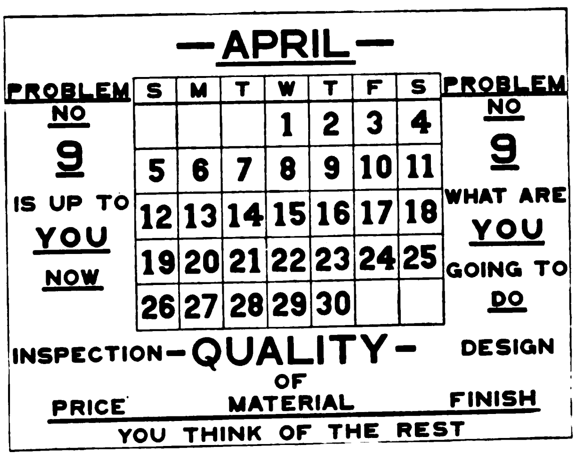


FIG. 9. EXAMPLE OF MONTHLY CALENDAR

fixtures, etc. We encourage safety-first suggestions, and they are frequently received.

I recall that one boy in particular, one of our mail carriers whose duties took him all over the plant, made 14 suggestions during the year 1915, and 8 of them were approved. They were all worth while, although none of them saved any great amount of money, nearly all being

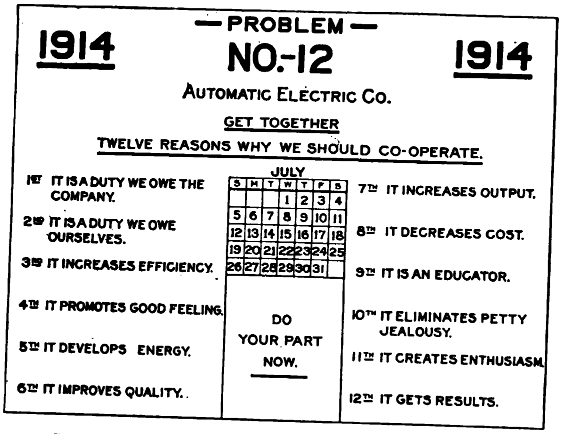


FIG. 10. EXAMPLE OF MONTHLY CALENDAR

along the line of efficiency. For example: In the office in which this boy works there are about a dozen overhead 250-watt lights, one for each 16-ft. square. Each one is controlled from a switchboard located at one end of the office. One of the errand boy's duties is to switch off lights when not needed or to switch them on at request, and it was noticed that each time a new boy was hired he had to learn which button to snap. The suggestion was to put up a plate designating the buttons and thus avoid delay and annoyance. I simply cite this case to show what a boy will notice and comment on when the whole force is more or less interested. Each suggestion when received is given a number and immediately acknowledged on the form, Fig. 12; when approved or rejected, the person making the suggestion is immediately advised by a special form.

Our suggestion year begins on Dec. 1, and since that date last year we have received 854 suggestions. There have been approved so far this year 297 suggestions. A number of these, however, were suggestions made last year, as it sometimes takes several weeks and often months before a suggestion is finally approved or rejected. There are several reasons for this. Suggestions of most importance are acted upon first; and frequently a suggestion may require experimental work and the approval of the engineering department, as well as various other departments, in some cases, all of which takes considerable time before justifying a final decision.

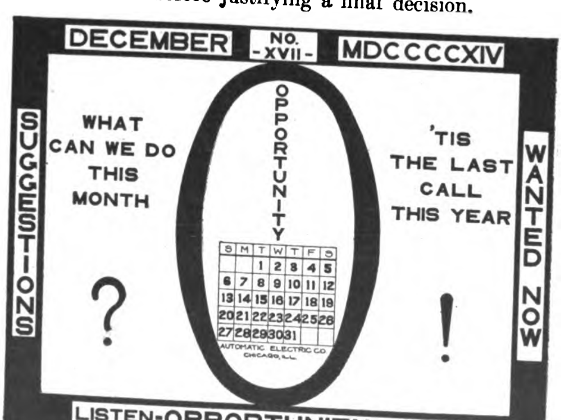


FIG. 11. EXAMPLE OF MONTHLY CALENDAR

Another feature in connection with our plan is that each suggestion made is sent to me personally in a sealed envelope, and I personally approve or reject it. True, I do not do the actual work of investigating the value of each suggestion made or estimate tool costs, savings, etc., but I do finally pass on the merits of the point involved. Each suggestion being acknowledged the day it is received and notice being sent out the moment a decision is reached are of considerable importance in maintaining a satisfied state of mind in the employee. In advising an employee that his or her suggestion has been rejected the cause of rejection is always given, and I repeatedly call attention in "Doings" to the fact that in case an employee has reason to believe that an error has been made in the decision he shall make it a point to see me personally and explain his views and reasons.

Assuring a Square Deal

Not allowing the general foreman, master mechanic or the head of any division outranking a foreman to compete reduces the chance of a possible suspicion arising that some foreman's thunder has been stolen. Also, having employees and foremen send their suggestions to

Mr.______________ Dept.________.

We acknowledge receipt of your suggestion of ________

regarding ______________________________

This suggestion will be given due consideration and a memorandum of its disposition will be sent you as soon as possible.

W. J. Tewksbury,

FACTORY SUPERINTENDENT.

FIG. 12. ACKNOWLEDGMENT FORM

me direct eliminates another chance for complications. By playing the game square, giving all an honest deal, the confidence of the employee is secured and ultimate success is assured.

The banquets, the public presentation of tokens in the presence of all one's fellow employees, personal pride, the success of others—all tend to create interest and enthusiasm, which to my mind can be maintained indefinitely just so long as everyone is treated honestly and justly. The success we have had cannot possibly be due to any peculiar condition in our plant. Others can secure the same results if the proper methods are adopted and used. Many are undoubtedly having equal success by means of other plans than ours, but the fact remains that what we have we have; and what has been done is being done here with increasing success each year in spite of the failures that have been experienced with other systems by other firms.

Resharpening Old Files

By Cecil H. Strupe

To resharpen an old file, heat it in a furnace or forge until a good scale appears uniformly over its surface and harden it at the proper temperature. Then take a good stiff file brush and clean the file thoroughly. You will find that the scale comes off readily, leaving the file with fairly good cutting qualities. The only trouble with this manner of sharpening a file is that it can be repeated only a few times.

Letters from Practical Men

Storage of Grinding Wheels

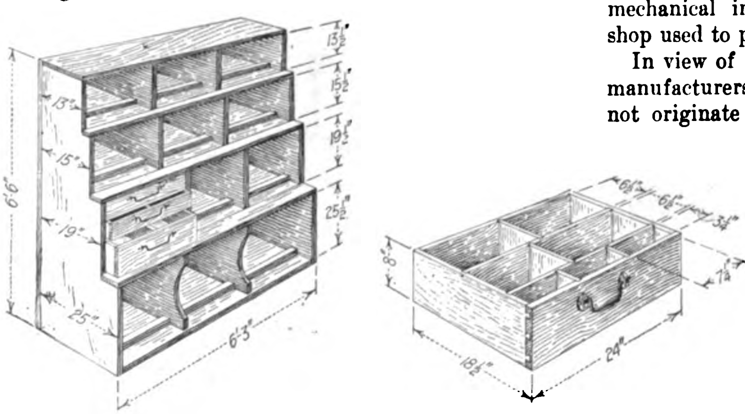
Grinding enters so largely into modern manufacturing methods today that the safe storage of the grinding wheel demands attention. The wheels usually vary largely as to size, and quite frequently wheels of the same general dimensions will vary considerably as to both grain and grade.

If the wheels are piled on top of one another the constant handling to which they will be subjected may result in damage; further, the identification tab is sure to get damaged or lost. Undoubtedly the best way to store grinding wheels is to stand them on a wooden rack so that any one wheel may be reached without interfering with any other wheel.

Apart from the larger wheels that will stand in a rack there are many kinds of small wheels required both for internal work and for general toolroom requirements. If an open rack is used for the large wheels, the small ones may be kept in boxes on the rack; but where much grinding is done, the best way to store the wheels, in the opinion of the writer, is to have a special rack or cabinet for the purpose. The one shown in Fig. 1 has for some years given satisfaction in a large plant where many sizes of wheels are used.

The general dimensions of the rack are given on the illustration, and it will be seen that the inside dimensions are such as to accommodate wheels of 24-, 18-, 14- and 12-in. diameter respectively. A strip across each of the various pockets effectually prevents any wheel from running forward.

It will be noticed that three drawers are provided for storing the smaller wheels. These drawers are 24 in.



FIGS. 1 AND 2. STORAGE CABINET FOR ABRASIVE WHEELS

long, 18½ in. from back to front and 8, 5 and 4 in. deep respectively. The two lower drawers have thin longitudinal spacers, so that 6- and 4-in. wheels stand edgewise and close together, thus giving maximum storage with accessibility. The lowest of the three drawers is shown in Fig. 2, with dimensions as used, but these of course must be varied to suit the wheels to be stored. The top drawer should be divided in such a manner that by means of adjustable spacers a variety of pockets may be formed for storing small wheels for internal grinding.

By putting the grade and grain of each of the larger wheels on its periphery with a stencil it is possible with such a rack to extract at once any wheel desired. Apart from this the stock available is seen at a glance, and consequently there is less risk of running out of sizes accidentally.

Made of white wood, generally about 1¼ in. thick, the cabinet presents a solid appearance, takes up very little space, considering its capacity, and will add to the efficiency of any tool-storage service.

Guildford, England. WALTER G. GROOCOCK.

Future of the Public-School Machine Shop

This is not written in the nature of a prophecy, but to set forth what, to the writer, seems to be the logical outcome of the industrial-education movement, if the schools are to progress and do the work which was expected of them.

My understanding of the trade school (and I confine myself to the machine-shop department) is that it is intended to keep up the supply of mechanics. The apprentice system in most shops is dead. Indeed, in most shops they will not even consider taking an apprentice. The largest number of their so-called machinists are simply men who turn a wheel or pull a lever, merely operators. Is this the kind of stock that will produce mechanics, where the son will follow in the father's footsteps with pride? There is nothing there that will tend to produce mechanical ingenuity or genius, such as the old-time shop used to produce. In fact, the contrary is true.

In view of this condition, then, some of our far-seeing manufacturers began talking trade schools. The idea did not originate among the teaching profession. It came from hard-headed, shrewd business men, who as they saw the gradual passing of the apprentice system, began to look around for a substitute and evolved the trade school. But having created the idea, they were content to turn it over to the educator. Now that the schools have passed their infancy, so to speak, and are beginning to arrive at the interesting stage where they take on character and individuality, the manufacturer is getting interested again and can begin to see in them something besides a plaything. With this added interest will come a desire to step in and shape the policies of the school, so that the graduate will fit into the machine shop or toolroom with the least possible adjustment. In other words, our school shop must differ in no way from the commercial shop, as we must always consider the kind of a place the boy will work in.

I expect to see the school shop commercialized. It will have to start manufacturing on a commercial scale some article or tool that will give sufficient general work in the shop and toolroom to develop all-around machinists, if I may use an expression to which no two people give the same meaning. It may even monopolize the market for its product by making the price below competition, and it can do this because it has no labor expense.

Such a course of procedure would be bound to hurt somebody, but this must be foreseen and taken care of. The thing must be done, even if it does hurt a few individuals, because it is a question of the greatest good for the largest number of people.

A possible solution might be to have some of the manufacturers' associations coöperate and decide what particular line of work should be undertaken. The school could then go ahead and take over that line, as private land is taken by the right of eminent domain and compensation paid to the parties damaged.

But by whatever method the result is obtained, I feel that some such action should be taken and these school shops put on a self-supporting basis. For surely so much labor should at least be made to support itself instead of only partly doing so, as at the present time. In order to preserve the commercial standard of the product, it may be necessary to employ some experienced workmen in addition to the instructors.

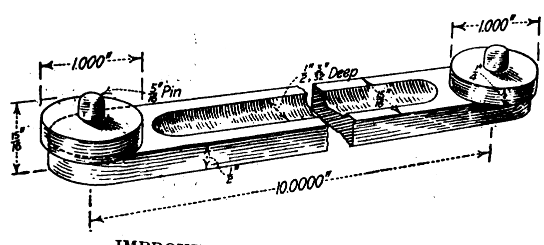
There will always be the danger of commercializing the school to too great an extent; but I believe that, with the proper mixture of shopmen and schoolmen on the governing board, the proper balance can be preserved.

Westfield, Mass. BURTON A. PRINCE.

Improved Type of Sine Bar

Those of us who set sine bars know that frequently one can spend a considerable amount of time in getting the bar just right. It was to save this time that the sine bar shown was devised.

The bar is $\frac{15}{16}$ in. wide, $\frac{1}{2}$ in. thick and $10\frac{15}{16}$ in. long. It has two holes through it at the ends, these holes being exactly 10 in. apart, center distance, and $\frac{5}{16}$ in. in diameter. Pins are snugly fitted to the holes, and on these



IMPROVED TYPE OF SINE BAR

pins are two 1-in. Brown & Sharpe micrometer test gages, such as come with all 1 to 2 in. micrometers.

It will be noticed that the disks project beyond the bar. If the bar is clamped against an angle plate, the lower end does not rest upon the surface plate, but the lower part of the disk touches the plate. If conditions are such that the bar cannot extend down to the base plate, the lower disk can rest on a parallel.

All that remains to be done to establish the angle with the bar is to multiply the natural sine of the angle by the center distance between the disks—10 in.—and set a vernier height gage to this dimension, using the side of the beam marked "Outside." Rest one disk of the bar on the surface plate or parallel and swing the bar so that the other disk just touches the under side of the projecting finger of the height gage—that is, standing on the surface plate or parallel, as the case may be. This establishes the angle. If an angle is being checked, the reverse of the foregoing is the correct procedure.

It will be seen that this bar can be set in a minimum amount of time, that only one "feel" is involved and that adding one diameter of a disk is eliminated.

New York City. WESLEY E. MCARDELL.

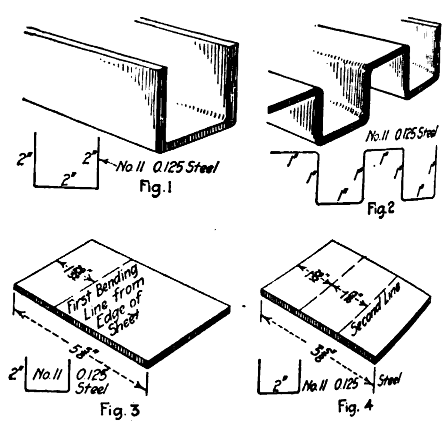
Sheet-Metal Data for Making Steel Furniture

The accompanying illustration shows data and tables which have been developed for laying out and bending sheet metal in the manufacture of steel furniture. Theoretical accuracy is not contemplated. These tables and rules are intended to be used by the practical mechanic in the process of actual production.

The rule for determining the development length or cutting size of a piece to be bent, where outside measurements are given, is as follows: From the length of all dimensions subtract $1\frac{1}{2}$ times the thickness of the metal to be used for each right-angle bend.

FOR DETAILING SHEET METAL

Gage No.	Decimals of an Inch	¾ Times Thickness of Material, In.	1½ Times Thickness of Material, In.	Gage No.	Decimals of an Inch	¾ Times Thickness of Material, In.	1½ Times Thickness of Material, In.
1	0.281	7/32	27/64	14	0.078	1/16	7/64
2	0.265	13/64	25/64	15	0.073	1/16	7/64
3	0.250	3/16	3/8	16	0.062	3/64	3/32
4	0.234	11/64	23/64	17	0.056	3/64	3/32
5	0.218	5/32	21/64	18	0.050	3/64	5/64
6	0.203	5/32	5/16	19	0.043	1/32	1/16
7	0.187	9/64	9/32	20	0.037	1/32	1/16
8	0.171	1/8	1/4	21	0.034	1/32	1/16
9	0.156	7/64	15/64	22	0.031	1/32	3/64
10	0.141	7/64	7/32	23	0.028	1/64	3/64
11	0.125	3/32	3/16	24	0.025	1/64	3/64
12	0.109	5/64	11/64	25	0.021	1/64	1/32
13	0.093	5/64	9/64	26	0.018	1/64	1/32



FORMS OF BENDS FOR STEEL FURNITURE

Example No. 1—$2 + 2 + 2 = 6$ in.; $1\frac{1}{2}$ times the thickness of No. 11 steel equals $\frac{3}{16}$ in. for each bend. For two bends, $2 \times \frac{3}{16} = \frac{3}{8}$ in.; $6 - \frac{3}{8} = 5\frac{5}{8}$ in., the cutting size of the material.

Example No. 2—$1 + 1 + 1\frac{1}{4} + 1 + 1 + 1 + 1 + 1 = 8\frac{1}{4}$ in.; $1\frac{1}{2}$ times the thickness of No. 11 steel equals $\frac{3}{16}$ in. For seven bends, $7 \times \frac{3}{16} = {}^{21}/_{16} = 1\frac{5}{16}$ in.; $8\frac{1}{4} - 1\frac{5}{16} = 6\frac{15}{16}$ in., the cutting size of the material.

The rule for locating the first bending line from the end of the sheet follows: Subtract $\frac{3}{4}$ times the thickness of the metal used from the measurement given in detail in example No. 3. The answer will be the distance of the first bending line from the edge of the sheet.

Example No. 3—First dimensions given, 2 in; thickness of No. 11 gage = $\frac{1}{8}$ in.; $\frac{3}{4}$ times the thickness of No. 11 gage equals $\frac{3}{32}$ in.; $2 - \frac{3}{32} = 1\frac{29}{32}$ in., which is the distance of the first line from the end of the sheet.

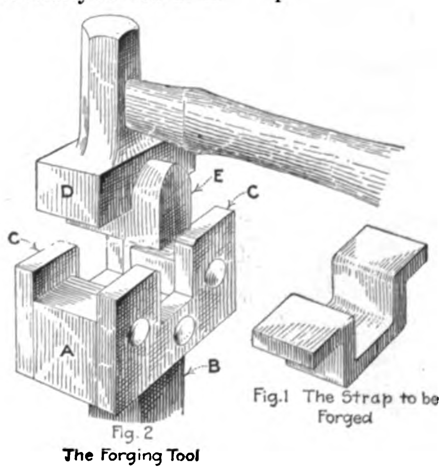
The rule for locating the second bending line from the first bending line is as follows: Subtract $1\frac{1}{2}$ times the thickness of the metal used from the outside measurement given in detail. The answer will be the distance of the second bending line from the first bending line. To lay out three or more bends, use the same rule as for the second bend. WILLIAM L. WEBER.

Two Rivers, Wis.

Forging Straps by Hand

In this time of stress many shops have to do the best they can with limited appliances. This is particularly true of blacksmith shops, and many interesting tools have been improvised to meet the present rush.

When repetition work is to be done, the modern smith too often thinks that the drop hammer and the press provide the only solution. In so thinking they are of course overlooking the fact that the smiths of old did excellent work with anvil tools, which in some classes of work are nearly as fast as the drop hammer or the press.



TOOLS FOR FORGING STRAPS BY HAND

The following is a case in point: A shop busy on some general service wagons for the army required about 1,000 straps, as illustrated in Fig. 1. Drop or press forgings being out of the question, a smith was put on to make the straps by hand. His progress was so slow that his foreman was in despair. The writer, visiting the shop at this time, was told the difficulty and suggested a set of anvil tools, Fig. 2.

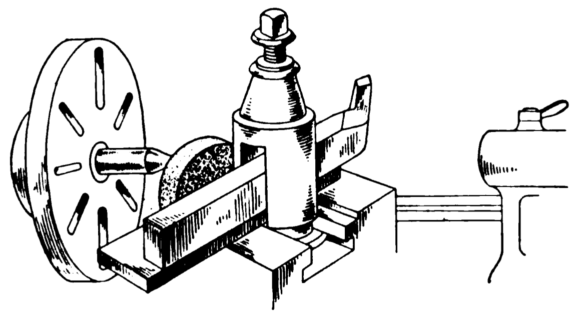
Another smith made a set of these tools from a sketch and with them turned out 900 staples complete in 12 hr. Considering that this was his first batch, the time was good, but undoubtedly he could do 80 per hr. with ease in any subsequent lot.

The illustration requires little explanation. The bottom tool *A* is forged square at *B* to fit the anvil. Riveted on the side are two guide plates *C*, which serve to guide both the steel to be worked on and the top tool *D*. The lugs *E* on the top tool are best made solid, as drawn, but they could of course be riveted on. The method of operation is obvious and needs no description. H. KING.

Guildford, England.

Truing a Lathe Center Without a Center Grinder

Before the modern lathe-center grinder came into use, the general method was to anneal the center and then turn it up. To avoid this annealing, rough the center down



TRUING A LATHE CENTER

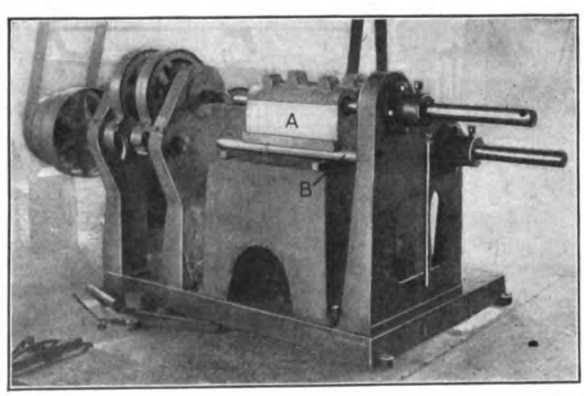
to gage by hand on an emery wheel, then stick it into the live spindle. Prop a small worn-down emery wheel about 2 in. in diameter against a tool in the tool post at the proper angle and press it against the center running at a high speed.

The sketch shows a $\frac{1}{8}$-in. piece of flat steel clamped under the tool and supporting the emery wheel.

Stockton, Calif. M. JACKER.

Special Boring Machine

Having a number of large shaft bearings to bore in dough-mixer frames, we decided to build a special duplex boring machine, the centers on the boring bars being the



A SPECIAL BORING MACHINE

same as on the frames to be bored. The two frames were set in an upright position and bored through with a tool fixed at each hole. Afterward a shell reamer was passed through

The operation is so simple that it requires only about an hour's time to bore and ream four 3-in. holes instead of nearly a day for each frame in the old way, when they were bored on a large drill press.

In the illustration at *A* is another job that we bored on this same machine. Two grooves were planed parallel with the holes to be bored. The piece was 18 in. long, but the holes to be bored were only 5 in. on each end, the center being chambered.

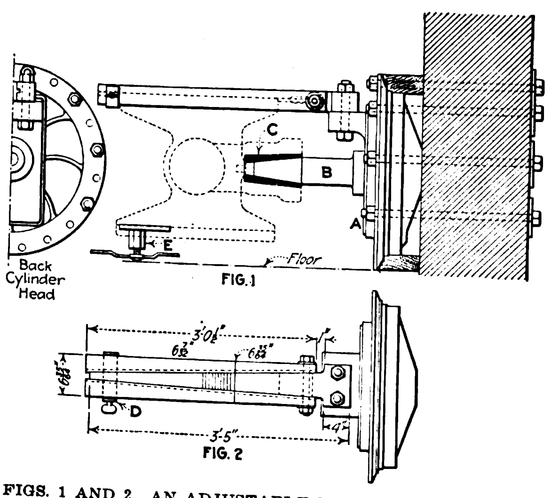
As the boring bars could travel only 14 in., we set the part *A* on two 2-in. shafts *B* to act as "ways." After going through the first end of the holes, we released the clamps and pushed the work ahead about 6 in., then clamped it down, ready for the other end of the bore. As there were two sets of holes to bore with centers 6 in. apart and as the boring bars were 16½ in. apart, only one bar could be used; but as the holes were central with the grooves, it was only necessary to set the ways central with the boring bar and turn the job end for end to get both sets of holes bored.

PETER MOTTA.

Joliet, Ill.

Babbitting Solid Crossheads

The illustrations show a method of babbitting solid crossheads of locomotives. First, a back cylinder head is bolted to the wall of the shop or one of the columns, as at *A*, Fig. 1. In using, a wooden distance piece, as shown, is put in the cylinder-head counterbore, next the large end of the babbitting mandrel *B*. Then the adjustable bushing *C*, which is in three parts held together by a spring band, is put in the piston-rod end of the crosshead and this is put on the mandrel *B*. The upper



FIGS. 1 AND 2. AN ADJUSTABLE BABBITTING FIXTURE

piece, representing a guide and adjustable as to width, is put in place and set to proper width to suit guides of locomotive to which the crosshead belongs. The series of graduations in Fig. 2 shows the range of sizes from $6\frac{7}{32}$ to $6^{35}/_{64}$ in. The clamp *D*, Fig. 2, is for holding the forms in place, while the small jack-screw *E*, Fig. 1, is for raising or lowering the end of the crosshead as may seem necessary. The babbitt is then poured.

Another mold for babbitting solid crossheads and those having shoes is shown in Fig. 3. The spindle *A* is put through the crosshead, the large tapered part being made to fit the bore at the piston-rod end. Then the sleeve *B* is put in from the opposite end over the spindle *A*, the square tapered part *C* entering where the front end of the main rod goes in. Next the end plate *D* is put on and tightened, then plate *E*, both of these plates having eye-bolts shown, and cross-end plates *F* are put in place and tightened by the long through bolts. The top and

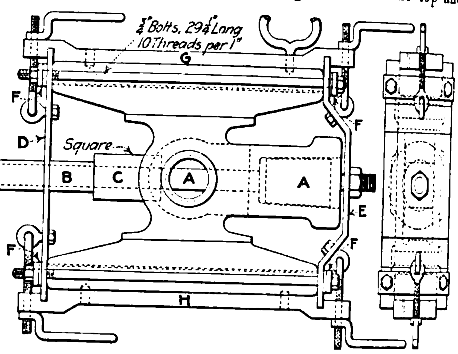


FIG. 3. ANOTHER TYPE OF BABBITTING FIXTURE

bottom forms are put in place and the eye-bolts swung into the slotted ends and tightened. By using gages of different thicknesses, the distance between the mold and the crosshead shoe can be made to suit.

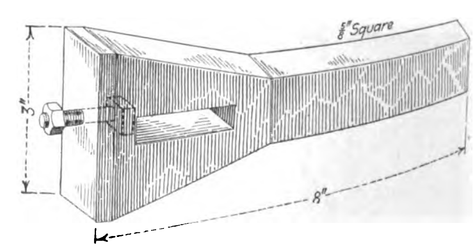
The large eye-bolts are for the purpose of picking up the mold after pouring, as it gets very hot. The molds *G* and *H* are usually made of three different thicknesses to suit requirements and are $\frac{1}{32}$ in. less in thickness at bottom than at top to facilitate easy removal. When assembled, the entire rig can be set on a small horse or stand, and after one side is poured it can be easily swung over to pour the other side.

Renovo, Penn.

JOSEPH K. LONG.

Gated Pattern Holder

The illustration shows a holder for gated patterns. It is a casting 8 in. long, with a ⅝-in. square shank and an opening large enough to take the head of a ¼-in. bolt.



GATED PATTERN HOLDER

The pattern gate is held to the holder by the bolt. The shank of the holder is held in a vise at any desired angle. The method of inserting the bolt makes it readily replaceable when it becomes worn.

A. E. HOLADAY.

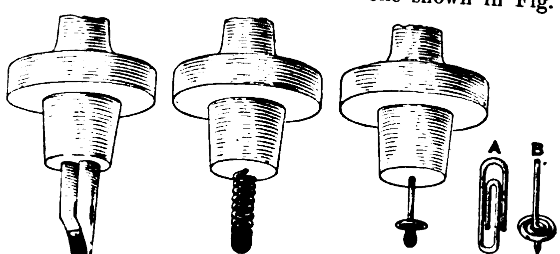
Naugatuck, Conn.

The British Board of Trade announces that the prohibition on the importation of hardware does not apply to the following articles: Awl blades, bayonets, bullet molds, caps for cartridge making, cartridges, cases, hammers, horse clippers, jacks, small and screw percussion cap shells, pliers, pulleys and blocks, scythes and sickles, shears, spanners, tools for carpenters, coopers, masons or shipwrights, trenching struts and brass or copper tubes.

Discussion of Previous Question

Helpful Drafting-Room Kink

The quill shown in the illustration by W. J. Gaffke on page 188 is rather old. The draftsman, however, sometimes has no means of getting the tin to make such a device. Under such conditions the one shown in Fig. 1



FIGS. 1 TO 3. HELPFUL DRAFTING-ROOM KINKS

may be used. Two common pen points are inserted, as shown, about $\frac{1}{16}$ in. apart.

In Fig. 2 is shown a quill that can be found around the shop all ready made, and Fig. 3 shows a contrivance that is useful when the ink in the bottle is low. Bend a paper clip *A* as shown at *B*, insert it in the quill, and the ink can be obtained at the very bottom of the bottle.

Chester Park, L. I. M. CARRY.

Built-Up Circular Forming Tool

I don't like to be "kicking" all the time, but in relation to Mr. Bennett's article describing a built-up forming tool, *American Machinist*, Vol. 44, page 560, there are a few things about forming tools that he neglected to say.

We have been using forming tools on National Acme, Gridley and Cleveland automatics for years and at very high speed. We work to a limit of 0.002 in. and use up, almost entirely, all our forming tools. My personal experience leads me to believe that a built-up forming tool would be highly undesirable and impracticable, primarily because of the rivets and secondarily because of the difficulty of true assembling.

A forming tool, on account of the stresses imposed upon it in service, must be of solid construction and rigid. Now a tool such as that described by Mr. Bennett, while it may work all right, is not suitable for the high production requirements of the present day. In such a built-up tool the line of fracture would be straight to the center of the cutoff tool, so we should lose the cutter and have to replace it. This would, very likely, be a frequent occurrence, owing to the lack of support, caused by minute particles of scale, grit, etc., getting between the disks of the tool while assembling. Nothing is perfect, you know; and while we all know the impossibility of making anything dead true, it is also a fact that nothing can be made perfectly clean. It is the unavoidable dirt and grit that would cause trouble.

Furthermore, a built-up tool is capable of very little grinding, since in grinding out a rivet not only a great deal of valuable tool steel is lost, but the tool is greatly weakened. The grinding operation mentioned is really quite simple. In sharpening a solid formed tool it is simply spun on an arbor, a dished grinding wheel being used to give the correct wheel clearance. Any fairly good tool grinder could readily grind this forming tool.

In our practice we have found it better to use a solid forming tool. The tool is ground 5 deg. below the center and is set in the machine with exactly the same setting as that of the cutting-off tool which I described in *American Machinist*, Vol. 44, page 518. In a solid tool operating on cold-rolled steel the line of fracture will approximate a vertical line, from the cutting point downward, of a depth about equal to the depth of the cut. Breakage is not so very common, the tool as a rule simply requiring grinding—that is, sharpening. As a good general average we might say that the formed tool, in case of fracture, would break about $\frac{1}{8}$ in. back from the cutting edge. Sometimes, but rarely, the break will be, or even exceed, $\frac{1}{4}$ in.

Generally speaking, to meet present-day conditions give me the faster, more easily made and more economical solid forming tool. J. B. MURPHY.

Plainfield, N. J.

Machinist Instruction in the Public-School System

On page 606 Mr. MacKenzie touched upon a rather delicate subject when he mentioned the difficulty of obtaining commercial work for trade and vocational schools and disposing of it upon favorable terms.

Inspection of the machine shops in the various trade schools in Massachusetts will show this to be true to anyone who recognizes commercial work when he sees it. This inspection will sometimes reveal also the reason why it is difficult to obtain such work—namely, a lack of confidence on the manufacturers' part in the ability of the schools to turn out machine parts that will stand the acid test of the commercial inspectors.

The manufacturers do well to refrain from placing orders with such trade institutions until the schools have, in a measure at least, demonstrated their ability to do work that in proper selection of material, in accuracy of execution and nicety of finish meets the requirements of the commercial standard.

However, with the proper equipment and methods of doing the work it is not impossible even with boys to manufacture machine parts that will be acceptable to responsible machine-tool builders. As evidence of this statement one of the Massachusetts trade schools has sold thousands of such parts to the manufacturers in the past few years, has under way several thousand such parts at present and would have no difficulty in obtaining orders for thousands more. That is only one department of a

school in which there are others doing the same thing on a smaller scale with less equipment and operating expense.

Apparently, the way to convince the men of responsibility in the commercial world that the schools can produce quality work is the same as in any other line—by doing it.

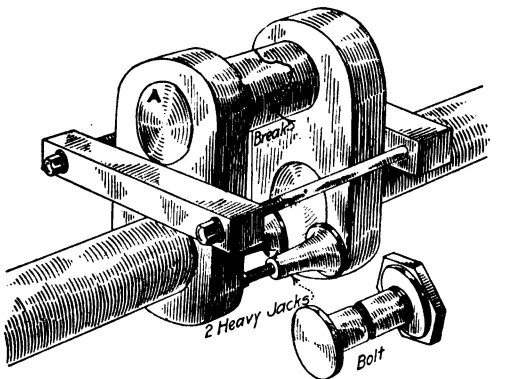
As to the boys' proneness to say, "We did it this way at the school," and to believe firmly that no other method is correct, the writer is inclined to attribute such an attitude to lack of experience rather than to consider it characteristic of the vocational-school product. Do we not all recall the younger and less experienced men coming into the commercial shops and saying almost the same as the schoolboy did, "We used to do it this way at the old shop," or, "That ain't the way we did it down to Reed's"?

Sterling Junction, Mass. M. H. FERGUSON.

Crankpin Repair Job

The article by James Ellis on page 470 reminds me that twice I have had similar work to do in our small shop, but was obliged to follow a different method. Owing to the fact that the equipment was somewhat limited, the whole job was done in the lathe.

The crankshafts were about 5 in. in diameter, and the pin in both cases was broken very irregularly—a condition that made it possible to avoid keyseating. First, the two halves were placed on blocks and the broken ends of the pin brought together. A clamp was made from 2-in. square iron, and 1¼-in. bolts were put around



CRANKPIN REPAIR KINK

the throws near the shaft, as shown in the illustration. Between the throws on the two corners farthest from the pin were set two heavy jacks, and the clamp bolts were tightened, bolts and jacks being adjusted to bring the two ends of the shaft nearly in line.

The shaft was then placed on centers in the lathe and the jacks and bolts adjusted until the shaft ran as true as possible. The shaft, still clamped together, was bolted to the carriage of the lathe on suitable blocking, with the center line of the crankpin approximately in line with the lathe centers. With a drill with a long extension held in the chuck serving as an improvised boring bar, a 3-in. hole was bored through the crankpin and counterbored at each end to receive the head and part of the nut of the bolt.

A bolt was made, as shown, a drive fit in the 3-in. hole, with the head to fit the counterbore. A nut with the hexagon turned off to fit the counterbore was also provided, leaving enough of the hexagon projecting to tighten up with a big wrench. This bolt was driven in and the nut tightened, after which, the clamp and jacks were removed and the shaft again placed on centers. The bearings were turned and the rough edges of the break filed off, finishing the repair. The nut, which had a rather fine thread, held the rough edges of the break together so tight that keys were unnecessary.

Morrisville, Vt. J. O. REED.

Counting Gear-Wheel Teeth

The simple little kink of "marking the space instead of a tooth," given us by Mr. Fletcher on page 1041, Vol. 43, caught me right in the neck, as it did Professor Sweet, and like him I tried it on my foreman millwright and some other boys. I must admit that we all appeared very small.

On page 295, Vol. 44, F. R. Mann takes exception to this idea, offering us a better way—"Mark the tooth and count the space"—telling us the chances of going wrong are materially lessened, because Mr. Fletcher's method does not take into consideration that "there are as many spaces as teeth in a gear." He also requires training our method of thought in another direction to make his method workable, which summed up in a few words means, "Change your count and leave the mark alone." Mr. Fletcher tells us "Change your mark and leave the count alone," and it requires no stretch of the imagination to decide which is the simple method.

After reading Mr. Mann's suggestions I decided on further experiments. Securing a 49-tooth wheel from the toolroom lathe, I placed it before my own special draftsman (a clever man with jigs and tools), with the numbered side downward, of course, and asked him to count the teeth. He commenced by marking a tooth and counted 49, then counted again because he thought it should have 50 teeth. The second count also produced 49, but he would not swear it was correct without another count, marking off the teeth in fives. I then suggested Mr. Fletcher's method—to mark a space—and after a trial he was quite satisfied that his method had been wrong. I then introduced Mr. Mann's suggestions, and after practical experiments we could not accept it as meeting the case.

Of course, we all believe in and carry out the casting or stamping of the number of teeth on wheels whenever possible, but many of us who have the handling of repairs and alterations to machinery must still rely upon the count as the only method of finding the number of teeth in a wheel. At least a dozen men in my own circle, including myself, will find this simplified by the suggestion of Mr. Fletcher, "Mark the space and count the teeth," leaving Mr. Mann's suggestion severely alone for several reasons, one of which may be given—because there are as many teeth as spaces in a gear—a fact that appears to have been entirely overlooked by Mr. Mann in accusing Mr. Fletcher of neglecting the obverse.

Belfast, Ireland. F. P. TERRY.

Wire Covered with Enamel is gaining in application for certain electrical uses in tropical climates. It is claimed such wire has withstood an electrical pressure of 1,000 volts after immersion in caustic soda, sulphuric acid, nitric acid and hydrochloric acid for 48 hours each and in potash 35 minutes.

Metric System in Export Trade

By Henry R. Towne*

An editorial commenting on a reference to the metric system in a recent report by Dr. S. W. Stratton, Director of the Bureau of Standards, Washington, was published on page 563 of the *American Machinist*. Having long been a student of the metric question as related to our national interests, I became interested in ascertaining the origin of the report in question and the facts concerning the use of the metric system by the American manufacturers who were named in that report.

For the first of these purposes I called on Doctor Stratton in Washington, who explained to me the origin of the report and stated that one of his objects in writing it was to show the extent to which American manufacturers are responding already to the preference of their foreign customers for the use of the metric system in export trade. For the other purpose I addressed letters of inquiry to the manufacturers named in the report. The result of these investigations is summed up in the following statement.

A report entitled "Metric System in Export Trade," by Dr. S. W. Stratton, Director of the Bureau of Standards, prepared by request of the Secretary of Commerce, was transmitted by him to the Secretary of the Treasury in November, 1915, for use by the latter when attending the meeting of the International High Commission on Uniformity of Laws, in Buenos Aires, in March, 1916.

In that report fifteen American manufacturers were named as examples of the large number who are "already using the metric system." Desiring to ascertain the extent to which this statement conformed to the facts, I addressed a circular letter of inquiry, dated Mar. 27, 1916, to each of the parties named, requesting brief answers to the following questions:

1. What proportion of your product is made to metric dimensions?
2. Do you use metric measures except in executing orders which require them, and if so, why?
3. In executing orders based on metric measures, do your workmen need to make large use of metric scales or are they guided by gages and templets furnished to them?
4. Do you favor legislation intended to compel the ultimate abandonment of our present units of length and the substitution therefor of metric units?
5. If not, for what reasons are you opposed to such changes?

Replies were received from all but two of the parties addressed, the character of which is indicated by the following extracts:

American Locomotive Co.—"Are using metric system when the purchaser requires it. Not a very large proportion of our output. Workmen guided chiefly by gages and templets, not largely by metric scales. Do not favor compulsory legislation, which would work a great hardship and cause confusion and unnecessary expense."

Baldwin Locomotive Works—"Do not use metric system except when specified. Have built 300 locomotives in all to metric measures. No inconvenience in using them; indifferent as to legislation."

Brown & Sharpe Manufacturing Co.—"Make tools to metric system for sale in metric countries, but use the English system entirely as a basis for work. Strongly opposed to compulsory measures which would introduce 'endless confusion which would continue for generations to come.'"

Pratt & Whitney—"Use metric measures in making taps and cutters for metric countries; in tool department only use them to 'an infinitesimal degree.' Never called on to use them in filling orders for machine tools. Are opposed to the change. If made, all scales, gages, measuring instruments and drawings would be worthless and require replacement at very great expense."

Waltham Watch Co.—No reply.

Standard Tool Co.—"Proportion of product made to metric dimensions is very small. Metric measures used in the manufacture of tools and may become universal 'sometime in the future.' Think manufacturers should not be compelled to adopt metric system."

Morse Twist Drill and Machine Co.—"Only use metric measures when specifically ordered. Workmen easily shift from one standard to the other. Do not favor compulsory legislation. To effect change 'would take so long that most of those now here would be obliterated before it could be accomplished.'"

Bausch & Lomb Optical Co.—"Have used the metric system for a great many years in making lenses and prefer it. In mechanical work, however, the English standards still in use 'on account of the great expense that would be involved in changing.' Do not advise compulsory legislation. Refer to fact that English inch is still used in Germany in steam, gas and water piping, although metric system adopted 45 years ago."

Eastman Kodak Co.—"Use metric system on very small proportion of product and almost wholly on export orders. Workmen using it guided by gages and templets, not by scales. Are opposed to compulsory legislation."

The Lufkin Rule Co.—"Not using the metric system for manufacturing purposes, 'but thoroughly indorse the system and believe that compulsory use of it in the United States would be of inestimable benefit.' About 5 per cent. of product made to metric measures, which are used only when called for. Favor compulsory legislation."

International Exporting and Importing Corporation—No reply.

Keuffel & Esser Co.—"Find no difficulty in working to metric standards, which are used for all optical measurements and calculations and also throughout the chemical profession. In our opinion there can be no doubt but that eventually the metric system will be adopted in this country as the only standard system, and that it would be best to hasten this date."

Powers-Weightman-Rosengarten Co.—"Only use metric system in a small way for occasional export orders. Not unalterably opposed to the change, but favor retention of the present system."

Library Bureau—"Originally used metric measures, but have recently changed to measures based on the inch. Only now use metric measurements when orders so specify. Do not favor compulsory legislation."

L. S. Starrett Co.—"Do not use metric measures except in executing orders which require them. Realize advantages of metric system, 'but on account of the infinite labor and expense of changing do not favor compulsory legislation.'"

A letter dated Apr. 7, 1916, from Doctor Stratton, on whom I had previously called and to whom I had shown the letters from which the foregoing extracts were made contains the following statements:

*Chairman of the board, The Yale & Towne Manufacturing Co.

It was our intention in this report to show that American manufacturers are meeting the needs of export trade as far as the metric system is concerned. It was not in any way intended as a metric propaganda. I am in favor of the metric system because it is a decimal system and because of its international character.

As to the method of adopting the metric system, my position has always been that its use should only be made compulsory in the ordinary affairs of commerce and trade, that manufacturers of machinery and other articles should be allowed to use whichever system they desire in their construction. In this manner only the output of the machine will be affected. Manufacturers of machinery should not be required to do any more than they are now doing to meet the needs of those countries in which the metric system is now in general use.

Industrial Preparedness from the Engineer's Viewpoint

SYNOPSIS—A continuation of the discussion on organizing for industrial preparedness presented at the New Orleans meeting of the American Society of Mechanical Engineers.

Put Engineers in Charge of Manufacturing

By Elmer H. Neff

I think Fred J. Miller's discussion has touched upon one of the most important elements that this society through its committees might investigate, and that is the question of the efficiency of the organization of the army and navy as at present administered—the question of the returns for the dollars that are being spent, which it would seem from the facts in Mr. Miller's letter are exceedingly small. This might very well be the subject of investigation by this committee.

Probably you have noticed in the public press that the navy is very short of officers. If you visit one of the navy yards, you find every department in charge of a naval officer overseeing in many cases if not in most cases, operations with which he has no familiarity whatever. The proper place for that kind of man, in my opinion, is on board a ship, where, we are continually being told, there is a shortage of men and of officers. In every arsenal you find army officers in charge, men who are not familiar with the work of manufacturing and who have had no experience whatsoever in that direction except what they have simply picked up while detailed to some particular place. Colonels, majors, captains are here a few months and at the next arsenal the next few months. There is no possibility, so far as I have been able to see, that there could be efficient administration under that sort of management.

As you well know, the British Government found out after the war had progressed a few months that it needed a munitions department. The United States of America needs in its army and in its navy a manufacturing department run by engineers. Then the gentlemen who are educated to manage ships and the operation of the men in the field can continue to perform the duties for which they are educated, while men such as you would place in charge of your factories shall be in charge of the manufacturing departments. If such an arrangement were effected, I believe the question of efficiency would be met, that there would not be the tremendous expenditures out of all proportion to returns, such as are indicated by Mr. Miller's letter.

A Census of Resources

By A. L. De Leeuw

I thoroughly believe in making a census of all our resources, which may lead to ultimate industrial preparedness. I should like to suggest, in addition, the desirability of making a census of those facts and conditions that may stand in the way of industrial preparedness.

I have been personally able to observe some of the conditions imposed by the Government upon making munitions for guns. These requirements are probably all right if nobody is in a hurry and if all we want is just a beautifully made piece of mechanism. But these conditions should not exist if we want guns that will shoot tolerably rapidly, tolerably close and that can be manufactured in a minimum of time. I refer here especially to the matter of limitations. In this case I do not believe the Government specifications or limitations are any worse than you will find in almost any industrial establishment; but it has also been our experience that in any shop there are limitations that are entirely too fine. They have simply crept in and remained until somebody suddenly wakes up and discovers them.

This statement holds good not only for guns, but also for ammunition and all other materials. The census of all those conditions that might be avoided should treat not merely of things that the Government has done which we would like to have changed, but also of things which ordinary private citizens have done. If the Government should ever send out jigs and fixtures to be used in various shops, there would arise the impossibility of taking a jig from one machine and putting it into another, taking it from one shop and placing it in another.

I realize full well it would not be possible, in the course of a few years, to have all planers or shapers, of exactly the same size and have all spindles the same size, but something ought to be done to prevent the annoyance of too much variation, the variation being simply the expression of the desire of some manufacturer to push his product at the expense of his neighbor. If there is any particular reason why his size is superior to his neighbor's, there is no reason why it should not be accepted by his neighbor also; but if there is not, the census I have mentioned should take into account the delay and the annoyance that might be caused by having too great a variation of design and size in machines. This applies not only to machines, but to everything. I should therefore recommend that in addition to the census of factory materials, machines, men, executives and so on there should also be taken a census or list or a tabulation of conditions that prevent the speedy and easy manufacture of those materials and products which we need.

Securing Skilled Workers

By H. T. Wright

In one city in the South there is a fund of nearly $1,000,000 for the establishment of a trade school. That fund has been available, I understand, for some time, but ground has not been broken for that trade school. I have been connected with the mechanical work in the vicinity of that city. I have had young boys come in to me, boys of 18, 20 and 22 years of age to work as laborers—intelligent men. When I asked them whether they ever attempted to learn a trade, they told me yes, but there was no such thing as the apprenticeship system in the city where they were working. Yet we have no trade school in that city today. What are we going to do about the men? We cannot mobilize an army of workmen unless we first educate them. You gentlemen who come from the Northern states know the splendid apprenticeship system of the Western Electric Co., the apprenticeship system of the Fore River Shipbuilding Co. Down here there is nothing that parallels those systems, because of the fact that we have not enough work to train our apprentices.

It is going to take a long time to build up that force of workingmen who must be the backbone of any industrial preparedness. No matter how much raw material you have available, no matter how many machine shops you have lying idle, you cannot obtain industrial preparedness without the men to manufacture the raw materials and operate the shops.

Very few of us know about the women who are willing to be employees in the manufacture of war supplies. All we have to do to see the result of the employment of women in the matter of industrial preparedness is to look at Great Britain today. Why not have, as an addition to the agricultural schools, trade schools where girls can be educated

at the public expenses, so as to give them a fundamental knowledge of the trades in order that they will be ready to step into the places of the men that have to go to the front to carry the rifle and operate the guns?

Another speaker said that Government specifications must not be too severe. The specifications must be reasonable; but we have also to consider that we must get everything that we can out of the material. We must consider what material we are going to use in each part of the machine or the gun and then get the best out of that. The question of tolerances was brought up; the necessity of the parts fitting; that all you needed was proper correlation of parts. Perhaps it is not realized that the navy retubes every one of its big guns. When a gun is taken off a ship, after it has been fired 200 or 250 times, that gun is retubed. When you are going to use your materials over and over again, merely replacing defective parts, mechanical tolerances have got to be watched pretty closely.

Bearing on the question of the education of the mechanic and touching closely the question of the mobilization of the American women in industrial preparedness, comes the question of coöperation. The most concise statement of coöperation will be found in the words of Fred W. Taylor: "The time has come when all great things will be accomplished by the coöperation of many individuals, each performing the function for which he is best suited, each supreme in his particular function, yet retaining his individuality, while collaborating with his fellows toward the production of the complete and perfect whole."

An Army Officer's View

By Maj. W. Goff Caples

I feel sure that something of the kind is needed very much. We should know accurately what we can rely on in the case of war. We will need assistance from everyone—the engineer, the chemist, the manufacturer and the man in the mills—and I am glad to see that an interest in this subject of industrial preparedness is being taken here by you.

I was engaged for 2½ years in the organization and equipment of troops. When we wanted to get military equipment, we did not meet very enthusiastic greetings from the manufacturers. They would say: "Well, what is the size of the business?" "At the present time, it is not attractive."

We know perfectly well that at the present time there are some misfits in our equipment. It may look queer that we have to have for military equipment certain things that are not of ordinary commercial sizes; but it is true, on account of certain limitations, one of which is how much can you pile on a man's back. At the present we have to pile on about fifty pounds, and that load feels very much heavier at the end of a fifty-mile march that at the beginning. We want to have the men in condition to fight at the end of the march. Therefore, we must have special stuff.

The same thing applies to transportation. There is an immense amount of wheel transportation required in the movement of troops, and the general staff and the other officers have been trying to bring this down to a minimum. A few years ago a wagon train of a division was longer than the fighting troops with it, and considerable transportation is necessary to carry feed for the animals alone. We have tried to get the equipment down so as to have less weight for transportation than the ordinary commercial tools afford. In getting out things of that kind we have found considerable difficulty, and we have had trouble in getting out things like standard military explosives.

It is gratifying to find that everyone is taking an interest in national preparedness, because it concerns us all and we are all vitally affected by it. One thing that we have to be sure of in connection with national preparedness is that we shall have the men to utilize the guns that will be manufactured, the explosives that will be manufactured, the clothing that will be manufactured and the other things. It is nothing short of criminal to send a man out to fight unless he has been trained to do it. That is not a new thing. That was started over one hundred years ago, and it was firmly impressed in the minds of the men who organized our Government. The Revolutionary War would have been a total failure except for the aid given by the French, and there was put on the statute books of the United States in 1789 the first comprehensive law for compulsory military training. That law was put on the books at the behest of General Washington himself, and it stood on our statute books until 1903. It was a dead letter because of the fear of a central government. There was no penalty clause in the act, and its enforcement was left to the states. None of them provided suitable enforcement, and the thing fell of its own weight.

We have had several propositions put up from time to time as to what should be done to secure an army in case of need. It is out of the question to attempt to have a large regular army. Carthage tried to hire its defense and made a failure of it, and no nation since has made a success of it. The only way that a nation can be defended is by its own citizens. When it comes to the question of national defense, we have got to consider national economics. We do not want to spare anyone; but when war comes, somebody has to be spared. We ought to figure out who are the men that we can best spare and put them out on the first line. The men that we can best spare are the men who have the fewest dependents.

There is another extremely objectionable thing that comes up with voluntary enlistment. The men who volunteer and go to the front at first have good stuff in them. They are killed off, and the future of the race depends upon those who are left. You build up your race out of its poorest stock and kill off the others. Under the system of universal training, the Government says which men shall go. It takes from all classes equally, and you lose from all classes equally. As far as that is concerned, it is a problem of distinct gain.

It takes about thirty years to bring up a trained corps of officers. What you gentlemen are doing is something that I think is very much needed—a knowledge of what we can count on, of where we are weak and how we can remedy those defects. I hope that the country at large sees clearly that to put into effect the information which you want to give, to get the value out of it, a sacrifice must be made and the principle recognized that manhood suffrage means manhood service.

The Importance of Securing Workmen for a Plant

By Harrington Emerson

I should like to tell you an experience that one of my friends had with a munitions plant that he organized a year ago in the South. There were no buildings, no machines, no employees. He told his assistant that they would subdivide the work; that he himself would look after the equipment, getting the buildings up, securing all the necessary machinery (much of which had to be designed), and that it would be the assistant's duty to have the men, when the time came, to go to work.

The assistant sulked. He had no desire to be sidetracked in that way, put on the job of employing men when he had expected to do executive work. The head of the concern said to him: "You seem to miss the whole point. You don't know that you have the biggest job that was ever offered to any man in connection with this work. You don't seem to know that you have got to have on hand, listed and ready for this plant, over 20,000 men in order that we may pick from them 2,000 of the kind that we need. What I expect of you is that when I call for men you will have them ready."

That woke the young man up to the importance of the undertaking that had been assigned to him. Then he went out into the country—South, West, North. He went South into North Carolina and as far as Georgia, and he collected the names of a great number of farm boys—boys who had been on the farm, boys who knew how to handle tools, to mend harness, who knew how to mend a wagon, to sharpen a plowshare, to do carpenter work about the house, boys that were all-around crude mechanics—and those boys were investigated. Owing to the war difficulty, they applied the principle of selection to a greater degree than I have ever seen it applied before anywhere, except perhaps for admission to West Point and to Annapolis.

Those boys were there when they were wanted, some 1,600 in all. The foreman had been told in advance what they were to do, and he had prepared for them. Each one was to be given two or three days' special instruction, the foreman having been obliged, first, to demonstrate his own ability in running a particular machine and turning out the work. In fact, the plant had been run by the foreman on a small scale for a few weeks before the recruits came in. The boys were put on the jobs, and inside of a week they were making the foremen hustle. One of the foremen told me that in all his experience of many years in one of the largest plants in the United States he had never brought together so good a lot of workmen as he had in that plant inside of three months. So there is hope here in America of finding the raw material, if we go about it in the right way.

Need of General Preparedness

By Frank B. Gilbreth

This problem of preparedness is not the problem merely of preparing for war, but also of preparing for efficient living at any time. It is a problem of obtaining a greater general education and a greater individual education in the same learning period. It is a problem of national elimination of unnecessary waste, of adequate general and individual effort toward utilization and conservation of our great resources.

This national preparedness divides itself, then, into two lines: (1) Preparedness of material things—that is, surroundings, living conditions, all of the material objects with which we deal; (2) preparedness of people, as individuals and as constituting society. In both these lines of preparation our problem in the United States is extremely complicated. Our form of government, with all its advantages, seriously lacks correlation of activities in many places and a permanent centralized department for the planning and development of definite lines of national progress. This we must supply through a uniform and universal realization of what preparedness means and what it is for.

There is perhaps no need to enter now into the necessity for Government ownership of railroads, telephones, telegraphs and other public utilities, so necessary for defense, but this must at least be kept in mind. Without disturbing, for the present, existing ownership of these utilities, much can be done toward unification by requiring railroads to adopt all Government standards, even down to the exclusive use of the Government's map for the timetable folders; requiring that all transportation companies operate and plan for the sudden need; and so standardizing design and equipment of all such utilities as to make a system of interchangeable parts where possible. The possibilities of the complete utilization of our national opportunities should be a matter of public knowledge and instruction.

We can establish standards of motor-truck, motor-bus, motor-car, motor-boat and motor-bicycle efficiency that will not only prepare these speed vehicles for greater service in peace times, but will transform them into a most valuable auxiliary corps in case of war.

Much has been said of proper inventory of our individual equipment and resources and a standardization of jigs, fixtures, templets and equipment of our factories and plants. Such an inventory must include information as to our naval stations, so that we shall judge the value of the location of our naval bases from the standpoint of their usefulness and not by the pork-barrel units of the appropriations. Such standardization will automatically return to their ships and their troops the officers now stationed at work for which they are not specially fitted and which can be done by civilians who have not had military training. Let us at once apply measurement and standardization to all these problems of material preparedness, so that every officer and each one of us can do his own work with all the might that is in him, knowing that the finished products are bound to be what is required.

Efficient preparedness is not only for the army and navy or of the men available for military service. It is preparedness of every man, woman and child in the country. Abroad, children are trained to spend much time out of doors and in out-of-door activity. Endurance is secured by out-of-door walks and contests. Thrift is instilled through its practice in the homes, even to the general custom of serving small portions at the table, with the intention of passing food many times rather than encourage the smallest portion being left over. To take more than one wants is considered as a misdemeanor and an unpatriotic act.

Women should be prepared as well as men, prepared by a training in physical endurance; by manual training, education in household economics and in nursing. This has made it possible for women in the countries abroad to take up the work of men in all lines of activity where it is necessary.

I would recommend that no man get a license for running an engine of any kind or motor busses, motor boats, etc., till he qualifies also on machine-gun assembly and operation. This training implies an opportunity open to all to learn to operate such machines. In many of the large national museums abroad are found working models that may be freely handled by the smallest boy. Practice machines, available to boys and girls of any age, teach them to be observant at an early age.

It is not enough that the equipments and tools of the sudden need be made available. The methods of handling them must be taught in such a manner that the workers may gain not only a knowledge of the machine that makes the machines, but an idea of motion economy and of personal effectiveness.

The important thing is rather to reëmphasize that preparedness means not merely getting ready for war, but getting ready for real living. What should shock us is not what might happen to us in a war, but what is happening right now, while there is general peace. National waste, lack of general and specific education, lack of easy means for obtaining the fullest education in the vocation for the worker in that vocation, lack of correlation! The "Spirit of 1776" is with us now, and so are the arms and ammunition of the same date. We have right here today the greatest opportunities that the world has ever offered. Let us not arm for a definite enemy, for tomorrow there may arise conditions that will cause us to revise our list of probable friends and probable enemies. Let us educate ourselves for individual and national efficiency.

The Chemist's Part

By C. S. Williamson

Attention is called to the fact that there are certain phases of investigation for the chemist. These subjects include gasoline, which means fuels; grain alcohol, which can be construed for either fuels or for extracted purposes, the alcohol to be derived from sawdust and other wood waste, sugar-house waste and cornstalks.

The production of alcohol from sawdust is beyond the experimental stage. It has been accomplished not on the experimental basis alone, but on a commercial basis; and as we chemists see it now, only two things remain to be done in regard to alcohol—one is the design of a motor that will use it, because it has a heat value two-thirds that of gasoline; and the other is the necessity of a tax-free alcohol for the safety of the state.

Nothing has been said in regard to national preparedness from the standpoint of medicines, nothing except from the standpoint of ammunition. Alcohol plays a part in regard to both these questions. In the case of ammunition we may use denatured alcohol, but not in the case of medicines. For that reason many of the medicines that we import are not produced in the states, because we have not an alcohol with which we may produce them. Denaturing alcohol with fluorine, which is commonly used, or with benzol or benzine renders it unfit for the extraction of certain medicines. The maintenance of an army is just as important when looked at from the standpoint of medicines as it is from some other sources, so we chemists have accomplished the extraction of alcohol from some other sources besides grain and molasses, because we have produced it from sawdust as cheaply as, if not cheaper than, from molasses, which is our common source in the South.

We are producing ammunition today for the fighting countries, but we are producing it from materials brought from another country. If we were thrown on our own resources today, we should have but 25 per cent. of the required amount of nitrate of soda available in the states for the manufacture of munitions. We import one-fifth of the production of the Chile mines. We use 75 per cent. of that in the manufacture of munitions, the other 25 per cent. being left in the fertilizer industry and for other purposes, which means that if we were suddenly cut off from our supply, we should have 25 per cent. left to deal with, which would be exhausted after a short while.

We hope this situation may seem pertinent to the United States Government, for the reason that we cannot make an explosive without the use of nitric acid. We cannot make nitric acid in America today, with the exception of one small experimental plant and a few small units in plants devoted to processes, except from Chilean nitrates. As I understand industrial preparedness, it is preparing for an emergency. It is especially significant to use when we recall that the manufacture of nitric acid by the synthetic process—the oxidation of nitrogen from the atmosphere—had its birth on American soil. Nitric acid is produced synthetically today in Norway and Sweden, because of their cheap water power. Since the outbreak of the war Germany has spent $100,000,000 for the production of nitric acid plants. Nitric acid is used in every dyestuff that we have and in many other processes.

Coöperation between the work of the engineer and the chemist is necessary and should be corelated, because of the fact that for every dyestuff and for every explosive we have to have heavy chemicals; for the manufacture of heavy chemicals, we have to have sulphuric acid. For the manufacture of explosives we have to have sulphuric acid, alkali and nitric acid. The chemist's problems are the engineer's problems. We are working hand in hand; one is absolutely dependent upon the other.

Editorials

Metric System in Export Trade

We hope no reader will fail to read Mr. Towne's communication on page 825 and compare the trifling use of the metric system disclosed by his inquiry with the impression conveyed by Dr. Stratton's listing of those manufacturers in his report on the metric system in export trade as "using" the system.

We also recommend to the attention of all the fact that the Library Bureau announces that it has given up the system. For 20 years this bureau has been a standing reference of the metric party as an example of the progress of the system in this country, and it now joins the procession of those who have tried the metric system only to abandon it. Chief of these is the firm of Willans & Robinson, of Rugby, England, who with a new product and a new shop, without old practice to interfere, adopted the system under the most favorable conditions under which it has ever been tried in English-speaking countries. Its advantages were found to be imaginary, and after 10 or 12 years' trial they gave it up for all new lines of work, although continuing it for the old, because of the difficulty of getting rid of established metric sizes.

Another case of the same kind is that of the American Solvay Process Co., which after adopting the metric system at the building of its plant later gave it up for the mechanical side of the work. Along with these instances all know the experience of William Sellers & Co., who adopted this system in beginning the manufacture of injectors, but who after a half-century of experience with it condemn it and would be glad to get rid of it, which, established as it is in their injector department, they cannot do.

What is the use of talking about the wonderful advantages of this thing when those who have tried it find, after the glamour of novelty has worn off, that the advantages do not exist?

Dr. Stratton's disclaimer at the end of Mr. Towne's letter must be read in the light of his record. When the bill of a dozen years ago was before the House Committee on Coinage, Weights and Measures, Dr. Stratton was always present at the hearings to urge the passage of the bill, which, as everyone knows, was compulsory on all manufacturers who dealt with the Government. Those hearings showed Dr. Stratton the strength of the opposition among manufacturers, and he has changed his program to an attack on the general public, which is without organization with which to oppose his plans.

Used in this limited commercial way, where does the uniformity of the system come in? When the manufacturers buy raw material and sell their finished products by one system and conduct all intermediate factory work in another, we will certainly have a beautiful example of "uniformity." It is exactly this condition in the textile industry of metric Europe which Mr. Dale has exposed as the cause of complexity and confusion.

No one has ever shown, because no one can show, the slightest superiority of the meter over the yard, of the kilogram over the pound or of the liter over the quart for commercial transactions. This side of the case was completely given away by Dr. Simon Newcomb—one of the most ardent of the metric party—who in a moment of forgetfulness said before the House Committee on Coinage, Weights and Measures: "So far as everyday purposes are concerned, I do not know of any particular advantage."

Meanwhile Dr. Stratton is on record as favoring compulsion in commerce and trade. The simple fact is that he wants all, but for the time being will accept anything he can get.

Future for Machine Tools in South America

Previous editorials on pages 697 and 741 have given statistics in regard to the machine tools, mechanics and shop executives of South American machine shops. With this information as a foundation it is very much in order to ask, "What is the future for North American machine tools in South American markets?" No other general reply can be considered except, "The prospects were never brighter than they are today."

The statistics previously given show in round numbers 460 shops, 11,500 machine tools and 14,500 workmen and executives attempting to do the machinery repairing and some part of the machinery building for a population of 40,000,000 persons. It is estimated that there are some 22,000 machine shops in the United States serving a population of 100,000,000. The prospects for machine-shop growth in the great southern continent are stupendous, even although South America never begins to manufacture machinery in the way in which it is produced in the United States. As that tremendously rich continent passes through the stages of development that this country traversed during the last century, machine shop after machine shop must come into being in order to care for the upkeep of the ever-increasing volume of machinery used in agriculture, transportation, mining and the thousand and one other uses to which machinery is put. With the locomotive, gang plow, harvester, sawmill and stamp must go machine tools.

Thus the bright prospect for the enormous future demand of machine tools in South America rests, first, upon the tremendous undeveloped resources, the vast unexplored regions filled with natural wealth, the world's richest store of undeveloped water power, the enormous areas of fertile land that can only be made available by railway connections, the new cities and the awakening people. The frontier of the world's greatest treasures of natural resources is now shifting to South America. As the frontier of resources advances, the frontier of industrial development follows. Machine tools now play a tremendous part in inaugurating the agricultural and

industrial eras. Fifty years ago the work of pioneering was done by the muscles of men, women and animals. Today machinery accompanies both pioneer and settler.

A second conclusion has to do with prospects for the United States machine tools in South America. Again the prospect is of the brightest. The South Americans really like North American products. Of all the machine tools now in South America nearly 40 per cent. are United States made. This record stands in spite of the fact that North American manufacturers have made no serious efforts to develop and control the southern market, have insisted on selling on a cash basis and have been in competition with European houses that were willing to cater to the wishes and fancies of the southern buyer and sell on long credit.

Generally speaking, there are two classes of customers for machine tools in South America: First, those who buy for quality, such as the large railroad-repair and shipbuilding shops, and, second, those who cannot afford the best, but need and are satisfied with plain, simple machines of average quality. The first class is accustomed to buying the regular line of machine tools produced by United States builders. A large part of the North American made machines in South America were purchased by men who belong to this class.

The second class must be reached by supplying machine tools of fair quality, but lighter in weight and cheaper in price than those that are considered standard in the United States. The reduction in weight lowers the cost to the buyer by reducing the amount of material used, by lessening the freight and by cutting down the amount of the custom-house charges and duty. In the aggregate these three items make an appreciable sum.

One reason for the lack of past developments amid the tremendous resources of South America is found in the traits and characteristics of the people. The South American lacks the energy of the northern races when it comes to industrial development. This is now being recognized in the north as never before, and the logical corrective steps are about to be taken. North Americans are now talking of going to the great southern continent; banking connections have already been established in a few large centers; the necessity of lending money to South American governments is being discussed. Each one of these things will have its influence in developing the agricultural, timber, mining and water-power resources of the great frontier of the Western Hemisphere.

Many of the plans now being developed to reach South American business are being laid with the expectation that ten years will pass before the results will be appreciable. Unfortunately, this foresight is not an any too prominent characteristic of the North American business man. It argues well for the future that in at least this one direction some of his usual business habits are being overcome. Just at present the lack of shipping facilities is acute. But this fact is well recognized by North Americans, and unquestionably before this year passes into history something will be done to relieve the situation.

A familiar objection to a visit or residence in South America on the part of a northerner is that of unhealthful living conditions. It is very true that there are some parts of South America which it is unwise for a northerner to visit; but if one will let his memory go back only a few years, he will recall the quarantines of New Orleans against yellow fever and the unhealthful, unsanitary conditions of Havana and Panama. Until very recently these drove the northern visitor to take most unusual precautionary measures. Now these sections have been cleaned up, and what has been done there can be done elsewhere. The precedent has been set, experience has been gained, and it merely needs the will and the effort to do for South American cities what has been done for New Orleans and Havana.

When plans are being seriously formed by North American machine-tool builders for South American trade, two things must receive consideration and should not be forgotten. In fact, these two require action at home. The first is some legal way of holding back products of the shoddy manufacturer. Some means should be available whereby everything exported from the United States would be exactly as represented. Misbranding, misclassifying, the uttering of exaggerated and lying descriptions should be punished by heavy penalties. It is of course impossible to set up a standard of quality for machine tools in the same way that standards can be established for the purity of foods and drugs, but steps can be taken to prevent the sending forth of dishonest descriptions and to compel a manufacturer or shipper to furnish just exactly what he has advertised or guaranteed to supply.

The second point for consideration at home is the matter of combination or coöperation for foreign trade. It is believed that under our present anti-trust laws such combinations are illegal for United States manufacturers. If such is found to be the case, immediate steps should be taken to do away with this hindrance. One of the most successful ways to further machine-tool trade in South America will be through the coöperation and combination of manufacturers in export business.

The Buying of Machines

The buying of tools is in many respects like the purchasing of labor and carries with it the same tendencies to look only at the outlay instead of to compare this with the results obtained. In this way many go over the specifications of a machine, compare bearings, weights, belts, etc., and decide on the one that is best for their particular work.

Others go to the other extreme and pay no attention to the design, to the weight, belts or anything else except the results that the maker is willing to guarantee. Advocates of this plan contend that they are buying not only the machine, but the experience of the builder; that it is not their province to criticize the design, the size of bearings or the belts, so long as the machine can be depended on to do the work under the manufacturer's guarantee.

There are of course many objections to a guaranteed output, as so much depends on both the work and the operator; but on the other hand, it is safe to assume that the maker of a machine is in better position than anyone else to know what a machine will do. If he is not willing to guarantee a minimum production, after knowing the conditions, we may be justified in looking askance at the machine he builds.

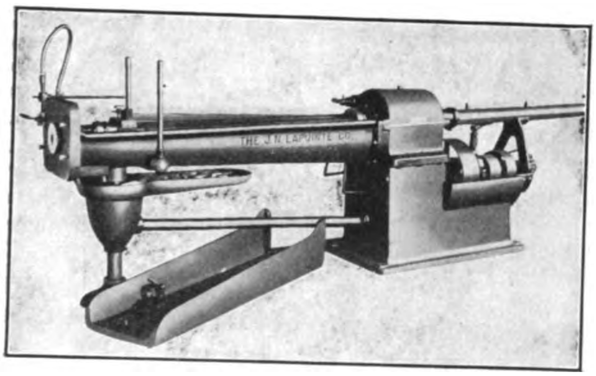
Some makers give very few details in their catalogs or elsewhere, believing that results should count and that the details of design are not necessary to the purchaser as long as the output of the machine is satisfactory in proportion to its cost. These are all problems for the careful buyer.

Shop Equipment News

Horizontal Broaching Machine

The broaching machine shown is the latest addition to the line made by the J. N. Lapointe Co., New London, Conn., and is known as the 3-B machine.

In general design and construction the machine follows the standard lines developed by the makers. All gears are incased, moving in a bath of oil, and two geared speeds are provided, which can be changed while the machine is running. A large roller thrust bearing is placed inside the gear casing to take the pressure of the cut and reduce the friction. The machine may be controlled either from the front or the rear, two operating handles being furnished. The size of the oil pump has been enlarged.



HORIZONTAL BROACHING MACHINE

Capacity, 1½ in. keyway, 10 in. long, or 3 in. square hole broached, 6 in. long; drive pulley, 18 in. diameter; travel of screw on low gear, 3 ft. per min.; driving screw, 2¾ in. diameter, 2 pitch, 54 in. stroke; floor space, 2½x16½ ft.; weight, 3,400 lb.

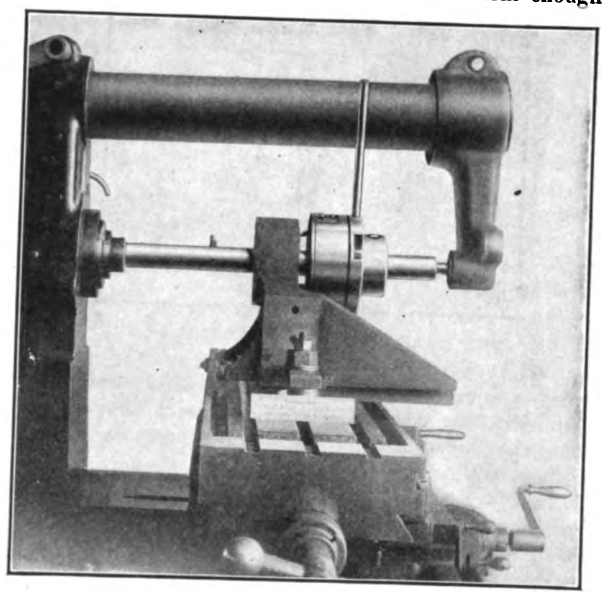
The machine is fitted with a duplex self-oiling clutch the lubrication for which is supplied from a reservoir. Automatic stops regulate the length of the stroke. The sliding head is fitted with bronze shoes designed to give a wearing surface of more lasting qualities than cast-iron ways.

Facing Head

The illustration shows a facing head that is built by the Mummert-Dixon Co., Hanover, Penn. These heads are made in three sizes—6, 9 and 12 in. They can be used in connection with a bar on any machine that will hold and drive the bar. The heads can also be used without a bar on the end of a spindle, such as that of drill presses, millers, etc., by supplying a tapered shank. The head, with its feeding arrangement, is self-contained.

To spot-face on a drill press has always been rather difficult. Ordinary flat spot-facing tools are hard to keep in order, and it is not easy to get them started under the scale of the iron. These tools overcome this trouble. The facing may start from the center and the tool bit feed outward, or it may start from the outside and feed in. The tool bit gets beneath the scale at the start and breaks it away as the tool is fed across the work. The tool bit is easily taken out and sharpened. The feed is effected by placing a pin in one of the holes in the feed ring and either holding it by hand or letting it bear against the frame of the machine. This operates the feed screw that moves the tool across the work.

When the head is used in connection with the taper shank on the end of a spindle that is not firm enough to steady it, a pilot projecting from the center of the head may be entered in the hole in the work. On this pilot, bushings can be placed to fit any size of hole.



FACING HEAD

A pilot with a center point is also provided for cases when there is no hole. The center is placed in a hole that is put in the work by a small center drill that, with its holder, is quickly attached with the facing head in place on the spindle.

Adjustable Drawing Board

The illustrations represent the latest developments of the Emmert Manufacturing Co., Waynesboro, Penn., in providing vertical adjustable drawing boards to which its combination T-square and protractor may be applied.

In Fig. 1 is shown a vertically inclined adjustable drawing board. The complete outfit consists of a drawing board adjustable to any desired angle and slidable to or from the draftsman, a cylindrical weight concealed behind the drawing board and used to counterbalance its weight in any position, a stationary base frame, a device for adjusting the swinging upper frame to different angles, a slidable horizontal board or leaf carrying a drawer, and an upright adjustable stand.

The drawing board is easily moved up or down to bring it into convenient position for the draftsman and on a level with his eyes, whether sitting or standing. When the work is on the lower half of the board, the latter is moved upward to the desired position; and when work is to be done on the upper half of the board, it is lowered. The board, being evenly balanced with just sufficient friction to hold it steadily in position, is moved without any noise.

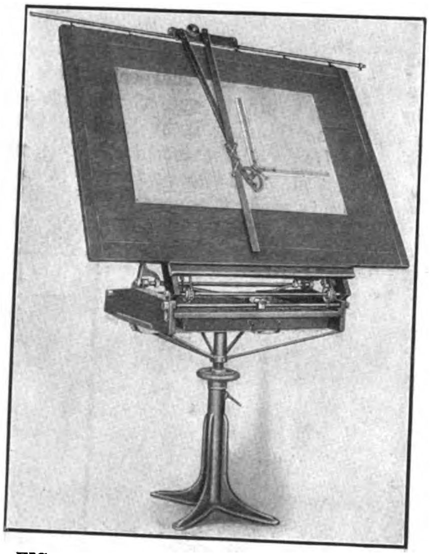


FIG. 1. ADJUSTABLE DRAWING BOARD

The draftsman need never twist or bend his spine to reach any part of the surface of the board, nor need he strain his eyes to read the fine graduations on the scale or the finer lines in the drawing, for with the aid of the adjustable vertical board he may assume a comfortable, normal position and adjust the distance between drawing and eye for correct vision.

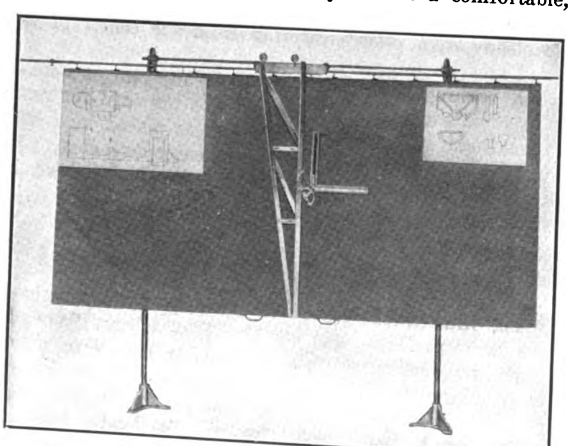


FIG. 2. ADJUSTABLE DRAWING BOARD FOR LARGE ASSEMBLIES AND LAYOUTS

The adjustable vertical board may be readily changed to the ordinary horizontal position where such position is preferable for inking, etc.

The adjustable floor stand provides a means for raising or lowering the drawing board and its attendant frame to accommodate the stature of the draftsman and to bring the drawing into position most favorable to light changes in the drawing room.

The board shown in Fig. 2 is intended especially for large assembled drawings, full-sized drawings, layouts, etc.

The board travels almost vertically a distance of from 4 to 5 ft. up and down on the supporting posts. Attached to its rear surface are the two sets of iron brackets carrying hardwood rollers, which rollers move against the supporting upright posts. The board is inclined at an angle of 3 deg., just sufficient to permit the rollers to bear slightly against the upright posts. The upward and downward movement is noiseless and requires but little effort on the part of the draftsman.

The upper set of brackets accommodate two ropes that pass over grooved pulleys at the top of the upright posts and are fastened to a balance weight. The grooved pulleys are joined by a connecting-rod and revolve together, thus providing an even movement at either end of the drawing board.

The counterbalance consists of a plain wooden box that may be filled with any suitable material, such as sand, scrap iron, etc., in sufficient quantity to balance evenly the weight of the drawing board. The upright posts are used in pairs, but for boards 15 to 20 ft. long, three posts should be used.

Micrometer for Measuring Tools with Three Flutes

The illustrations show a micrometer made by the L. S. Starrett Co., Athol, Mass., for the Union Twist Drill Co., also of Athol. With this tool the diameters of three-fluted drills, taps, cutters and so forth can be accurately measured.

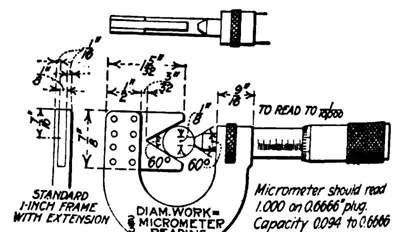


FIG. 1. DETAILS OF MICROMETER

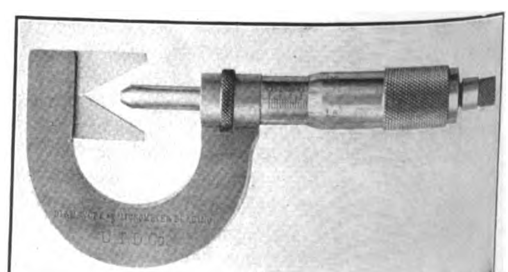
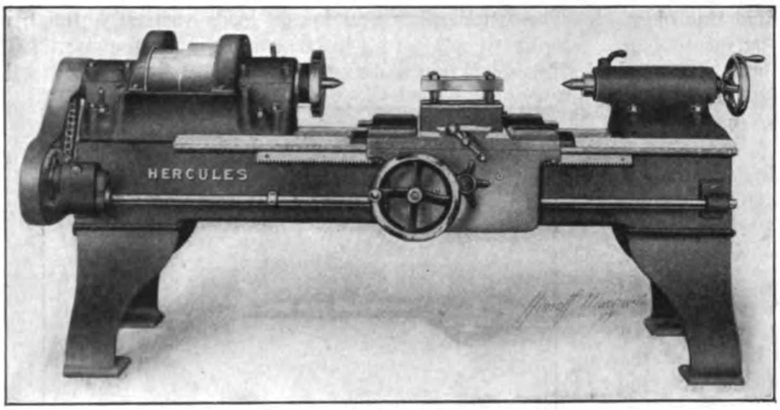


FIG. 2. MICROMETER FOR MEASURING THREE-FLUTED TOOLS

The anvil of the micrometer is replaced by a 60-deg. V-block. The tool to be measured is laid in this V-block, as shown in Fig. 1, resting on two of its teeth. The spindle is then brought down on the remaining tooth. The diameter of the work equals two-thirds the micrometer reading. The micrometer shown reads to 0.0001 in.

Single-Purpose Lathe

The lathe illustrated is of the single-purpose type, back geared, and in design and construction follows the standard lines developed for this particular class of tool.



SINGLE-PURPOSE LATHE

Swing, 16 in.; distance between centers, 40 in.; height from floor to center, 40 in.; belt, 5½ in. wide. Also made in 20-in. swing size

The machine is a recent product of the Himoff Machine Co., New York City, and is made with a two-step cone pulley, as shown, or a single-pulley drive.

Rotary Magnetic Chuck

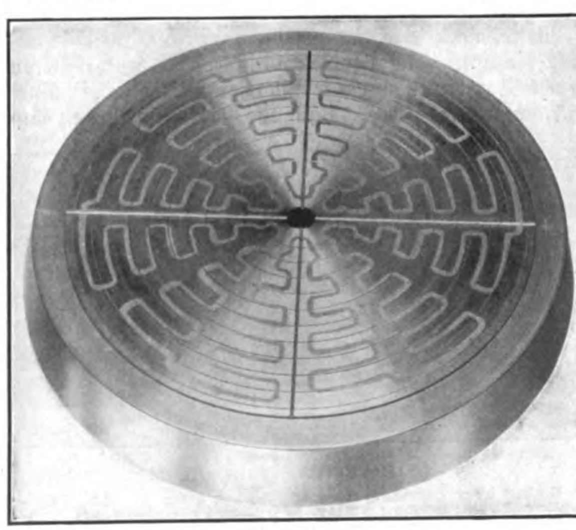
In the design and construction of the chuck shown, a recent product of the Persons-Arter Co., Worcester, Mass., the main object was to reduce to a minimum the number of air gaps between members, making a continuous magnetic circuit. This has been accomplished by reducing the number of principal parts in the circuit to three—the body or shell, the core or center and the yoke or base plate. This construction reduces the number of possible air gaps to two—between the base plate and the body, and between the base plate and the core. Further to insure a good magnetic circuit, the contact faces between these three members are ground and bolted rigidly together by soft-iron capscrews. There are only two poles in the chuck, the space between the pole faces being filled with a nonmagnetic composition of bismuth, antimony and lead having the characteristic of expanding when cooling, consequently establishing an air-tight joint between the poles.

The three members constituting the magnetic circuit are made of cast magnetic steel. Their cross-sectional area is exceptionally large, making it possible for an extremely large number of magnetic lines of force to be induced.

Although only one magnetizing coil is necessary for one particular voltage, it has been found advantageous to provide two coils. The voltage commonly used on such a coil is 110, but many firms are using a voltage of 220. With two coils it becomes a simple operation to connect to either a 110-volt or a 220-volt circuit; thus the coils are connected in parallel on a 110-volt circuit and in series on a 220-volt circuit.

The coils, after being wound and thoroughly covered with strong insulating material, are dipped in insulating compound and made waterproof. In making the electrical connections the leads from the coils run along a channel in the base plate and through an insulating bushing to the collector rings, to which they are directly soldered, thus making a positive connection and eliminating any chance of trouble due to loose connections. The collector rings are in the same plane—a feature that considerably simplifies the brush mounting. The brushes, of copper-coated carbon and mounted on hard spring brass strips, press underneath the rings and not the side, facilitating the removal and the replacing of the chuck without altering the adjustment of the brushes. The collector rings are mounted on a Bakelite-Micarta ring of substantial proportions, which is rigidly bolted to the chuck base plate. Before the assembly of the chuck is completed, all open space is filled with an insulating compound as an extra precaution against moisture, etc.

It has been observed that if two magnets are made of the same material, with the same sectional area and the same magnetizing force, but are of different shapes (for instance, one a solid circular section and the other shaped like a cross or having its surface broken up so as to present numerous edges), the one presenting the greater number of edges will show a decidedly greater pull in pounds per square inch. The chuck face illustrated consists of two series of arms—one series radiating from the center and the other radiating toward the center. Each arm carries a series of arms running concentrically, those of one pole interposed between those of the other pole, thus breaking up the face of the chuck into a



ROTARY MAGNETIC CHUCK

maximum number of parts. In order to effect a good holding power, especially needed on small parts, it is necessary to cross two poles, the part to be ground thus acting as a keeper. The concentric arms are staggered in relation to each other. This feature also assists in holding very narrow rings.

The whole surface of this chuck is magnetically alive, from the center to the edge, with the exception of the metal filling composition.

It has been found in some cases that magnetism has been transmitted to the machine by having the body of the chucks alive, but the advantage of being able to utilize the whole surface of the chuck is so great that some method had to be devised to overcome this objection. The desired effect is accomplished by introducing a nonmagnetic plate between the chuck base plate and the faceplate attached to the chuck spindle, thus blocking any stray lines that might otherwise pass to the machine.

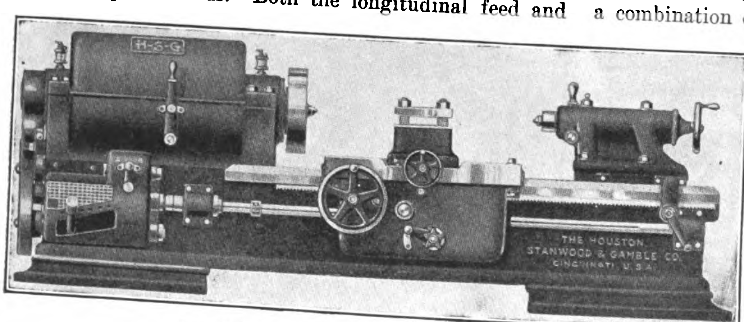
By using high-grade magnet steel, residual magnetism is eliminated; but where the work has itself become magnetized, it is necessary to demagnetize it before removal. For this purpose the chuck is provided with a special demagnetizing switch.

The removal of very thin disks after grinding is sometimes difficult, even after demagnetizing, owing to a vacuum or moisture suction between the bottom of the disk and the face of the chuck. To overcome this, the chuck has two grooves cut across its face at right angles, about 1/8 in. wide and 1/16 in. deep, enabling the introduction of a pointed instrument under the disk to lift it from the chuck face.

Heavy-Pattern Lathe with Geared Headstock

The heavy-pattern high-powered lathe shown is equipped with an all-geared headstock, having single pulley drive. The spindle bearings are bronze bushed, and steel gears are used throughout.

The tailstock is of the offset type, with adjustable set-over feature. The double-wall apron is worm driven by a feed rod with single friction control for longitudinal and cross-power feeds. Both the longitudinal feed and the crossfeed are reversed in the apron, an automatic stop for the longitudinal feed being provided. The quick-change feed has tumbler and a cone of gears with compounding arrangement within the feed box and an interchange of two gears on the end of the headstock. The gear box is driven through gears at the head of the lathe, there being a reverse plate and quadrant designed to provide a wide range of feeds.



HEAVY PATTERN ALL-GEARED LATHE

Swing over carriage, 30½ in.; swing over bridge, 19 in.; distance between centers, 72 in.; driving pulley, 19½x7 in.; ratio of gearing in head, 30 to 1 and 22½ to 1; hole through spindle, 2½ in.; length of carriage on bed, 44 in.; width of carriage bridge, 16 in.; feeds per inch, 4 to 56; length of bed, 13 ft.; weight, 13,000 lb.

The lathe is a recent product of Houston, Stanwood & Gamble, Cincinnati, Ohio.

Elevating Shop Truck

The illustration shows an elevating shop truck recently developed by the Lewis-Shepard Co., Boston, Mass., and featured by its all-steel construction, except for the wheels, which are made of gray iron.

The truck raises and lowers loads vertically, the lift ranging from 2½ to 3 in., depending upon the size. The vertical elevation is designed to conserve floor space, as it permits the loaded platforms to be placed close against each other. A free lifting and steering handle is provided by using a universal joint. The elevating mechanism may be operated by the handle, no matter in what position the latter may be. The lift is accomplished by a combination of positive leverages through which, it is claimed, only 7 per cent. of the power applied is lost by friction. This makes it possible to lift 3,000 lb. with only an 85-lb. pull in four short strokes and to lift 5,500 lb. with only a 110-lb. pull in six short strokes of the handle.

ELEVATING SHOP TRANSFER TRUCK

A positive release check, controlled by a pedal conveniently located on the front of the truck, permits a slow and jarless lowering of the load. The release check stands in a vertical position, rendering the possibility of leakage at the piston end remote and preventing buckling of the plunger.

In hanging the handle 16 in. above the floor it is designed to eliminate the waste of any of the strength applied to the pull. The strong front arch is also designed to steady the load.

This form of truck is made in a variety of sizes for different capacities.

NEW PUBLICATIONS

THE "MECHANICAL WORLD" ELECTRICAL POCKET BOOK FOR 1916—Two hundred and forty 4x6-in. pages; 129 illustrations; indexed; cloth bound. The Norman Remington Co., Baltimore, Md. Price, 30c.

This book in preparation for this years' edition has undergone revision, and matter dealing with switch gears and switchboards, earthing, reductors for half-watt lighting and the efficiency of direct-current dynamos and motors has been added. The sections on lighting circuits and switching, electric lamps and lighting have also been rewritten and brought up to date.

MECHANICAL ENGINEERS' POCKET BOOK—By William Kent. One thousand five hundred and twenty-six pages, 4x6¾ in. Published by John Wiley & Sons, Inc., New York City Price, $5 net.

To one who had the privilege of reviewing the first edition of this now famous pocket book it is particularly gratifying to see the growth both in its contents and in the number of editions printed. The changes in industry since the previous edition are indicated by the necessity of making alterations in over 400 pages and by the addition of over 150 pages of new material to bring it up to date.

It is difficult to enumerate the changes and additions made, the new tables, the condensation of matter to prevent making an unwieldy volume or, in fact, to do justice to such a book in any review without taking up each section in detail, which seems unnecessary with such a well-known volume. The revision, by William Kent and his son Robert Thurston Kent, is in keeping with the standards set by previous editions.

CORROSION OF IRON—By L. C. Wilson. One hundred and sixty-nine pages, 5x7½ in.; cloth bound; indexed. Price, $2. Published by the Engineering Magazine Co., New York City.

This book is the result of collecting and putting in handy reference form some of the facts connected with the corrosion of iron and its protection. The volume is divided into the following chapters: The Rust Problem, Theories of Corrosion, Protective Measures, Paint Materials, Protective Paint, Influence of Different Elements on the Corrosion of Iron, Corrosion of Wrought-Iron and Steel Pipe.

In the first chapter the question of rust is discussed at some length, and how it affects iron under various conditions is explained. The various theories to account for this corrosion are considered in detail in the second chapter.

The following chapters take up and describe various protective measures, and their success in preventing rust. This book should prove useful to machine-tool builders and to anyone to whom the preventing of rust is of vital importance.

Straight and Taper Forced and Shrunk Fits--Erratum

The captions of Figs. 1 and 2 of the discussion by W. Knight, which appeared on page 733, were inadvertently transposed. The chart, Fig. 1, therefore, applies to a cast-iron shaft and the second chart to a steel shaft.

PERSONALS

G. W. Helpman has been appointed superintendent of the Defiance Machine Works, Defiance, Ohio.

Oskar Kylin, for six years with the Warner & Swasey Co., Cleveland, Ohio, for the most part of which he acted in the capacity of designer, has accepted a position with the Foster Machine Co., Elkhart, Ind.

Joseph A. Horne, for more than 24 years associated with the Yale & Towne Mfg. Co., acting in the capacity of general superintendent in recent years, has been elected second vice-president, still retaining his executive position in the shop.

George H. Houston, for several years production superintendent of the Root & Van Dervoort Engineering Co., Moline, Ill., and more recently with the John Deere Co., has become associated with the American Can Co. as a member of the engineering division.

BUSINESS ITEMS

The offices of the Century Steel Co. have been transferred to the Equitable Building, New York, the warehouse remaining at 191 Pearl Street, New York.

The Independent Pneumatic Tool Company's Atlanta Georgia Branch was moved to Birmingham, Alabama on May first. A suite of offices have been leased in the Jefferson County Bank Building.

The Doehler Die-Casting Co., of Brooklyn, New York, and Toledo, Ohio has acquired a controlling interest in the American Die Casting Co., of Newark, N. J., which will hereafter be known as the Doehler Die-Casting Co., of New Jersey. Its present management remains unchanged.

TRADE CATALOGS

M. A. Palmer Co., 469 Atlantic Ave., Boston, Mass. Circular. Nonshrinkable tool steel.

Francis & Co., Hartford, Conn. Catalog. Diamond-pointed tools. Illustrated, 16 pp., 3½x6 in.

Worcester Pattern and Model Co., Worcester, Mass. Circular. Anderson tool grinder. Illustrated.

Rex Mfg. Co., Hyde Park District, Boston, Mass. Circular. Tool post for multiple and single tool work. Illustrated.

The A. & F. Brown Co., Elizabethport, N. J. Catalog. Power transmission machinery. Illustrated, 130 pp., 5x8 in.

Arthur A. Crafts, 125 Summer St., Boston, Mass. Catalog. Diamond and carbon-pointed tools. Illustrated, 16 pp., 3½x6 in.

Stow Manufacturing Co., Binghamton, N. Y. Booklet. "Portable Tools of Proven Value." Drills, grinders, buffers, etc. Illustrated, 20 pp., 3½x6 in.

Chicago Pneumatic Tool Co., Fisher Building, Chicago, Ill. Bulletin No. 34-Q. "A Few Applications of 'Giant' Gas and Fuel Oil Engines." Illustrated, 28 pp., 6x9 in.

Ingersoll-Rand Co., 11 Broadway, New York. Form No. 3029. Ingersoll-Rogler Class ORC duplex Corliss steam driven air compressors. Illustrated, 32 pp., 6x9 in. Form No. 3036. Turbo blowers. Illustrated, 10 pp., 6x9 in.

FORTHCOMING MEETINGS

Master Car Builders' Association. Annual meeting, June 14-17, Atlantic City, N. J. Joseph W. Taylor, secretary, Karpen Building, Chicago, Ill.

American Railway Master Mechanics' Association. Annual meeting, June 17-21, Atlantic City, N. J. Joseph W. Taylor, secretary, Karpen Building, Chicago, Ill.

American Society for Testing Materials. Annual meeting June 27 to July 1, 1916, Hotel Traymore, Atlantic City, N. J. Edgar Warburg, secretary, University of Pennsylvania, Philadelphia, Penn.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Wednesday each month. J. A. Brooks, secretary, Brown University, Providence, R. I.

New England Foundrymen's Association. Regular meeting second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. J. H. Warder, secretary, 1785 Monadnock Block, Chicago, Ill.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Technical League of America. Regular meeting second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York, N. Y.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	May 5, 1916	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$15.00	$15.00	$9.50
No. 2 X Northern Foundry, New York	20.75	20.50	14.00
No. 2 Northern Foundry, Chicago	19.00	19.00	13.00
Bessemer, Pittsburgh	21.95	21.95	14.55
Basic, Pittsburgh	18.95	19.20	13.45
No. 2 X, Philadelphia	20.50	20.25	14.25
No. 2, Valley	18.50	18.50	12.75
No. 2, Southern Cincinnati	17.90	17.90	12.40
Basic, Eastern Pennsylvania	20.50	21.00	13.25
Gray forge, Pittsburgh	18.70	18.70	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger from jobbers' warehouse at the places named:

	New York				
	May 5, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Steel angles, base	3.25	3.10	1.85	3.25	3.10
Steel T's, base	3.30	3.15	1.90	3.25	3.10
Machinery steel (bessemer)	3.25	3.10	1.80	3.25	3.10
Steel plates	4.25	...	...	...	...

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse at the places named:

	New York				
	May 5, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
No. 28 black	3.65	3.50	2.60	3.20	3.20
No. 26 black	3.55	3.40	2.50	3.10	3.10
Nos. 22 and 24 black	3.50	3.35	2.45	3.05	3.05
Nos. 18 and 20 black	3.45	3.30	2.40	3.00	3.00
No. 16 blue annealed	4.45	4.30	2.35	3.70	3.60
No. 14 blue annealed	4.40	4.20	2.25	3.60	3.50
No. 12 blue annealed	4.30	4.15	2.20	3.55	3.45
No. 10 blue annealed	4.25	...	...	...	...
No. 28 galvanized	5.65	5.65	4.00	5.50	5.50
No. 26 galvanized	5.35	5.35	3.75	5.20	5.20
No. 24 galvanized	5.20	5.20	3.55	5.05	5.05

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot:

	Black		Galvanized	
	May 5, 1916	One Yr. Ago	May 5, 1916	One Yr. Ago
¾ to 2 in. steel butt welded	70%	81%	52½%	72½%
2½ to 6 in. steel lap welded.	68%	80%	48½%	72½%
Diameter, In.				
¾	3.45	2.20	5.46	3.50
1	5.10	3.40	8.08	5.20
1¼	6.90	4.60	10.93	7.00
1½	8.25	5.50	13.06	8.40
2	11.10	7.40	17.58	11.15
2½	18.72	12.20	30.13	18.60
3	24.48	16.10	39.40	24.20
4	34.88	22.90	56.14	34.50
5	47.36	29.60	76.22	40.70
6	62.44	38.40	98.88	52.80

From New York stock the following discounts hold:

	Black	Galvanized
3½ to 6 in. steel lap welded	61%	36%
¾ to 3 in. steel butt welded	64%	42%

Malleable fittings, Class B and C, from New York stock sell at 30 and 5% from list price. Cast iron, standard sizes, 54%.

Bar Iron—Prices are as follows in cents per pound at the places named:

	May 5, 1916	One Month Ago
Pittsburgh, mill	2.50	2.45
Warehouse, New York	3.25	3.10
Warehouse, Cleveland	3.25	3.25
Warehouse, Chicago	3.10	3.10

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-size lots, the following quotations hold:

	May 5, 1916	One Month Ago
New York	List price plus 20%	List price plus 10%
Cleveland	List price plus 20%	List price plus 20%
Chicago	List price plus 10%	List price

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York — Today $6.00; One Year Ago $3.75@4.00. Cleveland... $5.80 Chicago... $4.75

In coils an advance of 50c. is usually charged.

Drill Rod—Discounts from list price in New York are as follows: Standard, 65%; extra, 60%; special, 55%.

High Speed Tool Steel containing from 10 to 18% tungsten sells as follows per pound in New York:
Billets ....$2.35 Bars $3.00

Bar Steel sells at $3.25 per 100 lb. from warehouse, New York.

METALS

Miscellaneous Metals—The present quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	New York		
	May 5, 1916	One Month Ago	One Year Ago
Copper, electrolytic (carload lots)	*30.50	27.50	19.00
Tin	51.50	53.00	40.00
Lead	7.50	8.50	4.20
Spelter	18.00	18.50	14.00
ST. LOUIS			
Lead	7.37½	8.50	...
Spelter	17.87½	18.50	...

*May or June delivery 30c., July 29½c., August 29c., September 28¾c.

At the places named, the following prices in cents per pound prevail:

	New York				
	May 5, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Copper sheets, base	36.50	35.50	24.00	38.50	36.50
Copper wire (carload lots)	36.50	35.50	18.00	34.50	37.00
Brass rods, base	44.00	41.50	21.50	36.00	38.00
Brass pipe, base	44.50	44.50	19.20	43.00	46.50
Brass sheets	43.00	40.50	21.75	36.00	38.50
Solder ½ and ½ (case lots)	31.62½	32.25	28.00	35.50	....

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York		Cleveland	
	May 5, 1916	One Month Ago	May 5, 1916	One Month Ago
Copper, heavy and crucible	25.00	23.00	25.00	22.00
Copper, heavy and wire	24.50	22.00	24.00	21.00
Copper, light and bottoms	22.00	19.00	24.00	18.00
Lead, heavy	6.00	6.50	7.00	6.50
Lead, tea	5.50	6.00	6.00	5.50
Brass, heavy	14.50	14.00	20.00	18.00
Brass, light	12.50	12.00	13.00	12.00
No. 1 yellow rod brass turnings	15.25	15.00	14.50	16.25
Zinc	12.00	13.00	16.00	14.50

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	31.50	32.00	32.50	33.00	36.00
¼ to 5/16	31.25	31.75	32.25	32.75	35.75
⅜ to 1⅛	31.00	31.50	32.00	32.50	35.50
1 3/16 to 2⅞	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3 7/16	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3½ to 3 15/16	32.25	32.75	33.25	35.75	36.75
Squares					
3 1/16 to 3 15/16	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4 15/16	33.00	33.50	36.00	36.50	37.50
5 to 6 15/16	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Antimony—Chinese and Japanese brands are quoted in cents per pound for spot delivery, duty paid:

	May 5, 1916	One Month Ago
New York	38.00	45.00
Cleveland	50.00@55.00	50.00
Chicago	44.00	45.00

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places named:

	New York	Cleveland	Chicago
Best grade	60.00@65.00	59.50	60.00
Commercial	30.00@35.00	22.50	25.00@28.00

Copper Sheets—In New York hot rolled 16 oz. (large lots) base per lb. is 36.50c.; cold rolled 14 oz. and heavier add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

Copper Bars from warehouse sell as follows in cents per pound:

	May 5, 1916	One Month Ago
New York	42.00	40.00
Cleveland	32.50	....
Chicago	38.25	38.50

SHOP SUPPLIES

Nuts—From warehouses at the places named, on fair sized orders the following amount is deducted from list:

	New York		Cleveland		Chicago	
	May 5, 1916	One Month Ago	May 5, 1916	One Month Ago	May 5, 1916	One Month Ago
Hot pressed square	$2.50	$2.75	$3.25	$3.75	$3.25	$3.70
Hot pressed hexagon	2.50	2.75	3.25	3.75	3.25	3.80
Cold punched square	2.00	2.50	3.00	3.00	3.00	4.25
Cold punched hexagon	2.50	3.00	3.25	3.75	3.50	4.00

Semifinished nuts sell at the following discounts from list price:

New York... 50-10% Cleveland... 65-10% Chicago... 65%

Carriage Bolts—From warehouses at the places named the following discounts from list price are in effect:

	New York	Cleveland	Chicago
⅝ by 6 in.	45—5%	50—10—5%	60—5%
Larger and longer	35%	40—15%	50%

At this rate the net prices are as follows:

Length, In.	New York ¼	New York ½	New York ¾	Cleveland ¼	Cleveland ½	Cleveland ¾	Chicago ¼	Chicago ½	Chicago ¾
1½	$0.53	...	...	$0.43	...	...	$0.38	...	...
2	.58	...	...	.48	...	...	.42	...	...
2½	.63	$2.12	$5.53	.51	$1.39	$3.63	.46	$1.63	$4.25
3	.68	2.30	5.85	.55	1.51	3.85	.50	1.77	4.50
3½	.73	2.48	6.18	.60	1.64	4.06	.54	1.91	4.75

Machine Bolts—From warehouses at the places named the following discounts hold:

	New York	Cleveland	Chicago
⅝ by 4 in. and smaller	50%	60 and 10%	60 and 10%
Larger and longer up to 1 in. by 30 in.	40%	50 and 5%	50 and 10%

At this rate the net prices per 100 follow:

Length In.	New York ¼	New York ½	New York 1	Cleveland ¼	Cleveland ½	Cleveland 1	Chicago ¼	Chicago ⅝	Chicago 1
2	$0.89	$2.32	$9.60	$0.67	$.146	$6.08	$0.64	$1.74	$7.20
2½	.83	2.48	10.14	.70	1.57	6.32	.67	1.85	7.60
3	.97	2.63	10.68	.73	1.66	6.86	.70	1.97	8.00
3½	1.01	2.79	11.22	.77	1.77	7.48	.73	2.08	8.40

Wrought Washers—From warehouses at the places named the following amount is deducted from list price:

New York.... $4.00 Cleveland.... $6.00 Chicago.... $6.30

At this rate, the net prices follows:

Diameter, In.	New York	Cleveland	Chicago
5/16	$10.00	$8.00	$7.70
¾	8.20	6.20	5.90
⅞	7.40	5.40	5.10
1	6.50	4.50	4.20
1¼	5.70	3.80	3.50
1⅜	5.20	3.40	3.10
1½	5.10	3.30	3.00
1¾	5.00	3.20	2.90
2, 2¼, 2½, 2¾	5.00	3.10	2.80
3, 3¼	5.00	3.00	2.70
3½, 3¾	5.20	3.00	2.90
4, 4¼, 4½	5.50	3.20	3.20

For cast-iron washers the base price per 100 lb. is as follows:

New York.... $2.50 Cleveland.... $2.00 Chicago.... $2.00

Rivets—The following quotations are allowed for fair sized orders from warehouse:

	New York	Cleveland	Chicago
Steel 7/16 and smaller	45%	45—10%	52½%
Tinned	45%	45—10%	52½%

Button heads ¾, ⅞, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.:

New York.... $5.25 Cleveland.... $3.85 Chicago.... $3.50

Cone heads, same sizes:

New York.... $5.35 Cleveland.... $3.95 Chicago.... $3.60

For the following sizes, the extras over the above prices in cents per 100 lb. are as follows:

1¼ to 1¾ in. long, all diameters	$0.25
⅝ in. diameter	0.15
½ in. diameter	0.50
1 in. long and shorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

Nails—Wire nails f.o.b. Pittsburgh sell at $2.50; galvanized, 1 in. and longer, $4.50, and shorter, $5. These prices are to regular customers and delivery is made at the mill's convenience. From warehouse wire and cut nails sell as follows:

	New York	Cleveland	Chicago
Wire	3.15	3.05	2.75
Cut	3.15	2.95	2.75

Copper Rivets and Burs sell at the following rate for orders 100 lb. and over:

	Rivets	Burs
Cleveland	List price	List price
Chicago	List price	List price
New York	20% from list price	List price

MISCELLANEOUS

Seamless Drawn Tubing (Iron Pipe Sizes)—The base price per pound from warehouse is as follows:

	New York	Cleveland	Chicago
Brass	42.50	44.50	42.50
Copper	45.00	43.50	43.50

For immediate stock shipment the following quotations hold:

Diameter, In.	Copper New York May 5, 1916	Copper New York One Year Ago	Copper Cleveland	Brass New York May 5, 1916	Brass New York One Year Ago	Brass Cleveland
¾ to 2½	48.00	22.50	44.50	45.50	19.50	43.50
3	48.00	22.50	44.50	45.50	19.50	43.50
3½	49.00	23.50	44.50	46.50	20.50	43.50
4	50.00	24.50	45.50	47.50	21.50	44.50
4½	52.00	26.50	47.50	49.50	23.50	46.50
5	54.00	28.50	49.50	51.50	25.50	48.50
5	55.00	29.50	51.50	52.50	26.50	50.50
7	57.00	31.50	51.50	54.50	28.50	50.50
8	59.00	33.50	55.50	56.50	30.50	54.50

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire

⅜, 11/32, 5/16, ¼, 7/32, 3/16	10.00
No. 8, 5/32 and No. 10	11.00
⅛	12.50
No. 12	13.50
3/32, No. 14 and 1/16	15.00
No. 18	16.50
No. 20	17.50

Special Welding Steel

⅛	33.00
3/32	30.00
1/16	28.00

Cast-Iron Welding Rods

¼ by 19 in. long	22.00
3/16 by 12 in. long	26.00
⅜ by 19 in. long	20.00
½ by 21 in. long	20.00

Vanadium Wire in Coils or Sticks

1/16	15.50
3/32	15.00
⅛	14.00
5/32	12.00
3/16 and larger	11.00

Tin Plates—The following prices are in effect from warehouses at the places named:

			New York May 5, 1916	New York One Month Ago	Cleveland May 5, 1916	Cleveland One Month Ago	Chicago May 5, 1916	Chicago One Month Ago
Coke tin plate, 14x20:								
100 lb.			$6.00	$5.00	$5.40	$5.00	$5.60	$5.00
I. C. 107 lb.			6.15	5.15	5.55	5.15	5.75	5.15
Terne plate, 20x28:								
Base Wgt.	Net Wgt.	Coating						
100 lb.	200	8	$10.00	$9.50	$9.10	$9.10	$8.70	$8.20
I. C.	214	8	10.30	8.90	9.35	9.35	9.25	8.80
I. X.	270	8	12.30	11.80	11.60	11.60	11.40	10.55
I. C.	218	12	12.00	12.00	10.50	10.25	10.75	10.30
I. C.	221	15	13.00	13.00	10.50	10.50	11.60	11.25
I. C.	226	20	13.50	13.50	12.50	12.50	12.50	12.05
I. C.	231	25	14.25	14.25	13.50	13.50	13.75	13.30
I. C.	236	30	15.50	15.50	14.50	14.50	14.75	14.30
I. C.	241	35	17.00	17.00	15.75	15.75	15.85	15.75
I.C.	246	40	19.00	19.00	16.75	16.75	17.10	16.55

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Apr. 15	Apr. 22	Apr. 29	May 6
Prompt furnace	$2.75@3.00	$3.00	$2.25	$2.25@2.40
Prompt foundry	3.75@4.00	3.75@4.00	3.75	3.75

Sponge Cloths (Wiping Towels) sell as follows per dozen: 16x18 in., 30c.; 18x20 in., 35c.; 18x22 in., 38c.

Foundry and Fire Clay in New York sells at $2 per lot of 300 lb. This does not include delivery charges.

Zinc Sheets—The following prices in cents per pound prevail:

Carload lots, f.o.b. mill 25.50

	New York	Cleveland	Chicago
In casks	26.50	26.50	26.00
Broken lots	27.00	27.50	26.50

Cotton Waste—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	11.00@13.00	11.00@14.00	11.00@13.50
Colored mixed	8.00@10.00	7.50@11.00	8.00@10.50

Sal Soda sells as follows per 100 lb.:

New York.............. $1.90 Cleveland.............. $2.25 Chicago.............. $1.90

Roll Sulphur in 360-lb. bbl. sells as follows per 100 lb.

New York.... $2.25 Cleveland.... $2.75 Chicago.... $2.80

Linseed Oil—These prices are per gallon:

	New York	Cleveland	Chicago
Raw in barrels	$0.81	$0.80	$0.81
5-gal. cans	.91	.90	.90

Boiled, it is 1c. per gal. higher.

White and Red Lead, in cents per pound, sell as follows:

	Red Dry	Red In Oil	White Dry and In Oil
100-lb. keg	10.50	11.00	10.50
25- and 50-lb. kegs	10.75	11.25	10.75
12½-lb. keg	11.00	11.50	11.00
1- to 5-lb. cans	12.50	12.50	12.50

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

F. L. Cone is constructing a 2-story, 40x120-ft. machine shop at Windsor, Vt.

The contract has been awarded for the construction of a 1-story, 68x90-ft. garage at Dorchester, Boston, Mass., for L. Cavagnaro, 1 Faneuil Hall Market, Boston. Estimated cost, $26,000.

The Simonds File Co. plans to construct a 93x100-ft. addition to its plant on Faluhah St., Fitchburg, Mass.

Plans are being prepared for the construction of a 1-story, 90x110-ft. garage at Malden, Mass., for David F. Cosgrove, 575 Broadway, East Malden.

Russell C. Parsons, Springfield, Mass., will construct a public garage at Paradise Rd. and Elm St., Northampton, Mass.

The contract has been awarded for the construction of a garage for Olen E. Doty, 120 Forest Park Ave., Springfield, Mass.

Kelley & Hawes, Winchester Sq., Winchester, Mass., plans to build a 1-story, 111x130-ft. garage at Winchester.

The D. & W. Fuse Co., manufacturer of fuses and insulated wire, has awarded the contract for the construction of an addition to its factory at Providence, R. I. Estimated cost, $50,000.

The Jones Garage Co. has been granted a permit for the construction of a garage at 295-97 Capen St., Hartford, Conn.

Fire, Apr. 26, damaged the factory of Rattan Furnace Manufacturing Co., State and Wall St., New Haven, Conn. Loss, $30,000.

MIDDLE ATLANTIC STATES

The Pierce Arrow Motor Car Co., Elmwood Ave., Buffalo, N. Y., will build an addition to its plant. Estimated cost, $100,000.

G. Boymann, New York, N. Y. (Borough of Manhattan), is having plans prepared by J. C. Cocker, Arch., for a 2-story garage on 64th St. near Amsterdam Ave. Estimated cost, $15,000.

The Blystone Manufacturing Co., manufacturers of concrete machinery, will build a plant at Niagara Falls, N. Y.

Henry Ford has purchased a site at Kearney, N. J. (Arlington post office), and plans to construct a plant. Estimated cost, $5,000,000. Plans have been prepared for the 1st unit which will cost $1,000,000.

The contract has been awarded for 2 additions to the plant of the Staten Island Ship Building Co., New York, N. Y (Borough of Richmond).

The Standard Oil Co., 26 Broadway, New York, N. Y., has awarded the contract for a can factory at Paterson, N. J.

The contract has been awarded for an addition to the plant of the Syracuse Malleable Iron Works, North Geddes St., Syracuse, N. Y. Estimated cost, $20,000.

Snyder Bros. & Benzo, Beaver, Penn., plans to construct a garage on 3rd St. Estimated cost, $20,000.

The Moltrut Steel Products Co., Beaver Falls, Penn., plans to construct an addition to its plant.

The Standard Tin Plate Co., Cannonsburg, Penn., will construct several additions to its plant.

The Venango Manufacturing Co., manufacturer of railroad specialties, 1st St., Franklin, Penn., has awarded the contract for an addition to its machine shop.

The Adder Machine Co., Kingston, Penn., will build an addition to its plant. Sturdevant & Peggi, Coal Exchange Bldg., Wilkes-Barre, Arch.

The Phœnix Iron Works, Meadville, Penn., is building an addition to its plant on Mercer St.

The Schwartz Motor Car Co., Philadelphia, Penn., plans to construct an 8- or 10-story service building at Broad and Cherry St. Estimated cost, $450,000.

The Reading Steel Castings Co., Reading, Penn., plans to enlarge its plant.

The American Steel Foundries Co., Sharon, Penn., plans to construct an addition to its plant.

The Pullman Motor Car Co., York, Penn., plans to enlarge its plant.

W. W. Kemp, 401 East Olive St., Baltimore, Md., has awarded the contract for the construction of a 2-story garage on Belvidere Pl., Baltimore. Estimated cost, $10,000. Noted Mar. 30.

The Navy Department, Washington, D. C., is advertising bids for Navy Yard, Boston, Mass., under Schedule 9621 for four 16-in. swing woodworkers lathes and three 12-in. saw tables.

The Navy Department, Washington, D. C., is advertising for bids for Navy Yard, Brooklyn, New York, N. Y., under Schedule 9623, for one 24-in. turret lathe, one 27-in. surface planer and one 36-in. band saw, under Schedule 9622, 1 planing machine.

SOUTHERN STATES

The Norfolk Southern Railroad Co., Norfolk, Va., has awarded the contract for the construction of shops at Carolina Junction. F. L. Nicholson, Norfolk, Ch. Engr.

The Murphy Hotel Corporation will construct a 2-story garage on Grace St., Richmond, Va. Estimated cost, $20,000.

The Ohio Valley Motor Car Co., Edgewood, W. Va., recently incorporated, plans to construct a garage on National Rd., Charleston, W. Va.

The Yankee Steel Co., 712 Union Bank Bldg., Pittsburgh, Penn., recently incorporated, plans to construct a sheet-metal plant at New Cumberland, W. Va.

The Seaboard Air Line Ry. plans to enlarge its shops at Atlanta, Ga. Estimated cost, $150,000. W. D. Faucette, Norfolk, Va., Ch. Engr.

Plans are being prepared for a 2-story garage for the Overland Automobile Co., Monroe St., Memphis, Tenn. Estimated cost, $50,000. G. M. Shaw & Co., Tennessee Trust Bldg., Arch.

The Falls City Machine Co., recently incorporated, has acquired the plant of the Louisville Shovel Co., Floyd and Lee St., Louisville, Ky., and will equip it for the manufacture of machine tools, particularly lathes. A. G. Schwable and W. T. Long, are in charge.

MIDDLE WEST

The Ironwood Manufacturing Co., manufacturer of cutting boxes, plans to construct a factory on West Sandusky Ave., Bellefontaine, Ohio.

The Cambridge Motor and Storage Co. contemplates constructing a 3-story, 66x100-ft. factory at Cambridge, Ohio.

Plans are being prepared for the construction of a 60x100-ft. garage for the Canton Electric Co. at Canton, Ohio. Estimated cost, $50,000.

G. C. Reiter, manufacturer of gongs and hardware specialties, has awarded the contract for the construction of a factory at Henry Ave. and 20th St., Canton, Ohio.

A. H. Wilson has been granted a permit for the construction of an addition to its garage at 514 Cleveland Ave., N. W., Canton, Ohio. Estimated cost, $100,000.

The Cincinnati Metal Refining Co. plans to construct a factory on Hopple St., Cincinnati, Ohio. Estimated cost, $14,000.

The Grabler Manufacturing Co., manufacturer of steel specialties, plans to build an addition to its plant at 6565 Broadway, Cleveland, Ohio.

The National Lamp Works will build an addition to its plant at 1764 East 45th St., Cleveland. Ohio. Estimated cost, $7,000.

The Northern Blower Co., 4515 Storer Ave., Cleveland, Ohio, has purchased a site at the foot of West 65th St., Cleveland, and will construct a plant. Estimated cost, $20,000.

E. A. Woolf and T. Lanning has purchased a site at Dennison, Ohio, and will construct a plant for the manufacture of sewer pipe, to be known as the Woolf-Lanning plant.

Press reports state that the Harrison Balancing Machine Co., recently organized, contemplates constructing a factory at Hamilton, Ohio.

The Ohio Iron and Steel Co. contemplates building an addition to its plant at Lowellville, Ohio.

The Waynesfield Stave and Bat Co. will build a factory at Napoleon, Ohio.

Plans are being prepared for enlarging the plant of the Pfau Manufacturing Co., manufacturer of plumbers supplies, at Norwood, Ohio.

The Elmwood Castings Co. plans to build an addition to its plant on Murray Rd., St. Bernard, Ohio.

The American Steel and Wire Co. is rebuilding its plant at Salem, Ohio. R. W. Ney is Gen. Mgr. Noted Apr. 6.

The contract has been awarded for the construction of a garage at Fountain Ave. and Monroe St., Springfield, Ohio, for Holland & Borden.

The Toledo Machine and Tool Co. plans to enlarge its plant at Toledo, Ohio. Noted Dec. 9.

The Trumbull Manufacturing Co., manufacturer of machinery, engines, etc., plans a 2- or 3-story, 88x175-ft. addition to its plant at Williams St. and South Park Ave., Warren, Ohio.

The Struthers Furnace Co. has awarded the contract for the construction of an addition to its plant at Youngstown, Ohio. Estimated cost, $125,000.

The Pressed Steel Manufacturing Co. plans to build a factory at Hammond, Ind.

The contract will soon be awarded for the construction of a 5-story garage at Meriden and 11th St., Indianapolis, Ind., for the Cadillac Automobile Co. C. F. Eckler, 500 Capital Ave., Indianapolis, is Mgr. Noted Dec. 16.

The Gilderman Manufacturing and Foundry Co., Syracuse, Ind., plans to build a foundry at Laporte, Ind.

The Kloeb Gas Stove Co. will build a plant on 12th St., Marion, Ind. Allen G. Messick is Secy.

The Rutenber Electric Co. plans to construct a 50x300-ft. addition to its plant at Marion, Ind.

The contract has been awarded for the construction of a 1-story, 60x500-ft. factory on Bridge St., Alma, Mich., for the Republic Motor Truck Co.

Work will soon be started on the construction of a factory at Battle Creek, Mich., for the Rich Twist Drill Co., Chicago, Ill. Estimated cost, $45,000. Noted May 4.

The Douglas & Rudd Co., manufacturer of automobile parts, is constructing an addition to its plant at Bronson, Mich.

The Detroit Copper and Brass Rolling Mills Co. has been granted a permit for the construction of an addition to its plant at Detroit, Mich. Estimated cost, $16,000.

The Detroit Iron and Steel Co. contemplates constructing the 3rd blast furnace at Zug Island, Detroit, Mich. Estimated cost, $1,000,000.

The Detroit Seamless Steel Tubes Co. has purchased a site on West Fort St., Detroit, Mich., and will build a plant.

The Detroit Tool Co. has awarded the contract for the construction of a factory on St. Antoine St., Detroit, Mich. Estimated cost, $20,000.

The contract has been awarded for the construction of a factory at Jefferson Ave. and Adair St., Detroit, Mich., for the Michigan Stove Co.

Plans are being prepared for the construction of a factory near Jefferson and Conner Ave., Detroit, Mich., for the Signal Motor Truck Co.

The Chevrolet Motor Co. is constructing an addition to its factory at Flint, Mich. Noted Mar. 2.

The Glendon A. Richards Co., manufacturer of sheet metal and roofing, is constructing a 2-story, 50x100-ft. factory at Scribner Ave. and Blumrich St., Grand Rapids, Mich. Noted Mar. 30.

H. B. and George W. Webber are organizing a company to build a factory at Ionia, Mich., for the manufacture of automobiles.

The Perlman Rim Corporation has purchased the business of the Jackson Rim Co. at Jackson, Mich., and plans to enlarge the plant.

Tentative plans are being prepared for the construction of an addition to the plant of the National Coil Co. at Lansing, Mich.

The Ford Motor Co. will build an addition to its assembling plant on Michigan St., Chicago, Ill.

The contract has been awarded for the construction of a 1-story, 30x175-ft. shop at Edwardsville, Ill., for the Litchfield & Madison Ry. J. J. Reardon is Supt.

The contract has been awarded for the construction of a 150x200-ft. addition to the plant of the Moline Tool Co. at Moline, Ill. Noted Nov. 25.

The contract has been awarded for the construction of a 3-story, 36x50-ft. and 2-story, 50x60-ft. addition to the plant of the Wright Carriage Body Co. at Moline, Ill. Estimated cost, $10,000.

The Western Seamless Pail Co. is constructing a factory at St. Charles, Ill.

The Algoma Motor Co. has awarded the contract for the construction of a 2-story, 60x100-ft. garage and shop at Algoma, Wis.

The Fairbanks-Morse Manufacturing Co., manufacturer of windmills and engines, plans to construct additions to its plant at Beloit, Wis. Estimated cost, $400,000. C. H. Morse, Jr., is Pres.

The contract has been awarded for the construction of a 1-story, 30x100-ft. garage and repair shop with a 30x127-ft. annex at Marinette, Wis., for the Twin City Auto Co. Estimated cost, $15,000.

The Hoppe-Hatter Motor Co., 539 Broadway, Milwaukee, Wis., has awarded the contract for the construction of a garage and repair shop in Milwaukee. Estimated cost, $25,000.

The Mechanical Appliance Co., 123 Stewart St., Milwaukee, Wis., has awarded the contract for the construction of a 1-story, 30x130-ft. reinforced-concrete machine shop at Milwaukee.

The contract has been awarded for the construction of a 3-story, 50x150-ft. garage, machine shop and stable at Milwaukee, Wis., for the Standard Livery Co., 5th and Prairie St., Milwaukee. Estimated cost, $35,000.

H. Whitten has awarded the contract for the construction of a 2-story, 35x100-ft. garage and repair shop on 8th St., Milwaukee, Wis. Estimated cost, $10,000.

WEST OF THE MISSISSIPPI

The Chicago, Burlington & Quincy R.R., Burlington, Iowa, plans to construct a 300x900-ft. locomotive shop. Estimated cost, $750,000. T. E. Calvert, 547 West Jackson Blvd., Chicago, Ill., Ch. Engr.

Fire recently destroyed the plant of the Hindman Die and Tool Works, Newton, Iowa.

F. Neiswanger, Washington, Iowa, will construct a garage. Estimated cost, $10,000.

The Keller Manufacturing Co., manufacturer of implements, vehicles and sleighs, Minneapolis, Minn., plans to construct an addition to its plant.

The Overland Auto Co. will construct a plant at 1662 Hennepin Ave., Minneapolis, Minn. Estimated cost, $150,000.

Bids are being received by the American Can Co., 747 North Prior Ave., St. Paul, Minn., for a 4-story addition to its plant in the Midway District. Estimated cost, $50,000. Noted Dec. 30.

Plans are being prepared for an addition to the plant of the Northwestern Shot and Lead Co., 90 Fairfield Ave., St. Paul, Minn. Estimated cost, $15,000. Noted May 4.

Thorevald Brondersiav, Omaha, Neb., will build a fireproof garage at 3814-16 Farnum St. Estimated cost, $30,000.

The Lee-Coit-Andreesen Wholesale Hardware Co., Omaha, Neb., plans to construct an addition to its plant at 9th and Harney St.

Plans being prepared for a 1-story garage at Pittsburg, Kan., for F. H. Fitch, 1012 Baltimore, Kansas City, Mo. Estimated cost, $20,000. Clyde Mack, 6 West 43d. St., Kansas City, Mo., Arch.

Fire recently damaged the shops of the Missouri Pacific Ry., Kansas City, Mo. Loss, $12,000. E. A. Hadley, St. Louis, Ch. Engr.

The Missouri Malleable Iron Co., St. Louis, Mo., will build a foundry.

The Williams Patent Crusher and Pulverizer Co., St. Louis, Mo., manufacturer of machinery, has awarded the contract for a 3-story reinforced-concrete addition to its plant.

The Austin Motor Co., Austin, Tex., plans to establish a repair shop and garage.

J. T. Purdy, Gorman, Tex., plans to construct a 1-story brick garage.

WESTERN STATES

Richey & Gilbert, manufacturer of hardware implements, plans to enlarge its plant at Toppenish, Wash.

The Dulmage-Manley Auto Co. will construct a 3-story shop at 11th and Burnside St., Portland, Ore. Estimated cost, $30,000.

The Department of Public Service, Bureau of Power and Light, 345 South Olive St., Los Angeles, Calif., has been granted a permit for the construction of a 2-story, Class "C" machine shop at 1604 St. John St., Los Angeles. Plans are being prepared under the supervision of E. F. Scattergood, Ch. Electrical Engr. Estimated cost, $12,000.

Harry P. Gray, 604 Jean St., Oakland, Calif., has awarded the contract for the construction of a 1-story garage on Broadway, Oakland. Estimated cost, $20,000.

The Standard Oil Co. has awarded the contract for the construction of a 2-story concrete garage on 16th St., San Francisco, Calif. Estimated cost, $24,000.

M. Ward has awarded the contract for the construction of a 1-story machine shop on Minna St., San Francisco, Calif. Estimated cost, $6,000.

CANADA

The Halifax Graving Dock Co., Granville St., Halifax, N. S., plans to construct a machine shop at Halifax. Estimated cost, $16,000.

T. McAvity & Sons, Ltd., St. John, N. B., is in the market for lathes for making 8-in. shells, from 16- to 18-in. single purpose, and from 24- to 36-in. standard lathes for roughing, finishing, boring, etc.; 35 to 40 drills, banding presses, wave ribbing, tapping, recessing, etc., including complete tool room equipment. Noted May 4.

The Dominion Sheet Metal Co. has been granted a permit for enlarging its plant on Burlington St., Hamilton, Ont. Estimated cost, $6,000.

The Blystone Manufacturing Co., manufacture of concrete mixers, Cambridge, Penn., plans to construct a factory at Niagara Falls, Ont.

Plans have been prepared for the construction of a machine shop for the Brandon Co., 108 Vine St., Toronto, Ont. Estimated cost, $5,000.

The Toronto Harbor Commissioners will construct a machine shop on the Don Division near Mill St., Toronto, Ont. Estimated cost, $13,500.

Fire, Apr. 28 damaged the factory of Wilson & Warden, manufacturer of bottlers supplies, at 58 Duchess St., Toronto, Ont. Loss, $7,500.

Boyd's Ltd. plans to construct a shipbuilding plant at Port Moody, B. C. Estimated cost, $200,000.

GENERAL MANUFACTURING

NEW ENGLAND STATES

The International Paper Co. plans to construct a plant at Berlin, N. H. Estimated cost, $1,500,000.

The Home Bleach and Dye Co. plans to construct a 3-story brick factory at Attleboro, Mass.

The Boston Elevated Railway Co., 682 East 1st St., South Boston, Mass., has been granted a permit for the construction of a timber and tie treating plant at Boston.

The contract has been awarded for the construction of a factory at Cambridge, Mass., for the Cambridge Paper Box Co.

Plans are being prepared for the construction of a 3-story dye house for the American Thread Co. at Fall River, Mass. Estimated cost, $300,000. R. H. Cook is Gen. Mgr.

The Franklin Paper Co. will build a 1-story, 50x50-ft. addition to its plant at Holyoke, Mass.

The Mears Adams Shoe Co. plans to construct an addition to its plant at Lowell, Mass.

The Dupaul, Lockhart Optical Co. plans to construct a 2-story, 40x65-ft. factory on Macey St., Southbridge, Mass.

Preliminary plans are being prepared for the construction of a factory at Stoneham, Mass., for Dadmum Co., manufacturer of photo supplies, 1 Washington St., Boston.

The contract has been awarded for the construction of a 2-story addition to the factory of the Noble & Westbrook Manufacturing Co., manufacturer of rubber stamps and machines, at East Hartford, Conn.

The Hartford-Bigelow Carpet Co. plans to construct additions to its plant on School St., Thompsonville, Conn.

MIDDLE ATLANTIC STATES

Tentative plans are being prepared for a factory for the Neville Process Dye Co., 7 Brooklyn Ave., Freeport, N. Y.

The Empire State Linen Mills, Lockport, N. Y., recently incorporated, has purchased the plant of the Clifford Textile Co., Lockport, and will enlarge and improve same.

The Robert Gair Co., manufacturer of paper products, New York, N. Y. (Borough of Brooklyn), is having plans prepared for an addition to Building No. 6 at 88-100 Washington St.

The Jersey Leather Co., 1067 North 2nd St., Camden, N. J., has awarded the contract for the construction of a factory. Estimated cost, $50,000.

The Florence Thread Works, Florence, N. J., is building a 3-story addition to its plant.

The Southland Knitting Mills, Macon, Penn., has awarded the contract for an addition to its plant.

The Mt. Carmel Silk Manufacturing Co., Mt. Carmel, Penn., plans to construct several additions to its plant.

The Beaver Refrigerator Co., New Brighton, Penn., plans to reconstruct its plant.

The Montgomery Mills, manufacturer of webbing, North Wales, Penn., plans to enlarge its plant.

The contract has been awarded for the construction of additions to the plant of Alexander Bros., 414 North 3rd St., Philadelphia, Penn., manufacturer of leather belting. Estimated cost, $75,000. Noted Apr. 27.

The Eclipse Pattern Co. has purchased a site on 27th St., Philadelphia, Penn., on which it will build a plant for the manufacture of wood patterns.

The Electric Storage Battery Co., Philadelphia, Penn., plans to construct an 8-story addition to its plant at 19th St. and Allegheny Ave. Estimated cost, $250,000.

Bids are being received by George S. Welsh, Arch., Coal Exchange Bldg., Wilkes-Barre, Penn., for the construction of a silk mill at Wilkes-Barre for the Duplan Silk Co., 4th Ave. and 17th St., New York, N. Y. Estimated cost, $110,000.

SOUTHERN STATES

The plant of the Crouch Cabinet Shop, manufacturer of furniture, Hockory, N. C., recently destroyed by fire with a loss of $5,000, will be rebuilt.

The Steele Cotton Mills, Rockingham, N. C., manufacture of print cloth, will enlarge its plant.

The Wadesboro Silk Manufacturing Co., Wadesboro, N. C., plans to construct an addition to its mill.

The contract has been awarded for the construction of an addition to the plant of the Swift Manufacturing Co., manufacturer of cotton, Columbus, Ga. Estimated cost, $10,000. Noted Jan. 6.

G. E. Noblit is interested in a project to establish a glass factory at Tarpon Springs, Fla.

R. W. and S. H. Henderson, Talladega, Ala., and M. C. Stockbridge of the Ruston Cotton Oil Co., Ruston, La., plan to construct a cotton oil mill at Shreveport, La. Estimated cost, $200,000.

Plans are being prepared by G. M. Shaw & Co., Arch., Memphis, Tenn., for a 2-story service station at Union Ave. and Dudley St., Memphis, for the 638 Tire and Vulcanizing Co. Estimated cost, $25,000. Noted May 4.

MIDDLE WEST

Work will soon be started on the construction of a factory at Akron, Ohio, for the Miller Rubber Co. Estimated cost, $90,000. Noted Dec. 30.

J. L. DeBrocq, Clarkesburg, W. Va., is back of a movement to construct a factory at Bellaire, Ohio, for the manufacture of window glass. Estimated cost, $75,000.

Plans are being prepared for the construction of a 2-story, 50x60-ft. factory at Cincinnati, Ohio, for the Coco-Cola Co. Estimated cost, $10,000. J. Mandrey, 315 Syracuse St., Cincinnati, is Mgr.

The Climax Cleaner Manufacturing Co. has awarded the contract for the construction of a 1-story, 43x250-ft. addition to its factory at Cleveland, Ohio. Noted Apr. 13.

Bids will soon be received for the construction of a 2-story addition to the factory of the Adamant Porcelain Co., East Liverpool, Ohio. Estimated cost, $15,000.

The Lancaster Tire and Rubber Co. will enlarge its plant at Lancaster, Ohio. Estimated cost, $60,000. J. T. Rose is Pres.

The American Bottle Co., a subsidiary of the Owens Bottle Co., has purchased a site on Woodville St., Toledo, Ohio, and will build a factory.

The Urbana Packing Co. is improving its plant at Urbana, Ohio. Estimated cost, $30,000.

Charles E. Miller, manufacturer of tires, vulcanizers and rubber goods, plans to build a 3-story addition to its factory at 140 Meridian St., Anderson, Ind.

The Rhoades Wagon Co. plans to construct additions to its plant on Main St., Anderson, Ind.

The United Refrigerator Co., Peru, Ind., will remodel its Gaar-Scott plant at Richmond, Ind. Estimated cost, $60,000.

The Columbian Enameling and Stamping Co. is constructing an addition to its plant at Terre-Haute, Ind. Estimated cost, $8,000.

Plans are being prepared for the construction of an addition to the factory on Commerce Ave., S. W., Grand Rapids, Mich., of the Globe Knitting Works. Noted Apr. 27.

The Nelson-Matter Furniture Co. has awarded the contract for the construction of a factory at 7th and Muskegon St., Grand Rapids, Mich. Estimated cost, $80,000.

Willian Horner, manufacturer of flooring, contemplates enlarging its plant at Newberry, Mich.

The Monroe Body Co., manufacturer of carriages, etc., plans to enlarge its plant at Pontiac, Mich.

The contract has been awarded for the construction of a cold-storage plant at Champaign, Ill., fkor Smith & Co.

The contract has been awarded for the construction of a 2-story cooling plant at 1226 North Halsted St., Chicago, Ill for Swift & Co.

The Northern Illinois Cereal Co. has awarded the contract for the construction of a 2-story, 60x125-ft. addition to its plant at Lockport, Ill. Estimated cost, $20,000.

The Herold Piano Co. plans to build additions to its plant at Marion, Ill. G. H. Wagner is Gen. Mgr.

The contract has been awarded for the construction of a 4-story, 90x225-ft. packing and cold-storage plant at Madison, Wis., for the Farmers Coöperative Packing Co. Estimated cost, $375,000. Noted Mar. 23.

Plans are being prepared for the construction of a 2-story, 72x93-ft. addition to the factory of the Prairie du Chien Woolen Co. at Prairie du Chien, Wis. Estimated cost, $15,-000.

The contract has been awarded for the construction of a 4-story, 80x144-ft. factory at Sheboygan, Wis., for the John C. Nicholas Harness Co., Janesville. Estimated cost, $25,000. Noted Apr. 27.

WEST OF THE MISSISSIPPI

Fire recently destroyed the plant of the Aetna Chemical Co., Heidelberg, Iowa. Loss, $50,000.

The American Liquid Heat Co., St. Louis, Mo., recently incorporated with $150,000 capital stock, plans to construct a factory.

The E. I. DuPont de Nemours Powder Co., Wilmington, Del., plans to construct a plant at Butte, Mont.

The Athens Pottery and Tile Co., Ft. Worth, Tex., plans to construct a plant. P. E. Miller is Pres.

The Freeport Chemical Works, Freeport, Texas, will build a new chemical factory. Estimated cost, $120,000.

J. F. Smith, Hiram, Tex., plans to rebuild his cotton gin at Terrell, Tex.

The contract has been awarded for the construction of a cotton gin for the Sequin Compress Co., Sequin, Tex. Estimated cost, $25,00. Noted May 4.

The Pontotic County Cotton Oil Co., Ada, Okla., recently incorporated, plans to construct a factory at Ada.

WESTERN STATES

The Utah-Idaho Sugar Co. contemplates constructing a plant at North Yakima, Wash. Estimated cost, $1,000,000. Merrill Nibley is Asst. Gen. Mgr.

Plans are being prepared for the construction of a 120x300-ft. factory at 55th and Alameda St., Los Angeles, Calif., for the California Tissue Manufacturing Co., 730 Consolidated Realty Bldg. Samuel Sparks, Alvarado Hotel, is Pres.

FOREIGN OPPORTUNITIES

Machinery and apparatus for manufacturing steel balls for ball-bearings is wanted by Jean Pierre Frauenberg, Quai de Passy 28, Paris, France. Correspondence in French.

Metal working machinery and machinery for making gun parts is wanted by the Northern Engineering and Trading Co., 'Ovre Slotsgt 7, Christiania, Norway.

An inquiry is made by an Italian firm who wishes to place an order with an American manufacturer, for machinery for making crayons and chalk. Italian Chamber of Commerce, 203 Broadway, New York, N. Y.

Classified Advertising

The Classified Advertising section appears on pages 154, 155, 156, *of this issue and will in future appear in the same relative position in the paper.*

American Machinist

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NEW YORK, MAY 18, 1916

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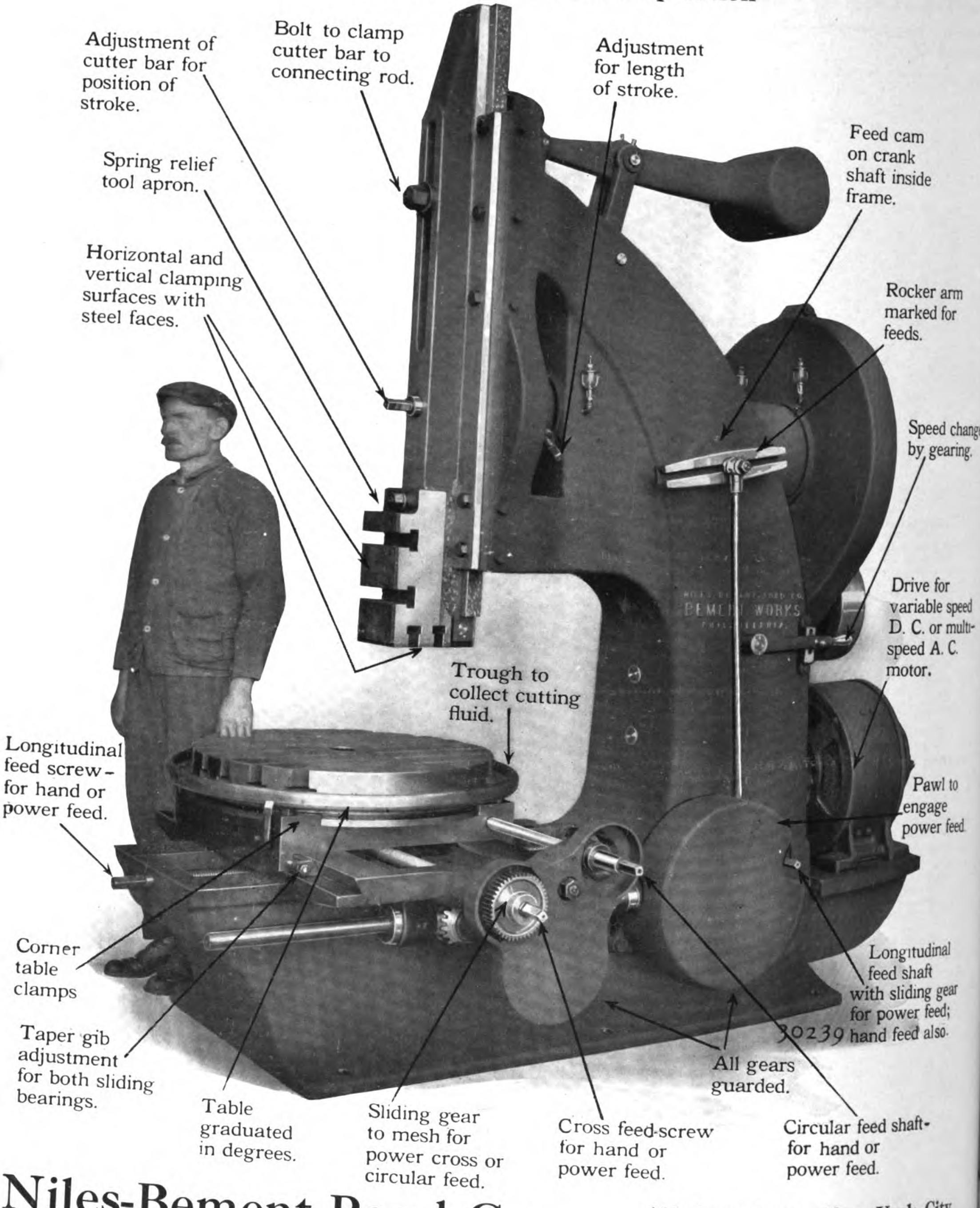
Contents, First Page
Advertising Index, Last Page

BEMENT SLOTTERS

Some Points You Should Know About Their Design and Operation



Niles-Bement-Pond Co.

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25 Victoria St., London, S. W.

SALES OFFICES AND AGENCIES—Boston: 93-95 Oliver St. **Philadelphia:** 405 N. 21st St. **Pittsburgh:** Frick Bldg. **Cleveland, O.:** The Niles Tool Works Co., 730 Superior Ave. **Hamilton, O.:** The Niles Tool Works Co. **Cincinnati:** The Niles Tool Works Co., 336 W. Fourth St. **Detroit:** Kerr Machinery Bldg. **Chicago:** W. Washington Blvd. and N. Jefferson St. **St. Louis:** 516 N. Third St. **Birmingham, Ala.:** 2015 First Ave. **San Francisco:** 16 to 18 Fremont St. **For Colorado: Utah, Wyoming and New Mexico:** Hendrie & Bolthoff Manufadturing & Supply Co., Denver. **For Seattle, Wash.:** Hallidie Machinery Co. **For Canada:** The John Bertram & Sons Co., Ltd., Dundas, Montreal, Winnipeg, Vancouver. **Japan:** The F. W. Horne Co., 6 Takiyama-cho, Kyo-bashi-ku, Tokio. **Italy:** Ing. Ercole Vaghi, Milan. **France:** Glaenzer & Perreaud, 18 Faubourg du Temple, Paris. **Russia:** S. G. Martin & Co., Ltd., Petrograd and Moscow. **Holland:** R. S. Stokvis & Zonen, Ltd., Rotterdam. **Brazil:** Comptoir Technique Bresilien, P. O. Box 802, Rio de Janeiro.

RS

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VOLUME 44 MAY 18, 1916 NUMBER 20

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WITH PRINCIPAL ARTICLES SUMMARIZED

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National Defense and International Peace

Are You Ready to Play Your Part?

THE power of a nation in time of need is the producing power of her industries.

America must find out what this producing power is and then develop it. The capacity of every plant must be gauged. The ability of every man must be known. For War is Mechanical. It is Electrical. It is Chemical. It is Mining, Manufacturing, Transportation. It is EVERY phase of Engineering fused into a single industry—

"THE NATION'S DEFENSE"

Thirty thousand Engineers and Chemists today are serving YOUR COUNTRY without pay. They are making a survey of YOUR COUNTRY'S Industrial Resources. They are helping YOUR COUNTRY to FIND ITSELF—and You! They are charting the channels of commerce. Sounding each source of supply. So that, *should* the Day break when War *must* come—

YOUR ARMIES in the field will be but the crest of a Wave of Industry, as wide as the American Continent and as deep as the American Soul.

That YOUR COUNTRY may know what the Engineers and Chemists are doing, the Associated Advertising Clubs of the World have pledged their services to the President of the United States. And this advertisement, published by the American Machinist, free, is part of a nation-wide series to secure YOUR cooperation.

"WHAT CAN I DO?"

This is, doubtless, the question you are asking yourself. Here is the answer: If you are a manufacturer cooperate fully with the Engineers and Chemists so they can do their job *quickly and efficiently*; if you are a mechanic help your employer to help the Engineers and Chemists and be prepared, if so needed, to be a Soldier of Industry, behind the firing line, which is just as important as being a soldier on the firing line; if you are a business man or a professional man, or whoever you are, help mobilize "GOOD WILL" behind this patriotic task of the Engineers and Chemists in behalf of National Defense and International Peace.

COMMITTEE ON INDUSTRIAL PREPAREDNESS OF THE NAVAL CONSULTING BOARD OF THE UNITED STATES

IN CO-OPERATION WITH

THE AMERICAN SOCIETY OF CIVIL ENGINEERS — THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

THE AMERICAN INSTITUTE OF MINING ENGINEERS — THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

THE AMERICAN CHEMICAL SOCIETY

ENGINEERING SOCIETIES BUILDING — 29 WEST 39th STREET, NEW YORK

Manufacture of Cartridge Brass*

By C. R. Barton

SYNOPSIS—The manufacture of cartridge brass has so long been kept secret that those interested will welcome this article at a time when this commodity is in such demand. The entire process of making cartridge brass—from the mixing to shearing the cast ingots—is given, together with the furnaces and tools, in detail.

The demand for cartridge brass during the past year has increased more rapidly than the means for its production. A number of firms not directly engaged in this class of work have installed equipment for making brass, in some instances building their own machines on account of the very long deliveries promised for nearly all classes of brass-working machinery. It is proposed to describe the methods and tools used in the production of finished bars of brass suitable for making blanks for cartridge cases. The author is not an experienced brass manufacturer, and concerning matters of technical details where practice may vary it is the intent to describe a proved method for turning out cartridge brass rather than completely outline the art of brass making. It is greatly to be regretted that brass makers still endeavor to maintain a medieval policy of secrecy in their work, which doubtless has much to do with the slow progress made in overcoming some of the difficulties in producing brass of uniformly good quality with small losses.

1. The specifications usually require either pure electrolytic or pure Lake copper and "Horsehead" spelter or its equivalent. Equally good results have been obtained using a spelter of not quite as high a grade as Horsehead. The maximum allowable impurities in good spelter should be: Lead, 0.30 per cent.; iron 0.04 per cent.; cadmium, 0.20 per cent.; and total, not over 0.25 per cent. In the copper the total impurities should not exceed 0.03 per cent. These are analyses which include all grades of copper and spelter suitable for cartridge brass and represent an average of materials supplied on recent orders.

2. A specification may be made covering the quality and maximum weight of scrap that may be used in the mixture for melting. This allowance runs from 50 to 65 per cent. of scrap brass, which may consist of scrap from the blanking press, overhauling machines and shears, the point being to eliminate foreign scrap, skimmings or scrap from the floor and mold pits, which may contain dirt and other impurities.

3. The right is reserved for inspectors for the purchaser to take samples and make chemical analysis of metals in stock, to check for conformity with specifications.

4. Chemical analysis of the finished metal ordinarily allows a variation of plus or minus 2 per cent. in the specified copper content, the proportions being usually 67 per cent. copper and 33 per cent. zinc up to 71 per cent. copper and 29 per cent. zinc. The total impurities permitted in the finished metal vary from 0.2 per cent. to 0.4 per cent., with the additional requirement that arsenic, antimony, phosphorus and cadmium must be kept within a minimum of from 0.04 to 0.08 per cent. In actual practice we have found that the foregoing limits of plus or minus 2 per cent. are fair and are about as good as may be secured with the average class of workmen. The average of 156 mill analyses running on metal 69 to 73 per cent. copper was 70.93 per cent., with six above 73 per cent. (the maximum being 78.6 per cent.) and seven below 69 per cent. (the minimum being 67.69 per cent.). In no analysis did the total impurities exceed 0.15 per cent., nor was there the least trace of arsenic, antimony or cadmium. There was a slight trace of phosphorus, which came from the phosphorized copper used as a flux.

5. Physical tests for finished metal are for breaking load and elongation. The requirements run from 40,000 to 44,000 lb. per sq.in. minimum breaking load, with a maximum sometimes specified between 48,000 and 50,000 lb. per sq.in. The minimum elongation required varies from 50 to 62 per cent.; but there is no standardized test piece used, so that these tests are not comparative. In addition, sometimes a formula for a combination of breaking load and elongation is specified, so that both minima may not occur at the same time. The pieces used for these tests are cut from blanks ready for ship-

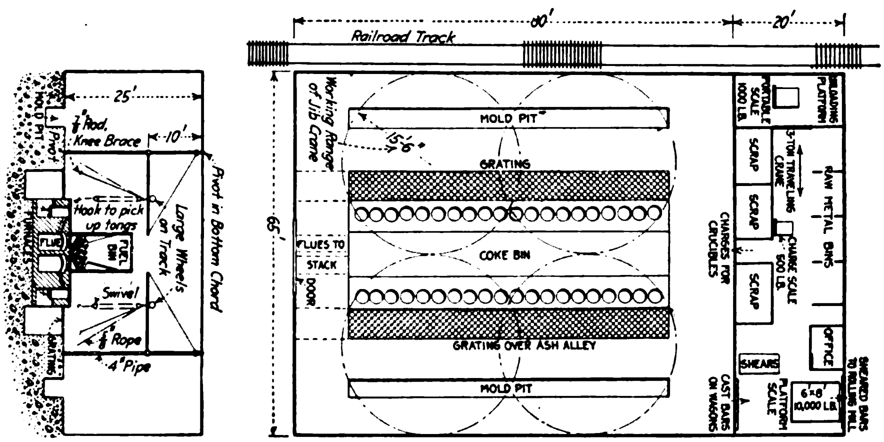


FIG. 1. PLAN AND SECTION OF CASTING SHOP

ment and have been annealed in the bar previous to being blanked. A cupping test is usually specified and is desirable, as it shows the temper of the metal and so checks its suitability for the first drawing operation without reannealing, as that is not absolutely determined by the elongation test previously described.

6. The variations permitted in dimensions of the finished blanks vary from plus or minus 0.005 in. to plus or minus 0.015 in. in diameter. The allowance in thickness varies from plus or minus 0.003 in. to plus or minus 0.007 in. Where close limits are required, it is usually because the disks are sold by weight and the purchaser wishes to keep poundage down as low as possible, as otherwise the manufacturer would furnish disks of approximately the maximum dimensions.

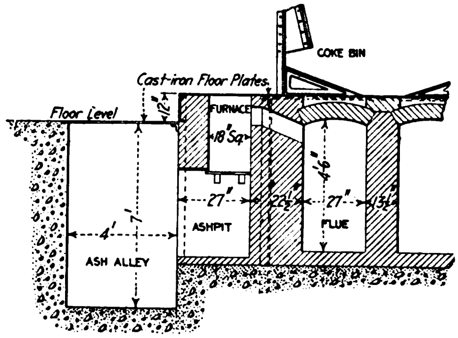


FIG. 2. TYPICAL SQUARE PIT CRUCIBLE FURNACE

7. The visual examination is one of the most important points of inspection. The disks are inspected for flaws, folding cracks and other defects in the surface and for pipes and cracks in the edge of the blank. This inspection is most important, and upon it usually 99 per cent. of all rejections are made.

8. Of the several methods of inspection probably 100 per cent. inspection is the best and fairest to both manufacturer and purchaser. As the metal is made in small lots at a time, there is not a condition of uniformity in manufacture which would warrant a partial or percentage inspection. Also, when the latter scheme is used, the inspectors require a lower proportion of rejected disks in the lot selected than the average on total inspection, so that usually it is necessary to return to total inspection.

9. Aside from the foregoing items various other clauses are inserted in the specifications by the purchaser's covering number of rehandlings allowed on rejected materials, size of lots submitted for inspection, microphotography and the manufacture of selected disks into cartridge cases for the development of interior flaws or defects not shown by visual examination.

As with all inspection where the most important point is visual examination, which is entirely dependent upon the judgment of the inspector, there is a possibility for considerable variation in opinion as to the extent and seriousness of defects. For this reason no hard and fast rule can be laid down as to what constitutes fair visual inspection. Where the inspection is done by a third party regularly engaged in inspection work, better results may be obtained than from inspection by the purchaser direct, whose judgment is based on personal opinions rather than experience as to the extent of defects that may be passed.

That division of the plant where the brass is melted and cast is usually termed the casting shop. This department covers all work from receipt and storage of copper and spelter up to the delivery of sheared bars to the rolling department. All the work may be carried on in one large room with suitable space partitioned off for a metal-storage and weighing room, hereafter called the scraproom. The usual construction is a steel-frame mill building about 25 ft. high to the bottom chord, so designed as to give maximum ventilation. The two main points to be considered in locating the casting shop are car sidings convenient for unloading metal for the scraproom and full and ample storage for fuel and ashes. As the sheared bars are handled on wagons, the location relative to the rolling mill is not so important as long as it is within a convenient distance for hauling.

Fig. 1 shows a floor plan of furnaces, ash alleys and mold pits for a typical installation. As the plant described was built for making cartridge brass in short bars, the pits are only 3 ft. 4 in. deep. In plants where the usual variety of rolled and drawn brass is handled, deeper pits, up to 10 ft. for casting bars up to 12 ft. long, are used. The unit of equipment is known as a set of fires, generally consisting of 10 furnaces and the necessary auxiliary equipment for the complete operation for casting bars. Each set of fires is handled by one caster and his helpers. The jib crane shown is for lifting the pots from the furnace and carrying them over the molds in the mold pits. The jib crane should be of such length that it can take in the extreme molds of each set of fires without greatly interfering with the adjoining set of fires. The space occupied by each set of fires is equal to that of 10 furnaces, the molds that can be filled by the output of the fires not taking a greater length of space in the mold pit. The size of the furnace is determined by the maximum size of the crucible used, the selection of which is covered under the discussion of crucibles. Assuming that the No. 90 crucible which is 13⅜ in. in diameter outside will be the largest size, and that we design our furnaces for coke as fuel, which re-

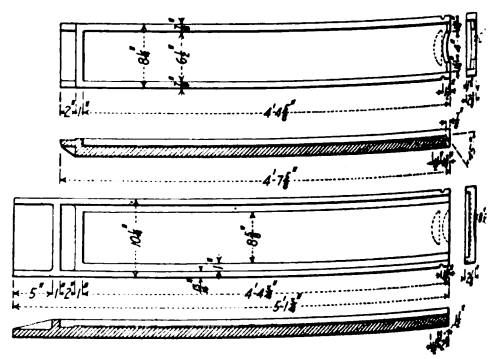


FIG. 3. MOLD FRONT AND BACK

quires the greatest space, say 5 in., and that the brick wall between each two furnaces must be not less than 13½ in., we have a maximum distance between centers of furnaces of 32 in.

Fig. 2 shows a larger-scale section of the furnace designed in accordance with these calculations. The furnaces are made square, as this style has a great advantage over the round furnaces in that the corners hold the fire

and permit placing the crucible tongs on the crucibles more easily. The furnace should be deep enough to provide at least 12 in. of fire beneath the bottom of the crucible, so that as the fire burns out on the grate the bottom of the crucible will not become cold. The depth should also be such that the top of the crucible is always below the bottom of the flue opening, in order to have all parts of the crucible subjected to an even heat. The furnace should be bricked up so that but one course of brick around the inside need be removed when the furnaces are relined, putting in only enough tie-bricks to the second course to hold the lining. The life of the lining varies greatly with the fuel used, coke making a much hotter fire than coal. Operating two shifts for four months made relining necessary on furnaces burning coke. The quality of firebrick and fuel must be considered as in other furnace work. The grate bars are 1 in. square, set on two bearers, such as a piece of 60-lb. rail. The draft may be natural or induced. A forced-draft system does not give satisfaction, as it rarely balances, thus throwing out into the room intense heat, which becomes a serious consideration in hot weather.

The ash alley should be of a cross-section that will allow easy passage of a wheelbarrow for removing the ashes when cleaning the fires. The coke bin, as shown, should provide storage for at least two days' requirements, and the monorail trolley is probably the simplest means for filling the bin from outside storage.

The quickest fire is not always the most desirable in the long run. Using a special 21-in. square furnace, we have been able to take out 21 heats in 24 hr., including cleaning fires twice. This is during cold weather; but it is doubtful if it is economical, as men cannot be secured readily who will stand up to such work, and the life of the crucible is greatly reduced. We believe 14 and possibly 15 heats per 24 hr. in winter a good production, falling off to 10 or 12 in warm weather. The men employed are not, as a rule, steady workmen, so that production is not a matter of simple arithmetic only.

There are other styles of furnaces, such as reverberatory furnaces, the Schwartz furnace and the type known as

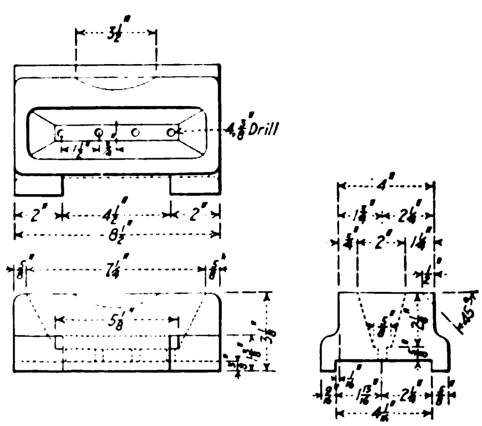


FIG. 4. MOLD STRAINER

the tilting furnace, in which the crucible is tilted for pouring. In all these a distributing ladle must be used, which means a second pouring of the metal. Repeated installations of the old-style crucible furnace, replacing some of the foregoing, show that for certain classes of work it is still the best in spite of the crucible expense.

Of late there has been considerable experimenting with various kinds of fuel. The plant here discussed is laid out for burning coke or coke and coal. Where maximum production is demanded, that method is most efficient which will enable the greatest number of heats to be obtained from one furnace in a given time. Hard coal

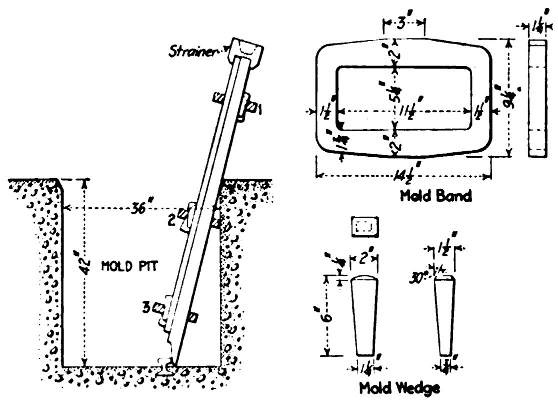


FIG. 5. MOLD BANDED FOR POURING

is probably the slowest fuel used, and the length of time required for getting out a heat is the only objection to it, as in other respects it is very satisfactory. Coke gives a much hotter and therefor faster fire, with a greatly increased wear on the furnace lining. Both oil and natural gas would seem to be desirable. The author has not had experience with oil-fired furnaces. Twenty of the furnaces shown in Fig. 1 were equipped for burning natural gas, using forced draft. Different methods for venting the furnaces were tried, but without great success. The heat from the furnaces was such that the cover brick became red hot and conditions were made intolerable for the workmen. We do not believe that the gas fuel was given a thorough trial, as it is no doubt the ideal fuel for crucible furnaces and will prove successful as soon as it has been put through an experimental stage in a large plant, where furnaces are necessarily set close together.

The fuel consumption varies with the rate of production and the size of the crucible furnace. No exact data can be given; the most reliable figures indicate from 0.4 to 0.6 lb. of coke and coal (mixed) per pound of metal melted during a period of several months, with 18-in. round and 21-in. square furnaces.

The molds for the cartridge brass may be seen in Fig. 3. They are made of gray iron containing 2.5 silicon and finished as shown. The size of the mold is determined by the width of bar required and the weight, which should be such that one pot of metal will make full-length bars. For convenience in handling, the bars are usually made from 80 to 125 lb., unless the size of the finished bar or sheet requires more metal. In rolling, the metal flows almost entirely in the direction of the rolls, so that if bars are passed through straight, there is no appreciable widening. Bars are cast in regular work up to 15 in. wide in short bars and up to 10 and 12 ft. long in narrow bars. It is always best to cast the bar of a thickness that will avoid as much rolling as possible, and the ⅞-in. thick bar is now about standard size, although 1¼-in. bars are made at times.

The molds should be planed on the joint. Otherwise they will be strained in banding, as the wedges tend to

straighten out the molds, which rarely come exactly straight from the foundry, and thereby produce stresses that will soon crack either the front or the back of the mold. Also, with unplaned molds the leakage is many times that of the planed type. Another advantage is that the bars come clean and of even thickness. Some experiments with molds planed all over inside have been made by other firms in an effort to insure cast bars more uniformly good, but without favorable result. The molds shown are of very heavy section, but the weight may be cut down as soon as the most economical form is determined. In making rolled rods bars are cast 1½ in. in diameter and upward in solid bored cast-iron molds. The iron must be free from blow-holes and other flaws.

An important adjunct of the mold is the strainer, Fig. 4. In pouring, the strainer should be kept full, so that the slag and dirt passing the skimmer will not enter the mold.

The mold is held together, as illustrated in Fig. 5, by three bands wedged up tightly. The bands and wedges should be made of first-quality cast steel, if the use of expensive forged pieces is to be avoided. The order and manner of driving the wedge are shown by the numbers. This method has been found to reduce leakage.

The life of a mold is very uncertain. Some few foundries make a specialty of ingot molds, and their product has a high reputation. One of the largest brass makers in this country, after some years of experiment and experience, found that the molds of one firm gave uniformly 50 per cent. longer life than any other make. Molds should average at least 2,000 to 2,500 heats.

The several kinds of tongs may be seen in Fig. 6. All are made of wrought iron by the blacksmith shop in the plant. The most important are the crucible tongs for handling the crucibles. In forging, these tongs should be shaped to a cast-iron crucible of the same size as that to be used. Tongs should always be refitted whenever there is a change in either the make or the size of the crucible. Ill-fitting tongs injure the crucibles and may cause a loss many times the value of several sets of tongs. When worn and burned out of shape, the bits should be redressed or cut off and new ones welded to the reins.

Other tongs are spelter tongs for dipping the spelter in the molten copper, mold tongs for lifting the fronts and backs of molds, band tongs for handling the hot bands, stirring-rod tongs for holding the graphite stirring rods, and bar tongs for lifting the hot bars from the pit when the molds are stripped. These different kinds are illustrated in Fig. 6, and the weights, number required and other data are given in the table.

The remaining equipment includes skimmers for skimming the pot when it is lifted from the fire and for holding back slag and charcoal that is not removed by skimming when pouring, scrapers for scraping the molds, wire brushes for cleaning molds after scraping, heavy buckets for mold dressing, powdered charcoal and flux, cheap 4-in. flat brushes for applying mold dressing, sledges, hammers, etc. Some of these tools may be seen in Fig. 6, and other data are given in the table. In most cases two sets of tools are allowed for each set of fires, as the tongs become too hot to be comfortably handled if used continuously.

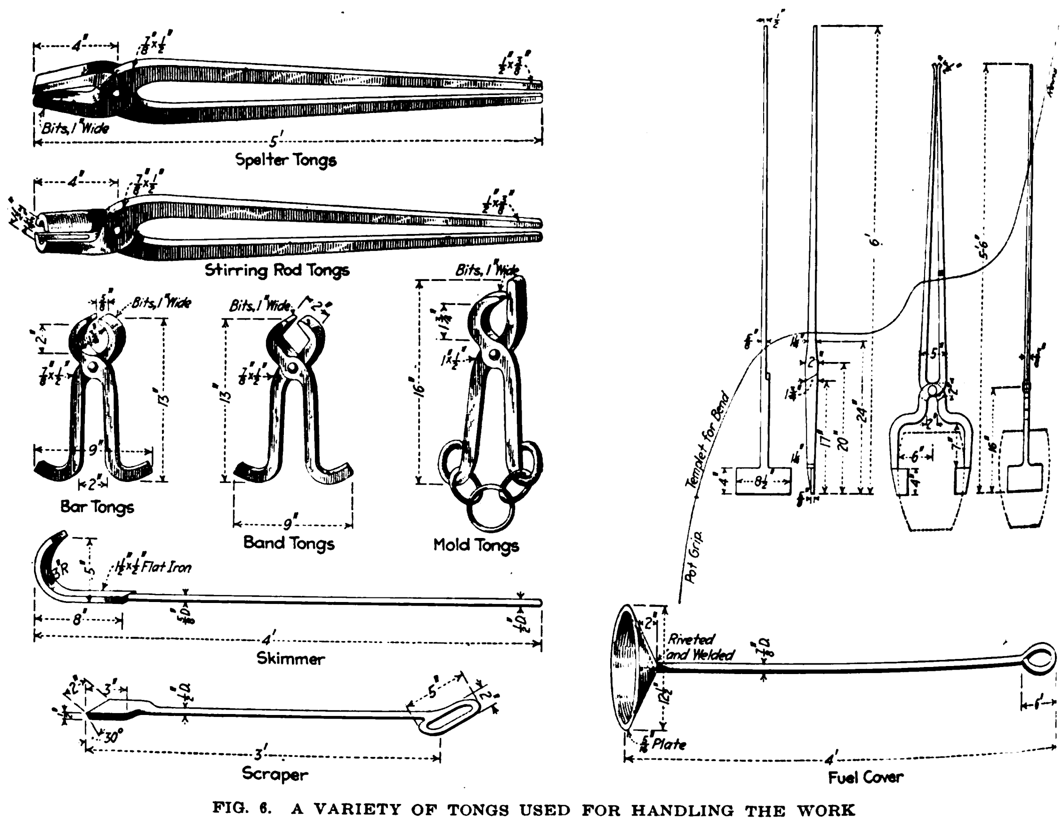


FIG. 6. A VARIETY OF TONGS USED FOR HANDLING THE WORK

In the table the probable life is given in heats. The author has not enough data at hand to give more authentic figures.

Crucibles are, aside from losses, the greatest single item in the cost of producing brass. For this reason many attempts have been made to get away from the use of crucibles. Long experience in crucible making shows that the best materials are Ceylon graphite and Klingenberg crown clay. Ceylon graphite is free from mica and is about 98 per cent. pure. The Klingenberg clay comes from a small district around the village of that name in Germany. These materials are blended and mixed in proper proportions, molded, dried and burned in a kiln. The amount of excess air in the kiln determines whether or not the graphite is burned out of the surface of the crucible, thus making the white or blue crucible. Obviously, the matter of color is of no importance, although manufacturers are called upon to supply crucibles of a given color. Crucibles usually contain from 50 to 60 per cent. of graphite.

Crucibles are known by number, each unit in the number representing nominally the capacity to hold 3 lb. of molten metal. Therefore, a No. 90 should hold 270 lb. of brass. About 80 to 90 per cent. of the capacity of the crucible may be used, depending on the care of the caster.

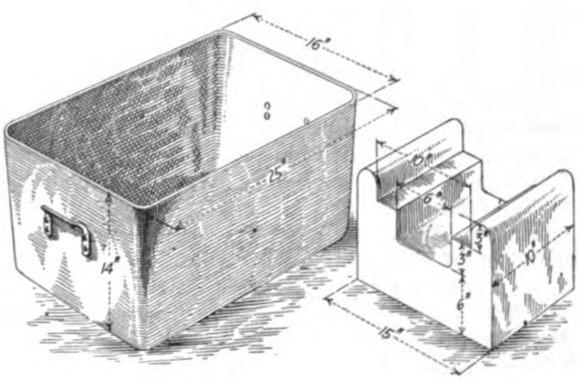


FIG. 7. TOTE BOX AND SPELTER-BREAKING BLOCK

A year ago crucibles containing the best material sold for from 5 to 7c. per unit in the number. At the present time, owing to the high value of Ceylon graphite, the prices are 11 to 13c. per unit; and as the makers have only American clay to use, they expect only 8 to 10 heats per crucible. The average life of 1,500 crucibles purchased in July, 1915, was about 18 heats, so that the actual cost per heat has quadrupled. Manufacturers claim that their crucibles average 25 heats, and doubtless this figure may be attained with the best materials.

The life of a crucible is shortened by ill-fitting tongs, as previously stated, by excess fluxes of various kinds, by soaking in the fire longer than necessary to melt the metal, by too high furnace temperatures in the endeavor to get quick heats, by wet or sulphurous fuels that attack the outside of the crucible, by carelessness in stirring the metal and by general lack of care in handling.

In the employment of fluxes such as fluorspar and various silicates a mean must be determined so that the metal will be purified with a minimum erosion of the crucible. The crucibles should be thoroughly dried and annealed for two of three weeks before being put into service. This is frequently done by storing them on a floor on top of the muffle furnaces used for annealing in the rolling mill. A careful record of the size and number of crucibles given to the casters should be kept.

The best size of crucible has been found by long practice to be the No. 80, holding a charge of 200 to 220 lb. of brass. This crucible makes two bars of convenient size in narrow metal or one in wide metal. It seems to have a somewhat longer life than larger crucibles and therefore, striking a mean between labor and crucible expense, gives the lowest cost of production. There is much juggling of sizes, and many makers rate their crucibles above standard, so that buyers should compare cubic contents and weights rather than size numbers.

There are several compounds on the market for applying to the crucible as a paint. Some report these materials to be of value. Broken crucibles should be placed in bins, and in spare time, laborers may be set to work chipping off the inside surface, which may have some metal adhering to it. The latter is reclaimed with the ashes. The old crucible material commands a market price of from $10 to $15 per ton.

Probably no subject in brass making has received as much attention as fluxes. And when all has been said, brass makers are still employing the same fluxes with or without their potent secret additions. For clean scrap and new metals such as must be provided in making cartridge brass, phosphorus and common salt seem to give the best results. The phosphorus is in the form of 15 per cent. phosphorized copper, 1 oz. per 100 lb. of metal. A larger quantity may be used if needed, but not enough to give a perceptible amount of phosphorus in the finished metal. Common salt, somewhat finer than crude rock salt, should be added, about one handful per 100 lb. of metal. Care should be taken to avoid an excess, as this attacks the crucible.

The impurities to be removed are mainly copper oxide, sand and dirt. The foreign metals—tin, iron and lead—cannot be removed, and none should be introduced by iron stirring rods, brass scrap containing lead, etc. The copper oxide forms readily, and for this reason the melting metals should be covered with powdered charcoal to prevent oxidation. Patent fluxes are generally in the identical class with medicines of the same description.

The metal-storage room, also known as the scraproom and weighing room, is one of the most important parts of the brass-manufacturing plant. Here the new metals are received and stored, all scrap is received and weighed, and the charges for each heat are weighed up in correct proportions. The plan, Fig. 1, gives the arrangement at the plant described. The room contains bins for the various grades of scrap, keeping clean metal, floor scrap and the recovered metal apart; space for storing bars of copper and spelter; a four-bar scale for weighing the charges; a platform scale for weighing metals received and the cast bars on wagons before and after shearing; and a powerful lever shear for cutting new metal and cast bars. As the records of this work are very important, a small office should be provided so that the foreman may keep his records neatly and accurately. The scales for weighing the charges are set by the chemist and should be kept under lock. The charges are weighed up in small iron pans illustrated in Fig. 7.

The cast bars are brought in in a wagon and weighed on the platform scales. The heads or gates of the bars

are then cut off in the shears and the bar cropped back until the cross-section shows good metal without pipes or other defects. It is important that a skilled man of excellent judgment have charge of the shears, as much good metal may be cut off as scrap if the bar is cut back too far. Likewise, a large amount of work is wasted and the percentage of scrap in the finished product increased if the bar is not cut back far enough. The color of the sheared section will indicate relatively small variations in the copper and zinc content, so that the experienced shearman will recognize bars that are outside the specified limits and cut them up. A bar that is cut to much less than half its length should be cut up, as it is probable that it has objectionable defects not visible. It also gives trouble in handling and rolling. The shears should be powerful enough to cut brass 1½x10 in. They will then be able to cut up copper ingots in suitable sizes for weighing out exactly on the charging scales. A small breaking block for spelter is also shown in Fig. 7. After the bars are sheared, they are weighed, and the caster is credited with the weight of good metal thus produced. The floor scrap—from broken pots and leakage from the mold pits—is collected once each day and weighed into the storage bin in the scraproom.

The charges weighed up in the scraproom are brought out on the casting floor and set behind each furnace, accurate record being kept of the number of boxes given each caster. The first operation, starting each day's work, is to clean the fires by pulling out the grate bars and removing the ashes, care being taken to punch out the clinker that has formed at the bottom, as this sometimes reduces the cross-section of the grate to one-third its actual size. A fresh fire is then built, which in continuous operation is usually lighted by the hot bricks in the furnace. As the fire comes up to heat, the crucible, which has been previously warmed by being on top of the furnace, is placed in the fire, and the heavier metal of the charge, except spelter, is laid carefully in the crucible, care being taken that the metal does not tend to wedge the pot apart during melting, when the pot becomes soft. Ordinarily, a ring made from the upper half of an old crucible is placed on top of the crucible to hold the scrap and copper that cannot be put inside. In this case the scrap should be put in the bottom, as it melts faster than the copper.

TABLE OF EQUIPMENT FOR ONE SET OF TEN FURNACES*

Name of Article	Number Required	Life in Heats, Each	Weight, Lb., Each	Cost, Each
Crucible tongs	2	7,000	55	$6.00
Spelter tongs	2	800	12	1.25
Stirring-rod tongs	2	2,500	13	1.25
Band tongs	1	Indefinite	6	....
Mold tongs	1	Indefinite	9	....
Bar tongs	2	7,000	6	....
Skimmer	1	35	5	....
Scrapers	3	Indefinite	4	....
Punch bars, 7 ft. of 1-in. round iron	3	....	..	....
Chisel, ⅞-in. hexagon flat, 14 in. long	1	....	..	....
Files, 18-in. bastard-cut mill	2	....	..	....
Hammers, 6-lb. crosspeen blacksmiths', 12-in. handle	3	....	..	....
Fuel cover	1	Indefinite	20	....
Wire brushes	3	10,000	..	.20
Charcoal box, wooden, 4x4x3 ft.	1	....	..	....
Oil pail, heavy 2-qt. bucket	1	....	..	....
Oil brushes, 4-in. flat paint	2	....	..	....
Salt pail, heavy 4-qt. bucket	1	....	..	....
				Per Lb.
Molds	20	2,000	450	.05
Bands	60	200	25	.05
Wedges	100	3,000	5	.03
Strainers	20	Indefinite	27	.03

*The figures are approximate, as in some instances they are based on estimate only.

After all the metal is melted and up to a bright heat, the spelter, which has been warmed by lying on the furnace, is thrust beneath the surface of the metal and is rapidly melted and alloyed with the copper. The brass is then stirred thoroughly with a graphite stirring rod, so as to secure a homogeneous mixture. The graphite stirring rods are expensive, but are the best for high-grade brass, as iron from an iron stirring rod will alloy with the brass and thus increase the impurities. During the melting, salt and powdered charcoal are thrown on the metal, the charcoal to protect the molten metal from the atmosphere and the salt to act as a flux. After a vigorous stirring, the metal is given a minute or two to allow the impurities and dirt to come to the surface in the form of slag. The crucible tongs are then placed on the crucible, which is raised from the furnace by means of the jib crane. The outside surface of the crucible is cleaned, and it is then lowered on clean sand on the floor. The slag is skimmed off and a block of wood thrown on the clean surface of the metal.

The point might be made that there is the same objection to the iron skimmer as to the iron stirring rod. Actually, the amount of iron absorbed in skimming is much less, and graphite is less suited to the rougher handling. The crucible is then raised and placed over the strainer on the mold and poured, tipping the crucible forward with the tongs, keeping back the residue of slag and charcoal with the skimmer.

The block of wood in burning tends to keep the air away from the metal and is useful in reducing the amount of spelter burned out. The strainer should be kept full of metal so that the slag and dirt passing the skimmer remain on the surface and do not enter the mold. The molds should not stand slanting sidewise, as there is a possibility that impurities and gas pockets will lodge in the corner of the mold instead of coming to the surface, so that one edge of the bar may be defective for the entire length of the mold.

The molds are prepared by scraping with the scraper and brushing down thoroughly with a wire brush, after which they are painted with lard oil. Many substitutes are offered as a mold dressing, but lard oil seems to secure the best results. The molds are then banded and wedged up tight and are ready for use, the strainer being placed on top. After pouring, the metal is soon chilled sufficiently to allow the bands to be knocked off and the mold opened. The bars are raised with the bar tongs, and the burrs are filed off. Then the bars are piled on the floor behind the mold pit and allowed to cool until they can be loaded on wagons and taken to the shears in the scraproom. The molds are cleaned thoroughly and dressed with lard oil each time before being used.

The term "losses" covers the difference between the metal weighed out and melted and the total metal returned. The gross loss includes the metal in the ashes, and the net loss is that determined after the ashes have been put through the recovery plant and a large part of the metal in the ashes reclaimed. The net loss is therefore the difference between metal melted and that returned from all sources.

The melting loss varies with the type of furnace used, size of charge and proportions of mixture. On cartridge brass under the conditions outlined the gross loss varies

from 3 to 5 per cent. No figures are available for the net loss, but in other plants it varies from 1 to 3 per cent.

The loss represents a greater money value than the profit in manufacture and therefore should be given the most careful attention. An installation and working conditions which prevent metal from being lost in the fire by careless charging and by the use of worn-out crucibles and which avoid excessive volatilization of spelter by not using enough charcoal to cover the molten metal, by not overheating the metal, by pouring as soon as ready and not soaking the metal, by not using unnecessary draft, etc., will go far toward reducing this expense.

Metal spilled in handling and pouring is recovered from the mold pits and floor each day. This is known as floor scrap, and to it is added the solid metal picked from the skimmings and ashes, which contain the metal representing the difference between the gross and the net losses. No figures are available to give proportion by weight of recoverable metal in the ashes in the plant described, but it has been found by other firms to run from 0.25 to 0.5 per cent. by weight of ashes.

This recovery is made by concentrating and refining processes. The quantity of ashes is not sufficient to warrant a recovery installation in any but a large plant. The floor scrap may be melted directly with the charge in small quantities or remelted and sheared before using, as the quality of work may require. Some specifications for cartridge brass permit the use of floor scrap; and if used judiciously, no bad effects will be noticed.

In addition to the tools and equipment mentioned the following materials are required in the approximate quantities given, which are the results of several months' operation:

Coke	50 lb. per 100 lb. metal melted
Charcoal (used in lighting fires)	0.1 bu. per 100 lb. metal melted
Lard oil No. 2	0.04 gal. per 100 lb. metal melted
Salt	0.25 lb. per 100 lb. metal melted
Phosphorized copper	1 oz. per 100 lb. metal melted
Graphite stirring rods, 1½ x 18 in. long	30 heats each

For a plant having 40 furnaces, or four sets of fires, there will be required 4 casters, 16 to 20 casters' helpers and 4 laborers. These men will be able to produce from 5 to 7 heats from each furnace in about 9 hr. The casters are paid on a tonnage basis at the rate of 17 to 20c. per 100 lb. of good sheared metal. The casters pay two helpers at 65c. per round, which is one heat from each of the two furnaces comprising a set of fires. The firm supplies additional helpers at the same rate, giving three men if special circumstances require them. A better arrangement is to pay on a tonnage basis for the entire crew about as follows, per 100 lb.: Caster, 8c.; floor helpers, 5½c.; pit, 4½c.

In this scheme the bars are marked with the crew number, and a deduction is made for bars scrapped at the overhauling machines in the rolling mill, as metal apparently good at the shears may be poor metal when overhauled—that is, the process of scraping off the surface metal, dirt, etc., preparatory to rolling.

The scraproom requires about 10 men—4 on the shears and 6 on the scales. The pay of these men runs from 20 to 30c. per hr.

The direct cost for producing sheared bars ready for rolling is about ½c. per lb. of metal melted, divided about evenly among labor, supplies, renewals, etc. To this figure must be added the value of metals lost and burden. These items may vary greatly. The distribution of metals between weighed charge and sheared bars is as follows:

	Per Cent.
Metal weighed out	100.00
Net loss, volatilization, etc	2.50
Recovered metal, ashes	2.00
Floor scrap	5.00
Shear scrap	10.00
Good sheared bars	80.50

These figures represent what may be called fair to good operation, but undoubtedly offer opportunities for further economies. The importance of accurate records will be appreciated in making an estimate. Several of the most necessary are shown.

To many it might seem that the crucible-furnace method of making brass is antiquated and that units of larger capacity should be used. But segregation, gas occlusion, rehandling and consequent cooling in ladles and higher losses are still disadvantages of the large furnace that must be taken into consideration.

For rolling, the metal must be homogeneous and absolutely free from dirt. Therefore, metal molds are preferred, and the consequent chilling allows no time for impurities to rise to the top. Also, the chemical analysis must be fairly close; and as one component of the alloy is easily oxidized, the metal must be melted, poured and cooled quickly. No doubt many improvements will be introduced into brass making in the immediate future, as experimental investigation is now being taken up in earnest by many manufacturers.

Connecting-Rod Testing Fixture for Cycle Motors

By E. V. Allen

A fixture used in the shop of the Henderson Motorcycle Co., Detroit, Mich., for testing connecting-rods is here shown. The rod bearings are first reamed out; then a ground bar is thrust through the crankpin end, as at *A*, Fig. 1. The small end of the rod is placed over the end of the bar *B*. Hardened pins and stops are placed at

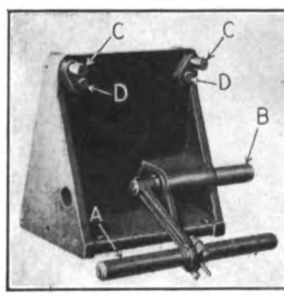


FIG. 1. CONNECTING-ROD TESTING FIXTURE

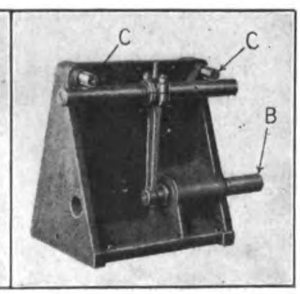


FIG. 2. ROD IN TESTING POSITION

C and *D*. The connecting-rod is swung upward against the gaging points, as in Fig. 2.

The bar *B* is eccentric, so that by turning it the rod may be raised or lowered to a certain extent. This eccentric movement makes it possible to see just how the bar in the small end lines up with the gage points. If they do not indicate true, the rod is twisted or bent until it registers correctly.

Motor-Truck Repairs in Mexico

By Hi Sibley

With 285 motor trucks now in daily service on the line of communication extending approximately 300 miles from the military base at Columbus, N. M., to the advanced front beyond Namiquipa, Mexico, and with some of the road in almost impassable condition the motor-repair shop has developed into a most important institution.

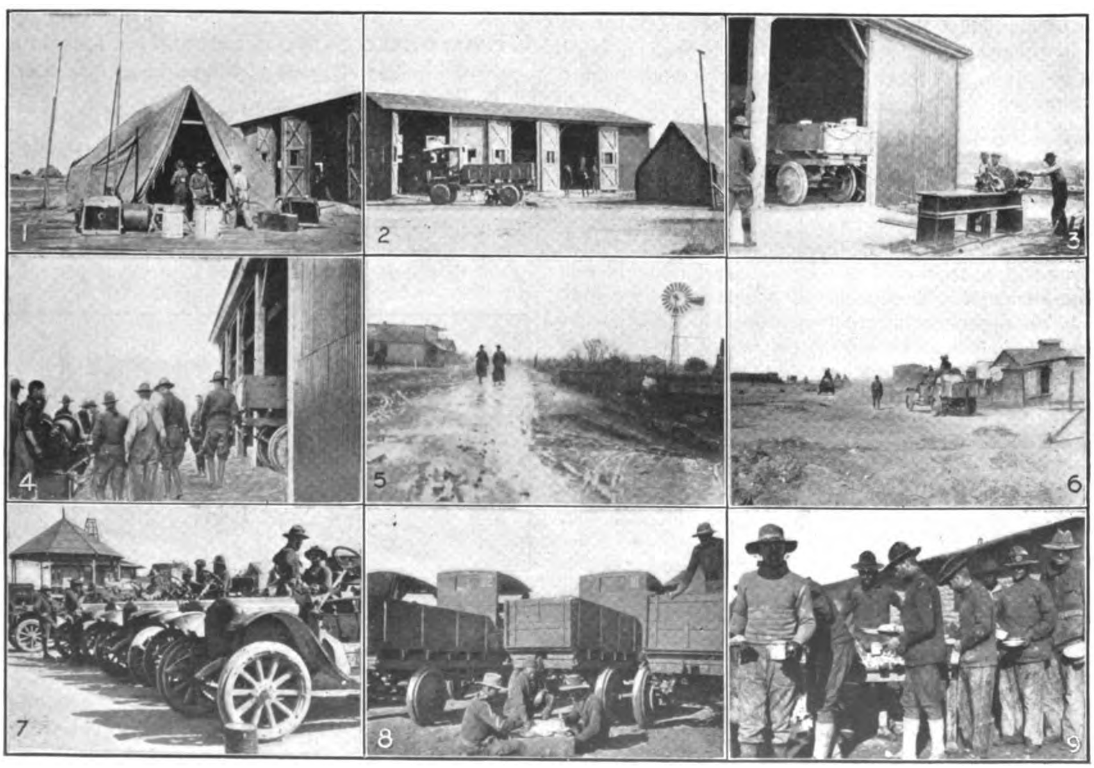
Beginning in a little tent equipped with work benches, a vise or two and the usual assortment of hand tools, it has grown to a substantial and well-equipped machine shop with concrete floor and individual power plant. The building, just erected, is of corrugated sheet iron over a 4x4 frame and is 60 ft. long by 40 ft. wide. On the eve of its completion an addition 40x40 ft. is contemplated and in all probability will be erected at once.

The present equipment includes a 20-in. Schumacher & Boye lathe with 16-ft. bed, a Smith & Mills 17-in. shaper, a 20-in. Champion drilling machine with back gears and power feed, a Buffalo forge and a Sterling No. 3 emery grinder. A miller probably will be added later. The power plant at present consists of a Stover 8-hp. gas engine, but this is to be exchanged for a larger one. The usual work benches and vises are installed, and a number of pits are built in the floor to facilitate work underneath the cars, which can be driven into the shop through the large sliding doors on both sides of the building. The doors give ready entrance and exit and make it much easier to handle the cars, as there is almost no position in the shop where a truck would be blocked by other trucks so as to prevent getting out and into service.

Considering the condition of the roads over this 300 miles through desert and mountain pass, ranging from soft and greasy adobe to heavy desert sand and rocky cañon trails, the amount of repairing required to date has been comparatively small. Apparently the damage to which all the makes of cars are most subject is tire injury from the sharp and jagged rocks in the cañons. After two round trips to the front, pieces of rubber weighing over a pound have been found in the trail of the trucks.

Occasionally there is a serious collision, due to the difficulty of driving at night without lights; then the truck is towed in by an accommodating team mate, and a general overhauling is given it. Several of the truck companies have their own repair car with two machinists in charge, and these traveling repair shops can handle anything that is not of too serious a nature. It is customary, however, to bring the disabled trucks back to the military base at Columbus whenever possible, where they may be given more thorough attention.

Green drivers, recruited on short notice from necessity, have in some cases wrought havoc with transmissions, and the principal work in progress at this writing is the replacing of broken gears. As yet no complete machine jobs have been turned out by the new shop.



MOTOR TRUCKS AND TRUCK REPAIRING IN MEXICO

Fig. 1—The first repair shop in camp. Fig. 2—New repair shop built at Columbus, N. M. Figs. 3 and 4—Truck helping to haul a lathe into the repair shop. Figs. 5 and 6—Mexican roads, wet and dry. Fig. 7—White truck section ready to start. Fig 8—Truck drivers dine in style before leaving. Fig. 9—Getting morning "chow"

Knurling in the Small Shop

By John H. Van Deventer

SYNOPSIS - This article describes the methods of making and using knurls. Cut, rolled and fancy knurls are described, and methods are given for using them on all the machines found in the small shop.

Every machinist and almost every apprentice has in his tool box one or more knurls that he is quite sure beat anything any other man ever made. Also, very good knurls in a large assortment of patterns may be bought ready to mount in a holder and use. With this prolific source of supply it may be asked why the small-shop man should be interested in knowing how to make knurls. But a small-shop man must be posted on many things that the large-shop man does not need to know, for in the course of his varied and exciting existence he rubs up against circumstances that are quite outside of his special line. And also, a knowledge of how things are made does not interfere with knowing how to employ them.

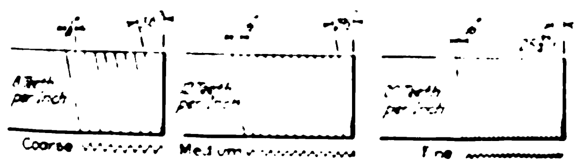


FIG. 1. ANGLES FOR CUTTING COARSE, MEDIUM AND FINE SPIRAL KNURLS

FIG. 2 ANGLES FOR TEETH

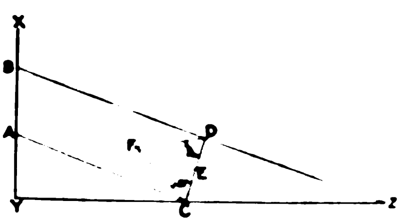


FIG. 3 OBTAINING THE DEPTH OF KNURLED TEETH

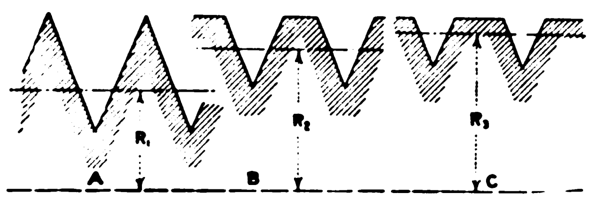


FIG. 4. VARYING THE DEPTH OF CUT GIVES SOME RANGE AS TO THE NUMBER OF TOOTH IMPRESSIONS

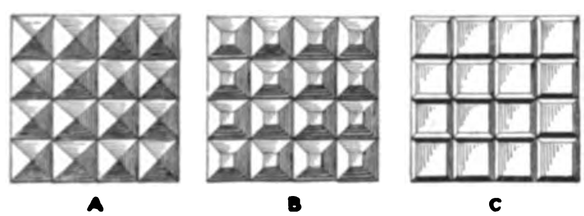


FIG. 5. PATTERNS OBTAINED WITH DIAMOND KNURLS BY VARYING THE DEPTH OF CUT

Knurling is one branch of the process by which impressions are transferred from one material to another by rolling. It is in the same class as thread rolling and the making of index dials by the rolling process. Knurling is applied to both flat and curved surfaces, and the tool itself may be either flat or curved. Where the work is flat, the knurl is circular; but when the work is circular, the knurl may be either circular or flat. An example of circular work and flat tool is the method of knurling work held in lathe centers by allowing a coarse file to "float" upon it.

I will pass up the ornamental knurls for the present and speak of the kind that will be found of greatest service in small shops—the straight and spiral patterns. These are originally produced by cutting what is known as a "master knurl." From this master, which is the same as the impression desired on the work, other knurls are produced by rolling and are used in the shop, the master being kept for reproducing purposes. Sometimes this process is carried back and forth many times, until the offspring lose their family resemblance. The great-grandchild of a master knurl will not produce as good work as his grand-daddy, and for this reason the best knurling is procured directly from machine-cut knurls without the use of masters.

The knurl has been called a "putting-on tool." It increases the diameter of the work, because metal is forced up between the knurl teeth. Knurls and thread rolls are similar in their action, knurling being simply a case of rolling multiple threads. The stock diameter increases in knurling as it does in thread milling and in both cases may be figured roughly as equal to the depth of the tooth produced, this being the same as saying that the knurl tooth goes down halfway into the stock and forces the stock halfway up into itself. The coarser the pitch of the teeth of the knurl the deeper these teeth become. The result is that more pressure must be brought against the work in order to raise the impression. For straight and spiral knurls it is well not to have less than eight teeth per inch for the coarsest pitch.

In a spiral knurl the finer the pitch the less may be the angle made with the axis of the knurl. This is shown in Fig. 1, which gives pitch and angles for coarse, medium and fine spiral knurls. The greater this spiral angle becomes the less is the "bite" taken across the face of the knurl, and it is for this reason that this angle is made greater on the coarse pitches. It also follows that a finer feed must be employed on coarse-pitch knurls than on fine-pitch ones, in order to get full tooth impressions.

The angle of the knurl tooth varies with the hardness of the material to be knurled. Various angles are illustrated in Fig. 2; they are suitable for brass, soft steel and tool steel. It also follows that the harder the material to be knurled the finer should be the pitch of the knurl, so that a sharp tooth angle and a fine pitch usually go together. This distinction, so far as hardness is concerned, is an important one.

Having the circular pitch of a spiral knurl and the number of teeth, the diameter is found by multiplying the circular pitch by the number of teeth. A simple way of obtaining the tooth depth is given in Fig. 3. XY and YG are laid out at right angles, and points A and B are laid out on line XY at a distance apart corresponding to the circular pitch of the knurl. Through these points lines AC and BG are drawn representing the teeth and making an angle with the line YZ equal to the angle of the spiral knurl. The line CB is drawn perpendicular to the line AC, and the lines CF and BF are drawn at an angle A equal to one-half of 180 deg. minus the tooth angle as shown in Fig. 2. In other words, for tool steel the angle A will be $\frac{(180 - 60)}{2} =$ 60 deg. For brass the angle A will be 45 deg. and for soft steel 55 deg. The height of the triangle thus formed, represented by the line EF, will be the tooth

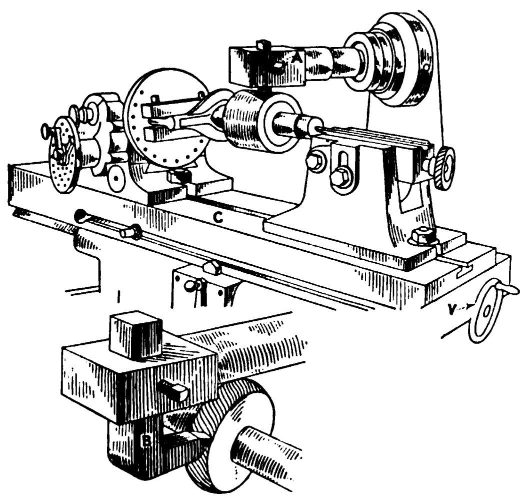


FIG. 6. A SIMPLE ARRANGEMENT FOR MAKING A SPIRAL KNURL ON THE MILLER

depth. If this diagram is laid out on paper ten times full size, the depth may be read off in thousandths of an inch by means of a scale reading in hundredths.

These calculations apply to the diameter of the knurl itself, but a similar calculation is not often necessary for the diameter of stock, although in a case of coarse-pitch knurls an attempt must be made to get the correct stock diameter to avoid tooth impressions overlapping.

This diameter may be "found" more easily than it can be "calculated." The thing to do is to leave the stock a trifle large and reduce it until the tooth impressions come out with no overlapping. On fine-tooth knurls this is not necessary, for a little more or less pressure when the knurl gets to its depth will bring satisfactory results. If you have but one piece to knurl, it is better to use a fine knurl and not have to make experiments on the diameter; but if a large number of pieces are to be knurled in the screw machine, the time spent in experimenting with one of them will not be of much importance.

Varying the depth of the cut gives a slight range as to number of tooth impressions, as shown in Fig. 4, and also produces a variation in pattern in the case of diamond knurls, as may be seen in Fig. 5. Full-depth knurling produces the pattern at A, Fig. 5, while B and C are modifications corresponding to the depths at B and C, Fig. 4. If the object of knurling is to provide a grip for the hand, as upon a chuck body, knurling to part depth is advisable, since it gives sufficient roughness to enable the piece to be gripped without having the sharpness of full-depth knurling, which is likely to hurt the hand.

Straight-tooth knurls are easily cut on a lathe by holding the blank between centers and indexing on the back gears. The tool is held horizontally in the tool post, and the carriage is moved back and forth by hand, thus planing the teeth. Spiral knurls are cut in a similar way on a universal miller having index centers. The dividing head is geared up for the correct lead of the spiral, and a single-point tool shaped to the angle of the knurled tooth is held in a fly-cutter holder such as is illustrated at A in Fig. 6. For ordinary work it is not necessary to rotate this fly-cutter; it is sufficient to hold it in a vertical position and plane the grooves by moving the table back and forth by hand, the dividing head with its gears taking care of the angular rotation of the work. When cut knurls are required in quantities, it is best to have a milling cutter.

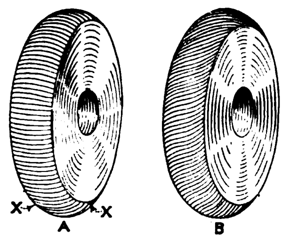


FIG. 7. PLAIN AND SPIRAL ROUND KNURLING

Surfaces formed with a radius may be knurled as shown at A and B in Fig. 7, the first being an example of convex straight and the second of spiral convex knurling. The radius of the rounding on a concave knurl, which is to produce a pattern on convex work of this kind, must be slightly greater than the radius of the piece to be knurled, in order to prevent tearing of the work at the corners marked X in the illustration. A knurl for work of this sort is produced on a simple swivel tool-holding device, Fig. 8, the work being mounted on an index center and the single-point tool being swung on a radius across the face of the knurled blank. The point D shows the position of the pivot in producing a convex knurl, and E shows the position of the pivot when making a concave knurl. Both concave and

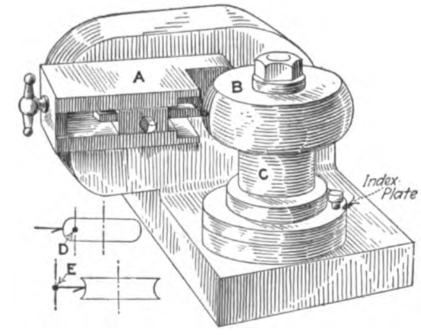


FIG. 8. ARRANGEMENT FOR CUTTING CONCAVE AND CONVEX MASTER KNURLS

convex knurls may be produced on the same device by shifting the position of the index center and of the tool with relation to the pivot pin.

Spiral convex knurling, such as shown at *B*, gives a very pleasing appearance, but requires more complicated arrangements for making the knurl. The universal miller is set up as for the straight-faced spiral knurl in Fig. 6, except that the tool is placed horizontally as at *B*. A templet is provided having a radius equal to that of the knurl, and this is followed with the cross-feed, while the longitudinal feed produces the spiral. When a knurl is required for a pattern like that in Fig. 9, in which the diameter

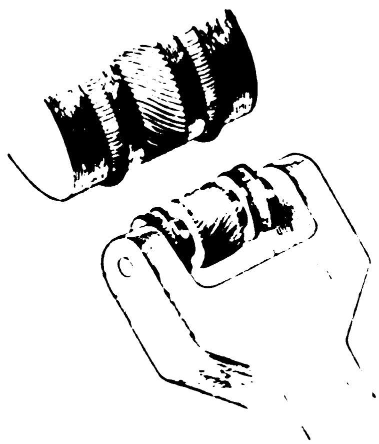
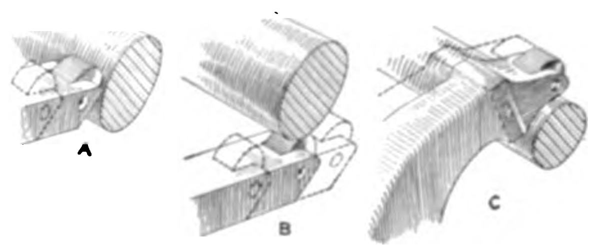


FIG. 9. HOLDER AND SPACING COLLARS FOR "BUILT-UP" KNURL



of the various knurled portions vary, it is a good scheme to make a "built-up" knurl with one roller for each portion and spacing collars between. The separate knurls are thus free to rotate at different speeds to suit the diameter of the work. Even on work of one diameter, in which three or four spots are to be knurled in this way, a built-up knurl will often prove a good investment, as it enables the pattern to be changed and a broken tooth does not cause as much loss as it would in the case of a solid knurl. There is a variety of ways to knurl in the hand screw machine and automatics. Sometimes the knurl is mounted on the cross-slide and is advanced directly in the work on the center line, as illustrated at *A*, Fig. 10, feeding in to the depth of the tooth and remaining a moment before being withdrawn. Another plan is to pass the knurl under the work, as at *B*, allowing it to rest a moment on the center line so that the tooth impressions become fully developed. Another plan makes use of the swinging arm, as at *C*, otherwise being similar in principle to *A*. Knurling

FIG. 10. GENERAL WAYS OF KNURLING ROUND STOCK ON SCREW MACHINE AND AUTOMATICS

with a box tool having roller backrests is shown at *B*. The knurl *E*, Fig. 10, is swung in toward the work by means of the eccentric *F*, and the plain rollers *G* running on each side of the knurled portion serve as backrests and balance the cut.

In connection with backresting, the location of the knurls and their number have an important effect on the strain produced in the work. The most common arrangement is illustrated at *A*, two knurls being held against one side of the work, resulting in a heavy unbalanced pressure. When one knurl is placed diametrically opposite the other on two opposite sides of the shaft, conditions are much better, although there still is a tendency for the rollers to ride up on the work in the direction of rotation. The scheme shown at *C* is the best of all, two rollers being mounted on one side of the shaft and one on the other, all tendency for rollers to ride up on the wo k being eliminated.

Ornamental knurling is an art not often practiced in the small shop. Artistic results can be obtained by knurls made as shown in Fig. 12, of which the result pictured at *A* is an example. The first step is to put in the ground lines, which consist of straight, fine-tooth knurling running across the piece, as at *B*. Punches are

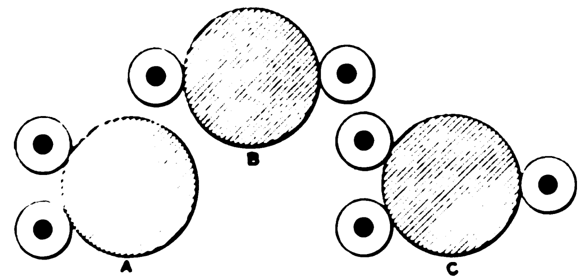


FIG. 11. GOOD, BETTER AND BEST COMBINATIONS

made carrying one unit of the figure, such as shown at *C* and *D*. The work is then held upon the arbor of an index head, as at *E*, and the pattern is stamped by means of a hardened punch sliding in a fixed guide *H*. Doing this work by hand is a delicate job, requiring a great deal of skill in giving the blow required to make the impression. A better way is to rig up a light drop that insures the same weight of blow for each repetition of the figure. The fine-ground lines at *B* are not put in simply for ornamental effect, but to serve the purpose of gearing the knurl to the work. They are quite necessary on ornamental designs of this kind, which are not positively driven, but in which the knurl depends for its rotation and registry upon its contact with the work.

Another way to repeat a design of this sort is by rolling. A hob carrying a single impression is applied to the work by gears having teeth so figured that the hob is brought into contact with the surface of the work at a different place each revolution, until the entire surface has been covered with impressions. For example, if 40 impressions are desired on a circumference, these may be obtained by using gears having 40 and 39 teeth respectively, the former connected to the blank and the latter to the hob.

In making a knurl, use tool steel having a carbon content between 90 to 110 points. Make the hole for the pin on which the knurl is to rotate small in diameter

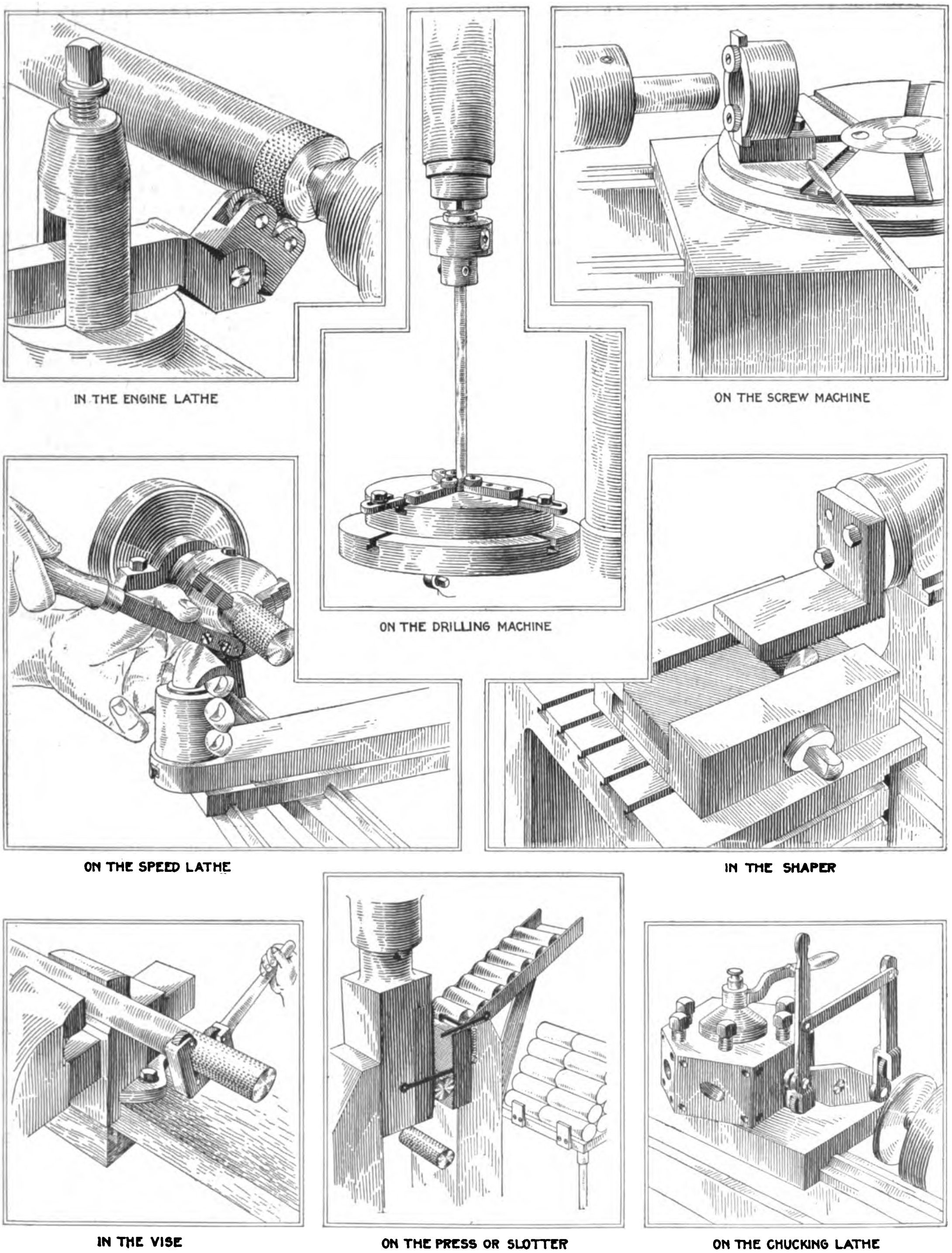


FIG. 17. KNURLING DONE ON ALL THE TOOLS IN THE SMALL SHOP

in order to reduce friction, and leave a collar on the side of the knurl for the same purpose. For a fancy knurl of complicated design it is best to use nonshrinking steel. Harden at a temperature corresponding to its carbon contents, as described on page 417, applying file cutters' paste to the knurl before heating. This is made up according to the following formula: Pulverized charred leather, 1 lb.; fine family flour, $1\frac{1}{2}$ lb.; table

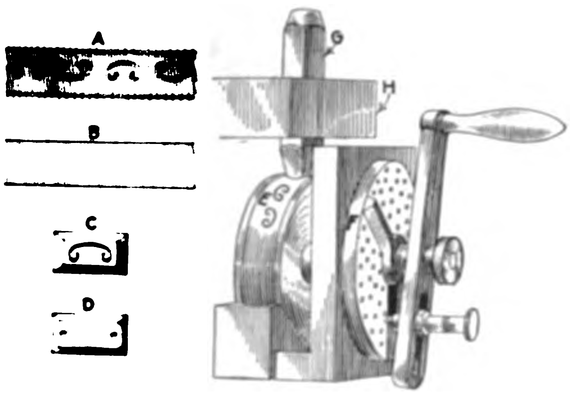


FIG. 12. ONE METHOD OF PRODUCING AN ORNAMENTAL MASTER KNURL

salt, 2 lb. The charred leather should pass through a 45-mesh screen. The ingredients of this paste are mixed dry, after which water is added slowly and it is kneaded to prevent lumps from forming. It is used at the consistency of thin molasses, is applied to the knurl with a brush and allowed to dry before the piece is heated. After heating, the knurl is quenched in water and then drawn to a color between dark yellow and yellow brown.

Some 20 years ago Edward Board, of Philadelphia, devised the triple adjustable knurl seen in Fig. 13. It combines the balance of forces described at *C*, Fig. 11, and has the good feature of being adjustable into the

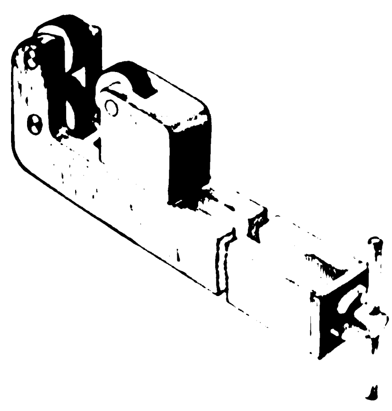
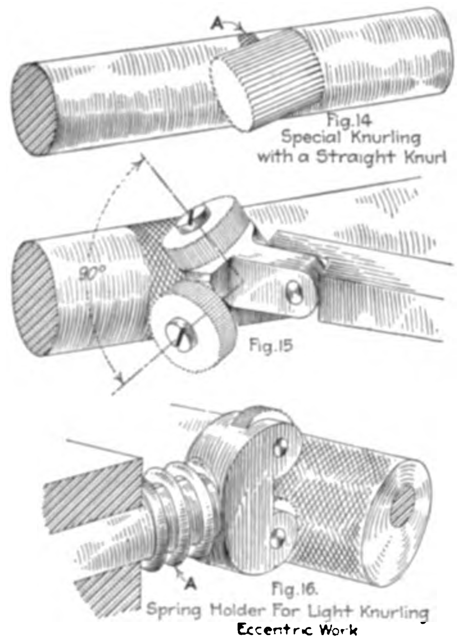


FIG. 13. ADJUSTABLE TRIPLE KNURL FOR HAND OR LATHE KNURLING

bargain. Mr. Board says that all small-shop owners are welcome to this idea, which is not patented, and which I can say from observation is a mighty good one for either hand or tool-post knurling.

One way to produce spiral knurling is shown in Fig. 14. In this case a straight knurl is inclined at an angle with the axis of the work and fed along by the tool carriage. This scheme is especially good for producing deep spiral knurling, as the teeth are cut to their full depth at the center of the knurl and there is no tendency to break off the tooth corners. This advantage is offset by having to use a comparatively slow feed, since the band produced by a single rotation of the shaft is much narrower than would be produced by the knurl held parallel with the axis, as is clearly indicated at *A*, Fig. 14.

An adaptation of this principle for double spiral knurling is given in Fig. 15. In this case we have



FIGS. 14, 15 AND 16. SPECIAL APPLICATIONS OF KNURLS

two straight knurls, both of them mounted and held at angles to the axis of the shaft and at right angles with respect to each other. The result is a diamond knurling, similar to that which would be made with a single spiral knurl held parallel to the axis. Deeper impressions of coarse pitches can be made with a knurl of this kind than with a spiral diamond knurl.

A scheme that has been used for knurling eccentrics is illustrated in Fig. 16. The tools are kept in contact with the work by means of the spring *A*, which must be sufficiently stiff to force the knurls into the work before the spring yields.

Sometimes knurled effects are produced not by knurling, but by stamping. An illustration of this is seen

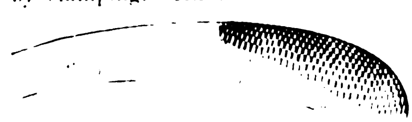


FIG. 17. KNURLED EFFECTS ARE PRODUCED BY STAMPING

in Fig. 17, which represents the roughening of one of a pair of plier handles by this simple means.

Although there is as a rule a machine best fitted for each kind of work to be done, this does not seem to hold true when it comes to knurling. The illustrations in Fig. 18 show how knurling may be accomplished in every machine usually found in the small shop and also by hand in the vise. If all work was subjected to such flexibility of handling, the small-shop man's trouble would be over!

Making Shell-Boring Cutters

Editorial Correspondence

Munition making in the United States has brought to the surface a number of things that have been concealed in the past. This work has taken on such an intensive form and production has been rushed to such a point that deficiencies are felt which would have been overlooked in the ordinary course of business. Shops have been crowded until their productive capacity has been squeezed against the sides of the buildings; and like feet squeezed into shoes too small for them, the corns and callouses make themselves unpleasantly evident.

This condition has brought about a definite idea of the value of the concentration of all the energy on one thing and has had its effect on the old policy of making versus buying small tools. A few years ago it was not uncommon to find shops buying one tool or a few tools when these were required, but rigging up to make them as soon as increased production called for larger numbers. Nowadays, under more strenuous conditions, the opposite policy has been put into effect—namely, making the one tool or the few tools and buying the quantity.

In shops with a production ranging from 1,000 to 12,000 shells per day the demand for cutters becomes enormous; and while it has been possible to double and sometimes triple the square-foot producing capacity of the machine stop by the use of specialized machines and

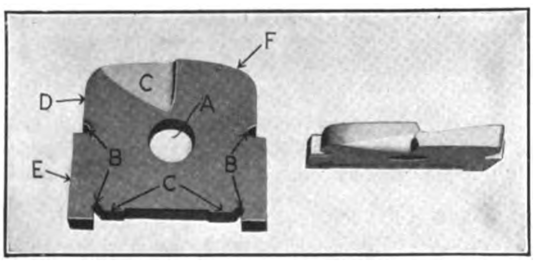


FIG. 1. BORING CUTTERS FOR 3-IN. SHRAPNEL SHELLS

attractive piece prices, it has not been possible to apply this scheme in the toolroom. If the toolroom were to be made to keep pace with the manufacturing part of the plant, it would be necessary to double or triple the floor space devoted to it; and floor space is at present worth its area in gold leaf.

One of the tools in greatest demand for shrapnel work is the step cutter used in reaming the powder pocket and disk seat. One of these cutters is illustrated in Fig. 1. It is this size that is used on 3-in. Russian shells, and the illustration shows the cutter as it appears after being milled and before hardening. It is customary to make these cutters to finished shell size and, when they wear down, use them for roughing cutters.

These cutters, as manufactured by A. Hankey & Co., Rochdale, Mass., are made from flat high-speed steel stock and require almost as many operations to finish them as do the shrapnel shells themselves. The bars are first cut into lengths, then milled on each side, after which the pin hole *A* and the clearance holes *B* are drilled. Following this operation, the edges are rough milled, this in itself being a job that requires a half-dozen separate chuckings. The next step is to mill the lips *C* in the top edge of the cutter, which is done by holding the piece on an angle block on the miller and feeding in nearly to the pin hole at the deepest part of the cut in the center of the blade. After these lips have been completed, the cutter is ready for hardening. Oil-burning muffle furnaces are employed. The fuel is

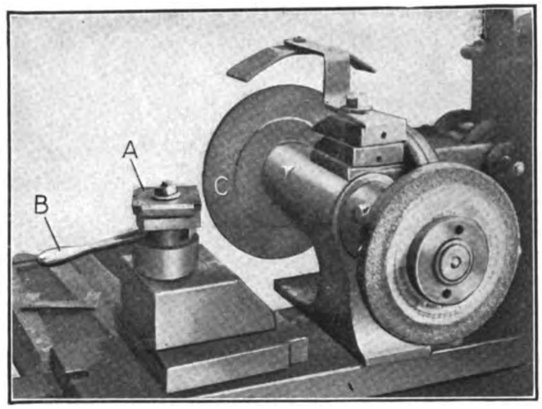


FIG. 2. CORNER-ROUNDING FIXTURE FOR SHELL CUTTERS

vaporized by steam, which has much less decarbonizing effect upon steel than air used for the same purpose.

The cutters are slowly preheated to 1,500 deg. F., after which they are placed on end vertically within the furnace and the heat is rapidly raised to 2,250 deg. At this point the high-speed steel begins to "sweat." It is then quenched in a cooling bath of Houghton's soluble quenching compound. The scale is removed by hand grinding, in order that the cutter may be tested for hardness, which is held between 85 and 90 on the scleroscope scale.

Most of these cutters are located in the boring bar by the base spots *C* and by the shoulders at each side of the spots. Some, however, are located by the pin hole *A*, and in a few cases the cutters are located by both the base spots and the pin hole, which doubles the difficulty of finishing them. There is apparently no standard prac-

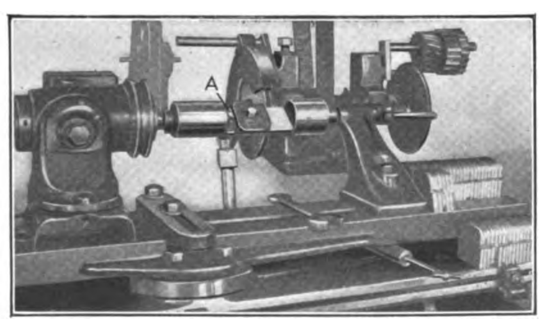


FIG. 3. GRINDING THE SIDES OF SHELL CUTTERS ON GRINDING ARBOR

tice on this point; and since work is being satisfactorily produced on cutters located by the hole only or by the spots only, it would seem as though the manufacturers who insist on locating by both of these are incurring unnecessary expense.

The cutting edges, since they are located by the base spots *C*, are the next to be ground, a number of cutters being clamped together for this operation. The shoulders on each side of the locating flats are trued up by means of a cup wheel, after which the edges *B*, *E* and *F* are ground. Then the flat sides of the cutter are surface-ground, and the lip *C* on each side is finished on a fixture similar to that provided for milling.

The fixture used in rounding the corner *F* is illustrated in Fig. 2. The cutter is held on a rotating block

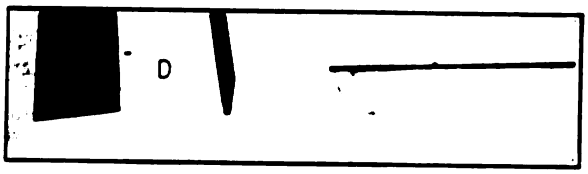


FIG. 4. TOOLS FOR CUTTING OFF COPPER DRIVE BANDS

at *A*, being clamped by a nut and washer upon a central stud. As the handle *B* is moved back and forth, the proper radius of the corner is secured through contact with the wheel *C*, a spring pressing this fixture forward until it comes to rest against a limit stop on the inside of the slide.

The method of rounding the parallel edges *E* is shown in Fig. 3. A special arbor is employed, recessed at its center to receive the cutter, which is located by a plate *A* fitting into the base recess of the cutter.

Another tool that is a development of munition making may be seen in Fig. 4. This is a high-speed steel cutting-off tool for parting copper driving bands. It is an ex-

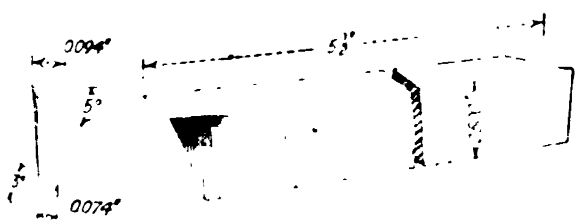


FIG. 5. DIMENSIONS OF CUTTING-OFF COPPER-BAND TOOLS

cellent example of thin high-speed steel toolwork; the dimensions of the tool are given in Fig. 5. Tools of this kind are made and hardened in lengths and cut off on an abrasive saw. It is necessary to grind at five different angles in producing such tools, and they are held within one-half thousandth of finished size on each dimension.

Cutting Gears on a Planer

By F. M. A'Hearn

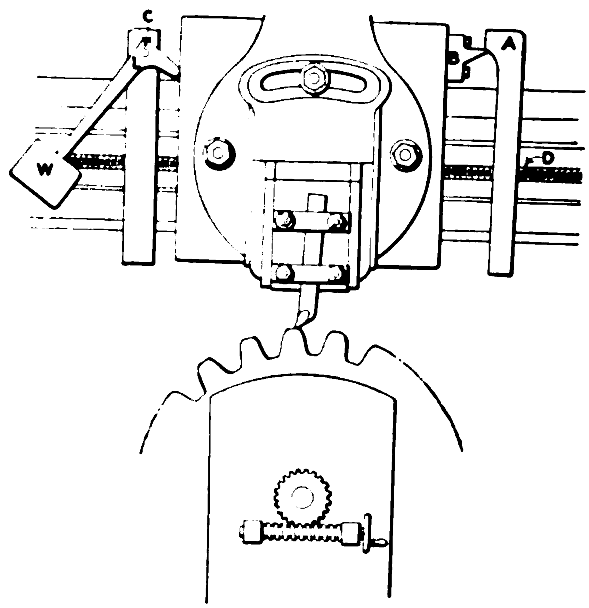
A lot of rough cast-steel gears about 3 ft. in diameter, with 18-in. faces and of coarse pitch, requiring the teeth to be machined, would not appeal to the average shopman as an attractive planer job. A plant equipped for building heavy machinery was confronted with a problem of this kind; and to avoid the delay of letting the work out, it was decided to finish the teeth on a planer.

A hardened block *A*, shaped to the required contour of the tooth, was bolted to the cross-rail. A follower *B*, having a narrow bearing against the side of *A*, was secured to the head. The fulcrum *C*, on the opposite side, supported a bell-crank lever *L* with a weight *W*, as shown. The crossfeed screw *D* was released at the ends to allow it to travel with the head.

With the work mounted on a rigid pair of planer centers, the tool was located at the top of the tooth. As the crossfeed screw was inoperative, slight side adjustments were made by moving the tool before drawing the nuts tight.

When the cut was started and the vertical feed thrown in, the weighted lever *L* held the follower *B* against the former *A* as the tool traveled down the cut, and the required contour was secured.

After the teeth were finished on one side, the fixtures were reversed and the other side completed in the same



AN IMPROVISED METHOD OF CUTTING HEAVY GEARS ON A PLANER

way. Sufficient clearance was cast at the bottom of the teeth to require no finish.

Slight errors were of course present in the finished work, but the gears were entirely satisfactory or, to quote one of the old-time contributors to the *American Machinist*, "They were sufficiently accurate for practical use."

Machinery Club of Chicago

The Machinery Club of Chicago has been formed as part of a get-together movement of machinery builders and dealers. The first meeting was held at Hotel Sherman on Apr. 17, 1916, and 130 enrolled as charter members. Only residents of Chicago directly connected with machinery or machinery supplies are eligible, but anyone outside of Chicago connected with machinery or machinery supplies will be welcomed as a guest. C. W. Blakeslee, Chicago manager of Abrasive Materials Co., acted as chairman, and Mr. Noble, of the E. L. Essley Co., as secretary.

Club luncheons are to be held every Monday at 12:15 p.m. and stated meetings once a month will be held in the evenings.

Jones & Lamson Fixtures for Textile-Machine Details

By Robert Mawson

SYNOPSIS—The illustrations show the construction and use of special tools for machining four textile machine parts. These tools are all for use on Jones & Lamson flat turret lathes. The fixtures are of rigid construction and employ sliding wedges, setscrews and jaws for locating and holding the work.

On these jig and fixture data pages are shown turret lathe fixtures for machining four textile machine parts. These parts are a web take-up bracket, a transfer cup, a transfer ring and a double-stitch cam. The special features were designed for, and are used on, Jones & Lamson flat turret lathes. The shop where they were designed and built and are used is that of the Hemphill Manufacturing Co., Pawtucket, R. I.

A consideration of the illustrations will show that the fixtures are simple in design and rigid in construction. In connection with each of the four details on page 853 are given the production time for each piece.

The methods of holding the pieces in the fixtures are worthy of study. The web take-up bracket, Fig. 1, page 853, is held in its fixture by two sliding wedges forced against the sides of the casting by means of square-headed set screws.

This is clearly shown in Fig. 2, which also gives a good idea of the substantial nature of this fixture. The opening in the piece to be machined slips over the two projecting jaws and seats on the base of the fixture. Then the wedges are easily and quickly slid into place and locked.

In the next piece shown—the transfer, cup, Fig. 3—the work is held in the special chuck shown in Fig. 4. The ear projects through the ring of the chuck and rests on the adjustable screw shown at *A*. The three radial setscrews hold the cup in place in the chuck.

The transfer ring, Fig. 5, is held in a special chuck shown in Fig. 6. This grips the ring by the large diameter and holds it laterally as well as from turning.

The double stitch cam, Fig. 7, is held in a very similar manner by the chuck shown in Fig. 8. This, however, locates the piece by its face against the face of the chuck. Two of the jaws bear against the smaller diameter and one against the outer cam face. The jaws are proportioned to center the work with the hole.

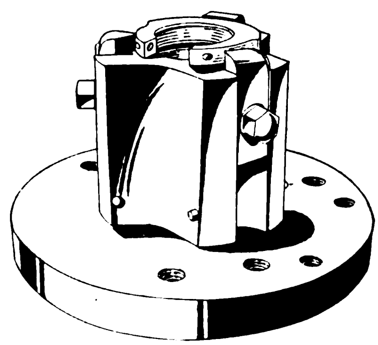


FIG. 8

FIG. 8. FIXTURE FOR MACHINING DOUBLE-STITCH CAM

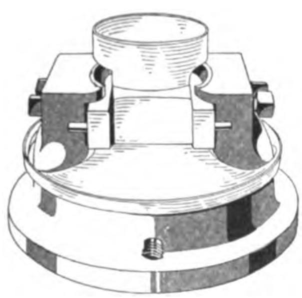


FIG. 2

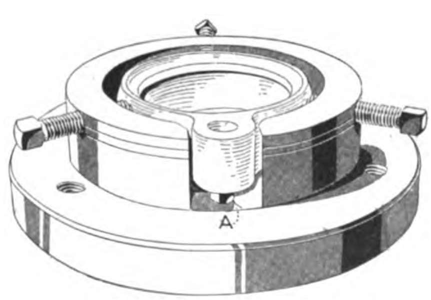


FIG. 4

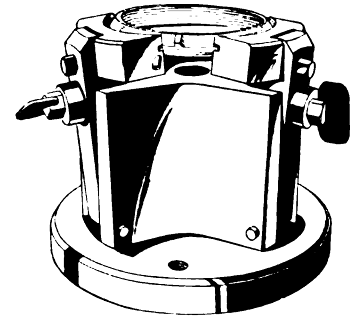


FIG. 6

FIGS. 2, 4 AND 6. J. & L. FIXTURES FOR MAKING TEXTILE MACHINE DETAILS, WITH PARTS SHOWN IN POSITION

FIGS. 2 AND 2-A

Operation—Machining the web take-up bracket, Fig. 1. The casting is placed on the fixture, and the two sliding wedges A are forced against the casting by the setscrews on the sides.

Surfaces Machined—Inside bored, edge faced and two surfaces turned.

FIGS. 4 AND 4-A

Operation—Machining transfer cup, Fig. 3. The casting is placed on pins and an adjustable screw A. The three setscrews on the sides are tightened against the part, holding it securely.

Surfaces Machined—Hole bored and inside contour turned and faced.

FIGS. 6 AND 6-A

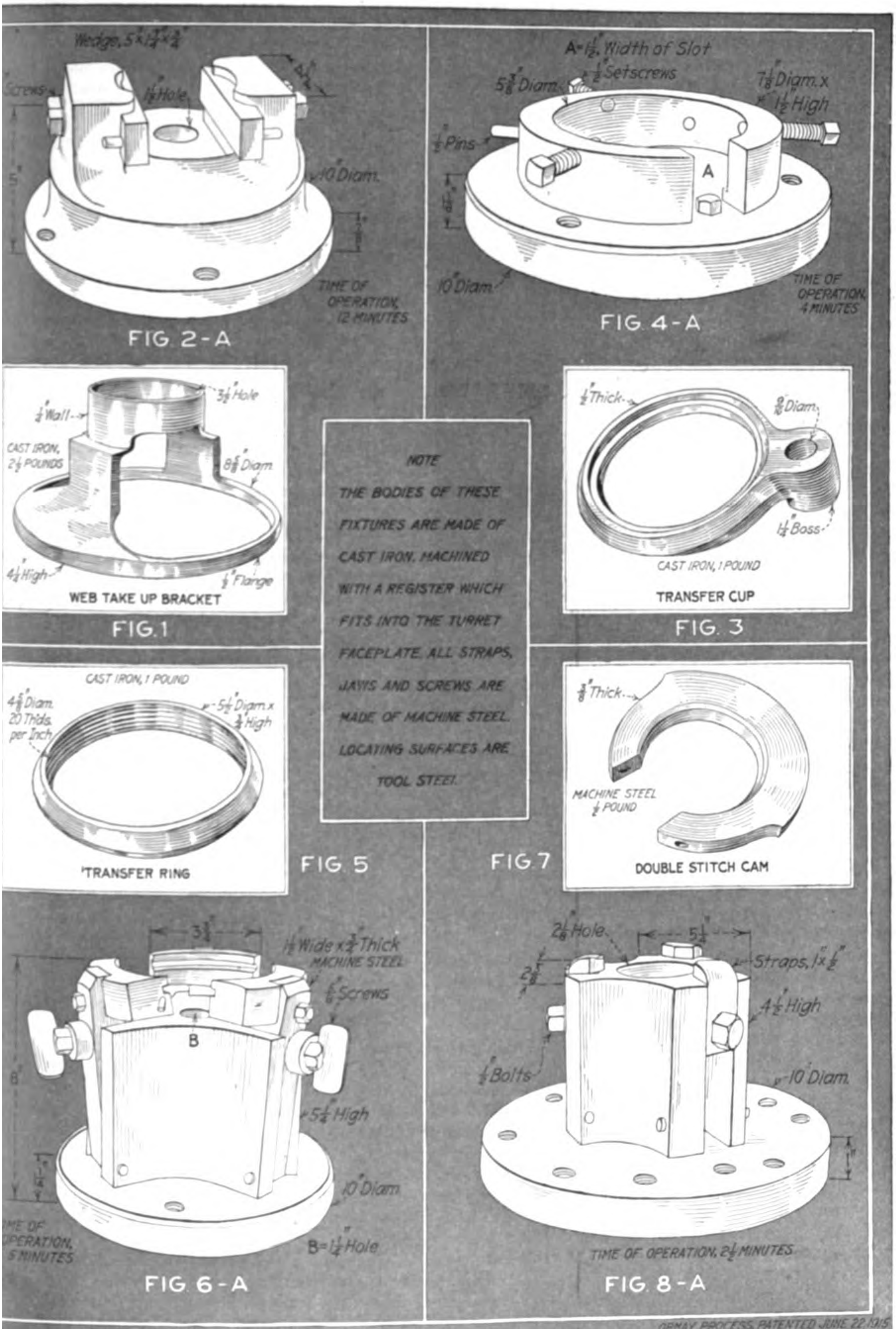
Operation—Threading transfer ring, Fig. 5. The casting is placed in the recess of the three jaws, and the screws, being tightened, force the jaws against the piece, holding it rigidly.

Surfaces Machined—Hole bored and $4\frac{5}{8}$-in. by 20 thread machined.

FIGS. 8 AND 8-A

Operation—Machining double sole cam, Fig. 7. The piece is placed on the outer surface of the fixture, and the three screws, forcing down jaws on the sole cam, hold it firmly.

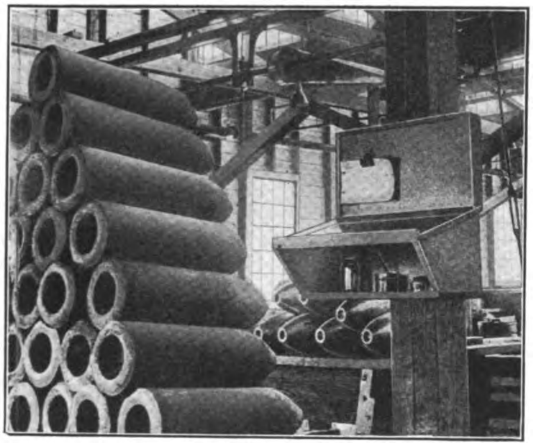
Surfaces Machined—Hole bored and outside faced. The piece is then reversed and the opposite side faced.



DETAILS OF J. & L. FIXTURES USED IN MACHINING TEXTILE-MACHINE PARTS

Convenient Desk for a Foreman

The accompanying illustration shows a foreman's desk that is most convenient. It might also be classed as portable, owing to the ease with which it can be moved from one point to another or set up on any post or wall. This desk is approximately 2 ft. long and perhaps 15 in. wide on the inclined surface, to afford ample room for writing.



CONVENIENT PORTABLE DESK

The back permits notices to be posted conspicuously or time and job slips to be hung up, as shown. In this particular case the work was the making of shells, and the marking part shown on the under shelf was for identification and also for marking the high spots when a shell was excessively eccentric.

This form of portable or temporary desk can be used to advantage where room is limited and where a change in the sequence of operations may make it desirable to transfer the desk to a new location at short notice.

Finding Surface Speeds for Machinery

By Chester E. Josselyn

Noticing a foreman obtaining a surface speed with watch in one hand and recording instrument in the other gave rise to the thought why it should be necessary to repeat this operation for each piece of work presented.

Of course, it is conceded that there are a right and a wrong speed for all kinds of tools and for the different materials worked by the various machines; also that by the selection of the proper speed for the work to be done the life and efficiency of both tool and machine are greatly increased.

Both the engineering department and the shop foreman are fully aware of these facts and can in most cases dictate very readily the necessary travel the work should have; but when it is given in this way, as so many feet per minute, many workmen are at a loss to know how to go about to find the nearest available speed, although the calculation requires but a knowledge of elementary arithmetic.

It seems that with a little effort a constant could be stamped on each step of a cone pulley, and this, multiplied by the diameter of the work to be turned or bored, would give its surface speed directly, reducing the mathematical operation to a minimum, except where a tabulation was made for each individual machine. Thus, mark each cone-pulley step with a constant equal to

$$\frac{\textit{Surface speed in feet}}{\textit{Diameter of step}}$$

Then the constant multiplied by the diameter of work would equal the surface speed of the work.

To illustrate: We find by using a surface-speed instrument or by calculation that the largest step, 10 in., has a surface speed of 175 ft. per min. Dividing this by the diameter, 10, equals 17.5, which should be stamped on the face of the pulley. A piece of work of known diameter, say 5 in., is to be turned; what will be the surface speed in feet of work with the belt on the 10-in. step?

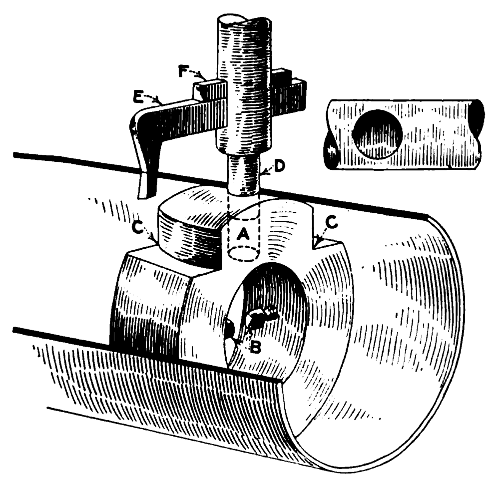
$$17.5 \times 5 = 87.5 \textit{ ft.}$$

There is no doubt that general satisfaction would be created in most machine shops if these constants were indicated.

Boring Tool for Copper Pipe

By Elmer C. Braden

Some time ago I had to cut 4-in. holes in a 6-in. copper pipe that was 1/8 in. thick. The holes were placed spirally around the pipe, about 12 in. apart. Their locations were first laid out on the pipe and a 3/4-in. hole drilled in the center. An inner ring with the hole *A*, which is also 3/4 in. in diameter, was placed on the inside of the pipe with the hole in line with the machined 3/4-in. hole. The ring was held in place with the set-



BORING TOOL FOR COPPER PIPE

screws *B*. The spaces *C* were cut away to prevent the tool from striking the ring after cutting through the pipe.

The projection *D* was put through the 3/4-in. holes in the pipe and ring. The bar was fitted with a tool *E*, held by a key *F*. The operations were performed on a common drilling machine, and the feed was by hand. The ring was moved from one position to another, and a true, clean hole was obtained.

Welded Tips on Cutting Tools

By C. B. Auel*

SYNOPSIS—A study of the welding of high-speed steel tips to machine-steel shanks in a large plant. Four methods of welding are described. The increased price of high-speed steel has made this course economical in instances where it would not ordinarily be good practice.

Under ordinary commercial conditions the welding of high-speed steel tips to machine-steel shanks is not to be recommended as an economical proposition. This may seem a rather startling statement to make, and it should be modified to the extent of saying that it does not apply to special tools involving a considerable weight of material; but it does apply to the great majority of lathe, boring-mill, planer tools and the like, such as are used daily in the average machine shop. However, under conditions as abnormal as they are at present, with the prices of high-speed steels reaching undreamed of figures and these materials, in fact, becoming increasingly difficult to obtain at any prices, the proposition is not only an economical but a necessary one.

The welding of high-speed steel to machine steel may be effected in several ways—(1) by the electric arc, (2) by the electric incandescent or resistance process, (3) by the oxyacetylene flame or (4) by the gas furnace. Which of these is the cheapest will depend upon the facilities already at hand, including not only the equipment, but the operators as well; for it must be said that this is a class of work in which skilled help is an essential, if uniformity in product is to be secured.

Generally speaking, the most uniform results are to be obtained through the medium of the electric incandescent or resistance process, it being not only the quickest, but the most nearly foolproof of the several processes mentioned and therefore requiring the least-skilled grade of operator. This process is one of butt-welding. The two pieces of steel—one high-speed and the other machine steel—are securely clamped in the jaws of a suitable welding machine, with their adjacent ends either somewhat rounded or even squared off and butting hard against each other. Fusion takes place upon current being passed through the abutting ends, and the weld is made. The time required, including setting the pieces in position in the jaws, welding and subsequently removing the pieces, is very little, possibly 2 or 3 min., depending in the main upon the size (cross-section) of the materials.

The current required will likewise depend largely upon the cross-section of the materials, though to some extent upon their composition, etc., reaching as high as 60 kw. for a 2-in. diameter section or the equivalent. In welding by this process alternating current is used, and the periodicity may range from 60 to 25 cycles, though the former is to be preferred. The machine-steel shank may be of any length desired, while the high-speed steel nose or tip may be as short as 1 in., though a length of 1½ in. is rather better, because the weld is usually exceedingly hard and, as the nose or tip generally requires some shaping after welding, the extra length will keep this hard portion beyond the area to be thus worked upon. Another reason for this increased length, though not so important, is that, when the tool is in actual use, the chip has a tendency to extend beyond the high-speed steel nose or tip to the machine-steel shank and wear the latter away, so that it is advisable to make the nose or tip sufficiently long to take such wear.

To prepare the pieces of steel for welding, it is only necessary, as already intimated, to have them of the same cross-section, to cut them off to suitable length and to square off or round their abutting ends. Sometimes the high-speed steel nose or tip may be forged to the desired shape before welding. Immediately upon being welded the tool is allowed to cool in lime, after which the fin at the weld may be ground off and the tool otherwise finished in the usual manner. The disadvantages of this process are that a special equipment is involved—one not likely to be found in the average machine shop—and the amount of high-speed steel required is rather greater than in any of the other processes.

The electric-arc process similarly requires a special equipment, but one that is more likely to be found in the average machine shop, it being exactly the same as the equipment required for the welding or repair of steel castings. It has been described very completely in previous issues of the *American Machinist*.

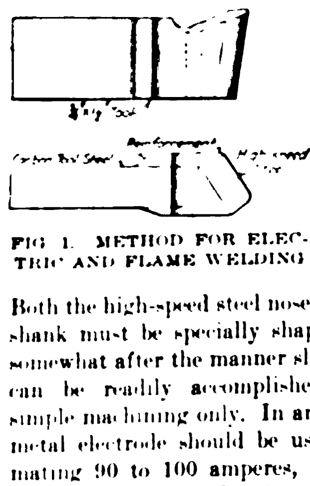


FIG. 1. METHOD FOR ELECTRIC AND FLAME WELDING

Both the high-speed steel nose or tip and the machine-steel shank must be specially shaped preparatory to welding, somewhat after the manner shown in Fig. 1. This shaping can be readily accomplished; the operations involve simple machining only. In arc-welding, a $\frac{5}{32}$-in. diameter metal electrode should be used with a current approximating 90 to 100 amperes, and the work, furthermore, must not be hurried. A good operator should be able to make between 25 and 30 welds for tools of 1½x2-in. cross-section in a day of 9½ working hours.

Considerable difference of opinion exists among individual operators as to the material for use in the metal electrode, but all are agreed that it must be a strictly high-grade material, neither hot- nor cold-rolled wire being at all suitable. Excellent results have been obtained with electrodes of the following compositions obtainable in the open market, the first giving perhaps the best results:

No.	Carbon	Manganese	Phosphorus	Sulphur	Silicon
1	0.04	0.002	0.034	0.002	trace
2	0.05	0.140	0.007	0.025	trace
3	0.096	0.122	0.005	0.064	0.056

Regarding the material for the shank of the tool, commercial hot- or cold-rolled steel may be used; but these steels are liable to bend under the heavy stresses encountered when used as tools in actual cutting service, or they may even crack through their smallest cross-section. The bending may to some extent be prevented

*Director of standards, processes and materials, Westinghouse Electric and Manufacturing Co.

by suitably supporting the nose or tip of the tool from underneath, while the tendency to crack may be almost wholly overcome by reinforcing the tool by the addition of welding material on both sides of the weld.

The same precaution should be observed that was pointed out under the process of electric incandescent or resistance welding, in regard to making the high-speed steel nose or tip about 1½ in. in length. Instead of employing either hot- or cold-rolled steel for the shank of the tool it is by far the best to use a tool steel, even though the cost be increased. Experience has shown that

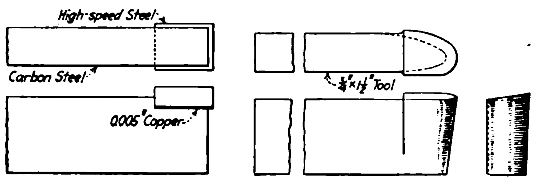


FIG. 2. METHOD FOR WELDING IN FURNACE

a tool steel of the following composition meets the requirements admirably: Carbon, 0.90 to 1.05; manganese, 0.15 to 0.30; silicon, 0.10 to 0.25; phosphorus, 0.025; sulphur, 0.025. The costs of hot-rolled, cold-rolled and tool steel will vary approximately as 1 to 2 to 4. As may be presumed, the grade of help required for electric-arc welding must of necessity be higher than that for electric incandescent or resistance welding.

The Oxyacetylene Process

In the oxyacetylene process of welding, the equipment is undoubtedly the cheapest in first cost of any of the several methods thus far mentioned, while the grade of help required will be on a par with the grade for electric-arc welding. The cost of the oxygen and the acetylene as well as of the actual labor will, however, make the cost of the finished tool run considerably higher than with either of the electric processes, even though preheating be used to reduce the consumption of gases. The pieces of steel require to be specially shaped preparatory to welding, and this may be done in the same way as shown in Fig. 1, though other shapes may perhaps be found to give equally good results.

The same remarks apply regarding the advantages of hot-rolled, cold-rolled and tool steel for the shank, as in the other processes, and the same precautions should likewise be used in reinforcing the weld for added strength and in the length of the high-speed steel nose or tip. Rather curiously the materials that give the best results for electrodes in the electric-arc process do not give similar results in the oxyacetylene process, as the best welds have been obtained with the purest grade of iron wire. This fact, though, may to some extent be due to the operator. The time required for making a weld by this process for a tool 1½x2 in. in cross-section and shaped as shown in Fig. 1 will vary from 30 to 60 min., depending upon the operator, the size of torch and whether or not preheating is resorted to.

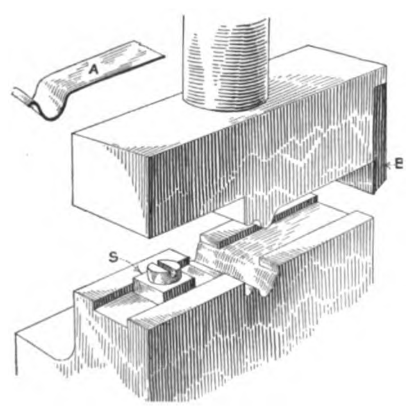
In gas-furnace welding, the high-speed steel nose or tip is laid, as seen in Fig. 2, in position on the machine-steel shank, being separated from it by a strip of copper 0.005 in. in width, the whole being then tied together by iron wire to hold it in position. Care is required in heating, as the high-speed steel nose or tip melts at a rather lower temperature than does the machine-steel shank. When the highest temperature possible short of actual melting has been reached, the tool is quickly removed from the furnace and squeezed between the jaws of a vise that has been set at right angles to its normal position for this purpose, or the tool may be placed under a drop or hammer and a single blow delivered to drive the component parts together. While this process is by far the cheapest of any of those described, the results obtained are not always uniform, both good and poor tools being produced from apparently the same treatment. The difficulty seems to lie in an air pocket sometimes forming within the area of the weld, which of course precludes a perfect union and causes failure through inability to carry the heat from the nose or tip when in use, which results in cracking.

Press Tools for Making a Brass Cable Clip

By H. King

Many modern guns are fired electrically, and this, of necessity, means that cables are used to carry the high-tension spark. The cables are fastened to the gun carriage by means of clips such as *A* in the illustration. This clip was made from a 16-gage brass strip, ½ in. wide, with the tools shown, which were used on a hand press and require little explanation.

The bottom tool had a groove, slightly wider than the strip to be used, cut along its length to guide the strip. Both tools were shaped to the contour desired. The top



THE DIES FOR A CABLE CLIP

tool was fitted with a blade *B*, which sheared the stock just before the completion of the stroke.

In use, the stock was passed along the guide groove of the bottom tool until it struck stop *S*, when the press, coming into action, formed and sheared the clip. The shearing blade of this class of tool should not be too long because if shearing takes place too soon, the sheared piece may jump the guide. The blade was made from tool steel, but the remainder of the tool was made of mild steel casehardened. While this choice of materials is somewhat unusual, the success of the tool at the shearing face justified the choice of material both from the standpoint of economy and durability.

Principles and Practice of Dynamic Balance*

By N. W. Akimoff†

SYNOPSIS—Dynamic balance is a part of the mechanics of engineering. The problem is capable of a definite solution if proposed in a rational manner and treated along rational lines. The author separates the problem into two parts—static and dynamic balance—and explains dynamic unbalance by the centrifugal couple. He describes his machine for creating a centrifugal couple at will, which may be adjusted by trial exactly to counteract the one that may be present in the body to be tested and permits definitely establishing the plane, sign and exact numerical value of the centrifugal couple of the body. Applications of these principles to the actual practice of balancing, together with explanation of working methods, are given in the article.

In this paper is described a machine that I devised to correct the condition of dynamic unbalance. The description is preceded by an explanation of the phenomenon of dynamic unbalance, made as elementary as possible by carefully excluding all references to products of inertia, momental ellipsoids, free and forced oscillations, etc. The subject of dynamic balance is not an involved one, and I feel it is time for it to be placed on a purely rational basis.

The balancing of reciprocating parts is purely a matter of calculations and of design; but the balancing of rotating parts, aside from the design, is a matter of trial and adjustment, because of its accidental nature.

In a theoretically perfect rotating body, symmetrical and made of homogeneous material, there cannot be any question of running balance—such a condition would be understood as a matter of course. But we know that in practice nearly all bodies rotating at high speeds show a certain amount of unbalance. The immediate consequences of this unbalance are vibrations in automobiles and turbines; defective commutation in electrical machinery; undue wear and strain on bearings; defective products in the cases of grinding disks for steel balls, woodworking machinery, etc.

As is well known to all, an unbalanced condition of a rotating body may be due to two distinct causes—lack of static balance and lack of dynamic balance.

By static balance is understood the condition when the center of mass of the body lies somewhere on the axis of rotation. Such a condition is easily obtained on one of the static balancing machines of the knife-edge or of the roller type. In order to place the body into static balance, it is sufficient to drill one hole or to add one weight, although either of these might be split up into one or more components whenever desirable.

Now, by dynamic balance is understood the condition when there is no so-called *centrifugal couple* in any axial plane. In a statically balanced body, Fig. 1, a centrifugal couple can only be due to *two* masses m and n on opposite sides of the shaft and located at a certain distance c axially from each other. Such masses may be, for instance, the centers of gravity of corresponding congested regions. At any rate, in view of the static balance (1) such masses must be in some axial plane, and (2) the products of each mass and its respective distance from the axis of rotation must be equal.

Such a couple is in general numerically equal to a certain coefficient multiplied by radius times weight times axial distance—that is, equal to $k\ m\ r\ c$, where k involves the speed as well as other numerical constants. Now we shall choose the unit of speed in such a manner that k can be made equal to unity, so that the centrifugal couple is equal to $m\ r\ c$ or $n\ R\ c$ (since $mr = nR$).

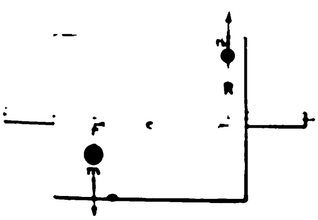


FIG. 1. CENTRIFUGAL COUPLE IN STATICALLY BALANCED BODY

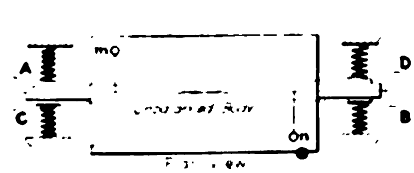


FIG. 2. FLOATING-BEARING PRINCIPLE

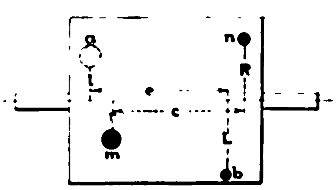


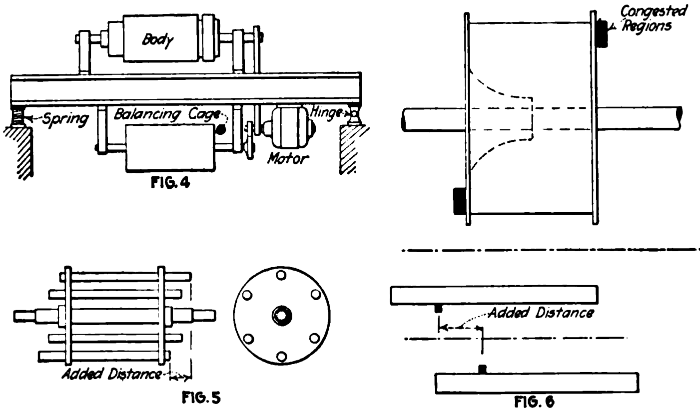
FIG. 3. COUPLE COUNTERACTING CENTRIFUGAL COUPLE

Since the effect of a couple can only be counteracted by that of another couple, it will be seen that any effort to balance such a body as in Fig. 1 by adding *one* weight or drilling *one* hole cannot fail to make matters worse. Such a method not only does not take care of the centrifugal couple, but also distorts the static balance.

It seems to be a "natural feeling" that the way to correct unbalance is to drill a hole at the "high spot"—the point where the marking tool touches the body. Indeed, it appears that various devices have been designed and are now on the market precisely for marking such "high spots," after which judicious removal of metal is supposed to secure the desired condition of balance. These devices are based upon the so-called floating-bearing principle, Fig. 2—that is, are provided with bearings yielding in the horizontal plane to emphasize the running of the body out of true. Of course, all such devices can only serve to indicate that the body is out of balance; they can give neither the true axial plane of the disturbing centrifugal couple nor the numerical value of it. Also, drilling in any one place, as has just been seen, cannot secure dynamic balance, but can only distort the static balance.

*Presented at the spring meeting, New Orleans, La., April, 1916, of the American Society of Mechanical Engineers.
†Engineer, Dynamic Balancing Machine Co.

It appears likewise that an attempt has been made to balance round disks, wheels, pulleys, etc., by pivoting them on one point and by marking the "high side." It is extremely difficult to ascertain just what is the underlying idea of such apparatus, as rotation of bodies on a fixed axis and rotation about a fixed point are two entirely separate chapters of dynamics, the latter much more difficult than the former; and the deductions of one apply in no way to the other. The same remark applies to the method consisting of rotating a body suspended on a flexible shaft (wire rope) and observing the high spots in this manner. All such attempts to ascertain the dynamic unbalance are perfectly irrational.



FIGS. 4 TO 6. PRINCIPLES AND CONSTRUCTION OF DYNAMIC BALANCING MACHINE AND SETTING OF BARS FOR AN UNBALANCED FAN

Fig. 4—Principle of dynamic balancing machine. Fig. 5—Construction of squirrel cage. Fig. 6—Dynamic unbalance in special fan

What it is absolutely necessary to know in a statically balanced body is: (a) The exact location of the axial plane of the disturbing centrifugal couple; (b) the exact numerical value of the disturbing couple; (c) the sign of the couple—that is, the direction of the vector representing the couple. Indeed, with the axial plane of the disturbing couple known, attention can be limited to that plane; and what is done on one side of the shaft will be repeated on the other side so as to preserve the static balance. Furthermore, with the numerical value of the couple *m r c*, Fig. 3, known, all that has to be done to secure dynamic balance is to introduce an opposing couple *a l e* of the same magnitude. Of course, this counteracting couple can be introduced in a variety of ways, small holes drilled on a large radius and far apart axially being equivalent to larger holes located on smaller radii and nearer to each other axially.

It will be seen from the foregoing that a machine to deserve the name of dynamic balancing machine absolutely must indicate the plane of unbalance as well as the numerical value and sign of the unbalancing couple. I claim to have produced such a machine, of which the following is a brief description:

A rigid horizontal beam, such as a lathe bed, Fig. 4, is hinged at one end and supported by a spring at the other. The body to be tested, already in perfect static balance, is rotatably supported on the beam. If dynamically unbalanced, the body will, when rotated, cause the beam to vibrate in a vertical plane, with a period of oscillation equal to the period of rotation of the body. In other words, if the speed of the unbalanced body is, say, 315 r.p.m., the beam will vibrate at the rate of 315 complete oscillations per minute, quite regardless of the characteristics of the spring (except possibly at the very beginning of motion). Now imagine a second body, exactly similar in every respect to the first, also in perfect static balance, but dynamically unbalanced to precisely the same extent as the first body, temporarily associated with the same beam, say suspended under it. If these two bodies are oppositely located as to balance and run precisely at the same speed (synchronously), then the unbalancing or disturbing couples will cancel out and the beam will have no tendency to vibrate, no matter how badly unbalanced individually are the two bodies. This is the fundamental principle of the machine—to determine unbalance by determining the unbalance necessary to neutralize its effect. In the actual machine, instead of the second body being an exact image of the original unbalanced body it is a so-called squirrel cage, and this is rotated in unison with the article to be tested. The cage, Fig. 5, consists of two or more circular disks, carrying an even number of rods (usually six or eight) arranged slidably in the disks. The rods are accurately made, and their common weight is known; therefore, any displacement of one of the rods with respect to the one exactly opposite will not affect the static balance, originally perfect, of the cage, but will introduce a certain centrifugal couple, according to the relative displacement or *added distance*.

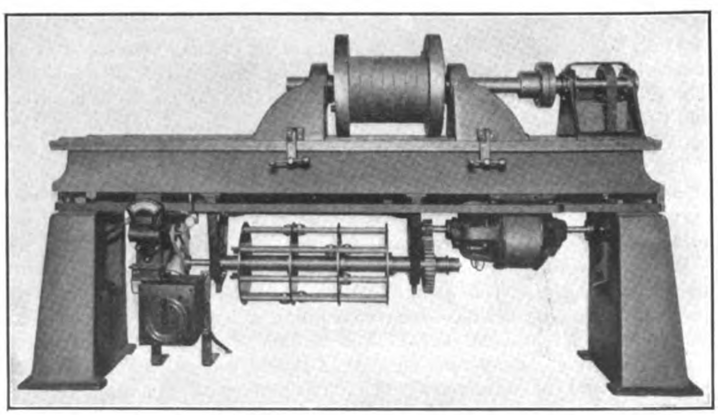


FIG. 7. AKIMOFF'S DYNAMIC BALANCING MACHINE

For instance, suppose that the unbalanced body is a special fan, Fig. 6, and that the unbalance is due to two excess weights, grossly exaggerated in the figure. This

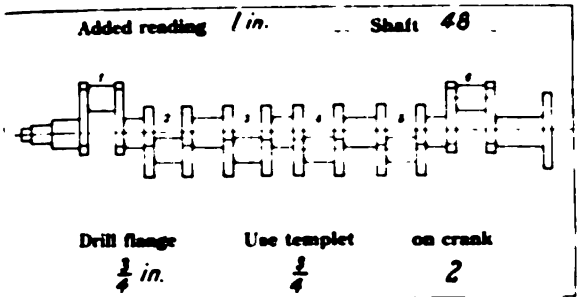


FIG. 8. DIRECTIONS FOR BALANCING SHAFT

will result in a centrifugal couple; and to counteract it, the cage will have to be put into a state of unbalance, as shown by the relative displacement of the rods and as measured by the added distance.

Thus the cage has means for indicating the exact amount of unbalance which has been put into it in order to reproduce with the opposite sign the exact unbalance of the article being tested. For instance, the displacement or added distance of 1¾ in. may represent (for a certain speed) a couple of, say, 120 oz.-in. The plane of unbalance is easily established by the location of the two rods, the moving of which into a new position stops the vibrations; and the value of the couple is immediately given by the added distance.

It should be clearly understood that the centrifugal couple due to the body acts upon the beam in a simple harmonic manner—that is, according to the law of sines—but so does the effect of the balancing cage. In other words, when the axial plane of unbalance is vertical, the effect of unbalance on the hinged beam is the greatest, as also is the effect of the correcting element, the cage.

When the plane of unbalance is horizontal, that of the correcting element is likewise horizontal, since the cage and the body rotate in unison and neither is in any manner felt by the beam, which does not respond visibly to any but vertical efforts or the vertical components of other couples.

So far as the spring, Fig. 4, is concerned, its object is to intensify the amplitude of the vibrations, although an unbalanced body will always cause the whole bed to vibrate with a frequency corresponding to the speed of the body (on this principle is based the well-known vibrating tachometer).

However, there is an additional advantage in the use of the spring, as it is always possible to select the characteristics of this so that, under its load, its free period of oscillation will correspond exactly to the rate at which it is desired to run the test. Such a synchronism has a large magnifying effect, so that even a slight unbalance results in a considerable amplitude of oscillation. The natural period of oscillation of the spring is calculated from

$$T = 2\pi \sqrt{M U_d}$$

where

T = Period in sec. of one complete (double) oscillation;

M = Mass by which the spring is actually loaded;

U_d = Unit deflection, feet per pound of load;

π = 3.1416.

The details of construction of the cage would not be of any material interest in the present discussion, but the main feature is that the rods can be adjusted axially while the cage is in rotation, the speed of the cage never being higher than 400 r.p.m. or so.

With regard to the proper speed at which to balance a body, I submit the following considerations: Unless the

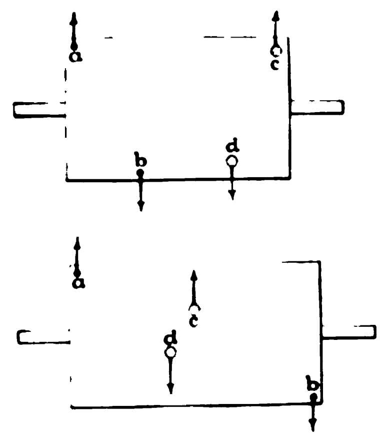


FIG. 10. SPECIAL CASES OF CORRECTING COUPLE

body itself is elastic or is mounted on a flimsy shaft, the body balanced at any speed will run true at any other speed. If the shaft is not strong enough, no balancing machine can make it stronger. If the windings of a rotor seek to find their places under a certain speed and temperature, they should be allowed to do so, after which balancing can be done. In the high-spot method, in which azimuth (commonly known as lag or lead) depends upon the speed itself, it is of course of considerable importance to watch the speed; but in the rational method here proposed the best speed is determined only by the characteristics of the spring, Fig. 4.

Fig. 7 illustrates a dynamic balancing machine for testing automobile crank-shafts previously placed in perfect static balance. The information furnished by the machine is simply the relative displacement (added distance) of one of the pairs of rods of the squirrel cage. By referring to a set of specially prepared tables, similar to the one shown in Fig. 8, the operator can pick out readily the necessary directions as to how to remove a certain amount of metal from one of the cranks and how to drill the flange in order to secure perfect dynamic balance.

Fig. 9 shows a machine for balancing special blowers. If all such fans are of the same size, the directions will be given in the very easy form shown in Fig. 10. There can be no ambiguity in carrying out the instructions.

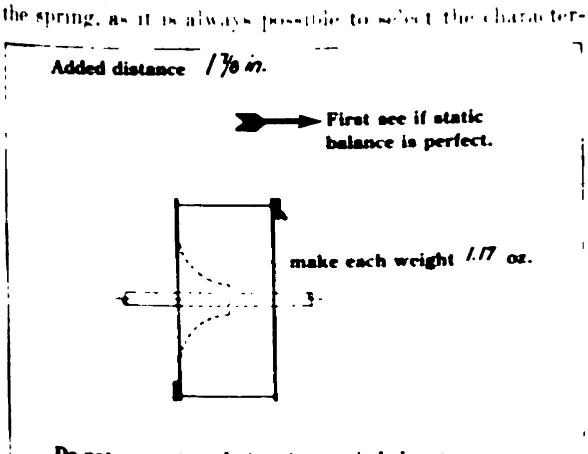


FIG. 9. DIRECTIONS FOR BALANCING BLOWER

It is not necessary to dwell on the extreme importance of testing a body for unbalance in its natural position and upon its own bearings. This machine in its very conception is adapted for testing under such conditions. The shaft in Fig. 7 is being tested in its own crank case.

The importance of static balance cannot be over-estimated. Fortunately, such a condition can be readily secured. Theoretically, one pair of rods in the squirrel cage, Fig. 5, of the machine would suffice, since the relative position of the rods to the body being tested can be altered readily through the transmission (chain drive shown in Fig. 4). For convenience, however, it is best to have three or four pairs of rods, and even then it is sometimes necessary to change the angular position of the cage so that the balancing can be done by one pair of rods and not two, as often happens at the beginning of a test.

Fig. 10 illustrates a somewhat special case. Here the correcting couple *c d*, numerically equal to the disturbing couple *a b*, has been introduced for some local reason in the manner shown; that is, the action of the correcting couple seems to be in a region rather remote from that of the disturbing couple. This simply means that the two actions will neutralize through (and within) the body. Even in such an extreme case, however, the supports or foundations of such an apparatus will be found to experience no vibratory effect.

Some of the Troubles of a Small-Shop Foreman

By H. E. Billton

I have been trying for nine years to get a clock in my department and have just got one. We have a good many short jobs that have to be charged up, and it is essential to know the time spent on them. There is a clock on a stack four or five hundred feet away. When it snows or there is a fog, I have to guess at the time. When the sun hits this clock from a certain angle, we cannot see the face for about two hours, owing to the reflection, which is so strong that we are obliged to have shades on the northwest windows. For these reasons there has been time enough lost to buy a carload of clocks. It seems strange that a company cannot see these little things and their importance.

I have a lot of old men working for me. I interceded for one—the fellow who wears ten-cent eyeglasses—and had him promoted to take charge of the time clocks. This makes a good job for an old man, and he feels that he is monarch of all he surveys.

Most of my men have left and gone into shops where they are working eight or nine hours a day, and they are making as much, if not more, money. About the only help I can keep consists of apprentice boys (who are under contract) and old men. I try to get along this way; but it looks as if we should have to reduce our working hours to get some good men, and the quicker the company wakes up to this fact the better. On Saturday we start work at 6 a.m.; and you can't get young men to go to work at this unreasonable hour, when they can start work in some other shop at 7 a.m. with just as much pay.

But we are having other troubles. Last month a customer sent in a brass model pattern and wanted a dozen castings made, so that he could make his jigs. We sent the castings; he reported that they were all right and ordered us to go ahead and make up full gates of them, which we did, and sent him several thousand pounds of castings.

What a call-down we got from that customer! It seems that he used the first dozen castings, made from the model, to make his jigs by; we used the same models to get our brass pattern castings from, which made another shrinkage, and of course the castings came too short. When they came out of his jigs, the holes looked as if they were made by one who had freely imbibed.

Of course, they tried to put it up to the pattern department, but it has a boss who is not asleep on his job. He came back and said that he did not know anything about their making a dozen castings from the model, so that the customer could make his jig.

He said any d— f— that knew anything at all about the foundry business should have informed his department that there had been castings made from this model to make jigs by. If he had known this, he would have made proper allowance for shrinkage; and besides he asked the assistant superintendent if it was all right to use this model for patterns, and he said it was.

What can we expect if assistants with no mechanical ability are put in charge? They cause all kinds of trouble and losses, not only for the company that employs them, but for the customer as well, and every mechanic gets disgusted with them and eventually leaves. Then the company wonders why.

Wanted--Data on Cylinder and Piston Grinding

By A. D. Marcotte

While having had considerable experience in building gasoline engines, I have been puzzled at various times by finding cylinders out of round, which I attribute to the action of the metal in the cylinder and possibly somewhat to the vibration of the machines employed.

I should like to hear from experienced brother mechanics who have had these troubles and have overcome them by grinding the cylinders after they are bored and seasoned. Is it possible to arrange a motor-driven grinder on a horizontal boring-mill bar and grind cylinders of this kind after they are bored?

I am also interested in getting opinions as to the practical allowance for piston play in gas-engine cylinders. In other words, how much smaller should the piston be made than the cylinder for best results, when both cylinders and pistons have been ground true?

[We are publishing the foregoing request for information in the hope that it may bring out some helpful and interesting experience on the subject of cylinder grinding.—Editor.]

Ground Asbestos and Oil for Babbitting Putty

Anyone having much babbitting to do knows what trouble it is to keep the clay of the right consistency for "mudding up" when pouring. The use of ground asbestos mixed with engine oil is reported by J. M. Ericson to give fine results. It never gets hard and is always ready for use.

Principles and Practice of Dynamic Balance

COMMENTS AND DISCUSSIONS

SYNOPSIS—A number of comments and discussions on N. W. Akimoff's paper on "Dynamic Balancing," given at the spring meeting of the American Society of Mechanical Engineers. The novelty of his machine and methods is recognized and appreciated, although not all who offered discussion agree that it is first necessary to secure static balance when putting a machine part in dynamic balance.

[On page 857 is reprinted a paper on "Principles and Practice of Dynamic Balance," presented at the spring meeting of the American Society of Mechanical Engineers by N. W. Akimoff. There was considerable discussion of this important engineering and shop subject. Most of these comments have been gathered together here, with some condensation because of the limitations of space.

A discussion by F. A. Halsey, treating of the lag of unbalanced revolving bodies, is not included, for this subject was carefully gone into in the *American Machinist*, Vol. 41, p. 1157.—Editor.]

The Two Classes of Balancing Machines

BY F. HYMANS

Mr. Akimoff's paper will not fail to arouse profound interest in the engineering profession both on account of the simple and clear manner of presentation and the ingenious machine it discloses. In addition to the detrimental effects of an unbalanced rotating body as enumerated in Mr. Akimoff's paper, loss of power should be mentioned in causing and maintaining vibrations of the structure supporting the body.

This has been demonstrated by Sommerfeld ("Zeitschrift des Vereins deutscher Ingenieure," 1902) in his experiments with a small electric motor that carried on its shaft an eccentric weight. Placing the motor on a table, it was found that at 310 r.p.m. the table began to execute horizontal vibrations. In an endeavor to increase the motor speed the voltage impressed on the armature was raised. It was found, however, that the voltage could be considerably increased without causing any increase in the speed of the motor, and the increased power consumption was absorbed in maintaining the vibrations of the table. Under perfect balance of a body rotating free around a horizontal axis, for instance, is understood the condition when there is no bearing pressure, save that due to its weight. If it were possible therefore to measure directly the bearing pressure and its direction relative to the body, we should have the simplest form of a balancing machine and should directly be in a position to determine the corrections necessary to bring about perfect balance. Unfortunately, direct measurement of forces is rarely possible.

All balancing machines serve, as a rule, to bring about a dynamic balance after the body has first been statically balanced. This is not due to any impossibility to determine the corrective means for static as well as dynamic balance simultaneously on one and the same machine. However, the problem is considerably simplified if static balance is first secured, as in a body so balanced the resultant of the centrifugal forces to which its particles are subject is a couple only, instead of a couple and a force, as in a body entirely unbalanced. In order to detect the plane and magnitude of the couple, the machine must be arranged so that the couple can manifest itself in motion of some sort. Incidentally then a dynamic balancing machine affords a plain demonstration of what a rotating body only statically balanced may cause when the conditions are favorable.

Considering the balancing machines of the vibrating type more in particular, we can broadly divide them into two classes: First, machines in which the vibrations excited by the centrifugal couple are directly employed to determine its plane of action, as is the case with nearly all balancing machines existing heretofore (see also the description of the Lavaczeck machine in the "Journal" of the American Society of Mechanical Engineers, March, 1916, page 268); second, machines in which the vibrations are merely employed to indicate lack of balance, of which class Mr. Akimoff's machine is to date the sole representative.

Referring to the first-mentioned class, the position of the plane of unbalance is always determined by observing the position of the body at the instant of maximum amplitude of the oscillations. When the body is rotated at a sufficiently low speed, so that the period of rotation is very large as compared with the period of free vibration of the system, the oscillations of the machine will be in phase with the exciting forces and it would be simple to determine accurately the plane and even the magnitude of the centrifugal couple. A machine so arranged would, however, not be sensitive enough for the purpose. On the other hand, when the body is rotated at a speed at which the period of free vibration of the system is no longer negligible as compared with the period of rotation, there is a phase of difference, due to mechanical friction and damping forces, between exciting forces and oscillations. As the amount of this phase difference is uncertain, the plane of unbalance can only be determined approximately. In addition, the oscillations can no longer be employed to calculate the magnitude of the centrifugal couple.

In the Akimoff machine it is quite immaterial if there is phase difference between oscillations and exciting forces. As described, an additional couple is introduced, which can be so adjusted in phase and magnitude that the vibrations of the balancing machine vanish. It affords therefore at once the means to determine exactly both the plane and the amount of unbalance. Disturbing influences such as "weakness" of the shaft of the rotating body can practically be wholly eliminated by selecting a spring of a flexibility which is large as compared with that of the shaft. In other words, by the proper selection of the spring the speed of rotation of the balancing machine can be made sufficiently low so that the transverse vibrations which the centrifugal couple tends to set up in the shaft of the rotating body will be practically of no effect on the beam of the balancing machine.

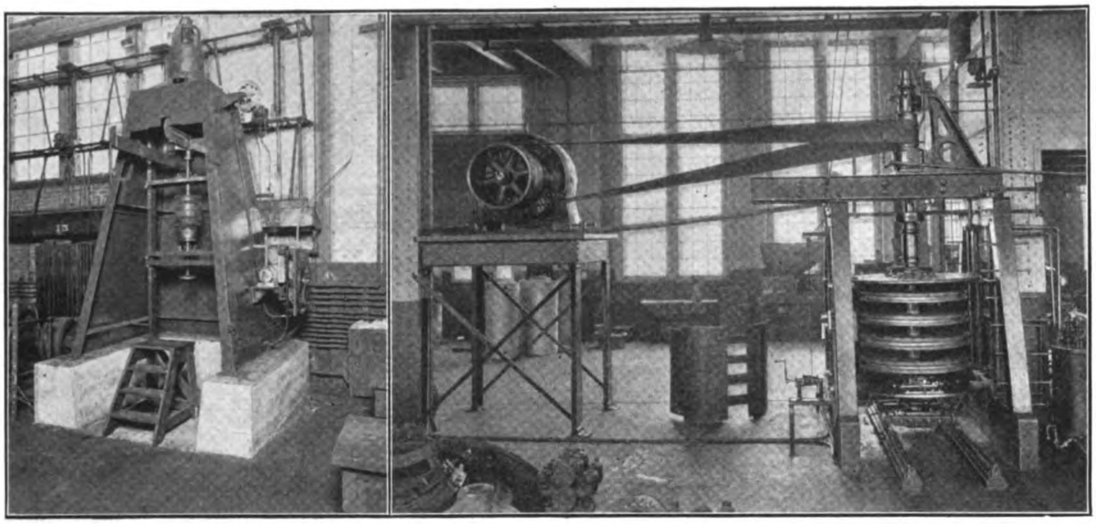
Looking at it from an angle, it must be conceded that Mr. Akimoff has found a complete and practical solution of the problem, and with the advent of a machine with which a perfect balance can be obtained easily and accurately there should be no reason why a perfect balance should not become a standard requirement for nearly all classes of rotating machinery.

Vertical and Horizontal Balancing Machines

BY JOHN RIDDELL

A good deal has been said and written on the dynamic balancing of machine parts, and therefore it is not an easy thing to add new matter to the subject. Dynamic balancing has of course been practiced whenever it has been necessary to do so, and while the old-time miller probably did not call his action by that name when he balanced a millstone, it was, nevertheless, the proper term for what he did. The man that could do this work was considered of importance.

The balancing of millstones was no doubt one of the earliest problems of dynamic balancing, and of course the laws governing the work were the same then as they are at the present time. Only within recent years has the subject received the attention that it merits. The reason for this is not hard to find when we notice the steadily increasing speeds employed in modern machinery, such as steam turbines, gas engines, woodworking machinery, etc.



FIGS. 1 AND 2. TWO FORMS OF VERTICAL DYNAMIC BALANCING MACHINES

The subject of dynamic balancing is at the present time a thing uppermost in the mind of the manufacturer of high-speed machinery, and it must be said that a great deal of ingenuity has been shown in dealing with the question, such as the introduction of specially designed machines for the purpose and also a better understanding of the underlying principles governing the operation.

The introduction of specially designed machines with which to give parts a dynamic balance was caused more by a desire to cheapen the operation of balancing than by the expectation of producing a better balance than it was possible to get when balancing the rotor in its own bearings—that is, in the machine of which it is a part. While unquestionably the latter method produces as good results as can be obtained by any other method, it is not the most economical way to do the work, especially when production requirements call for the rotor to be ready for operation when the other parts of the machine are finished.

The use of balancing machines has now become universal, and the results are generally satisfactory, both as regards the quality of work produced and in the matter of economy. It becomes simply a matter of selecting the type of machine deemed most suitable for the particular kind of work to be done, and more especially depending on the degree of perfection to which the rotor should be balanced.

To me, it appears as though the present-day balancing machines can be divided into two distinct classes: First, that which carries the rotor in a vertical position suspended from an overhead drive by means of a cable or a flexible shaft; and, second, the class which carries the rotor in a horizontal position, running in either ordinary bearings or on rollers carried in suitable holders that can rock against springs or buffers of some description—in other words, bearings that possess some degree of flexibility.

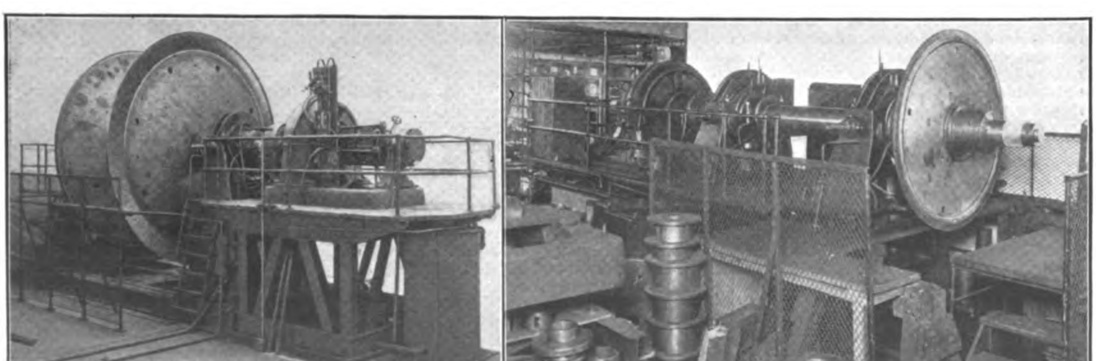
My experience is that the vertical type of balancing machine gives the most nearly perfect balance, owing, no doubt, to the fact that there are no bearings to influence the running of the rotor; also, since the rotor is suspended, it can run out and show the amount "out" much more easily and to a greater degree than if supported in bearings. The cost of balancing in the vertical-type machine is, at least for heavy work, somewhat greater than that of balancing in a horizontal machine, partly on account of attaching the work to be balanced to the machine.

Another reason is that the machine is so much more sensitive than one of the horizontal type that the very balancing operation becomes somewhat more delicate, and it no doubt often is the case that the refinement obtainable on a vertical balancing machine is not needed for some kinds of work. In such cases it is proper to use the horizontal type of machine; but one thing should be remembered, and that is that when it is desired to balance a rotor the service speed of which is somewhere near its critical speed it is much easier to do the balancing in the vertical machine than in a machine of the horizontal type.

It is my opinion that, in order to give a body a perfect dynamic balance, it is necessary to do this at a speed at least equal to the maximum speed at which it is to be operated in actual service, as it is quite possible to have an apparently perfect dynamic balance at one speed and then find that the balance is imperfect at higher speeds. Whereas, if a body is in perfect balance at its highest speed, it will also prove to be in perfect balance at all lower speeds.

I also wish to say that it is a useless and wasteful practice, except in a very few specific cases, to give a body a static balance if a dynamic balance is to be finally produced.

Figs. 1 to 4 show machines used by the General Electric Co. for obtaining dynamic balance of electric-machine parts.



FIGS 3 AND 4. TWO FORMS OF HORIZONTAL DYNAMIC BALANCING MACHINES

Balancing Practice of the Westinghouse Companies

By Francis Hodgkinson

Mr Akimoff describes a device of a very ingenious character for dynamically balancing rotating bodies It seems to me, however, that it is open to the objection that the member to be dynamically balanced must be put in perfect static balance before being balanced by the means described. This in the case of heavy revolving bodies is quite difficult and is not to be satisfactorily attained by the usual method of rolling the body on ways or the like. Therefore, it seems to me that a machine to do dynamic balancing should by its means render possible the elimination of errors in static balance.

Mr. Akimoff points out that he is enabled to move the rods of his balancing machine axially while the cage is in rotation, but withholds his method for accomplishing this and the details of the cage

It would seem evident that the spring support at one end of his frame should have a natural period of oscillation equal to the period of revolution of the body being balanced. This, of course, would mean a different spring for every different weight of body applied, which would require some calculation in advance of doing the work, where there is a great variety of things to be balanced

Mr. Akimoff speaks very disparagingly of the older method of securing dynamic balance--that is, running the body at a reasonably high speed and marking the shaft and determining the "high spots" He says they can only serve to indicate that the body is out of balance As a matter of fact a very well organized system of adding weights may be employed that renders both the static and dynamic balancing of the body a simple operation. One of the hardships of the matter, however, is that the adding of weights or drilling, as the case may be, must be done more or less piecemeal, and the time occupied by speeding up and shutting down occasions a rather severe loss of time.

I said previously that the static balance is not easily obtained. In this I referred particularly to bodies such as revolving fields of great weight where to mount these on ways, giving them a rolling balance, is unsatisfactory because in spite of the surfaces being hardened and made as level as possible the journals will sink into the ways to a slight degree, so extreme sensitiveness cannot be obtained, because of the field having to run up hill

It has been frequently found in the case of very large fields that an approximate static balance may be obtained by smearing the bearing surface and journals well with a heavy cylinder oil, dropping the field into the bearings and quickly removing the chains, when the friction would be so low that the field would respond to an error in static balance better than with the previously described method of rolling on ways. Of course, the field must not be allowed to stand more than a fraction of a minute, or until the oil film has been squeezed out, for then, of course, the friction becomes very material.

So far as steam turbines are concerned, it has not been the practice of the company with which I am associated to resort to dynamic balancing except in a few extreme cases. Turbines generally are comprised of a drum or quill to which are attached the spindle ends and journals. This drum has secured to it a certain number of disks or rings. Generally the speed of the drum is low, so that ordinarily static balancing—that is, rolling it on ways is sufficient Further, the disks or rings are short in their axial length as compared with their diameter, and a careful static balancing of these is found to be all sufficient For balancing these disks and rings a special static-balancing machine was devised many years ago and has been in continual use Inasmuch as this paper is confined to the subject of "dynamic balancing" its description is out of place. A description of it was published in the "American Machinist," Vol 35, p 59. I might further add that with this machine a disk weighing 4,000 or 5,000 lb. may be given a static balance within an error of half an ounce.

I previously stated that there is on organized system available for balancing bodies, which Mr Akimoff disparages and which he has illustrated in Fig 2 It may perhaps be of interest to describe this system, although the description is rather more of instruction to a mechanic than technical data to our society.

The bearings being mounted on springs as described is not really a necessity The bearings employed for large turbine rotors have enough clearance and oil-film thickness to give sufficient amplitude of vibration to determine the "high spots," although in building a balancing machine, I would prefer to mount the bearings on springs, or their equivalent, but taking care that the natural period of oscillation of the bearings and the rotary masses be higher than that of the running speed to be employed in balancing. It does not matter at what speed the balancing is done any more than it would with the machine Mr. Akimoff described. It is only necessary to run it fast enough so that the vibration due to error in the balancing is well in evidence. It, however, is necessary that marks be applied to the shaft, always at the same speed, because the angle between the error in the balance and the mark on the shaft will vary with different speeds. It is invariably found that the error in balance will be a number of angular degrees behind the mark, this angle becoming less with the speed and greater with more rigid shafts.

Inasmuch as it is the centrifugal couple which is to be eliminated and the bodies are of such proportions—that is, great relative axial length—and the balancing at each end must be done independently and as in the case of Mr. Akimoff's machine, it is impossible to eliminate centrifugal couples such as he illustrates in Fig. 11. It is found in practice that it is undesirable to work on more than one end at a time, and the end should be first selected that is most out of balance, this to be judged by the degree of eccentricity of the path of the shaft rather than in shaking of pedestals, bedplates and such. Having marked the shaft at each end, a mark is made that may be used for future reference, and a temporary weight is added, as judgment would dictate, some degrees behind the mark. When the machine is again speeded up, it may be found that the balance may be better, but the position of the mark has changed. If this is so, an additional weight should be added or the original weight have its angular position moved so as to maintain the mark in its original position, continuing the operation, one end or the other, whichever has the most eccentric path. This process is carried on, and if the mark is maintained in the original position, it will be found finally that a weight added will throw this mark 180 deg. away from its original position, when the weights are then slightly in excess of that required for perfect balance, and only require to be slightly reduced.

By such a means both error in static balance and the centrifugal couple are simultaneously eliminated. Balancing frequently has to be performed in the field—when it is successfully carried out in its own bearings and with no knowledge as to the condition of static balance. Plainly, should the marks appear at each end on opposite sides of the shaft and the body run with similar eccentricity at each end, it would be inferred that the body was in static balance, only requiring the correction of the centrifugal couple.

Generally speaking, it is the practice of the Westinghouse companies to employ this method for all larger revolving fields, as well as for the occasional time when a turbine rotor may need dynamic balancing because some element of it is, due to some error, out of static balance.

Slow-Speed Test Is Not Conclusive

By E. J. Loring

I would define a body as dynamically balanced when its unconstrained axis of rotation is concentric with its journals. The method proposed assumes perfect static balance; but dynamic-balance conditions are far more sensitive, because a slight static unbalance is greatly magnified at high speed. I do not agree that static balance is easily obtained; on the contrary, unbalance always persists to some degree and must be provided for in the dynamic-balancing operation. A body dynamically unbalanced does not usually show high spots diametrically opposite at the two ends, as it would if a simple couple were acting.

The wire-rope suspension is not irrational. It supports the shaft with far less constraint than any rigid bearing, transforms a "rigid shaft" construction to "flexible shaft" conditions and leaves the rotating body more nearly free to rotate on its own principal axis in space.

When provision is made for attaching balancing weights in two well-separated planes between the bearings of a two-bearing shaft, it is possible to determine the position and amount of added weight required in the nearer plane to each bearing in not more than three "shots," and with this information for each balancing plane the proper weight and position for each plane to clear both bearings simultaneously may be found by a simple calculation.

A slow-speed test is by no means conclusive. A body in dynamic balance at 400 r.p.m. may be dangerously far from balance at 3,000 r.p.m.; when corrected for 400 r.p.m. it is

safer than when only statically balanced, but its balance is never fully proved at less than its full speed.

I would be interested to know how the correct plane of displaced rods is picked out from the behavior of the beam and the rotating body. Is it by a definite rule or by selection and trial?

Early Attempts at Obtaining Dynamic Balance

By H. P. Fairfield

While the question of running balance is yet much discussed, commercially considered it would seem to be fairly solved. The necessity of providing some means for indicating a running balance I believe to have arisen first in the cases of the cutter heads of woodworking machines and in machines used for threshing grain. In these machines when placed upon the market a generation or two ago the cylinders upon which the knives or cutters were mounted in the wood-planing machines were given a considerable rotative speed. This was also true in the case of the threshing machine, where the teeth that beat the grain from the straw were attached to a cylindrical drum which was made to rotate rapidly. The first attempt at solving this question, so far as I know, was to place the piece to be tested in a pair of boxes that were hung by wire, or other flexible connections, from the ceiling. The part being tested was then rotated at speed, its action noted and indicated by the operator, who made the necessary weight changes to give the required effect. (In the Norton machine the pendulums are inverted.)

What Mr. Norton has accomplished in his balance-indicating machine is to attack the problem of balancing rotating bodies by treating the subject as a problem of running balance only, giving no attention to questions of standing balance. It is believed that his machine was the first which provided a means by which the workmen could locate the exact position of the error of balance. This is accomplished by designing and constructing a machine that provides means for reversing the directions of rotation, thus eliminating all guessing as to the amount of lag in indicating. This practically eliminates the question of judgment in operating and brings it to that of an exact science, rendering it possible to place a rotating body in commercially exact balance if the removing of, or adding to, of weight is carefully done.

Another peculiar feature of this machine over some others is that nothing foreign is mounted upon the body being tested, thus confining the test to the piece itself. Also with this machine the critical speed for the piece can be noted as the exact speed at which the high spot passes from the heavy to the light side. [The Norton machine was fully described in the "American Machinist," Vol. 32, p. 1023.]

It may be well to take note of several practical points that have been well proved in practice:

A. That while a body placed in static balance may be decidedly out of running balance, one that is placed in running balance must also be in static balance.

B. Exact symmetry of form must not be taken to mean that the machine part is in running balance.

C. A machine part put in running balance at any speed is certainly in running balance at any other speed, if it is not distorted from its true axial conditions.

This fact renders it possible, therefore, to rotate the part which is being tested at any speed desired that does not distort or spring it.

It will be admitted, I think, by all users of speed machinery that all rotating parts should be placed in exact running balance if the machine is to perform its functions quietly.

Two Pertinent Questions

By T. A. Bryson

Mr. Akimoff explains that it is extremely difficult to ascertain the underlying idea of apparatus in which the axis of the body is pivoted at one point and that the dynamics of the case is much more difficult of solution than that of a body having a fixed axis. Is not the action of the device shown similar to the former case, since all axial motions of the body are transmitted to the hinged frame?

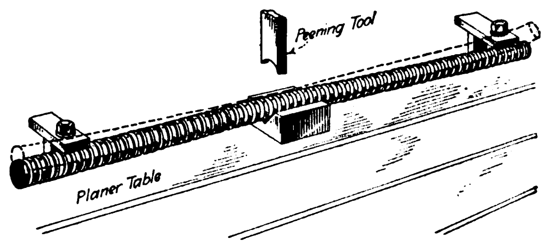
It would seem that much might be gained by providing for close adjustment of the axial plane of the balancing weights while the cage is in rotation, thus performing both operations without stopping to change the angular position of the cage. Is the chain and gear drive free from vibrations that would affect the results?

Straightening a Long Screw

By D. A. Hampson

A special 3-in. screw that had been bent in transit was brought in to be straightened. As the threaded part was 20 ft. long and the truth of the work must be undoubted, it was no usual job. The bend was ascertained to be a decided "kink" not far from the middle.

The first step, after definitely locating the bend, was to lay the screw in a V-block on a long planer, with the bend right in the block and the screw in the position shown exaggerated by the dotted lines. Clamps were put on each side of the block and the screw drawn down until the



STRAIGHTENING A LONG SCREW

bend was in the opposite direction. Dents and bruises on the thread could not be tolerated, so leather liners were used in the block and under the clamps.

Springing the screw to line was not attempted. It was sprung beyond straight while the metal at the bend was swelled enough by peening to give a set to the screw. No peening was done on the face of the screw, but a concave-faced tool was made that could be used on the bottom of the threads. Three or four trials were made before a perfect job was secured, but it was done very easily and proved much less formidable than it first appeared.

The Group Insurance Plan

In adopting the group insurance plan to cover its employees the president of the Chain Belt Co., Milwaukee, Wis., made the following statement:

In order to show our appreciation of loyal and efficient service, I have been instructed by the board of directors to announce that the Chain Belt Co. has contracted with the Equitable Life Assurance Society to insure the lives of those between the ages of 21 and 65 who have been in our employ continuously for one year or more on Apr. 20, 1916, for the sum of $500 each and those who had been in our employ continuously for two years on Apr. 20, 1916, for the sum of $1,000 each. In the case of the employee who has been with the company for one year a substitute certificate for $1,000 will be given her or him when the term of continuous employment will have reached the two-year period. All new employees over 21 years of age will receive a certificate for $500 upon completing one year's service. In the event of an employee's leaving the company's employ the insurance, of course, expires automatically.

This is term insurance and is given without charge, and in the event of death while the policy is in force the beneficiary named will be paid the amount of the policy by the insurance company. It will be issued for the year ending Apr. 20, 1917, but it is our intention to renew from year to year, unless in the judgment of the board of directors it shall prove unsatisfactory or experience suggests amendment. The insurance company is now preparing the policy and making out individual certificates of insurance, which will be delivered in a few days.

The officers of this company are not only interested in you and the women and men in our employ, but also in the welfare of those dependent upon you and feel that in this manner they can show that interest to be real and substantial.

Letters from Practical Men

Making Accurate Templets

When the manufacture of shells in large quantities first began in this country, I had some flat templets to make for gaging the form of shells. At that time I was satisfied to fit them to a master by using the method shown by Mr. Van Deventer on page 142, Vol. 44. But when flat gages began to come along in lots of 50 to 100, I found it tiresome to hold them up toward the window in fitting, so made the rig shown in Fig. 1.

It is an ordinary wooden box, about 6x6x9 in., with the ends removed. On the rear I nailed an ordinary tin light-shade containing an 8-c.p. electric light. The front end is a piece of heavy plate glass, with oiled paper

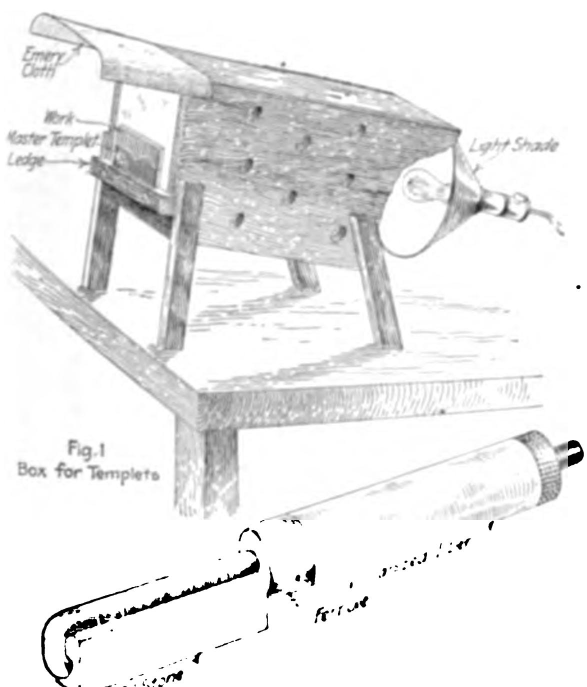


Fig. 1 Box for Templets

Fig. 2. Handle for Oil Stones

MAKING ACCURATE TEMPLETS

behind it. A ledge runs across the front, to support the master templet. There is a projecting hood out over the glass, formed by nailing a sheet of emery cloth to the box. I cut a large V-shaped opening and bored a number of holes on each side of the box, for ventilation, so that the electric light would not heat the plate glass or templet. The legs bring the box up to the proper height and angle to meet the line of vision as I sit at the bench. I find that I can fit gages much more accurately and quickly with this rig than formerly.

In finishing hardened gages I use a number of India oil stones. I keep handy a shallow tin containing a kerosene-soaked felt pad. Occasionally wiping my oil stones across this pad keeps them clean and free-cutting. The flat surface of an oil stone will soon wear round or otherwise get out of shape. To restore the flat surface of the stones, I sprinkle No. 90 emery and a little kerosene on a piece of plate glass and lap the oil stone perfectly flat on it. This is the quickest method I know of to restore a flat surface and at the same time retain the fast cutting quality of an oil stone.

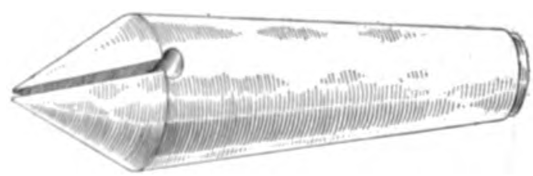
To make use of short pieces of broken oil stones, I use the handle, Fig. 2. It allows me to work up short pieces of oil stones that could not conveniently be held in the fingers. The hook passes through the knurled handle and has a long thread at the end, permitting quite a range of adjustment, so that oil stones of various lengths may be used. HERBERT M. DARLING.

Greenfield, Mass.

A Center Scraper

The accompanying illustration shows a center scraper that has been found useful in the toolroom where lathe arbors are made, the object of the tool being to correct and smooth the center in the arbors after they have been first drilled and centered in the usual way.

The center scraper is similar to a lathe center. It must be made of a good carbon steel; and before it is



A CENTER SCRAPER

hardened, a hole must be drilled as shown and a $\frac{1}{32}$-in. saw cut put in. After it is hardened, the point is ground to the angle required.

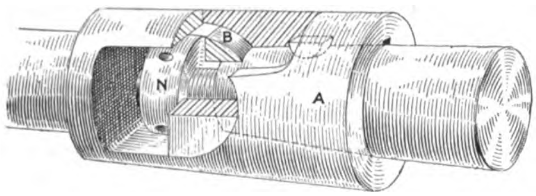
When the scraper is in use, the pressure causes the center to close slightly at the slit and thus makes the edges of the saw slit become cutting edges on either side. While the cutter is effective for the purpose named, it is not intended to be used to produce the center completely. W. SMITH.

Birmingham, England.

Connecting a Conical Shaft End to a Coupling

Some time ago I was confronted by the following problem: The end of a shaft of the design illustrated had to be connected to a coupling. As it was only for an experiment, no alterations on the shaft were allowed; but the connection had to be made absolutely safe, because the machine was required to run alternately in each direction. When I asked for instructions, I was told: "It is only temporary; fasten it any old way; glue it on, if you like, etc."

The inexpensive construction illustrated was the outcome. The sleeve A is made of machine steel. A hole is drilled crosswise and enlarged, as shown. The



CONNECTING A CONICAL SHAFT END TO A COUPLING

piece has a good bearing in it and is self-adjusting, as it has the same radius as the opening in *A*. The nut *N* will, when screwed backward, pull the sleeve off, thus serving a double purpose.

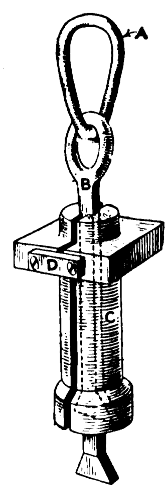
All the pieces were casehardened and formed a very solid, easily exchangeable connection. S. KOPSCH.

Plainfield, N. J.

Lifting Device for High-Explosive Shells

The illustration shows a lifting device for use on high-explosive shells that have the nose end open. The construction of this contrivance and the method of using it are as follows:

The part *A* is a steel ring welded into the eye of part *B*. This ring goes over the crane hook. The part *C* is of a very tough grade of bronze, cast in one piece. It is machined on the outside, then split with a ⅛-in. saw and milled after the slot that receives part *B* has been split. The reason that this piece is made of bronze is to prevent any marring of the threads in the nose end of the shell. If this device is used on shells before tapping, the part *C* could just as well be made of steel, assuring a much longer life. Part *D* consists of two pieces of cold-rolled steel, fastened on the sides of part *C* so as to keep the loose pieces from dropping off when the device is outside of the shell. The screws that hold these pieces on should bottom, so as to leave part *C* free to move. In putting this device into the shell the part *C* is held up against the eye on part *B* until the shoulder on part *C* rests on the shell. When the crane starts to lift, part *C* is caused to expand on the inside of the shell by the action of the taper on part *B*. The heavier the load the tighter the device will hold.



LIFTING DEVICE FOR EXPLOSIVE SHELLS

This device can be used for picking up shells from a horizontal position as well as from a vertical position. If it is desired to pick up more than one shell at a time, all that is necessary is to splice a cable in part *A*, making each cable 4 in. longer than the preceding one. Having these cables of different lengths allows the hooker-on time enough to adjust the device, using the shortest cable before the next one begins to lift. In setting the shells down, the operator will have time enough to steady the shell on the longest cable before the others touch the floor.

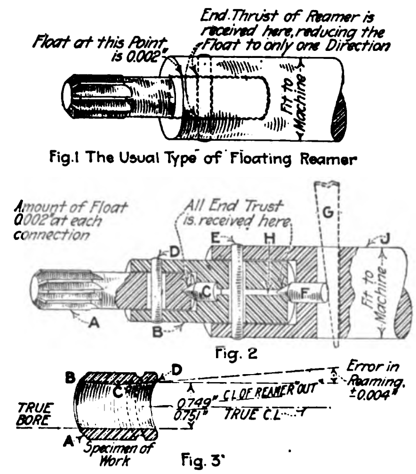
In removing this device lift part *C* up against the eye of part *B*, in this manner removing the whole thing from the shell. Making a hitch with this device (lifting single shells) can be done as quickly as the crane operator can reverse the direction of his hook.

Erie, Penn. ARTHUR A. MERRY.

Compound Float for Reamers

Fig. 1 shows what seems to be a general and serious fault of the usual type of floating reamer. The design in Fig. 2 is a solution of the problem. In Fig. 3 is shown a specimen of work.

The operations are (1) drill and form-turn, (2) nick and turn chamfer at *A*, (3) ream, (4) cut off. There is a "float" of 0.002 in. given the reamer, to compensate for the inaccuracy of the machine and produce a straight hole. The general arrangement is shown in Fig. 1. Of course, as the reamer enters the drilled hole, it simply becomes "cramped" all the more, since the end thrust is taken by the driving pin, prohibiting entirely



A COMPOUND FLOAT FOR REAMERS

all float in a direction corresponding with the longitudinal center line of the pin. The result of floating a reamer tap or any other tool in this way is seen at *B*, *C* and *D*, Fig. 3. The correction makes a great deal of extra work for the internal grinder. Now, Fig. 2 shows a method that is simple and far better. This compound float is in effect two simple universal joints.

Suppose the reamer enters the drilled hole 0.0025 in. out of line. The reamer *A* is centered by the drilled hole. A free universal float of the reamer in the bushing *B* is permitted by the center thrust bearing *C* and the elliptical pin hole, the pin *D* being used for driving only. As the drilled hole is 0.0025 in. out of line, an angle is formed between the drilled hole and the center bearing *C*.

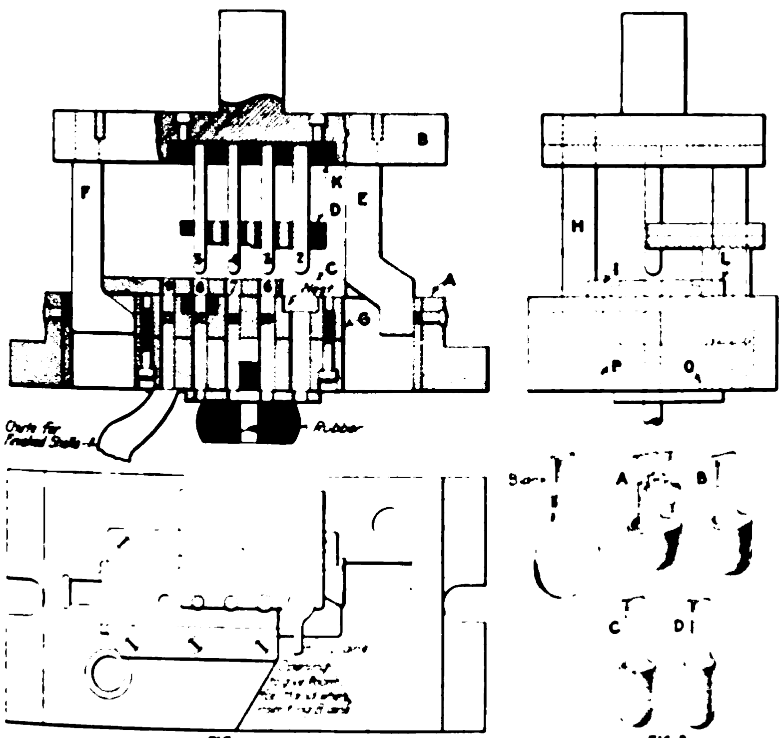
This is where the trouble arises. Now, as the angle is produced by the action of the reamer in reaming the hole, the second joint becomes a counteracting agent and allows the reamer to align itself with the drilled hole. *E* is the main driving pin, and like *D* is a taper drive fit. *F* is the main center bearing and is removed

for grinding by means of the "drift" G, while the secondary center C is removed by driving through the centrally drilled hole H. J is the body of the tool holder and is fitted to the machine. J. B. MURPHY.

Plainfield, N. J.

Automatic Punch and Die for Tube Drawing

It may be of interest to some readers of the *American Machinist* to know how four tube-drawing operations have been converted into one. The illustration, Fig. 1, shows a sectional front view of the tool that I designed and built to produce the tubes shown in Fig. 2. I will mention only the new features of the device, and tool makers familiar with this kind of work will need but a few words in explanation of this punch and die.



AUTOMATIC PUNCH AND DIE FOR TUBE DRAWING

The blank, Fig. 2, is inserted in the die nest, as shown in Fig. 1. After the first operation is performed and stripped from the punch 2, the work will drop into the hole 6 of the sliding hopper C, Fig. 1. The slide is so adjusted that, as soon as the tube falls off the punch 2 into the sliding-hopper hole 6, it is carried over to the next drawing position 10 and drawn by punch 3, and so on until through 7, 8 and 9. After the tube is finished and pressed back in the upper position, it is again taken by the sliding hopper and carried into the knockout hole 13, whence it falls through the chute to a box, without being touched by hand. The sliding hopper is actuated by keys E and F and a spring (not shown).

In Fig. 1, A is the die shoe, K is the punch holder plate, B the punch holder and D the stripper. The pressure pad E carries knock-out pins to press the work out from the die. Aside from the guide-pin bushings G and P, all other parts shown are of regular design. The stock used was 0.016-in. German silver, and the finished tube was $\frac{3}{32}$ in. in outside diameter and about $\frac{5}{16}$ in. long.

I have made quite a number of similar dies to draw work of this nature, and they worked satisfactorily and saved time in combining the operations.

Bloomfield, N. J. CHARLES EISLER.

Balanced Production

One essential of stability, whether of equilibrium, aviation, central-station power, manufacturing success or diplomacy, is the quality termed balance. In distinctly technical and mechanical matters the need for balance is easily apparent; it has also importance in less tangible things. The troubles of management are not all directly technical; the major portion of them concern commercial, organizing and human aspects of production. Questions of coördination and of allocation of work cause troubles of no small order. To meet these difficulties requires the faculty of generalship, the provision in due time of material, avoidance of overlapping, economical employment of labor, precedence of work; and the mental characteristics needed are special and peculiar. A well-balanced works would keep all hands busy without delays; would insure that the foundry provided the casting on the instant; would insure raw material in regular but sufficient increments, always delivered to date; would abolish large stocks to save interest charges; and would be sure of all work passing in correct sequence to the dispatch floor. These are counsels of perfection unattainable in a material universe, dependent as they are upon promises and upon matters like transport, impossible to regulate. Unfortunately for our peace of mind such systematic perfection does not exist. Promises are unfilled, and delays in transit are common. Yet in spite of the relative importance of the matter we find works where jobs are held up for minor details under the control of the executive. The difference between fair profit and liquidation is apt to rest upon details that are cumulative in their effect. It needs vision and insight (to leave out so nontechnical a matter as imagination) besides system, to insure balance.

The larger the concern the more difficult it is to avoid wastage, to key up intensity of production. Delegation of authority often leads to conflicting aims between departments, and coördination is difficult to secure. In a transition stage from single to departmental control there is a danger zone to be crossed; such a condition affords many perplexing problems.

The balance between the various arms in an army corps is not less important than the same factor in the equipment and staff of a manufacturing concern. That it is possible to employ more men, each a potential source of profit, and lose money thereby is a commonplace of economics; the fact is perhaps less realized than it might

be. On the other hand, permanent overhead charges may by reduction of staff and output lead to total loss of profit. This second case is more generally realized than the first.

In a human sense, balance is a quality readily appreciated; the irrational enthusiast, the man who jumps to conclusions, is always a danger. Promotions frequently lead to discovery of a lack in this direction, and many a good man has been spoiled by want of balance. The most serious aspect of the matter at the moment is national. The entire resources of the country are being unified to a single end. We have now one huge enterprise in scattered locations. In a large works in normal times we realize difficulty (in what is by contrast a domestic sense) when material is overdue and delivery dates behind. The mere thought of 2,500 controlled establishments to be coördinated and planned for is one to appall and stagger any individual conversant with the troubles incidental to the management of 1,000 men.

So huge a control is intrinsically bound to result in lack of economy, in a strictly commercial sense. The generalship needed has never been trained to direct work on such a scale, to balance production so widespread. To effect commercial economy without wastage under the conditions is inconceivable; only the patriotism of an entire community could make the scheme workable.

Few of the many isolated cities stop to ponder upon the immensity of the task or are qualified to appreciate the difficulties to be faced or the results already achieved. There must be overlapping and lack of exact coördination. The size of the job in itself is sufficient to account for this, leaving aside forced production and intensity of effort. It is only the man experienced in handling a big labor force, shouldering the burdens incident thereto, who can even begin to appreciate the immensity of an entire nation under a single productive control.

An army in the field is not expected to be a strictly commercial affair, earning a percentage upon capital involved. It cannot be so conducted even upon peace lines; wastage is inevitable and allowable. Likewise, an industrial army organized in a time of crisis cannot be run like a retail shop. It is production, irrespective (more or less) of cost, that is required, and the economy or otherwise cannot be estimated until victory is achieved. Balance in production is often assumed to be cared for by system. In actuality, brains, patience, tact and numerous other intangible questions not directly technical enter into the equation. Neglect of a detached viewpoint is perhaps one of the surest harbingers of disaster in the usual business.

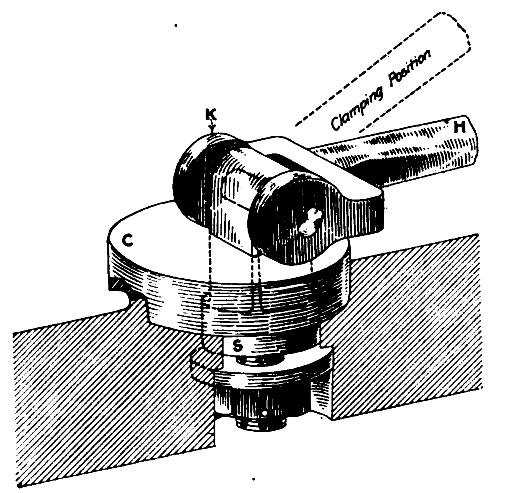
Never before in the history of the world has such a question of production arisen. The coördination needed to produce balance under existing conditions would tax the greatest mind, especially if it be held to strict accountability for economy in a commercial sense.

Tooting, S. W., England. A. L. Haas.

Locking Cam for Jigs

As applied to jig and fixture design, the cam used as a clamp presents some attractive features. It is a very simple element and may be strongly made. It is rapid in operation and readily understood by unskilled labor. Unfortunately, this type of cam must be designed with an angle of rise insuring it against slippage, if the work is to be held securely in place. Very little clamping movement can be had with this small angle, unless the cam is inordinately large. However, if means are provided to hold the cam rigidly, almost any movement can be secured. Such a cam can be used against rough surfaces and would work well on milling fixtures where difficulty is generally experienced with the nonlocking cam.

The cam shown possesses the favorable features mentioned and by a simple movement can be quickly and securely locked in the required position. The clamping cam C is free to move vertically on the square stud S;



A LOCKING CAM FOR JIGS

and when the handle H is horizontal, it can be rotated to any clamping position. When the desired position is reached, the handle is elevated, thus clamping the whole in place by means of the cam K. Of course, the stud S can be made with an integral head in place of the washer and nut, as shown. In many cases where trouble is being experienced this cam can be applied without altering the fixture. W. Burr Bennett.

Bridgeport, Conn.

Portable Sanitary Drinking "Fountains"

Here is how we have solved the sanitary drinking-fountain problem. Each man has a bottle or canteen and keeps it at his elbow or in a proper receptacle on ice, if he prefers ice water. It is somebody's job to keep the bottles filled and in proper condition. A sensible woman is best for this work—one who will keep things as clean as mother used to. This plan saves a trip of a mile or so for a drink, and the boys drink more water, too, when it is handy.

Once the cheerful idiot dropped beet juice in his bottle, and many an eye looked on that bottle while it was red. C. D. Michener.

Cœur d'Alene, Idaho.

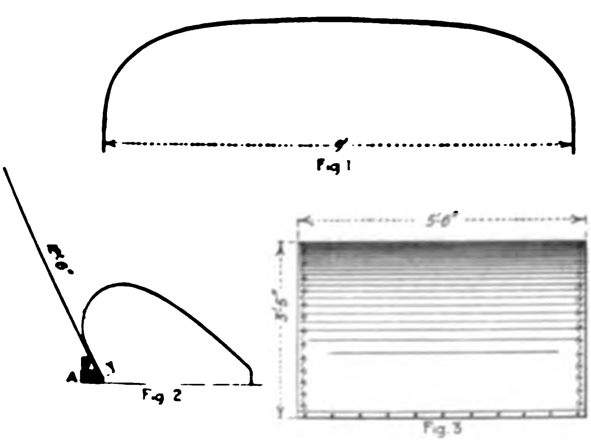
Manufacture of Lathes in United States—According to the preliminary statement by the Bureau of the Census showing the results of the 1914 study of the manufacture of leather in the United States, there was a decrease of 19.5 per cent. in the number of establishments between 1909 and 1914, but an increase of 12.1 per cent. in the value of the products.

Discussion of Previous Question

An Improvised Bending Form in a Railway Shop

After reading the article on page 281 I am prompted to show a simple bending form that I recently made for a number of hard-rolled bright-quality aluminum sheets. These were 12 ft. 6 in. in length, 5 ft. in width, 0.080 in. in thickness and were for the roof plates of some modern all-metal passenger cars.

The main point in favor of aluminum sheets for car construction is lightness. A sheet of aluminum 1 ft. square and 0.072 in. in thickness weighs less than 1 lb. (0.995 lb.), while steel weighs three times as much.



IMPROVISED SHEET-METAL BENDING FORM

This reduction in weight becomes of very great importance, particularly in suburban work, where stoppages are frequent.

In Fig. 1 is shown the contour desired and in Figs. 2 and 3 the side elevation and plan of the bending form. It was our desire to prevent, if possible, any further work being done on the sheet after bending. Had it been attempted to shape the sheets by some other method, such as with bending rolls or over iron bars, the sheets would have been likely to contain many irregularities on the surfaces. This is especially the case with hammering, for aluminum sheets will not stand anything like the severe treatment that may be given to steel sheets of the same thickness. When thin metal sheets, either of aluminum or steel, are painted for car construction, it is surprising how small defects are readily discernible on the surface.

The efficiency of the bending device enabled the work to be performed quickly, and exactness of contour was obtained without blemish. The cost of this form was very small. In fact, it paid for itself the first day.

It was simply constructed of steel sheets $\frac{1}{16}$ in. thick. Three pieces were required—two pieces for the ends and one for the center portion. They were cut to the required shape and dimensions, the center piece being bent to the contour of the side pieces and secured to them by $\frac{1}{4}$-in. cup head bolts. The ends were notched and then flanged at right angles on the inside for this purpose. The bottom edges were flanged at right angles on the outside, for fastening to the wooden floor by screws. A piece of wood was fixed to the floor as shown at *A*, Fig. 2, to prevent the turned-up edge or groove from damage and to support the process of bending.

A cast-iron bending block was at first suggested, but this would have necessitated an expensive wooden pattern in addition to the cost of a heavy casting. Then there was the inconvenience of having to wait several weeks for its delivery, whereas the sheet-metal bending form, with its simplicity and cheapness, enabled me to proceed bending the aluminum sheets on the following day. It was necessary to employ two workmen to manipulate the sheets satisfactorily, owing to their large dimensions. One end of a sheet was put into the groove, as at *B*, Fig. 2, and worked over the form as far as possible. The roof sheet was then taken out of the groove and the opposite end treated similarly.

Manchester, England. E. ANDREWS.

Quick-Acting Grinding Dog

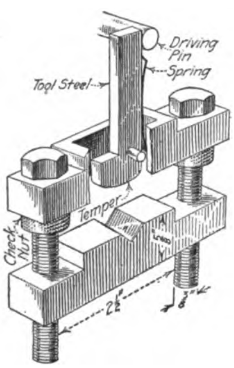
The quick-acting grinding dog illustrated and described by Harold E. Greene on page 558 reminds me of one which I made in 1909 and which I show herewith. I have used it almost continually since in several factories, both as a grinding dog and as a lathe turning dog. Although, in common with Mr. Greene's, it carries out the same idea of a gripping cam, it differs in being adjustable, like the ordinary clamp dog.

On paper I developed the proper cam, but never put the theory into practice because at my request Thomas Barter, of the Norton Grinding Co., filed up a cam and attached it to the dog for me without seeing the drawing of the cam I had made. This cam of Mr. Barter's worked so well from the beginning that I have never changed it for one to correspond with my design. Mr. Barter, therefore being a co-inventor with me, went ahead and made some dogs after the plan of the one illustrated by Mr. Greene, for use at the Norton Grinding Co.'s factory. They have been in daily service for a considerable time.

It will be noticed that my dog has a spring against the tail, to compensate for vibration in the driving pin or work. I thought that this spring would be helpful, because the vibration might have a tendency to jar the dog loose, especially in grinding stock in the rough. It will be seen that the swivel pin is placed a trifle to one side of the center line. This arrangement assists the cam in locking the dog to the work positively and yet at the same time enables it to be disengaged easily with a backward pressure of the finger. The dog is put on and removed exactly as a revolver trigger is pulled and almost as easily. Because no wrench is required, it makes dogging very rapid.

The fact that on certain grinding jobs the putting on and taking off of the dog occupy as much time as the grinding operation led me to devise a dog that would be quick acting, and the one illustrated is the result. As a lathe dog it proves very successful on turning jobs, but of course is of no use on pieces that require a change in the direction of the work, as in the reverse return in threading.

While using this dog in the grinding department of the Stevens-Duryea Automobile Co., I was surprised to learn from the assistant superintendent that he had seen a similar grinding dog in Boston a few years ago. This was news to me, as I thought I was the originator of it. In Rochester, N. Y., I also came across a dog almost identical with mine, and I looked it over carefully to see wherein it might be better. Now Mr. Greene brings forward a dog that shows the application of the same principle and that may antedate these others that I know about.



QUICK-ACTING DOG

Joshua Rose, in his work on machine-shop practice, illustrates Shartles' self-tightening dog, in which a pivoted tongue grips the work automatically. The tongue in this case, however, instead of being a cam, has serrated edges, but the principle is very nearly the same. The Shartles dog was patented Apr. 6, 1886, just 30 years ago. ROBERT J. SPENCE.

Worcester, Mass.

Take Warning!

After reading your recent editorials on the great danger to American industries through the adoption of the metric system of weights and measures, those articles impressed me as entirely too subtle if intended to be facetious. If not so intended, they should be supported by much more substantial and convincing reasons than have so far appeared in your paper.

The adoption of the metric system in this country is very much of an open question in the minds of a great many American manufacturers. Men of enlightenment and progressive tendencies are entirely willing to consider the matter in an impartial and judicious way; but assertion that to advocate the adoption of the metric system as Dr. Stratton does constitutes him "the most dangerous enemy of our industries which our country harbors" is a lapse into the burlesque that can hardly be considered appropriate.

What the American manufacturer wants are the facts in the case, not the half-baked conclusions of those who believe that any particular system of weights and measures is an integral part of the Ten Commandments or the Golden Rule, nor assertions of unlimited disaster to come if any change is made in the present system.

If the *American Machinist* is in favor of the metric system, a frank declaration to that effect would be in order. If opposed to the metric system, it should be equally frank. On page 609 in reference to a telegram from the National Association of Manufacturers, signed by George Pope, president, protesting against any change in the present status of the laws of the United States as between systems now in use here, you say, "These actions indicate the attitude of responsible manufacturing and commercial interests of the country toward any attempt to change the present status of our weights and measures." This is obviously funny, whether intended to be or not. It represents the attitude of just exactly those few persons who were consulted about and agreed with that telegram and, as a matter of fact, nobody else. The matter has not been presented to the "responsible manufacturing and commercial interests of the country" for their consideration, and any alleged conclusion as to their "attitude" is manifestly premature and based on incomplete data.

During the last 20 years there has been considerable controversy over the adoption of the metric system in this country; but the discussions that I have heard or have seen in print have too often descended into reasonless denunciation, and this has not been confined to either side of the controversy.

Speaking after an experience of many years with both systems—inch and metric—I am ready to concede that there are good points and bad points about both and that neither is perfection. As to the relative merits of the two systems I would be most willing to express my opinion when the matter is up for discussion by "responsible manufacturing and commercial interests of the country"; but what I wish to point out is that neither my opinion nor the opinion of the "National Association of Manufacturers," by George Pope, president, indicates the attitude of the "responsible manufacturing interests of the country" in any way. HALCOLM ELLIS.

Newark, N. J.

Taper-Shank Drills

I have read with interest the article by Robert J. Spence on page 554. If the author of this article has access to any twist-drill catalog not over ten years old, he can get a far better opinion of the progressiveness of twist-drill manufacturers than he has expressed in the last paragraph of his article. The facts are that the manufacturers of twist drills have gone even farther in putting large-sized taper shanks on small drills than Mr. Spence's recommendations, and they did this a number of years before the article in question was written, without waiting for outside influence, thereby acting on their own experience.

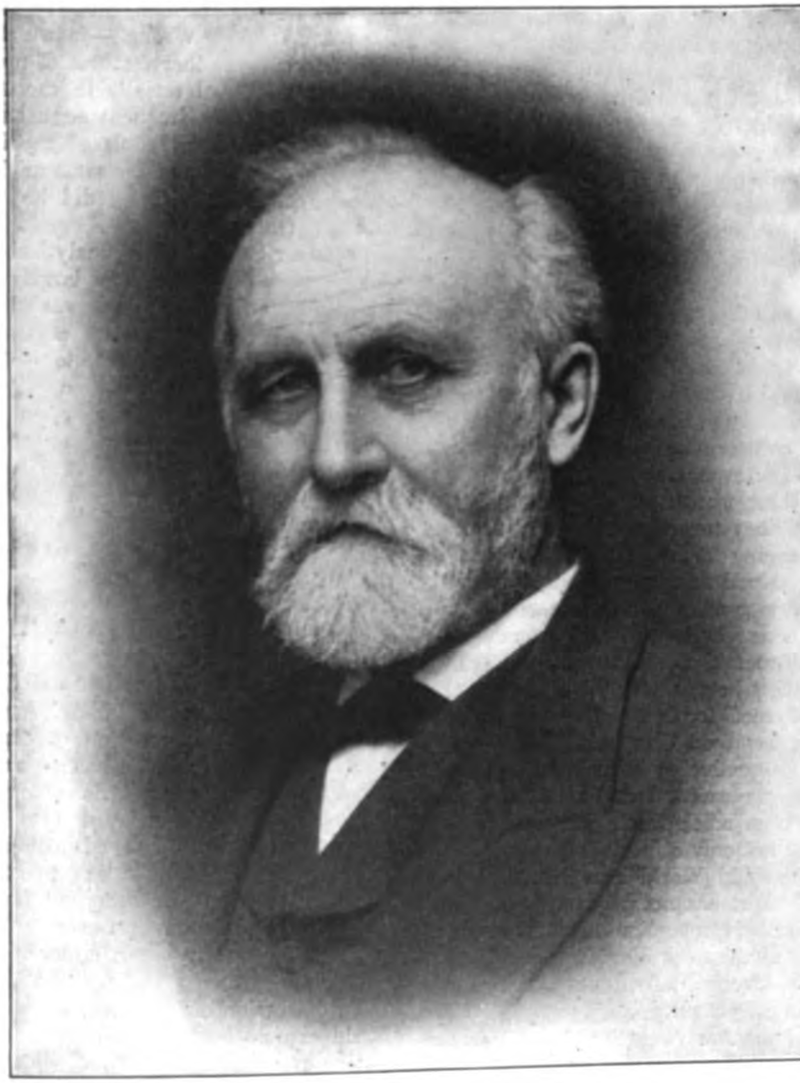
Every catalog of the Cleveland Twist Drill Co. since 1907 shows that taper-shank drills are regularly listed and carried in stock with the No. 2 shank on the $\frac{5}{16}$-in. size—Mr. Spence suggests changing the taper at ½ in. On this same list the No. 2 taper changes to the No. 3 at $\frac{11}{16}$ in. (instead of ¾ in., as recommended by Mr. Spence), and the No. 3 changes to No. 4 at 1⅛ in. Mr. Spence recommends changing at 1 in., but experience has shown that for sizes smaller than 1⅛ in. the No. 3 shank has ample strength. He makes no suggestion with reference to the No. 5 shank, but the drill manufacturers list drills with this shank as small as 1¾ in. in diameter.

It seems only fair to give the devil and the twist-drill manufacturers their due. S. H. COX.

Cleveland, Ohio.

Dr. John Edson Sweet

John Edson Sweet, the venerable dean of American machinery building, engineer, educator and for many years the most endeared figure in the mechanical engineering world, died suddenly at his home in Syracuse, N. Y., on May 8, in his eighty-fourth year. His passing is a great loss tempered only by the realization that to him was granted more years of influence than to the average man in any walk of life. No other engineer of his generation, or of any other generation, has so profoundly modified, directed and advanced the art and practice of machinery building in the United States. Many of those foremost as machinery constructors today came under his teaching, were inspired by his personality through acquaintanceship, or guided by his marvelous mechanical insight through his technical writings.



DR. JOHN EDSON SWEET

John E. Sweet was born at Pompey, Onondaga County, N. Y., Oct. 21, 1832. His father, Horace Sweet, was a farmer at that place where he had settled. The family was descendant of John and Mary Sweet, who came to Salem, Mass., in 1631. Horace was a respectable, though an undistinguished man. His wife, Candace (Avery), however, came of a family that has been somewhat eminent in mechanics. As an inheritance from her, therefore, we may regard Professor Sweet's engineering potentialities. He was one of eight children, six sons and two daughters. One of his brothers, Homer, became a civil engineer and surveyor, while two others, Anson and William, like himself, entered manufacturing at Syracuse.

John's education in the local schools, from the age of 7 to 15, was of an ordinary sort, but during this time, at the age of 12, his constructive resourcefulness manifested itself in the making of a violin. His mechanical disposition was sufficiently marked to bring about his apprenticeship, in 1850, to a carpenter and joiner, John Pinkerton, and with his earnings he purchased the second set of socket or firmer chisels ever made. In the winter of 1850-51 he obtained a position in the office of Elijah T. Hayden, an architect at Syracuse, and during an interval he worked for an artist named Holyoke. The architecture of that date and place was elementary, but young Sweet made the best of it and designed a barn which won a prize offered by the *Rural New Yorker*. This was followed by a series of articles on architecture, which ran for a dozen years. When the war broke out he had charge of building a fine hotel at Selma, Ala., but found it expedient to return North without finishing the job. Building operations being slack, he worked for a while as a pattern maker and draftsman in railroad shops at Syracuse. In 1862 he went to the London exhibition, traveling on the Continent and engaging as draftsman in the international patent office of Hazeltine, Lake & Co. Later he acted as draftsman for the Patent Nut and Bolt Co. of Birmingham, England while this company was building a nail machine of his invention. During the European sojourn he wrote letters of travel to a local paper at home and also contributed articles to Zerah Colburn's London *Engineering*.

Returning to Syracuse in 1864 he became designer and draftsman for Sweet, Barnes & Co., which occupation he suspended long enough to attend the Paris Exposition of 1867 and show a pioneer typesetting machine which he had devised. This is still preserved at Cornell University and is a marvel of ingenuity. He married, in 1870, Miss Caroline Hawthorne, who died in 1887, and two years

later he married Miss Irene Clark, who died about a year ago.

In the period from 1871 to 1873 he did chiefly bridge-building work for Howard Soule, of Syracuse, and at that time wrote articles for *Engineering* on "Mechanical Refinements." He also began work on the first straight-line engine.

Professor Sweet's ownership of that title, which has ever since remained inseparable from him, was acquired through his connection with Sibley College, Cornell University, during the period 1873-79. As professor of practical mechanics, he made a deep and lasting imprint of his personality both on the university and on his students. Under his direction they built some machines embodying features of distinctive originality, among which were the famous Cornell measuring machine, the first American-made Gramme dynamo and the second straight-line engine. The last mentioned was an innovation, combining a balanced valve, shifting eccentric and shaft governor. The engine and other devices were exhibited at the Centennial in Philadelphia.

The measuring machine was the first to be built in this country and was intended to have been the starting point in the manufacture of solid caliper gages of which Professor Sweet was the originator. The manufacture of these gages proved to be a failure owing to the imperfect nature of the only emery wheels then to be had.

Professor Sweet resigned his scholastic work to return to Syracuse and engage in the commercial manufacture of his engine. To this end the Straight Line Engine Co. was formed in 1880, he becoming president and general manager and his brother Anson, treasurer. They rented a building for two or three months at the start and employed six men. Here they turned out about one engine a month in sizes averaging 25 hp. In 1884 a foundry that had been run by a local firm was added to the business. Ten years saw a gratifying development of the enterprise. In 1890 a new building 130 ft. square—one of the first saw-tooth-roof shops—was occupied. Professor Sweet believed that he was the first to employ this weaving-shed type of roof for machine-shop purposes, although the priority has been disputed. There ninety men were employed in producing some fifty engines a year, averaging 80 hp. per unit. Subsequently the plant and production have been much further expanded. His engines have sold well, not only at home but abroad. His close relations with the Old World have therefore been reciprocal ones. His plant has not become large, but it enjoys a reputation out of proportion to its magnitude, because of the quality of the work done in it and because of Professor Sweet's strong individuality, which has permeated his mechanical output.

In the formation of the American Society of Mechanical Engineers, Professor Sweet played a leading part. The idea was discussed in correspondence between him and Jackson Bailey, then editor of the *American Machinist*, as a result of which a call was issued Jan. 18, 1880, over Professor Sweet's signature, and the organization meeting was held Feb. 16, in the office of the journal named. He manifested, however, some hesitancy in promoting the enterprise and an unwillingness to accept its early honors. He consented, nevertheless, to read the first paper and was its third president. Except for his own modesty he would undoubtedly have been its first president.

Professor Sweet never permitted his engineering abilities to grow rusty. He improved his engine from time to time and he designed other devices, such as a traversing machine and a steam separator. His forte lay in the perception and employment of those designs that were artistically simple and mechanically correct. He undoubtedly surpassed all other machine designers in his perceptions of the part in construction which is the outgrowth of perfect fitness, and also in his perception of fundamentally correct principles in construction, as illustrated, for example, by the three-point system of machine support, which is now so common, but which during his early advocacy of it, was smiled at by all as a useless refinement, or worse. Typical of his genius was one of the later among his many literary productions—"Things That Are Usually Wrong"—in which he discussed bearing surfaces and other features of machine design. This was first published serially in the *American Machinist*, to which he was a frequent contributor. Over the door of his engine works he placed the inscription "Visitors Always Welcome," and the same might have been written on his forehead, so freely did he admit others to the confines of his brain.

Professor Sweet had an analytical mind of a very high order, yet he did not depend largely upon formal mathematics in his designing. He was so uniformly correct in his methods and deductions, and these were so simple and direct, that he seemed to be possessed of almost infallible mechanical intuition. His results, however, were in reality due to a clear conception of *all* of the factors of a problem and of the interdependent relations of these factors. This is the characteristic of true analysis, the prime difference between Professor Sweet and others who have been eminent in analytical work being that he employed less conventional expression in conveying his thoughts to others. Nearly all true analysis consists in such a conception of the problem in advance of its mathematical expression. Had Professor Sweet been merely gifted with an intuitive faculty he would have been unable to expound and defend his conclusions with such logical and convincing force.

With his keen perception of that which is right in mechanical principles, he had an artist's appreciation of correctness in details. It is difficult to decide which is the more admirable in his designs, the soundness of the scheme or the skill displayed in its execution.

Many have been unwilling to go as far as Professor Sweet in the right direction, but few of those who lacked the courage to follow him ever succeeded in demonstrating that he was in error, either in his theory or in his practice.

In discussion of questions, mechanical or otherwise, he could express himself with extreme clearness and vigor, yet he ever displayed unusual consideration and patience with the views of others. Few men of his attainment were so appreciative of the work of others, and he seemed quite as interested in the good achievements of another as in his own.

The influence he exerted over men, and the inspiration he imparted to those with whom he came into intimate contact, were, probably, his most important, as well as his most enduring, contributions to mankind.

It was fitting that this man whose most natural instinct was to impart of his abundant knowledge should have

(Continued on page 879)

Editorials

Recommendation vs. Action

The discussion before the House Naval Committee during the hearings on the naval appropriation bill of the question of a general staff for the navy has an industrial interest because of the analogy between the two problems of military preparedness and business preparedness.

The navy must be prepared as to material, of course—that is, ships, guns, ammunition, etc.—and also as to personnel—trained officers in sufficient number; likewise thoroughly drilled sailors. These requirements correspond to plant, organization and working force in the industrial problem. These latter, we know from experience, are of no avail even if they are perfect, unless wielded in accordance with a sound, far-sighted policy, campaigning for business on the one hand and developing internally on the other. So in the navy there must constantly be under way the study of plans of campaign, characteristics of ships, use of the fleet in war, etc., coupled with the detailed preparations necessary to put these plans promptly into effect upon declaration of war. The advisability of getting ready is granted, but the question is how to actually get ready.

At present in our navy there are two groups of officers chiefly occupied with this work the General Board and the Chief of Operations with his staff. These officers investigate, report and recommend to the Secretary of the Navy what should be done; and the Chief of Operations carries out what the Secretary approves. A great many naval officers appear to believe that the work of investigating and planning should be vested in one group or general staff and that this staff should have the power to put its work into action—governed by the appropriations and restrictions made by Congress. But there is much opposition to such a plan, because it would set up military authority free from that of civil authority (the Secretary) and thus would seem to be "militaristic" in tenor.

Just a little reflection will bring up the thought that those officers now busily engaged in investigating and reporting and recommending may get tired and discouraged if the things they recommend are not done, that there is a delay between thought and action, that there is a division of responsibility and that there can be no continuity of policy and strategy. This is because there is so much human nature in the people involved—a consideration that must not be overlooked in any plan where concerted action is necessary.

Now turn around and see how this discussion applies to the industrial problem. There are those who recommend a type of organization such that certain members shall always be reporting and recommending and that others shall be doing. Will those who recommend be as painstaking in study and use as careful judgment as if theirs were to be the responsibility of doing what they recommend? Will those who do, feel the same responsibility and enthusiasm that they would if the plans were theirs? Will there be quicker action if recommending and doing are placed on the same shoulders?

Advance in Dynamic Balance

The latest machine and methods for the dynamic balancing of machine parts are described in an article on page 857 of this issue. It is a reprint of a paper presented at the New Orleans meeting of the American Society of Mechanical Engineers. The discussion that it called out is also printed in this issue on page 861.

During the last five or six years the *American Machinist* has published many articles on dynamic, or running, balance, which taken together have described all the important machines and devices used for this purpose, as well as completely reviewing the underlying principles and describing many of the best-known shop methods. That these principles are none too well understood is, however, shown by the following three quotations that touch upon the action of a dynamically balanced body at different speeds.

John Riddell in his discussion states: "It is my opinion that, in order to give a body a perfect dynamic balance, it is necessary to do this at a speed at least equal to the maximum speed at which it is to be operated in actual service, as it is quite possible to have an apparently perfect dynamic balance at one speed and then find that the balance is imperfect at higher speeds. Whereas, if a body is in perfect balance at its highest speed, it will also prove to be in perfect balance at all lower speeds."

E. J. Loring states positively that dynamic balancing at slow speed is not conclusive: "A slow-speed test is by no means conclusive. A body in dynamic balance at 400 r.p.m. may be dangerously far from balance at 3,000 r.p.m.; when corrected for 400 r.p.m. it is safer than when only statically balanced, but its balance is never fully proved at less than its full speed."

Opposed to these two opinions is the following from the discussion by H. P. Fairfield: "A machine part put in running balance at any speed is certainly in running balance at any other speed, if it is not distorted from its true axial conditions."

The latter opinion is the one commonly held and is the one supported by all theoretical considerations.

Mr. Akimoff's machine differs from others that have been constructed in this important feature: All the others rely for their operation upon indicating unbalance. The vibration or deflection of some parts is used as a means to determine the heavy or light side, as the case may be, of the part that is out of balance and perhaps to give some hint as to the amount of this unbalance as expressed in weight.

The Akimoff machine, on the other hand, relies for its operation upon destroying the vibrations caused by unbalance. After the machine is properly set for a part that is to be put in dynamic balance, the vibration of the work-holding frame is zero or practically zero. Once this condition has been set up, it is possible to determine the plane of the unbalanced centrifugal couple, its sign and also its magnitude.

Tributes to John E. Sweet

We will remember him as the doer of the many things for which the engineering world has honored him so signally and so justly, but the memory which will come to us oftenest and which we will cherish most will be of the kindest, most unselfish, most helpful friend we ever knew. E. J. ARMSTRONG.

Our departed friend was one of the most lovable men I have ever known. Not only was he a finished mechanician, but the human element, which makes life worth living, was strongly marked in his character. What visitor to his workshop in Syracuse will ever forget the inscription cut deep into the stone lintel over the doorway, "Visitors Always Welcome"?

In his address as president of the American Society of Mechanical Engineers, thirty-three years ago, he spoke these memorable words:

> Let us hope that, if the high tide of human progress is sweeping on toward a more useful education, the day may not be far away when he who knows what to do and how to do it will be regarded as the equal of him who only knows what has been done and who did it.

May I repeat the beautiful words of the Poet of the Sierras in his tribute to Peter Cooper:

> Or whether to wander the stars or to rest
> Forever hushed and dumb,
> He has done with a zest; he has done his best;
> Give him the best to come.

If it is to be the gateway to the stars, our friend will find cut in the lintel thereof his own lovely words that he placed over the doorway to his earthly workshop, "Visitors Always Welcome." JOHN A. BRASHEAR.

Professor Sweet was a pioneer in that modern practice which has revolutionized the world by applying logic not to what was taught but to actual fact. He did much to destroy that fetish worship of education founded upon books, which had survived from the Middle Ages, in order that true education founded upon the fundamental laws of the universe might grow. This intellectual freedom, combined with his brilliant mechanical genius and his marvelous gift of expressing profound thought in homely language, put him in the very forefront of engineers and engineering educators, as the honors of all kinds conferred upon him amply show.

But to those blessed by the privilege of intimate association with him these traits pale into insignificance in the light of his personal character.

He never preached and never criticized others, yet by his example and above all by his natural mental attitude inspired others with high ideals. He did not make others do right; he inspired them with the desire not to do wrong. J. E. JOHNSON, JR.

The secret of Professor Sweet's wonderful popularity lay primarily in his unfailing spirit of helpfulness. More than all else he was a teacher. With an exhaustless fund of experience and ideas, he was possessed by a desire to impart them to others. Knowing that he had developed principles that were fundamental and correct, his chief aim in life was to secure their recognition and adoption; in this, repetition had no terrors for him, his patience in explaining and expounding those principles having no end. His feelings in this regard found recent expression when, referring to the honors which had been showered upon him, he said, "I would give them all if people would only use the things that I have proved to be good"; for his chief disappointment in life was the slowness with which his ideas were adopted.

His rise to public esteem was meteoric. He took charge of the Cornell shop—an unknown man; he remained there only about five years, and within that short period his reputation was made. Those were the days of small things, but they were also the days of new things; and little as it showed upon the surface, little, probably, as he realized it, the opportunity for the right man was there.

The esteem in which he was held was made manifest in a manner that was unique. I refer of course to the annual dinner tendered first during the A. S. M. E. meetings and later on the occasion of his succeeding birthdays, when his former students—both of the university and the shop—assembled year after year in numbers that tended to increase rather than diminish.

He always considered himself unworthy of the honors that came to him, for he was an absolute stranger to the spirit of self-seeking and self-aggrandizement. He sought to give, not to acquire, but the bread which he cast upon the waters came back to him. As a man he was unique. We will not look upon his like again. F. A. HALSEY.

A host of memories of him, reaching back nearly forty years, crowd upon me. I seem to see again the little straight-line engine that astonished the engineering world at the Centennial Exhibition in 1876; the workshops established by him at Cornell University about the same date; the Straight-Line Engine Works at Syracuse, with the words "Visitors Always Welcome" carved in the stone arch above the front door, and the many evidences of his genius as a designer and as a mechanic to be seen within; the little Apprentices' School which he established in Syracuse about ten years ago and to which for a few years he devoted a large part of his time. I recall his being one of the leaders in founding the American Society of Mechanical Engineers, and I think of him a quarter of a century later as a founder of the Technology Club of Syracuse, of his being president of both societies, of how he was honored by his old pupils of Cornell (who established the little organization of "Professor Sweet's Boys"), of his vigorous and stimulating writing in the *American Machinist* and elsewhere. I think of his pleasant smile and his cheerful voice, of his optimism and his commonsense.

In August last, while waiting two hours at Syracuse for a train connection, I called him on the telephone to inquire for his health. He replied: "I am eating three meals a day, going to the shop twice a day and am drawing my salary every month. Feel as well as ever I did; come up to the house and see me." I did so and was surprised at his vigor and apparent youthfulness.

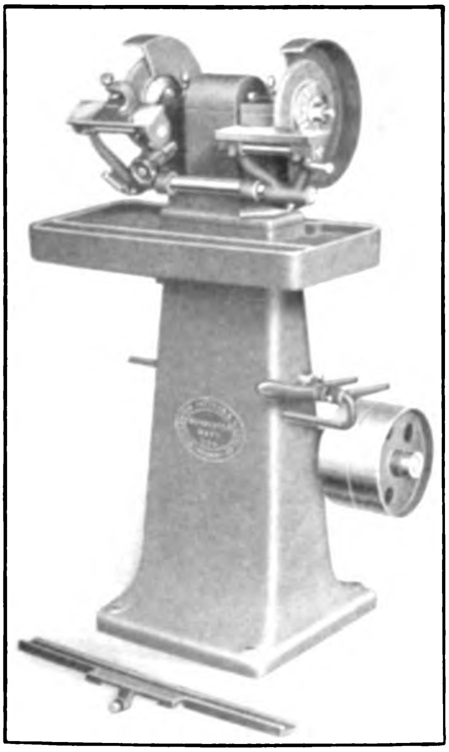
But far beyond these memories of the incidents and the achievements of Professor Sweet's career is the memory of what he was to me as a friend for over thirty years and of the character of the man himself. Friend of mine! He was the friend of thousands. Ranking among his friends the great engineers of the world, who all honored him, among them those who have lately left us—Fritz, Meier, Taylor, Dodge, Leavitt and Woodbury—he was equally the friend of the young college student, the apprentice and the workman. WILLIAM KENT.

Shop Equipment News

Tool Grinder

While primarily designed for pattern-shop work, the machine shown is adapted for machine-shop use in meeting the requirements of general tool grinding. To make it particularly suitable for machine-shop application, plain rests may be furnished for both ends; and the design is such that a buffing wheel can be readily attached by means of a special nut.

The support is first adjusted at the desired distance from the wheel by means of the handle. The tool to be ground is clamped into the tool holder and the proper bevel given by turning the wheel, which tilts the table by means of a worm gear.



TOOL GRINDER

The tool holder is free to slide along the surface of the rest and always holds the tool in exactly the same position. The operator simply moves this holder back and forth until the entire width of the tool has been ground to an accurate edge. When tools with a long edge, like a planer knife, are to be ground, the tool holder shown in the foreground is used upon the table, which is adjustable.

Because the tool is held in the same position during the entire grinding process, the tool holder being in constant contact with the table surface, the edge is kept straight and the grinding uniform.

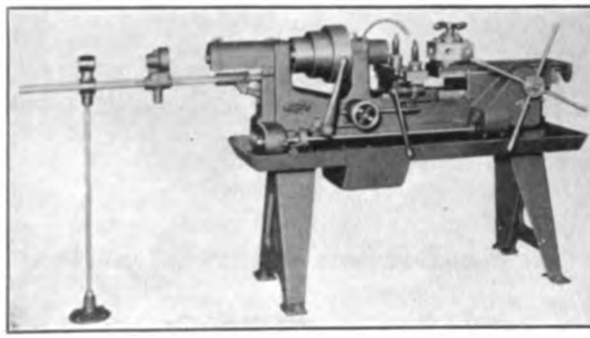
The machine is made either in the solid-pedestal type shown or in bench form by the Worcester Pattern and Model Co., Worcester, Mass.

Hand Screw Machine

In the description of the plain-head hand screw machine made by the Charles Stecher Co., Chicago, Ill., published on page 656, an illustration of another make of hand screw machine was erroneously used.

To clear up any possible misunderstanding the description is herewith repeated with the proper accompanying illustration.

The machine is similar to that shown on page 700, Vol. 43, with the addition of power feed to the turret.



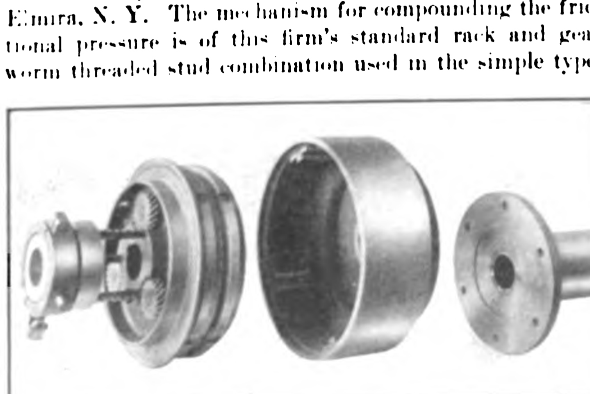
PLAIN-HEAD HAND SCREW MACHINE

Wire-feed capacity, 1⅝-in. round, [illegible]-in. square and 1¼-in. hexagon bars, hole in spindle, 1⅝ in.; swing over bed, 14 in.; diameter of holes in turret, 1¼ in.; length that can be turned, 7 in.; greatest distance from end of spindle to turret, 17 in.; width of belt, 3 in.

The arrangement of the power feed is such that the tools are fed positively the same distance each time. This is accomplished by an arrangement of the friction in the power-feed rod. The friction permits the rod to slip when the tools have reached the positive stop and can be easily seen by the operator, who trips the feed. The gears are entirely inclosed and run in oil.

Double-Disk Clutch

The form of clutch shown is a recent addition to the line made by the Hilliard Clutch and Machinery Co., Elmira, N. Y. The mechanism for compounding the frictional pressure is of this firm's standard rack and gear worm threaded stud combination used in the simple type.



DOUBLE DISK CLUTCH

The compounding pressure ranges from 96 to 1 in the small-size clutches up to 168 to 1 in the largest size; the ratio of travel of the sliding collar, containing the racks, operated by the shifter yoke, has a movement in comparison with the movable friction pressure plate in the same proportion. Only half of the length of the operating racks is required to engage and release the clutches, the remainder being available for automatically taking up wear without stopping to adjust the clutch.

The large-diameter friction disks are lined with asbestos-wire brake linings, four such linings being used. These are riveted to the plates, and the cast-iron plates themselves have hardened tool-steel liners at the point where they drive on the hardened tool-steel keys inserted in the clutch housing, through which the power is transmitted to the pulley mounted on the extended sleeve. The sleeve is separable from the housing, and the sleeve member only is split, for convenience in assembling and rebabbitting without removing the clutch mechanism from the shaft.

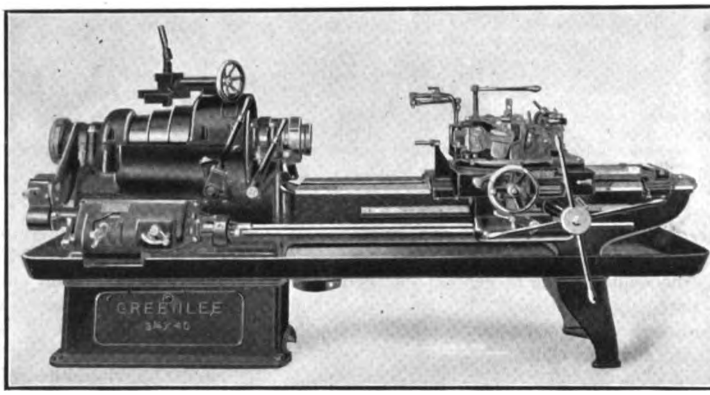
Cone-Driven Turret Lathe

The turret lathe shown is made by the Greenlee Machine Tool Co., Rockford, Ill., and differs in a number of ways from the smaller size made by it. The bed and headstock are a one-piece casting above the pan. It is reinforced under the front-spindle bearing in an unusually strong manner. The bed rests on a three-point bearing. Cone drive is used, and the back-gear shaft is below the spindle, making a compact and well-proportioned head, the outline being completed by the large cast-iron cover inclosing all the parts except the upper half of the cone pulley.

The spindle is of hammered steel, running in babbitted chain-oiling bearings. Large oil reservoirs and glass cups are provided. Spindle thrust is taken through a threaded adjustable clamp collar. The spindle drive for all speeds is through one of two large-diameter wide-faced gears immediately behind the front bearing. These gears mesh with pinions on the auxiliary shaft directly below the spindle, and the pinions are driven by interlocking positive friction clutches keyed to this shaft. At the other end of this shaft are two friction clutches, one driven at high speed direct from the cone and the other at low speed through back gearing from the high-speed gear. Twelve spindle speeds are secured in this way, four from each of the cone steps.

The double friction countershaft gives a reverse drive, so that the speeds are available in either direction. All the clutches are controlled by a single lever, and the connection is such that the positive clutches cannot be shifted while either friction clutch is engaged, nor can the two clutches of either set be thrown in at the same time.

Automatic roller feed is used for handling bar stock. This has only three movable members and is positive in action. The lever opens the chuck and operates the feed. While the illustration shows the crossfeed turret type, the same size of machine is made with a rigid turret.



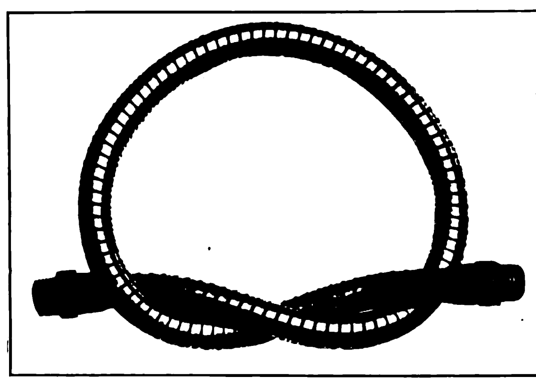
CONE-DRIVEN 3¼x40-IN. TURRET LATHE

Made with cross-slide and rigid turrets. Spindle hole, 3½ in.; maximum swing over ways, 22 in.; over turret, 8 in.; spindle speeds, 12, 16, 21, 28, 38, 50, 66, 88, 118, 157, 211 and 280; feeds, 0.006, 0.009, 0.014, 0.019, 0.035, 0.048, 0.072 and 0.108 in. per revolution; largest step on cone pulley, 15½ in. for a 4-in. belt; weight, 6,600 lb.

A mechanical belt shifter is also provided. It is shown in position on the headstock and over the spindle cover. It operates with a handwheel and gives a rapid and positive belt movement in either direction.

Metallic Flexible Tubing

The use of metallic tubing for conveying lubricant to the cutting tool and for similar shop purposes is growing rapidly and other uses are being found daily.



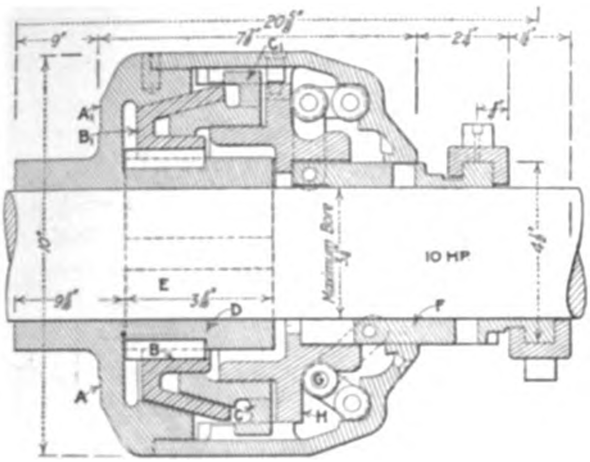
METALLIC FLEXIBLE TUBING

The illustration shows the product of the Worcester Flexible Tubing Co., Worcester, Mass., along this line. This tubing is made to suit varied requirements.

Multi-Cone Clutch

The illustration shows a multi-cone clutch that has recently been developed by the Akron Gear and Engineering Co., Akron, Ohio. The action of the clutch will be readily understood by referring to the illustration. The three cones are shown out of engagement at *A*, *B* and *C* and in engagement at *A1*, *B1* and *C1*.

The driving ring *D* is keyed to the shaft *E*. The driving cone *B* is driven by two feathers in *D*. The driven cones *A* and *C* are brought into contact with *B* when the shifter sleeve *F* is thrown forward. This forces the roll-

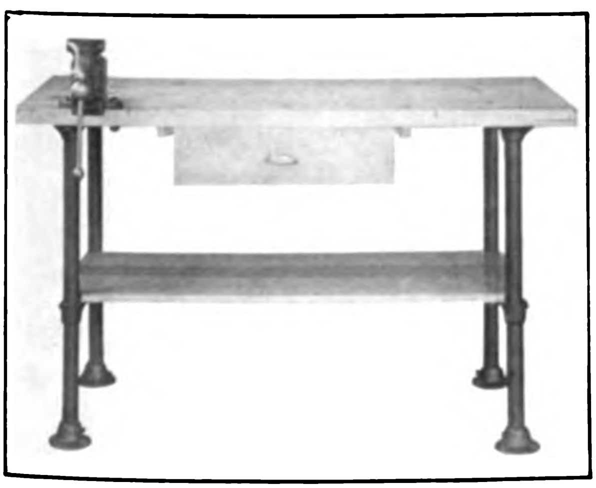


MULTI-CONE CLUTCH

ers *G* outward and moves the adjustment ring *H*, which carries the cone *C* forward into contact with the driving cone *B*. Further movement slides the cone *B* on the driving ring and brings it into contact with the cone *A*.

Mechanics' Bench

The bench shown, provided with vise and drawer, is constructed in such a manner that by loosening the set screws which secure the top to the steel legs the bench can be taken apart for ready removal or substitution.



MECHANICS' BENCH

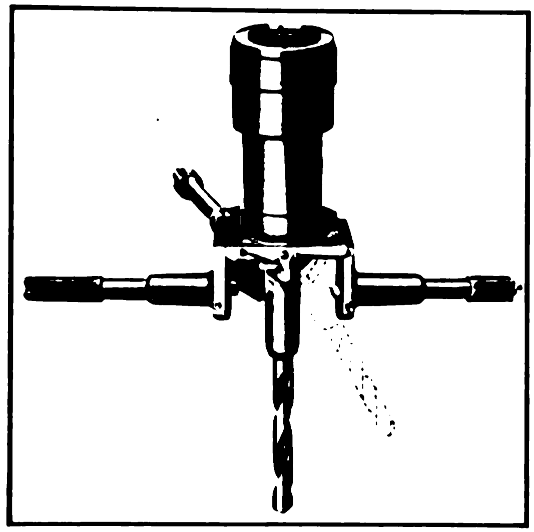
The general construction is apparent, and the design is intended to be especially adapted for tool makers and machinists.

The bench is a recent product of the Motor Engineering Co., East Sixty-first and Curtiss St., Cleveland, Ohio.

Four-Spindle Drill Head

The illustration shows a four-spindle drill head made by the Newman Manufacturing Co., Cincinnati, Ohio. This head is intended for use on the ordinary drill press, the individual spindles of the head being brought into action as required.

The sleeve of the head is secured to the drill-press quill. The spindles of the head are then, as desired, swung into line with the drill-press spindle and locked



FOUR-SPINDLE DRILL HEAD

in place by the latch. Only the spindle in use is rotated by the drill-press spindle, the others remaining inoperative.

A Piston Ring

A piston ring with interlocking joint, illustrated herewith, has recently been placed on the market by the Chalsmith Sales Corporation, 2 Columbus Circle, New York City, and is made in the usual variety of sizes.

A PISTON RING

These rings are made of gray iron cast singly. The skin of the iron is left on the inside, to insure resiliency. The joint is machined to close limits and is practically gas-tight. It can open from $\frac{3}{16}$ to $\frac{1}{4}$ in., according to the size of the ring, before there is passage for the gas.

Balanced Hoist

The balanced hoist here illustrated was made for handling shells or other similar work. In Fig. 1 it is seen used for large bushings. The operator can attach a hook to a piece of work in the lathe or other machine and also a second hook to another piece on the floor or truck. Then with comparatively little exertion he can swing the rough piece to the machine and remove the finished one. The method of operating the clutching jaws is shown in the detailed

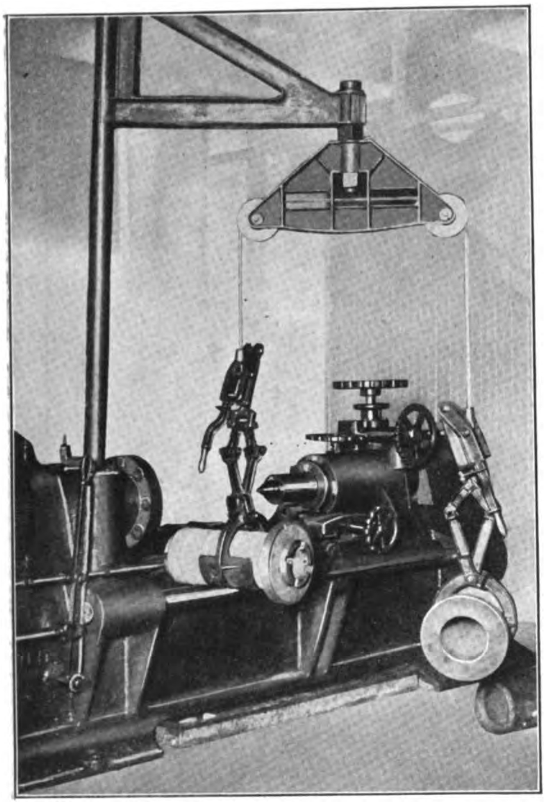


FIG. 1. BALANCED HOIST
Net weight, without upright pipe, 247 lb.

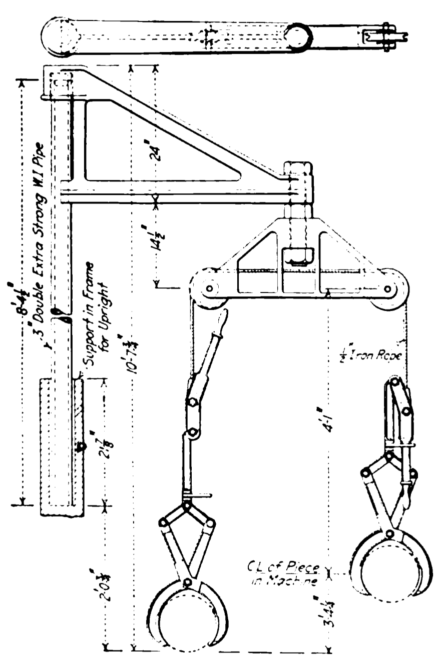


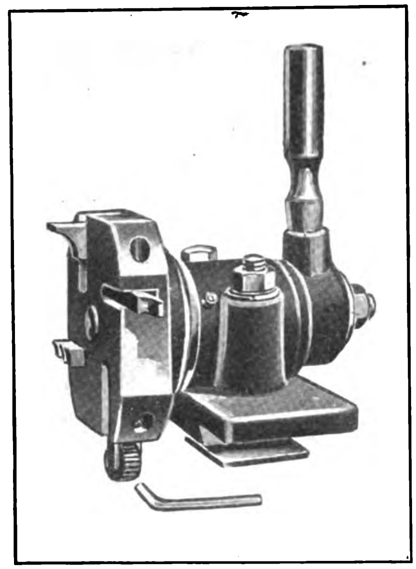
FIG. 2. DETAILS OF BALANCED HOIST

drawing, Fig. 2. All parts are well made and guaranteed to stand up under the rated capacity.

These hoists are made by the Mann Corporation, Chicago, Ill.

Tool-Post Turret

The illustration shows a tool-post turret which is a recent development of the Newman Manufacturing Co.,

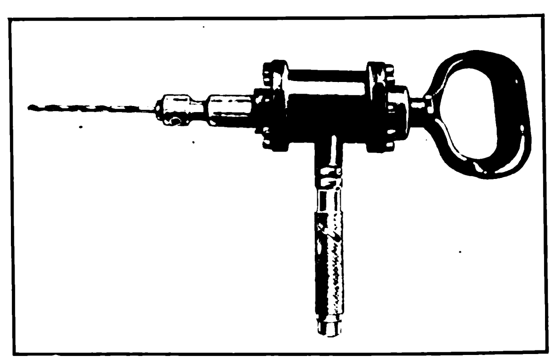


TOOL-POST TURRET

Cincinnati, Ohio. The turret provides stations for four tools. It is mounted direct on the tool slide. The lever to the left operates the locking mechanism.

Pneumatic Telltale Drill

The machine shown, which was designed for drilling telltale holes in locomotive-boiler stay-bolts to meet the Federal law on boilers, is made by the Baird Pneumatic



PNEUMATIC TELLTALE DRILL

Tool Co., Topeka, Kan. It has a speed of 1,500 r.p.m. and weighs less than 4 lb., which enables an operator to handle it for a long time without fatigue. It has but five working parts, including the operating handle.

Dr. John Edson Sweet

(Continued from page 872)

given much of his last years to the Artisan School, which he himself founded in pursuance of a cherished dream of many years.

The most fruitful years of Professor Sweet's life were undoubtedly those spent at Cornell. He went to the university an unknown man and left it after six years of service with a reputation that was more than national. Those were the days of small things in engineering education. The number of students was small, and the department was in a formative state, a condition which perhaps added to his success, as it undoubtedly increased the value of his work from the students' standpoint.

The small number of students made his instruction largely individual and it rendered unnecessary that icy hand of formalism which followed as a necessity upon the great increase in the popularity of engineering education. There never was anything, and there probably never will be anything, quite like that old Sibley shop. It can be compared with nothing but the schools of the ancient Greek philosophers who gathered their students about them without formality, without organization and without system, but with results that from the standpoint of the inspiration received have probably not since been equaled. It is doubtful if such an enthusiastic body of students as Professor Sweet's could be matched then or since, a condition which is perhaps best shown by the fact that most of them spent their spare hours at work in the shop instead of upon the football field, while some passed their vacations in the same manner, partly from an appreciation of the value of what they received, but more from the indefinable charm of the work and of the atmosphere in which it was done.

Few teachers have ever secured the lasting affections of their students as did Professor Sweet. Perhaps the greatest personal gratification that ever came to him was the presentation in December, 1901, of a Jurgensen watch by a number of his former students, meaning by that term graduates from the Cornell shop and from the Straight Line Engine Works. The occasion was managed with such success that he had no inkling of what was coming until the watch was placed in his hands, the result being that his eyes filled and his usual ready speech failed him. Since that occasion the same students, most of them beyond the meridian of life, under the title of "Professor Sweet's Boys," dined with him yearly during the annual meeting of the American Society of Mechanical Engineers in New York—an occasion which was looked forward to with equal eagerness by him and by them.

As an outgrowth of the unstinted esteem of his fellow men Professor Sweet was showered with honors during his later years, always against his protest in his characteristic and unmatchable modest manner. Most notable among these honors was the award of the John Fritz Medal in 1914—the highest award within the joint gift of the four national engineering societies—"for his achievement in machine design and for his pioneer work in applying sound engineering principles to the construction and development of the high-speed steam engine." The degree of Doctor of Engineering was conferred upon him by Syracuse University the same year.

The last day of Dr. Sweet's life was spent in a way that was typically characteristic of him and of all his activities. He went to the shop as usual, about 9:30 o'clock in the morning. A visitor from Texas—a man whom he had never seen, but who knew him through his reputation and writings—came with the design for an inertia governor to control the poppet valves of a steam engine. Dr. Sweet at once went into this problem, spending the greater part of the morning upon it, pointing out that the main pin was in the wrong position and was too small in size, and before luncheon made an appointment with his visitor to meet him again in the afternoon.

Dr. Sweet then went home for luncheon and returned to the shop as usual. About three o'clock he complained of feeling tired and some of his associates persuaded him to go home. This he did, taking care, however, to give detailed instructions as to what should be said to the Texan visitor who was to come again somewhat later in the day.

On reaching home he rested, a physician was called, and he retired. About eight o'clock he was given medicine and five minutes later when the nurse entered his room he was lying in a position of natural sleep with his life's work ended. If he could have preplanned and ordered the events of his last day on earth, it is probable that he would not have wished for the change of a single detail—at least to his friends who remain every event and detail of the day seems singularly fitting and in keeping with the purpose of his whole life.

Chicago Machinery Club Officers

The organization and plans of the Machinery Club of Chicago were announced in last week's isue and further interest in this development now attaches to the election of officers for the initial administration.

The results of the election at the first formal meeting held on May 1 were as follows:

President, Clyde W. Blakeslee, Chicago manager, Abrasive Materials Co.; 1st vice-president, Edward P. Welles, president and general manager, Chas. H. Besly Co.; 2d vice-president, H. A. Stocker, president, the H. A. Stocker Machinery Co.; 3rd vice-president, E. L. Essley, president, E. L. Essley Machinery Co.; treasurer, Arthur L. Beardsley, Chicago manager, Cleveland Twist Drill Co.

The following board of directors was elected: F. L. Peterson, manager, The Hendey Machine Company, Hiram N. Cudworth, Chicago manager, Norton Grinding Company; Herbert E. Nunn, western sales manager, Cleveland Automatic Machine Co.; E. L. Beisel, Chicago manager, Gardner Machine Company, George M. Pearse, western representative, Brown & Sharpe Mfg. Co.; Robt. R. Cuthbertson, manager, Manning, Maxwell & Moore; David F. Noble, creditman, E. L. Essley Machinery Co.

The reported enthusiasm exhibited at the preliminary and first formal meeting of the club confirms the generally accepted belief that the machinery trade in the western section has grown to sufficiently large proportions to well support such a club.

PERSONALS

C. J. Bambach, for several years associated with the Marshall & Huschart Machinery Co., Chicago, Ill., is now vice-president of the recently organized Pierce Machine Tool Co., Chicago, Ill.

R. T. Lane, general sales manager of the Standard Tool Co., Cleveland, Ohio, delivered a technical talk on "Steel, Taps, Drills and Reamers," at Passaic, N. J., on May 15. While intended for the benefit of dealers in that section the talk was open to the general mechanical public and cover both commercial and technical considerations.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	May 12, 1916	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$15.00	$15.00	$9.50
No. 2 X Northern Foundry, New York	20.50	20.50	14.25
No. 2 Northern Foundry, Chicago	19.00	19.00	13.00
Bessemer, Pittsburgh	21.95	21.95	14.55
Basic, Pittsburgh	18.95	19.20	13.45
No. 2 X, Philadelphia	20.50	20.50	14.25
No. 2, Valley	18.50	18.50	12.75
No. 2, Southern Cincinnati	17.90	17.90	12.40
Basic, Eastern Pennsylvania	20.50	21.00	13.25
Gray forge, Pittsburgh	18.70	18.70	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger from jobbers' warehouse at the places named:

	New York May 12, 1916	New York One Month Ago	New York One Year Ago	Cleveland	Chicago
Steel angles, base	3.50	3.15	1.85	3.25	3.10
Steel T's, base	3.55	3.20	1.90	3.25	3.10
Machinery steel (bessemer)	3.25	3.15	1.80	3.25	3.10
Steel plates, base	4.50	...	...	3.65	3.50

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse at the places named:

	New York May 12, 1916	New York One Month Ago	New York One Year Ago	Cleveland	Chicago
No. 28 black	3.65	3.50	2.60	3.20	3.20
No. 26 black	3.55	3.40	2.50	3.10	3.10
Nos. 22 and 24 black	3.50	3.35	2.45	3.05	3.05
Nos. 18 and 20 black	3.45	3.30	2.40	3.00	3.00
No. 16 blue annealed	4.70	3.75	2.35	3.70	3.60
No. 14 blue annealed	4.60	3.70	2.25	3.60	3.50
No. 12 blue annealed	4.55	3.65	2.20	3.55	3.45
No. 10 blue annealed	4.50	...	...	3.50	3.40
No. 28 galvanized	5.65	5.65	4.00	5.50	5.50
No. 26 galvanized	5.35	5.35	3.75	5.20	5.20
No. 24 galvanized	5.20	5.20	3.55	5.05	5.05

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot for carload lots f.o.b. mill:

	Black May 12, 1916	Black One Yr. Ago	Galvanized May 12, 1916	Galvanized One Yr. Ago
¾ to 2 in. steel butt welded	70%	81%	50½%	72½%
2½ to 6 in. steel lap welded	68%	80%	48½%	72½%
Diameter, In.				
¾	3.45	2.19	5.69	3.16
1	5.10	3.23	8.42	4.68
1¼	6.90	4.37	11.39	6.33
1½	8.25	5.23	13.61	10.18
2	11.10	7.03	18.32	10.18
2½	18.72	11.70	30.13	16.09
3	24.48	15.30	39.40	21.04
4	34.88	21.80	56.14	29.98
5	47.36	29.60	76.22	40.70
6	61.44	38.40	98.88	52.80

From New York stock the following discounts hold:

	Black	Galvanized
3½ to 6 in. steel lap welded	61%	36%
¾ to 3 in. steel butt welded	64%	42%

Malleable fittings, Class B and C, from New York stock sell at 30 and 5% from list price. Cast iron, standard sizes, 55%.

Bar Iron—Prices are as follows in cents per pound at the places named:

	May 12, 1916	One Month Ago
Pittsburgh, mill	2.60	2.50
Warehouse, New York	3.25	3.15
Warehouse, Cleveland	3.25	3.25
Warehouse, Chicago	3.10	3.10

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-size lots, the following quotations hold:

	May 12, 1916	One Month Ago
New York	List price plus 20%	List price plus 15%
Cleveland	List price plus 20%	List price plus 20%
Chicago	List price plus 10%	List price

Drill Rod—Discounts from list price in New York are as follows: Standard, 65%; extra, 60%; special, 55%.

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York Today	New York One Year Ago	Cleveland	Chicago
$0.00	$3.75@4.00	$5.80	$5.00

In coils an advance of 50c. is usually charged.

High Speed Tool Steel containing from 10 to 18% tungsten sells as follows per pound in New York:
Billets ....$2.35 Bars $3.00

Bar Steel sells at $3.25 per 100 lb. from warehouse, New York.

METALS

Miscellaneous Metals—The present quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	New York May 12, 1916	New York One Month Ago	New York One Year Ago
Copper, electrolytic (carload lots)	30.50	27.25	19.00
Tin	49.50	55.00	39.50
Lead	7.50	6.75	4.20
Spelter	16.37½	19.50	14.00
ST. LOUIS			
Lead	7.37½	6.75	...
Spelter	16.50	18.00	...

At the places named, the following prices in cents per pound prevail:

	New York May 12, 1916	New York One Month Ago	New York One Year Ago	Cleveland	Chicago
Copper sheets, base	37.50	35.00	24.00	38.50	36.50
Copper wire (carload lots)	37.50	35.00	21.50	34.50	37.00
Brass rods, base	45.50	37.00	20.50	38.00	38.00
Brass pipe, base	46.00	41.00	23.50	43.50	46.00
Brass sheets	44.50	37.00	20.50	38.00	38.00
Solder ½ and ½ (case lots)	30.50	31.00	28.50	35.50	35.00

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York May 12, 1916	New York Three Months Ago	Cleveland May 12, 1916	Cleveland Three Months Ago
Copper, heavy and crucible	25.00	21.50	26.00	12.10
Copper, heavy and wire	24.50	21.00	25.00	11.75
Copper, light and bottoms	22.00	18.00	21.00	10.50
Lead, heavy	6.00	5.00	6.50	3.20
Lead, tea	5.50	4.50	5.50	...
Brass, heavy	14.50	13.50	20.00	8.25
Brass, light	12.50	11.00	13.50	6.75
No. 1 yellow rod brass turnings	15.25	13.00	15.50	...
Zinc	12.00	12.50	14.00	4.50

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
$\frac{3}{16}$ to $\frac{7}{32}$	31.50	32.00	32.50	33.00	36.00
¼ to $\frac{5}{16}$	31.25	31.75	32.25	32.75	35.75
⅜ to 1⅞	31.00	31.50	32.00	32.50	35.50
1$\frac{15}{16}$ to 2⅞	31.75	32.25	32.75	33.25	36.25
Rounds					
3 to 3$\frac{7}{16}$	32.50	33.00	33.50	36.00	37.00
Squares					
3	32.50	33.00	33.50	36.00	37.00
Rounds					
3½ to 3$\frac{15}{16}$	32.25	32.75	33.25	35.75	36.75
Squares					
3$\frac{1}{16}$ to 3$\frac{15}{16}$	32.25	32.75	33.25	35.75	36.75
Rounds—Squares					
4 to 4$\frac{15}{16}$	33.00	33.50	36.00	36.50	37.50
5 to 6$\frac{15}{16}$	36.00	36.50	37.00	34.50	38.50
7	36.50	37.00	37.50	38.00	39.00
Flats	32.50	33.00	33.50	36.00	37.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.
Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Antimony—Chinese and Japanese brands are quoted in cents per pound for spot delivery, duty paid:

	May 12, 1916	One Month Ago
New York	35.00	45.00
Cleveland	50.00@55.00	50.00@55.00
Chicago	45.00	45.50

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places named:

	New York	Cleveland	Chicago
Best grade	60.00@65.00	58.75	60.00
Commercial	30.00@35.00	21.00	28.00@30.00

Copper Sheets—In New York from warehouse hot rolled 16 oz. (large lots) base per lb. is 39c.; cold rolled 14 oz. and heavier add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

Copper Bars from warehouse sell as follows in cents per pound.

	May 12, 1916	One Month Ago
New York	42.00	40.00
Cleveland	32.50	33.50
Chicago	38.50	38.00

SHOP SUPPLIES

Nuts—From warehouses at the places named, on fair sized orders the following amount is deducted from list:

	New York May 12, 1916	New York One Month Ago	Cleveland May 12, 1916	Cleveland One Month Ago	Chicago May 12, 1916	Chicago One Month Ago
Hot pressed square	$2.50	$2.75	$3.25	$3.50	$3.25	$3.70
Hot pressed hexagon	2.50	2.75	3.25	3.75	3.25	3.80
Cold punched square	2.00	2.50	3.00	3.00	3.00	3.25
Cold punched hexagon	2.50	3.00	3.25	3.75	3.50	4.00

Semifinished nuts sell at the following discounts from list price

	May 12, 1916	One Month Ago
New York	50—10%	65%
Cleveland	65%	70—10%
Chicago	65%	70%

Carriage Bolts—From warehouses at the places named the following discounts from list price are in effect.

	New York	Cleveland	Chicago
1/2 by 6 in	45—5%	50—10—5%	60—5%
Larger and longer	35%	40—15%	50%

At this rate the net prices are as follows:

Length, In	New York 1/4	New York 1/2	New York 3/4	Cleveland 1/4	Cleveland 1/2	Cleveland 3/4	Chicago 1/4	Chicago 1/2	Chicago 3/4
1 1/2	$0.52	...	...	$0.42	...	...	$0.38	...	...
2	.58	...	...	.48	...	...	.42	...	...
2 1/2	.63	$2.12	$5.53	.51	$1.39	$3.42	.46	$1.63	$4.25
3	.68	2.30	5.85	.55	1.51	3.85	.50	1.77	4.50
3 1/2	.73	2.48	6.18	.60	1.64	4.06	.54	1.91	4.75

Machine Bolts—From warehouses at the places named the following discounts hold.

	New York	Cleveland	Chicago
1/2 by 4 in. and smaller	50%	60 and 10%	60 and 10%
Larger and longer up to 1 in. by 30 in.	40%	50 and 5%	50 and 10%

At this rate the net prices per 100 follow

Length In	New York 1/4	New York 1/2	New York 1	Cleveland 1/4	Cleveland 1/2	Cleveland 1	Chicago 1/4	Chicago 1/2	Chicago 1
2	$0.89	$2.32	$9.60	$0.67	$1.46	$6.09	$0.64	$1.74	$7.20
2 1/2	.82	2.48	10.14	.70	1.57	6.32	.67	1.85	7.60
3	.97	2.62	10.68	.73	1.66	6.84	.70	1.97	8.00
3 1/2	1.01	2.79	11.22	.77	1.77	7.48	.73	2.08	8.40

Wrought Washers—From warehouses at the places named the following amount is deducted from list price:

New York.... $4.00 Cleveland.... $6.00 Chicago.... $6.00

At this rate, the net prices follows

Diameter, In.	New York	Cleveland	Chicago
3/16	$10.00	$8.00	$8.00
1/4	8.20	6.20	6.20
5/16	7.40	5.40	5.40
3/8	6.50	4.50	4.50
7/16	5.80	3.80	3.80
1/2	5.40	3.40	3.40
9/16	5.10	3.10	3.10
5/8	5.20	3.20	3.20
3/4	5.10	3.10	3.10
7/8, 1, 1 1/8	5.00	3.00	3.00
1 1/4, 1 3/8, 1 1/2	5.20	3.20	3.20
1 5/8, 1 3/4, 1 7/8, 2	5.50	3.50	3.50
2 1/4, 2 1/2	6.50	4.50	4.50

For cast-iron washers the base price per 100 lb is as follows

New York.... $2.50 Cleveland.... $2.25 Chicago.... $2.00

Rivets—The following quotations are allowed for fair sized orders from warehouse.

	New York	Cleveland	Chicago
Steel 7/16 and smaller	45%	45—10%	52 1/2%
Tinned	45%	45—10%	52 1/2%

Button heads 1/2, 3/4, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.:

New York.... $5.25 Cleveland.... $3.85 Chicago.... $3.50

Cone heads, same sizes:

New York.... $5.35 Cleveland.... $3.95 Chicago.... $3.60

For the following sizes the extras over the above prices in cents per 100 lb are as follows

1 1/4 to 1 3/4 in long, all diameters	$0.25
3/4 in. diameter	0.15
1/2 in. diameter	0.50
1 in long and shorter	0.50
Longer than 5 in	0.25
Less than kegs	0.50
Countersunk heads	0.50

Nails—Wire nails f.o.b. Pittsburgh sell at $2.50, galvanized, 1 in. and longer, $4.50, and shorter, $5. These prices are to regular customers and delivery is made at the mill's convenience. From warehouse wire and cut nails sell as follows

	New York	Cleveland	Chicago
Wire	3.15	3.05	2.75
Cut	3.15	2.95	2.75

Copper Rivets and Burs sell at the following rate for orders 100 lb and over.

	Rivets	Burs
Cleveland	List price	List price
Chicago	List price	List price
New York	20% from list price	List price

MISCELLANEOUS

Seamless Drawn Tubing (Iron Pipe Sizes)—The base price per pound from warehouse is as follows:

	New York	Cleveland	Chicago
Brass	43.50	44.50	42.50
Copper	46.00	43.50	43.50

For immediate stock shipment the following quotations hold.

Diameter, In.	Copper New York May 12, 1916	Copper New York One Year Ago	Copper Cleveland	Brass New York May 12, 1916	Brass New York One Year Ago	Brass Cleveland
1 1/4 to 2 1/2	49.00	22.50	44.50	46.60	19.50	43.50
3	49.00	22.50	44.50	46.60	19.50	43.50
3 1/2	50.00	23.50	44.50	47.50	20.50	43.50
4	51.00	24.50	45.50	48.50	21.50	44.50
4 1/2	53.00	26.50	47.50	50.50	23.50	46.50
5	55.00	28.50	49.50	52.50	25.50	48.50
6	56.00	29.50	51.50	53.50	26.50	50.50
7	58.00	31.50	51.50	55.50	28.50	50.50
8	60.00	33.50	55.50	57.50	30.50	54.50

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire

[illegible]	10.00
No 8, 3/16 and No. 10	11.00
1/8	12.50
No 12	13.50
1/16, No 14 and	15.00
No 18	16.50
No. 20	17.50

Special Welding Steel

1/2	33.00
3/8	30.00
[illegible]	28.00

Cast-Iron Welding Rods

3/4 by 19 in. long	22.00
3/16 by 12 in. long	26.00
5/8 by 19 in. long	20.00
1/2 by 21 in. long	20.00

Vanadium Wire in Coils or Sticks

[illegible]	15.50
3/16	15.00
1/4	14.00
5/16	12.00
3/8 and larger	11.00

Tin Plates—The following prices are in effect from warehouses at the places named:

	New York May 12, 1916	New York One Month Ago	Cleveland May 12, 1916	Cleveland One Month Ago	Chicago May 12, 1916	Chicago One Month Ago
Coke tin plate, 14x20:						
100 lb.	$6.25	$5.00	$5.40	$5.00	$5.60	$5.00
I. C. 107 lb.	6.40	5.15	5.55	5.15	5.75	5.15

Terne plate, 20x28:

Base Wgt.	Net Wgt.	Coating	New York May 12, 1916	New York One Month Ago	Cleveland May 12, 1916	Cleveland One Month Ago	Chicago May 12, 1916	Chicago One Month Ago
100 lb.	200	8	$10.50	$9.50	$9.10	$9.10	$8.90	$8.50
I C	214	8	10.80	8.90	9.35	9.35	9.25	9.10
I X	270	8	12.80	11.80	11.60	11.60	11.40	11.15
I C	218	12	12.00	12.00	10.50	10.25	10.75	11.75
I. C	221	15	13.00	13.00	10.50	10.50	11.60	11.50
I C.	226	20	13.50	13.50	12.50	12.50	12.50	12.20
I C	231	25	14.25	14.25	13.50	13.50	13.75	13.50
I C	236	30	15.50	15.50	14.50	14.50	14.75	14.50
I C.	241	35	17.00	17.00	15.75	15.75	15.85	16.00
I. C.	246	40	19.00	19.00	16.75	16.75	17.10	16.75

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Apr. 22	Apr. 29	May 6	May 13
Prompt furnace	$2.00	$2.25	$2.25@2.40	$2.00@2.25
Prompt foundry	3.75@4.00	3.75	3.75	3.50@3.75

Sponge Cloths (Wiping Towels) sell as follows per dozen: 16x18 in., 30c.; 18x20 in., 35c.; 18x22 in., 38c.

Foundry and Fire Clay in New York sells at $2 per lot of 300 lb. This does not include delivery charges.

Zinc Sheets—The following prices in cents per pound prevail.

Carload lots, f.o.b. mill 25.50

	New York	Cleveland	Chicago
In casks	26.50	26.50	26.50
Broken lots	27.00	27.00	27.00

Cotton Waste—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	11.00@13.00	11.00@14.00	11.00@13.50
Colored mixed	8.00@10.00	7.50@11.00	8.00@10.50

Sal Soda sells as follows per 100 lb.:

New York	$2.05	Cleveland	$2.25
Philadelphia	1.80	Chicago	1.90

Roll Sulphur in 360-lb bbl. sells as follows per 100 lb.

New York.... $2.75 Cleveland.... $2.75 Chicago.... $2.80

Linseed Oil—These prices are per gallon:

	New York	Cleveland	Chicago
Raw in barrels	$0.78	$0.80	$0.81
5-gal cans	.88	.90	.90

Boiled, it is 1c. per gal. higher.

White and Red Lead, in cents per pound, sell as follows:

	Red Dry	Red In Oil	White Dry and In Oil
100-lb. keg	10.50	11.00	10.50
25- and 50-lb. kegs	10.75	11.25	10.75
12 1/2-lb. keg	11.00	11.50	11.00
1- to 5-lb. cans	12.50	12.50	12.50

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

The contract has been awarded for the construction of a 1-story, 40x200-ft. addition to the machine shop of Scott & Williams, Laconia, N. H.

The contract has been awarded for the construction of a factory at South Boston, Mass., for Albert & J. M. Anderson Manufacturing Co., Boston, manufacturer of electrical goods.

The contract has been awarded for the construction of 3 factory buildings at Boston, Mass., for the Gillette Manufacturing Co. Noted Apr. 20.

The Bristol Brass Co. contemplates constructing an addition to its plant at Bristol, Mass. Estimated cost, $35,000.

Fire, May 3, damaged the foundry of the Lebaron Foundry Co. at Brockton, Mass. Loss, $5,000.

The contract has been awarded for the construction of an addition to the foundry of W. A. Hardy & Sons Co. on Water St., Fitchburg, Mass.

Fire, May 1, destroyed the foundry of the W. R. Hart Co., Island St., Lawrence, Mass.

The Vitrified Wheel Co. will construct an addition to its mill on Emery St., Westfield, Mass.

Plans are being prepared for the construction of an addition to the plant of the Gilbert & Barker Manufacturing Co., manufacturer of gas machines, tanks, etc., at West Springfield, Mass.

The contract has been awarded for the construction of an addition to the plant of the American Steel and Wire Co. at Worcester, Mass. Estimated cost, $20,000. Noted Mar. 30 and Apr. 20.

The contract has been awarded for the construction of a factory at Bantam, Conn., for the Bantam Anti Friction Co., manufacturer of ball and roller bearings.

Plans are being prepared for the construction of a plant at Danbury, Conn., for the Ball and Roller Bearing Co. Noted Apr. 13.

Work will soon be started on the construction of an addition to the plant of the Stamford Rolling Mills Co. at Stamford, Conn.

MIDDLE ATLANTIC STATES

The Donner Steel Co., Buffalo, N. Y., plans to construct additions to its plant at 475 Abbott Rd. Estimated cost, $140,000.

The contract has been awarded for 2 additions to the plant of the Aluminum Co. of America, Niagara Falls, N. Y.

Plans are being prepared for a 2-story factory for the Schatz Manufacturing Co., manufacturer of castings, Poughkeepsie, N. Y. Estimated cost, $25,000.

Bids are being received by the American Locomotive Co., Schenectady, N. Y., for equipment for the new cylinder and forging shop which it plans to construct at Schenectady. Noted Apr. 27.

The Lefever Arms Co., Maltbie St., Syracuse, N. Y., has awarded the contract for a 2-story factory. Noted Apr. 27.

The contract has been awarded for an addition to the factory of the Kerr Turbine Co., Wellsville, N. Y., manufacturer of machinery. Estimated cost, $20,000. Noted May 4.

The Audubon Wire Cloth Co., Audubon, N. J., will soon receive bids for a reinforced-concrete building. Robert T. Korb is Pres.

A 100x100-ft. plant will be constructed on South Spring St., Elizabeth, N. J., by the Elizabeth Auto Body Manufacturing Co.

Press reports state that the Waclark Wire Co., Elizabeth, N. J., plans to construct 5 additions to its plant at Bayway, (Elizabeth post office). Philip Foster is Supt.

The Carnegie Steel Co., Newark, N. J., plans to construct a 1-story building on Bessemer St.

D. B. Dunham & Son, Inc., Newark, N. J., manufacturer of automobile bodies, has acquired a site on Halsey St. and will rebuild its plant recently destroyed by fire. Noted Jan. 27.

The Isotta Fraschini Motors Co., Newark, N. J., representing the Isotta Fraschini and Scripps-Booth cars, will construct a 2-story garage and service station on Central Ave.

C. T. Silver of the Overland Motor Co., New York, N. Y., has arranged for the construction of a garage and sales station on Central Ave., Newark, N. J.

The contract has been awarded for a 1-story factory on Elm St., Parth Amboy, N. J., for the Raritan Copper Works. Estimated cost, $4,000.

The Keystone Watch Case Co., 15 Maiden Lane, New York, N. Y., is in the market for equipment for making time fuses for its plant at Riverside, N. J. Noted Apr. 20.

The American Steel and Wire Co., Trenton, N. J., will build a 1-story addition to its plant on South Broad St.

William F. Hughes, Trenton, N. J., plans to construct a sheet metal working plant on Phillips Ave., Trenton, N. J.

The Trenton Malleable Iron Co., Trenton, N. J., will construct a 1-story addition to its plant on New York Ave.

Plans are being prepared by Brickell & Brickell, Wagner Bldg., Bradford, Penn., for a 1-story foundry for the Bovaird Co., 181 Main St., Bradford. Estimated cost, $6,000.

The machine shops and roundhouse of the Monongahela R.R. at Brownsville, Penn., recently destroyed by fire, will be rebuilt. Loss, $100,000. D. K. Orr, Brownsville, Ch. Engr.

Worth Bros., Coatesville, Penn., will construct machine and blacksmith shops and yard runway in connection with its steel plant. Estimated cost, $130,000.

The United States Lock and Hardware Co., Columbia, Penn., plans to construct several additions to its plant in the fall.

Plans are being prepared by Morris & Erskine, Arch., Philadelphia, Penn., for a 4-story addition to the factory of Leeds & Northup, manufacturer of scientific instruments, near Wayne Junction, Philadelphia.

The Pringle Electric Manufacturing Co., 1912 North 6th St., Philadelphia, Penn., will construct additions to its plant.

SOUTHERN STATES

The Virginia Steel Corporation, recently organized by Edmond H. Patterson and Tarlton F. Heath, of Petersburg, Va., with $2,000,000 capital stock, has retained W. R. Miller Co., Pittsburgh, Penn., to prepare plans and supervise construction of plant at Hopewell, Va. (City Point post office). Estimated cost, $1,000,000. Noted Apr. 20.

F. C. Kramer, Savannah, Ga., will construct a 1-story, reinforced-concrete building for the manufacture of automobile tops.

The National Pipe and Foundry Co. is building achine and pattern shops at Attalla, Ala.

The Louisville, Henderson & St. Louis Ry. will rebuild its shops at Cloverport, Ky., recently destroyed by fire. R. N. Hudson, Louisville, is Pres. and Gen. Mgr.

The National Foundry and Machine Co., 1406 West Main St., Louisville, Ky., is enlarging its plant and is in the market for foundry and tank shop equipment. Noted May 4.

MIDDLE WEST

The Sommers Motor Co. will build a 100x200-ft. machine and erecting shop addition to its plant at Bucyrus, Ohio.

The American Brass Manufacturing Co. has awarded the contract for the construction of a factory at 1521 East 49th St., Cleveland, Ohio.

The contract will soon be awarded for the construction of a 2-story, 60x350-ft. reinforced-concrete factory for the Champion Register Co., 6921 Colfax Rd., Cleveland, Ohio.

The Cuyahoga Spring Co., 16606 Waterloo Rd., Cleveland, Ohio, will construct an addition to its plant at Cleveland. Estimated cost, $4,000.

We have been advised that the Ferry Cap and Screw Co. is constructing an addition to its plant at 2147 Scranton Rd., Cleveland, Ohio. Estimated cost, $4,000. Noted May 4.

The contract has been awarded for the construction of a 1-story factory at Lakeside and 51st St., Cleveland, Ohio, for the Forest City Electric Co., Windsor, Ave., manufacturer of electric equipment and automobile parts. Estimated cost, $25,000.

The contract has been awarded for the construction of a 200x500-ft. factory at Coit Rd. and Kirby Ave., Cleveland, Ohio, for the Grant Motor Co., Findlay.

Plans have been prepared for the construction of an addition to the plant of the Kuhlman Car Co., Adams Ave., Cleveland, Ohio.

The Mustee Water Heater Co., 3008 Cedar Co., Cleveland, Ohio, has been granted a permit for the construction of a factory at 3409 Superior Ave., Cleveland. Estimated cost, $10,000. Noted Jan. 27.

The Standard Oil Co. has awarded the contract for the construction of a 60x100-ft. garage at 3041 Broadway, Cleveland, Ohio. Estimated cost, $12,700. Noted May 4.

Work will soon be started on the construction of a 2-story, 60x100-ft. factory at Cleveland, Ohio, for the West Steel Castings Co., 805 East 70th St., Cleveland. Noted Jan. 20.

The New York Central R.R. through its purchasing department in Cleveland, Ohio, is in the market for the following metal-working and wood-working tools for its shops at Coalburg, Ohio: 1 planing machine, one 4-spindle combination horizontal car boring machine, 1 vertical hollow chisel car mortiser with 2 vertical boring attachments, one 42-in. band sawing machine, one 36-in. rip sawing machine, one 2-in. triple head bolt cutting machine, one 2-in. pipe threading machine, one 12-in. power punching machine, one 250-lb. power hammer, one 28-in. vertical drilling machine, one 3x18-in. emery grinding machine and two 10-ton standard electric traveling cranes. G. R. Ingersoll, Cleveland, is Pur. Agt.

The Fyr-Fyter Co., recently incorporated, plans to establish a factory at Dayton, Ohio, for the manufacture of fire extinguishers and kindred lines.

The Galion Iron Works and Manufacturing Co. is constructing additions to its plant at Galion, Ohio.

The Fischer Can Co., recently incorporated, plans to establish a plant at Hamilton, Ohio C R Greer, Secy. Hamilton Chamber of Commerce, is interested.

The Niles Tool Works Co. will construct an addition to its plant at Hamilton, Ohio.

The Standard Car Construction Co., recently incorporated, plans to construct a plant at Hubbard, Ohio Estimated cost, $1,000,000

The Buckeye Foundry Co. is rebuilding its plant at Overpeck, Ohio, which was recently destroyed by fire with a loss of $25,000. Noted May 4.

The Bay View Foundry Co is constructing a 1-story, 60x125-ft. addition to its plant on McDonough St, Sandusky, Ohio. Noted Nov. 4

J E. Galvin, of the Ohio Steel Foundry Co, Lima, Ohio, and others are interested in the organization of a company to construct a steel foundry at Springfield, Ohio.

The Western Conduit Co will construct an addition to its plant at Youngstown, Ohio. Estimated cost, $50,000. L. J. Campbell is Pres.

The Elwood Foundry Co., recently incorporated, will enlarge and equip the plant of the Elwood Iron Works at Elwood, Ind. M. H. Pilkington, Elwood, is in charge.

The Dudlo Manufacturing Co. manufacturer of wire enameling, plans to construct additions to its plant at Ft. Wayne, Ind. George A. Jacobs is Mgr

The United States Steel Corporation is constructing a plant at Gary, Ind. Noted Dec 9

The National Steel Casting Co plans to enlarge and improve its plant at Montpelier, Ind Estimated cost, between $25,000 and $75,000

The Michigan Stamping Co. is constructing a plant on Mack Ave., Detroit, Mich. Noted Mar 9

The contract has been awarded for the construction of a 60x200-ft addition to the plant of the Morton Manufacturing Co., manufacturer of iron working machinery, at Muskegon Heights, Mich

The American Glyso Metal Co will build a 1-story factory at 1625 Rockwell St, Chicago, Ill Estimated cost, $4,000

The Anheuser-Busch Brewing Association, St. Louis, Mo., will construct a 1 story garage at 2609 Jones St, Chicago, Ill Estimated cost, $10,000

The Apex Appliance Co., 3223 West 30th St, Chicago, Ill., manufacturer of washing machines will build a 1 story addition to its factory at Chicago. Estimated cost, $5,500

The Austin Motor Co, 4701 West Maison St, Chicago Ill, will construct a garage at 44 North Saramic Ave, Chicago. Estimated cost, $10,000

The contract has been awarded for the construction of a garage at 5045 Lake Park Ave., Chicago, Ill., for J. A. Carroll

Bids are being received for the construction of a 50x150-ft addition to the plant of the Chicago Bearing Metal Co, 43rd and Western Ave, Chicago, Ill

The Chicago & Northwestern Ry, Chicago, Ill, is in the market for locomotive repair shop equipment, consisting largely of bolt making machinery, forging presses and plate working tools Noted Jan 27

The Cole Manufacturing Co, manufacturer of stoves, 3218 South Western Ave Chicago, Ill, will construct a 2 story machine shop at 2428 Bross Ave, Chicago. Estimated cost, $12,000

W C. Griswold, 3616 Grand Blvd, Chicago Ill manufacturer of steel drawn metal goods, will construct a 2-story factory at Chicago. Estimated cost, $25,000

Bids are being received for the construction of a 1 story, 100x120-ft machine shop for A M Harroun, 5501 Cornell Ave, Chicago, Ill.

The Illinois Central R R, Chicago Ill, is receiving tentative figures for 12 machines for machine shop work A S Baldwin, 135 East 11th Pl, Chicago is Ch Engr

H P Kroencke, 2710 Iowa St, Chicago Ill will construct a 1-story garage at 2611-20 North California Ave, Chicago, Ill. Estimated cost, $10,000.

The Lawrence Manufacturing Co, 9 South Clinton St, Chicago, Ill, manufacturer of metal gasoline lamps, is constructing a factory at Chicago Estimated cost, $75,000.

Matthew Schmidt will construct a 1 story garage at 3720 Southport Ave, Chicago, Ill Estimated cost, $10,000

L. Shon will construct a garage at 825 East 43rd St, Chicago, Ill. Estimated cost, $14,000

The Weller Manufacturing Co, 1840 North Kostner Ave, Chicago, Ill, will construct an addition to its machine shop at Chicago. Estimated cost, $2,000

The Holt Manufacturing Co manufacturer of traction engines, is constructing a 100x180-ft addition to its plant at Peoria, Ill. Noted May 4

The contract has been awarded for the construction of a 2-story, 40x120 ft shop at Grand Rapids, Wis, for the Wood County Cooperage Co Noted Apr 13

C H Lohr will construct a 25x70-ft. machine shop addition to his garage at Hartford, Wis

The Goethal Blow Pipe and Ventilating Co, 627 Prairie St., Milwaukee, Wis, has increased its capital stock, and plans to equip and enlarge its plant at Milwaukee.

The automatic plant of the Harley-Davidson Motor Co., 160 Clinton St, Milwaukee, Wis, is being remodeled.

The contract has been awarded for the construction of a 1-story, 84x100-ft. addition to the plant of the Manufacturers' Foundry Co., 15th and Oklahoma Ave., Milwaukee, Wis.

The Reedsburg Auto Co. will construct a 1-story, 56x115-ft. addition to its plant at Reedsburg, Wis.

The Townsend-Metcalf Automobile Co. is constructing a 3-story addition to its plant at Reedsburg, Wis. Noted Mar. 16.

The Ozaukee Heater Co. will construct a plant at Saukville, Wis., for the manufacture of oil burners and stoves.

F. J. Moeller will construct a 30x60-ft. machine shop at Sturgeon Bay, Wis.

Preliminary plans are being prepared for the construction of an addition to the foundry and finishing shop of the Werra Aluminum Co., Waukesha, Wis.

The John Obenberger Forge Co. plans to construct a factory at West Allis, Wis. John Obenberger, John S. Pease and others are interested.

WEST OF THE MISSISSIPPI

The Ford Motor Co., Detroit, Mich., plans to construct a factory at Des Moines, Iowa. C. L. Herring is Local Agt.

The Central Cornice Works, Sioux City, Iowa, will construct 2 factory buildings at 411 and 469 Water St.

The contract has been awarded for the construction of an addition to the plant of the American Can Co., 747 North Prior Ave., St. Paul, Minn., in the Midway District. Estimated cost, $50,000. Noted Dec. 30 and May 11.

The Tom Thumb Tractor Co., Minneapolis, Minn., plans to take over the plant of the Peteler Cra Co., Como Ave., St. Paul, Minn., and equip it for the manufacture of its specialty.

The Sarnia Fence Co., Ltd., Sarnia, Ont., is building a plant at Stillwater, Minn., which will be branch of United Fence Co. of Port Huron, Mich. T. S. Prendergast is Mgr. Noted Apr. 20.

Plans are being prepared by D. W. Line, Bee Bldg., Omaha, Neb., for a 2-story garage for the Bankers' Realty and Investment Co., Bee Bldg. Estimated cost, $30,000.

J. R. Reardon, Mo., will construct a 2-story, 50x120-ft. garage at 2nd and Joplin St. to be leased by the Overland Motor Car Co.

W E. Zahner, 12 West 10th St., Kansas City, Mo., is building a 1-story, 50x100-ft. brass factory. Estimated cost, $3,000

The contract has been awarded for the construction of a new building for the Korman & Steirly Garage and Machine Shop, Taylor, Tex.

WESTERN STATES

The Port Commission, Seattle, Wash., is in the market for a 35-ton locomotive crane for the South Cove Pier. Estimated cost, $16,000

The Western Scale Co., recently incorporated, plans to construct a plant at Vancouver, Wash. John B. Easter, Vancouver, is interested.

F Gilhuly plans to construct a garage and machine shop at White Bluffs, Wash.

Chanslor & Lyon Co. has awarded the contract for the construction of a 2-story garage at Broadway and Couch St., Portland, Ore. Estimated cost, $20,000.

F. C Knapp, Pres of the Peninsula Lumber Co., and associates plan to construct a shipbuilding plant at Portland, Ore. Estimated cost, $100,000.

The contract has been awarded for the construction of a 5-story reinforced-concrete automobile building at 11th and Hope St, Los Angeles, Calif., for the Harris Newmark Co Estimated cost, $105,000.

The Howard Co. will construct a 1-story machine shop at 1st and Market St, Oakland, Calif. Estimated cost, $5,000.

The Wahtoke Citrus Association will build a packing plant at Reedley, Calif Estimated cost, $10,000.

The Pacific Coast Steel Co., Sacramento, Calif., is in the market for a 75-ton ladle crane.

CANADA

We have been advised that the Canada Stove and Furniture Co Ltd, Montreal, Que, is in the market for cleaning mills, molding machines, sheet steel machinery, polishing machines, etc. Noted May 4

We have been advised that Taylor Bros., Ltd., Carleton Place, Ont, is in the market for a lath, drill, miller, vulcanizer and forge. Noted Apr. 27.

The Goldie & McCulloch Co., Ltd., will construct an addition to its plant at Galt, Ont., for the manufacture of machinery, boilers, etc. Estimated cost, $100,000.

Work will soon be started on the construction of a foundry at Guelph, Ont., for the Guelph Stove Foundry Co.

The Stanley Steel Co. is constructing a steel plant at Hamilton, Ont.

The Harbor Commissioners plan to construct a machine shop on the Don Division near Mill St., Toronto, Ont. Estimated cost, $13,500.

Work will soon be started on the reconstruction of the plant of the Dominion Harvester Co., manufacturer of farm machinery, at Medicine Hat, Alta. The company is in the market for machine tools and other equipment.

GENERAL MANUFACTURING

NEW ENGLAND STATES

The Lunn & Sweet Shoe Co. will construct a 4-story, 82x148-ft. addition to its factory at Auburn, Maine.

McLean & Taylor will build a 3-story, 40x80-ft. cold-storage plant on Elm St., Manchester, N. H.

The Milford Manufacturing Co. plans to construct an addition to its weave shed at Milford, N. H.

The Cherry Valley Woolen Mills awarded the contract for the construction of a 1-story, 62x80-ft. addition to its factory at Cherry Valley, Mass.

The contract has been awarded for the construction of an addition to the plant of the Falulah Paper Co. at Fitchburg, Mass. Noted Mar. 2.

Fire, May 3, damaged the plant of the New England Paper Bottle Co. at Northampton, Mass. Loss, $15,000.

The Glencairn Manufacturing Co., manufacturer of silk fabric, is constructing a 1-story, 80x90-ft. addition to its plant at Pawtucket, R. I.

MIDDLE ATLANTIC STATES

The Globe Woven Belting Co., 1396 Clinton St., Buffalo, N. Y., will be in the market for about 50 looms for its proposed new addition. Estimated cost, $10,000. M. Beecher is Vice-Pres. Noted May 4.

Plans being prepared by William Higginson, Arch., 21 Park Row, New York, N. Y. (Borough of Manhattan), for a 6-story, 100x125-ft. braid dyeing factory for R. H. Comey Co., 78 18th St., New York, N. Y. (Borough of Brooklyn). Estiated cost, $75,000.

The Tempest Knitting Co., Perry, N. Y., is building a new 3-story factory in Tempest St.

Scott & Bowne, Bloomfield, N. J., manufacturer of cod liver oil and chemical specialties, will build a reinforced-concrete addition to its plant on Orange St.

The Victor Talking Machine Co. has awarded the contract for a cabinet plant at Camden, N. J. Estimated cost, $500,000.

The Butler Chemical Co., Butler, N. J., plans to construct a new plant at East Bloomingdale, N. J.

A plant will be constructed at Elizabeth, N. J., by the United Chemical Co., New York, N. Y.

The Pennsylvania Shipbuilding Co., 828 Land Title Bldg., Philadelphia, Penn., is constructing a shipbuilding plant at Gloucester, N. J., and is taking bids for equipment. George S. Hoell, Secy. and Treas.

The contract has been awarded for the construction of an addition to the leather factory of Berkowitz, Goldsith & Spiegel, Garden St., Newark, N. J. Estimated cost, $25,000. Noted Apr. 6 and 27.

Fire recently destroyed a section of the plant of the Consolidated Color and Chemical Co., Brown St., Newark, N. J. Loss, $100,000.

The Empire Leather Co., Newark, N. J., will enlarge and improve its plant on Southh 10th St.

The contract has been awarded for the construction of a plant on Chestnut St., Newark, N. J., for the Hanovia Chemical Co. Estimated cost, $25,000.

The Keystone Reduction Co., New York, N. Y., will build a new plant for the manufacture of acids on Ave. P, Newark, N. J. Estimated cost, $100,000.

The contract has been awarded for 2 additions to the plant of Marden, Orth & Hastings, Newark Meadows, Newark, N. J., manufacturer of oils and acids. Estimated cost, $75,000. Noted Jan. 27 and Apr. 27.

The New Toy Manufacturing Co., Newark, N. J., will build a 1-story addition to its plant on Central Ave.

Thomas Preston, Newark, N. J., manufacturer of leather, will construct a new 2-story factory on Ferdon St.

The Seaboard Chemical Co., Newark, N. J., will construct a 4-story building at the foot of Blanchard St. Estimated cost, $40,000.

The Thermoid Rubber Co., Trenton, N. J., manufacturer of auto tires, etc., has awarded the contract for a 2-story addition to its plant.

The Sun Shipbuilding Co., Chester, Penn., and Finance Bldg., Philadelphia, Penn., is building a 2-story, 55x640-ft. plant at Chester, Penn., with 6 shipways and is taking bids on equipment. Estimated cost, $3,000,000.

The Belmont Packing and Rubber Co., Philadelphia, Penn., will construct a 2-story factory at Sepviva and Butler St. C. P. Berger, Arch.

Plans are being prepared for a shoe factory at Richland, Penn., for the Curtis & Jones Co., 702 West 8th St., Reading, Penn. Estimated cost, $20,000.

We have been informed that the Rich Woolen Mills, Woolrich, Penn., will be in the market for looms, etc., for its proposed new addition. Noted May 4.

The Linde Air Products Co., 30 East 42nd St., New York, N. Y., manufacturer of oxygen, etc., plans to construct a plant at Baltimore, Md.

SOUTHERN STATES

The American Agricultural Chemical Co., Boston, Mass., has awarded the contract for the construction of a plant at Alexandria, Va., for the manufacture of guano.

The cotton compress of the Sheffield Cotton Co., Sheffield, Ala., recently destroyed by fire with a loss of $125,000, will be rebuilt. Noted May 4.

MIDDLE WEST

Plans have been prepared for the construction of a factory for the National Artificial Silk Co., 735 Central Ave., Cleveland, Ohio. Estimated cost, $300,000.

The American Lace Co. contemplates constructing an addition to its plant at Slyria, Ohio. Estimated cost, $10,000.

The Central Ohio Paper Co., 124 Ontario St., Toledo, Ohio, is constructing a factory at Toledo. Estimated cost, $50,000. Noted Feb. 3.

Work will soon be started on the construction of a 7-story, 120x130-ft. factory at Grand Rapids, Mich., for the Globe Knitting Works. Noted Apr. 27 and May 11.

Fire, May 4, damaged the plant of the Acme Asbestos Co. at Kinzie and Ada St., Chicago, Ill. Loss, $5,000.

The L. A. Harsha Manufacturing Co., 2010 Carroll Ave., Chicago, Ill., has awarded the contract for the construction of a 4-story, 60x75-ft. factory at Kinzie and Lincoln St., Chicago, for the manufacture of moldings and frames.

The Western Packing Co., 3854 South Morgan St., Chicago, Ill., will construct a packing plant at 38th and Morgan Ave., Chicago. Estimated cost, $400,000. John Haltzel is Vice-Pres.

The H. M. T. Chemical Co., Merchants Laslede Bldg., St. Louis, Mo., will equip a plant at East St. Louis, Ill., for the manufacture of coal tar dyes. Estimated cost, $50,000.

The contract has been awarded for the construction of a factory at Eau Claire, Wis., for the Gillette Safety Tire Co.

The Bain Wagon Co. is constructing a 3-story addition to its plant at Kenosha, Wis.

The contract has been awarded for the construction of an addition to the plant of the Morgan Co., manufacturer of sashes, doors and blinds, at 6th and Oregon St., Oshkosh, Wis.

WEST OF THE MISSISSIPPI

B. L. Fields, Temple, Minn., plans to install a canning factory.

The Fredonia Realty Co., St. Louis, Mo., has awarded the contract for the construction of a 2-story building to be occupied by the Goodyear Tire and Rubber Co., 1909 Locust St., St. Louis, as a shop and sales building.

The Standard Corrugated Box Co., St. Louis, Mo., recently incorporated with $15,000 capital stock, plans to equip a plant for the manufacture of paper and fiber boxes. George C. Huth, Jr., is interested.

A cotton gin will be established by the Merchants and Farmers' Gin Co., McGhee, Ark. About $12,500 will be expended on machinery. George B. Ewing is Pres.

Anderson, Clayton & Co., Houston, Tex., has awarded the contract for the construction of a cotton concentration plant. Estimated cost, $83,000.

WESTERN STATES

Work will soon be started on the construction of an addition to the factory at Camas, Wash., of the Crown-Willamette Pulp and Paper Co., Portland, Ore.

The Kanite Explosive Co., Seattle, Wash., plans to build a plant near Renton, Wash. Joseph Bjorn is Pres.

The National Canning Co. will construct a cannery at Seattle, Wash. Estimated cost, $50,000.

The Quinault Salmon Packing Co., recently incorporated, plans to construct a cannery at Tacoma, Wash.

The Oregon Packing Co. is constructing 2 additions to its plant at Vancouver, Wash.

E. J. Crandall, Los Angeles, Calif., and T. F. Burke, Secy. of the Bakersfield Board of Trade, Bakersfield, Calif., are back of a movement to construct a sugar factory at Bakersfield.

The Pacific Fruit Express Co. plans to construct an icing plant near Pacific Electric tracks at Colton, Calif. Estimated cost, $35,000. L. E. Cartmill is Supt.

The United States Rubber Co., Los Angeles, Calif., plans to equip a 3-story factory at 921 South Los Angeles St., Los Angeles. J. B. Magee is Local Mgr.

The Oakland Textile Manufacturing Co., manufacturer of woolen goods, plans to construct a 2-story plant at Oakland, Calif. Estimated cost, $50,000.

The V. K. Sturgis Co. has awarded the contract for the construction of a 1-story automobile tire factory on Foothill Blvd., Oakland, Calif. Estimated cost, $12,795.

The San Diego Sugar Co. plans to construct a factory at San Diego, Calif. Estimated cost, $200,000. H. S. Hadsall is Dir.

CANADA

The Fleishhacker & Johnson interests of California plan to construct a paper mill as an addition to the pulp mill at Ocean Falls, B. C. Estimated cost, $2,500,000. Crown Willamette Paper Co., L. Bloch, Vice-Pres. and Gen. Mgr., San Francisco, Calif., interested.

Classified Advertising

The Classified Advertising section appears on pages 184, 185, 186, *of this issue and will in future appear in the same relative position in the paper.*

American Machinist

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VOLUME 44 — MAY 25, 1916 — NUMBER 21

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WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormsby processes, protected by United States patents issued June 22, 1915, and Apr. 18, 1916.

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Machining Valve Sleeves for Knight Motors

By Fred H. Colvin

SYNOPSIS—The good mechanic does not attempt the impossible. Knowing that a thin sleeve will spring if left to itself and that it will be held true when in use, the obvious solution is to hold it to its proper shape while it is being machined. This requirement involves very accurate roughing or first cuts, in order to have the sleeves fit properly in the fixtures that are to hold them.

The making of the sleeves, or sleeve valves, of the Knight engine is an interesting machine-shop proposition, and the way in which it is handled by the Moline Automobile Co., East Moline, Ill., well illustrates some of the mechanical problems involved and the ingenious and workmanlike way in which they are solved. These sleeves are approximately $4\frac{1}{2}$ in. in diameter and 8 to 10 in. long; and when it is considered that the thickness is only $\frac{1}{8}$ in. and $\frac{3}{32}$ in. respectively, the perplexing features of the problem become more apparent. The difficulty of securing and maintaining cylindrical sleeves of such a thickness has developed the use of a number of interesting methods and fixtures that may have application in other fields.

Fig. 1 shows sleeves in some of the various stages of development from the rough casting to the finished product. The one at the right, however, is a short outside sleeve *F*, which happened to be the only one available in the finished condition. Beginning with the rough casting *A* at the left, the end of the chucking piece is disk-ground on the bottom to make a flat surface and is ground square with reference to the center of the lugs or ears, to which the driving rod connects. The sleeve is then rough-turned on the outside, rough-bored, the end faced off and chamfered inside and out, finished on the inside of the bottom end by a tool coming through the lathe spindle, and the undercut *G* is turned by the cross-slide—all on a Potter & Johnston semiautomatic.

The third operation is to hold the rough-turned sleeve *A* in its draw-in collet *B*, Fig. 2, also on a Potter & Johnston lathe, while the holding ring *C* is cut off, the bottom faced off and chamfered and the first reaming operation performed. In order to hold the sleeve successfully in a draw-in collet it is necessary that it be of practically uniform diameter, so that the so-called rough-turning is more properly a first turning within close tolerances instead of a rough-turning in the usual sense. The sleeve must fit the draw-in collet quite accurately or the desired results will not be obtained. The two pins on *B* are to relieve the driving stress on the chuck.

There is a single-point boring tool in front of the reamer, which leaves 0.007 in. for reaming, while the

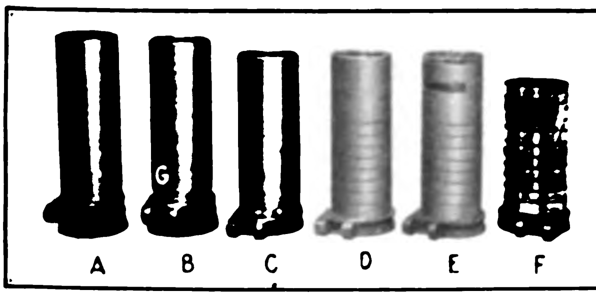


FIG. 1. PARTIAL SEQUENCE OF OPERATIONS

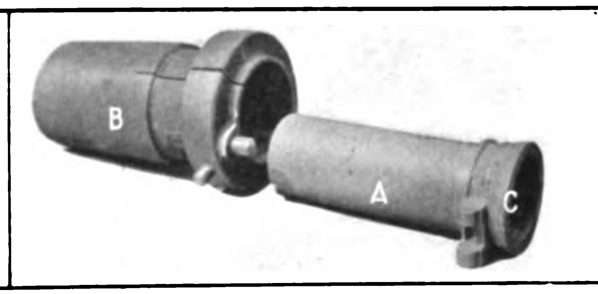


FIG. 2. CHUCK FOR FINISH BORING

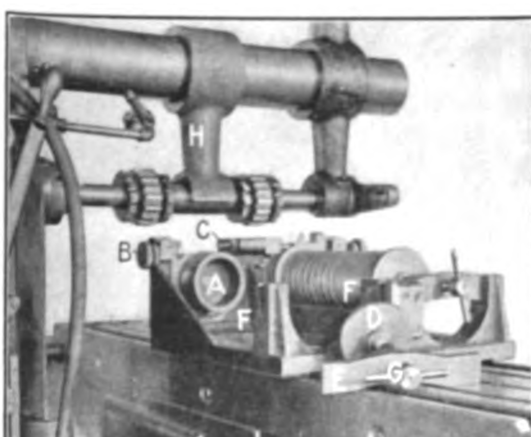


FIG. 3. MILLING DRIVING EARS OF SLEEVE

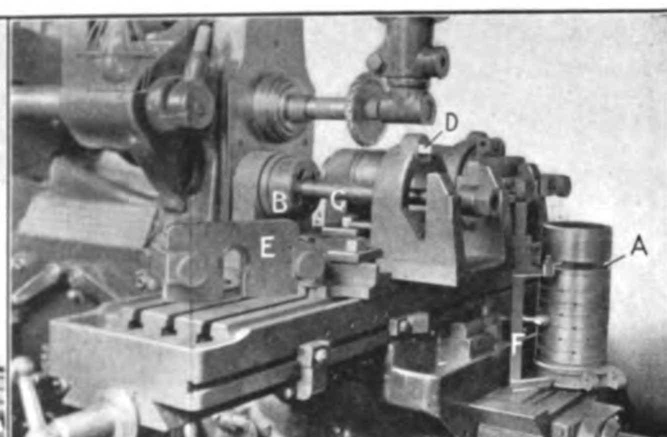


FIG. 4. MILLING SLEEVE PORTS

reamer leaves from 0.018 to 0.02 in. for the final reaming. The second turning is done on a Fay lathe, which is kept solely for finish-turning of the sleeve and the head. In this way extreme accuracy can be maintained. This lathe also turns the oil grooves in the sleeve, the work being clamped on a mandrel that centers and clamps the sleeve without tending to distort it.

The driving lugs are next milled with a double gang of form cutters, Fig. 3. Two sleeves are milled at one effectually prevents spring and enables a heavy cut to be taken without chatter.

The intake ports are next milled, as shown in Fig. 4, this fixture being designed along somewhat similar lines to the one in Fig. 3, but modified to suit the differing conditions. The illustration shows one sleeve in place under the milling cutter and the other part of the fixture empty, so that its operation will be perfectly clear. The milling cutter is set over the sleeve at the proper joint,

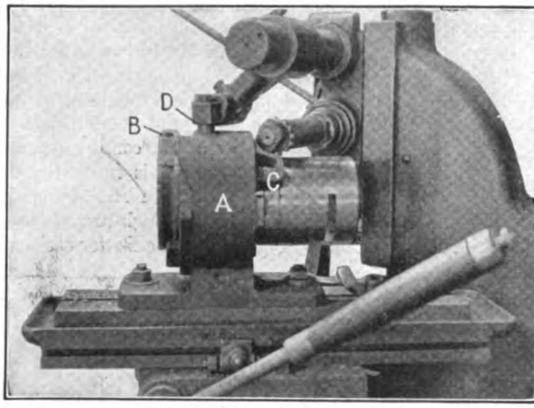


FIG. 5. MILLING SPIRAL OIL GROOVES

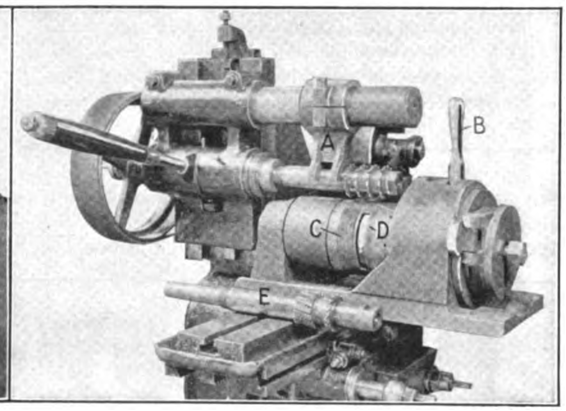


FIG. 6. MILLING OIL GROOVES

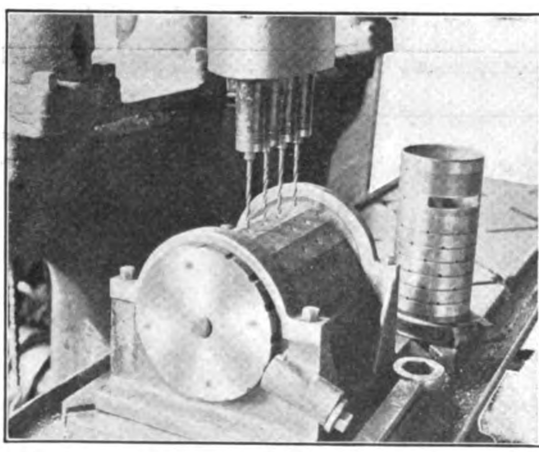


FIG. 7. DRILLING OIL HOLES IN SLEEVE

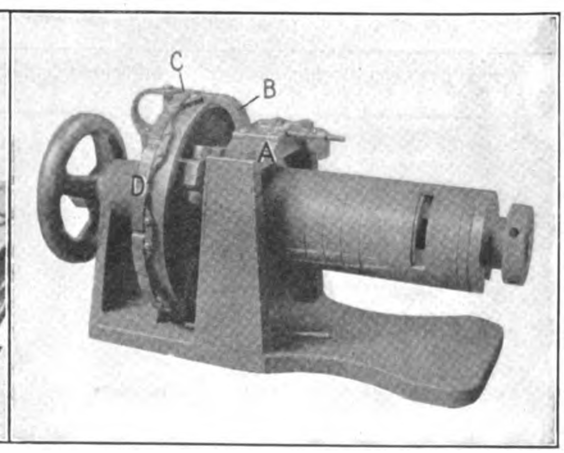


FIG. 8. OFFSET DRILLING JIGS

setting, as can be seen, the near side of the fixture being left empty to show its construction and the way in which the sleeve is clamped. The base of the sleeve fits over the projection *A*, which locates this end, while the thumb-screw *B* adjusts the lug against the hardened stop *C* so that the sleeve can be exactly located at each setting. The other end is centered and supported by the clamp *D*. The crossbar *E* drops into the slot *F*, and the jackscrew *G* tightens to hold it firmly in place. This arrangement gives a fixture that is easily operated, so that the handling time is about as low as can be secured.

It will also be noticed that precautions are taken to prevent the upward spring of the milling-cutter arbor by the introduction of the arm *H* with a half-bearing placed between the two gangs of cutters. This feature and after adjustment to the correct depth it cuts the port to the desired size, as at *A*.

The end of the sleeve is supported on the plug *B*, the sleeve being slid over the bolt *C* so that the driving lug will locate properly against each side of the stop *D*. The plate *E*, carrying the two knurled-head screws shown, slips over the rod *C* and forces the sleeve firmly in place while the port is being milled.

The location of this port is tested by the vernier height gage *F*, seen in position on a finished sleeve. The other port is milled in a similar manner, which it is unnecessary to illustrate.

The spiral oil grooves *F*, Fig. 1, are next milled by the fixture illustrated in place on the hand miller in Fig. 5. The cylindrical base *A* carries an inner sleeve in

which the sleeve valve fits. This valve is located by the lugs *B*, and the spiral is produced by the slot shown in the inner sleeve at *C*. As the table is moved back and forth by the hand lever in front, the stationary guide pin *D* acts in the spiral slot and turns the sleeve as it passes under the milling cutter.

The short oil grooves on the side of the valve are milled in a somewhat similar fixture, Fig. 6. The miller spindle carries a gang of cutters, supported against upward thrust by the overarm bearing *A*. The sleeve is located by the lugs, as before, and the short oil grooves are milled by moving the sleeve back and forth under the cutters by the handle *B*, the amount of movement being determined by the length of the slot. There is a second slot, as can be seen, to which the handle is transferred so as to secure a slightly different indexing, if it can be so called.

There are also fine serrations on each side of the port opening, as at *C* and *D*. They are milled in a similar way by the gang of cutters *E* on the miller table.

Oil holes are next drilled through the sleeve by the four spindle head and the fixture illustrated in Fig. 7. This is an indexing fixture that can drill 16 series of four holes each, as can be seen.

Fig. 8 shows the manner in which each successive row of holes is offset. This method prevents errors on the part of the operator by blanking first one drill bushing and then the other by means of a sliding plate. The sleeve is located by its lug in the usual way, the drill bushings being carried in the plate *A*. One of these bushings is covered by the slide *B*, according to its position as controlled by the cams *C*, each alternate position on the index being covered by one of these cams. This procedure makes it impossible for the operator to enter the drill in the wrong bushing, and it is a very simple method which may have other applications.

The next operation is drilling the ears of the sleeve for the bearing pin and is accomplished in the fixture illustrated in Fig. 9. Here the block *A* locates the sleeve and also supports it against the drilling stress. The hole is located both with reference to the sleeve diameter and the location of the port *B*. This port fits over the block *C*, while the ears go over the block *A* and the swinging portion of the jig *D* centers and holds it in place while being drilled. For quick handling, the clamping is done by dropping the enlarged head bolt *E* over a suitable slot in the upright side of the drilling jig, the final clamping being done by the nut at the other end. The reamer and its bushing are shown in place in the fixture, but the drill and its bushing can be seen under the swinging portion *D* of the jig.

All these operations have been performed on the sleeve in its rough condition, both as to the outside and inside finish. Recalling that they have been done in sleeves or on locating plugs or mandrels, the necessity for maintaining accuracy in the roughing, or more properly the first, operations will be seen.

Before either the inside or the outside is finished, the sleeves are carefully annealed in large furnaces. The sleeves are heated up slowly to about 500 deg. F. and then allowed to cool off in the furnace, in which they are usually left overnight, so that all internal stresses are removed before the sleeves are taken out of the furnace.

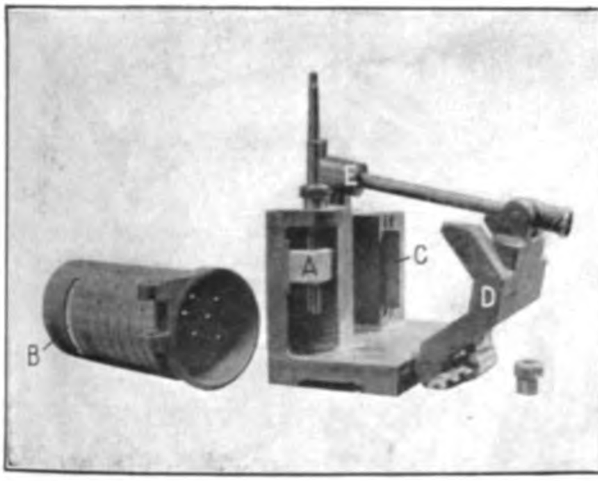


FIG. 9. DRILLING DRIVING LUGS ON SLEEVE

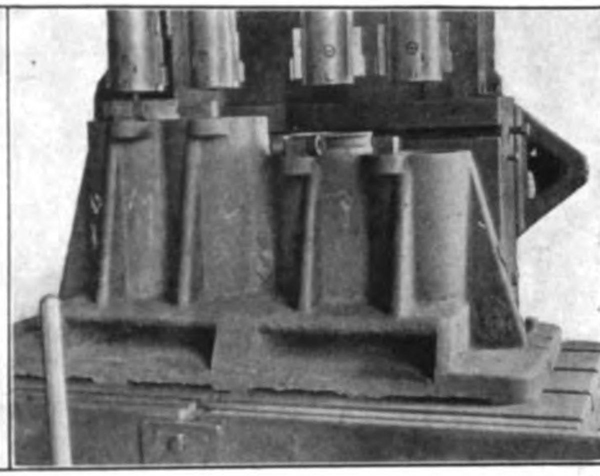


FIG. 10. BORING BOTH LENGTHS OF SLEEVES

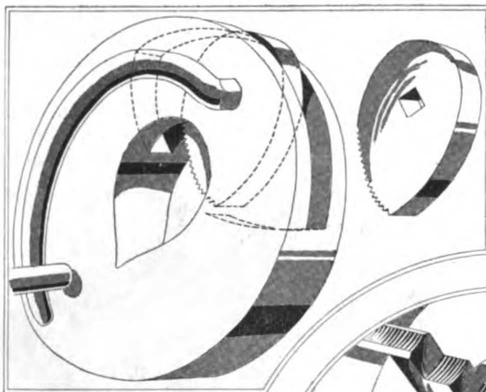
Finish-boring is the next operation, and it is done in the fixture seen in Fig. 10. This fixture handles two of the long sleeves and two of the shorter ones, the lugs being used to prevent the sleeve from turning under the action of the boring cutter. The cutters are of the floating type, the operation being performed in a four-spindle Moline vertical drilling machine. The fixtures are quite heavy and are accurately bored to size, so as to hold the sleeve firmly at all points while it is being bored. The walls being so very thin makes it impossible to prevent the sleeve from going out of round during various operations as well as in the annealing process. These heavy fixtures force the sleeve back into a cylindrical position, so that it is bored with reference to its outside surface.

The pieces are next finished by grinding on the outside, being slipped over a mandrel of the proper size and held concentric with the finish bore while they are ground. Extreme care is taken to maintain finish sizes so as to hold the sleeve concentrically during both the finish-boring and the finish-grinding of the outside.

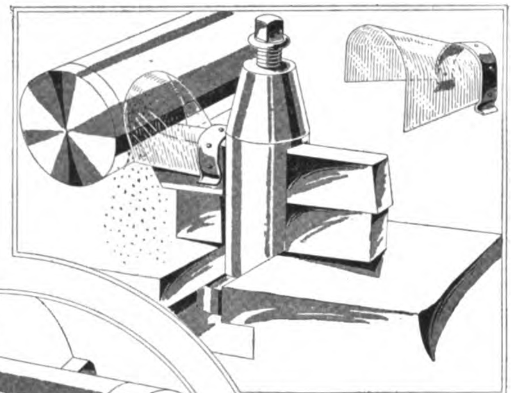
It has been found that when the boring fixture or the grinding mandrel wears slightly below the size, it is an easy matter to increase either dimension by changing the surface with a thin layer of blue vitriol, or sulphate of copper, such as is used for laying out work. Although this treatment adds a seemingly inappreciable amount, it is often found sufficient to restore the fit desired.

From a Small-Shop Notebook

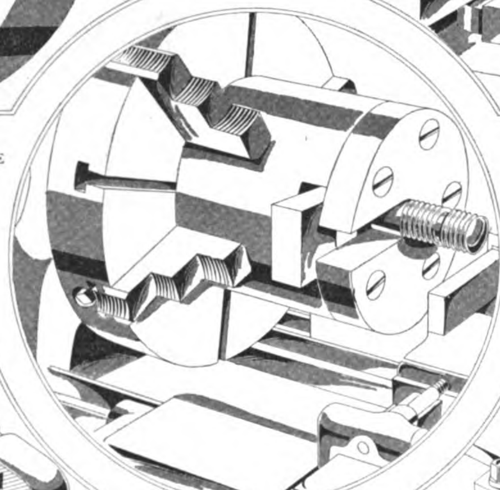
By John H. Van Deventer



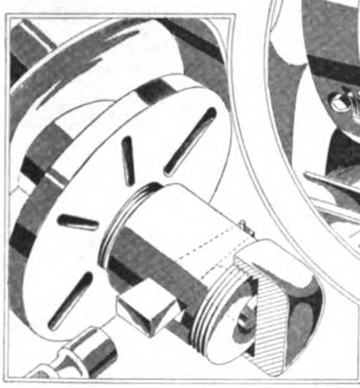
This Dog Is Safe, But Has a Vicious Bite



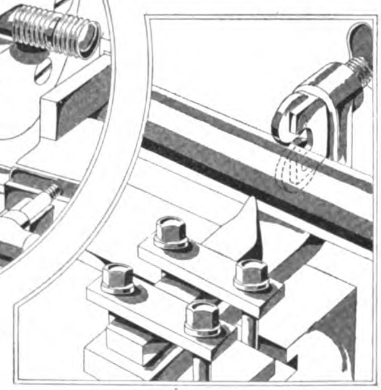
Celluloid Is Transparent, But It Stops Brass Chips



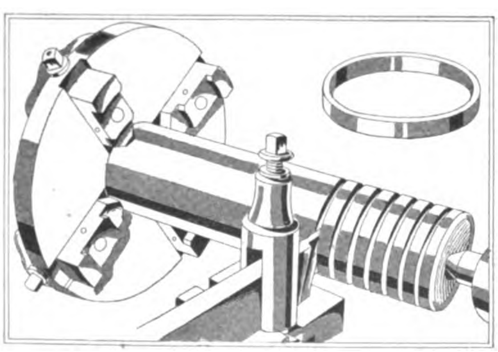
This Wedge Chuck Made Good on Piecework



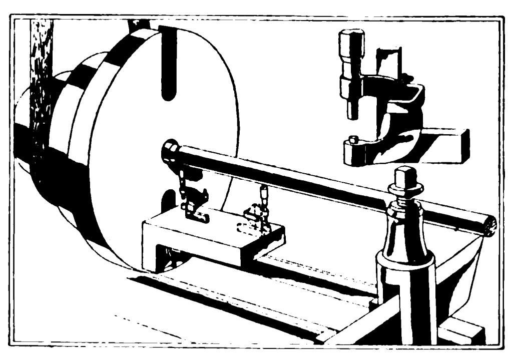
Screw Caps are Held Firmly and Released Quickly



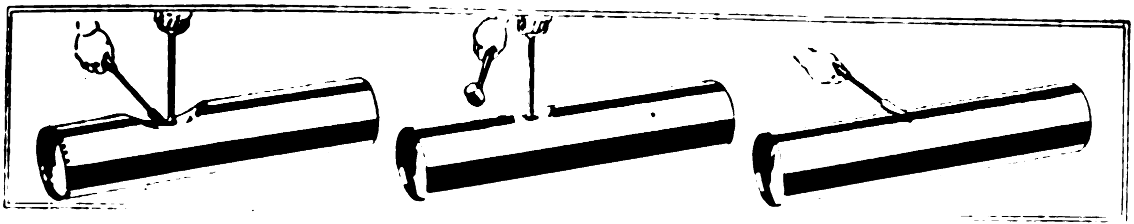
Improvised Follow Rest with Screw Adjustment



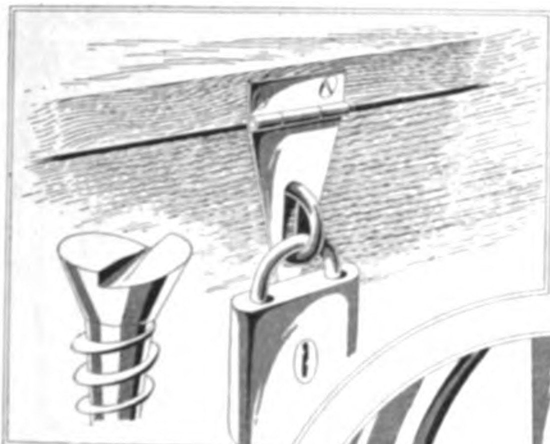
Cutting Brass Oil Rings on a Wood Arbor



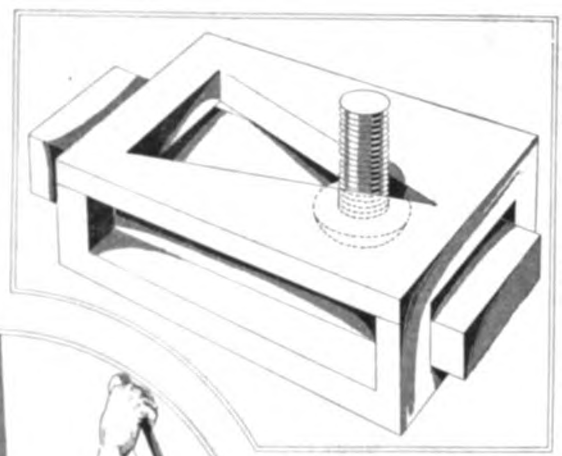
"Mikes" Help to Square the Angle Plate



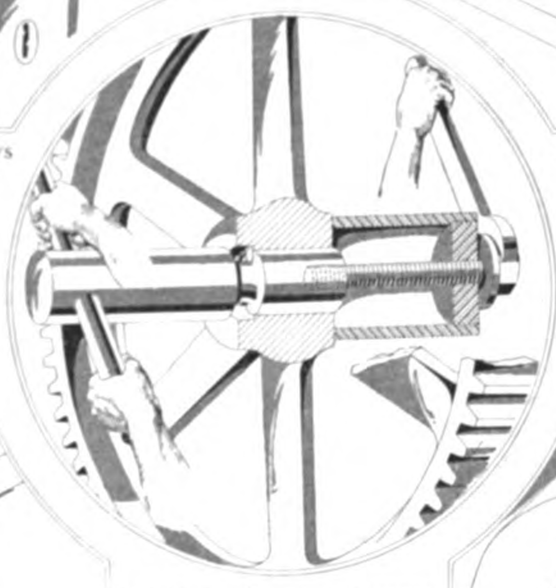
A Hammer, Soldering Iron, Pull and Patience Will Take a Kink Out of a Closed Boiler



Burglar-Proof Wood Screws for Cupboards



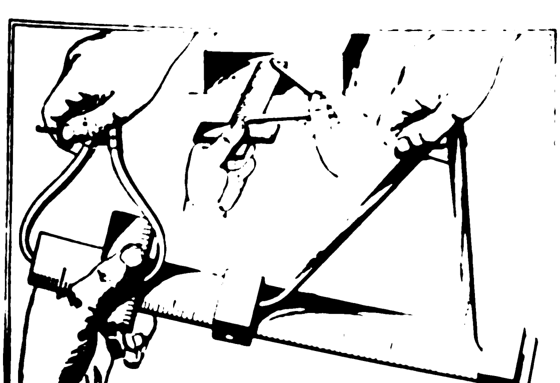
This Taper Chucking Block Helps the Vise Hand



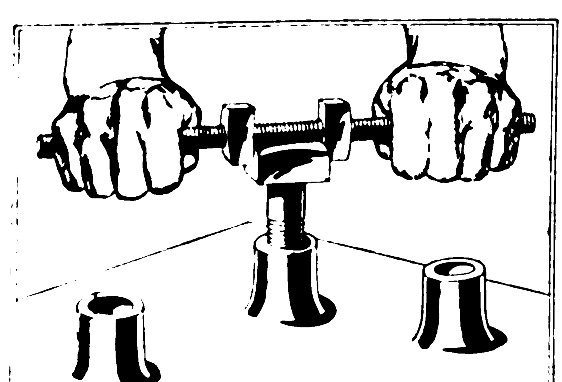
Sometimes a Pulley or Flywheel Must Be Rebored

Putting a Handle on the Templet Helps in Fitting

Wing Nuts Are Held Firmly in Split Square Nuts



Sliding Blocks on Scales Aid in Setting Calipers

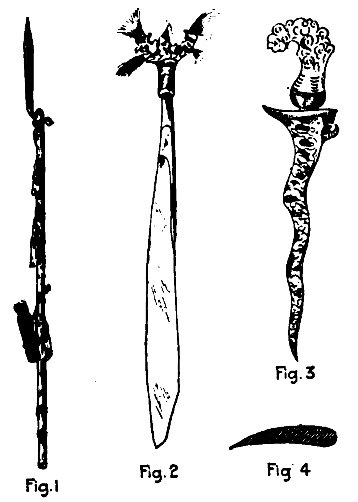


This Emergency Wrench is Handy to Have Around

Bornean Head-Hunters as Expert Mechanics

By Jan Spaander

Hardly credible feats of mechanical skill are performed in Central Borneo (Dutch East Indies) by the head-hunters. Any man, with the best machinery at hand, may regard himself an accomplished machinist if he can drill a 1/4-in. hole 7 ft. long, straight, highly polished and without a flaw in the boring. The writer saw that feat performed time and again by Bornean head-hunters (Dyaks), and without machinery. To them war is no necessity, and murder is a fine art for which superfine tools are required. A grandfather will spend many hours of a lifetime to provide his grandson with a fighting outfit—a *chris*, a *parang-ilang* (sword), a shield and a blow-pipe with bayonet.



FIGS. 1 TO 4. BORNEAN WEAPONS

The head-hunter has to start at the very beginning. In a turbid brook he will fish for warty, root-like pieces of carbonate of iron, which shows a silvery fracture. A heap of the ore mixed with charcoal from a burned-down forest is covered with clay to regulate the air for the combustion while the iron is roasting. From an economic point of view the results obtained are very poor. This process leaves the Dyak a heap of slacks and a small piece of really fine malleable iron. Out of this he makes his weapons.

The *chris*, Fig. 3, a Javanese novelty, is a crooked piece of steel, which has to be buried in wet earth to rust the edges sharp. The more corrosive parts of the metal deteriorate first, and the finished article shows beautiful waves all over, their steel, notwithstanding all the hammering, not being as homogeneous as ours. The bayonet on the blow-pipe, Fig. 1, resembles the latest European models. The *parang-ilang*, Fig. 2, does not resemble any white man's work. It is superior to our sword in every point, but it misses the wrist protector. The blade widens toward the end, and this produces the killing swing. The thick back gives it the necessary weight. The blade is convex on one side and slightly concave on the other, as shown in Fig. 4. Lengthwise the blade has a slight twist. All these little points enable the skillful fighter to sever a head at a single blow.

The mechanical masterpiece, however, is the boring of the blow-pipe, which is used to dispatch small poisoned arrows with deadly accuracy. For this the Dyak chooses a very tough log of wood about 6 to 7 ft. long and fastens it rigidly in vertical position to a scaffolding as in Fig. 5, leaving him ample room to work underneath. His only tool is a long, thin iron rod, chisel shaped at the end.

This rod he throws up with measured stroke and clock-like precision, striking the center of the vertical log. Gravity is the guide for the direction of the boring; and

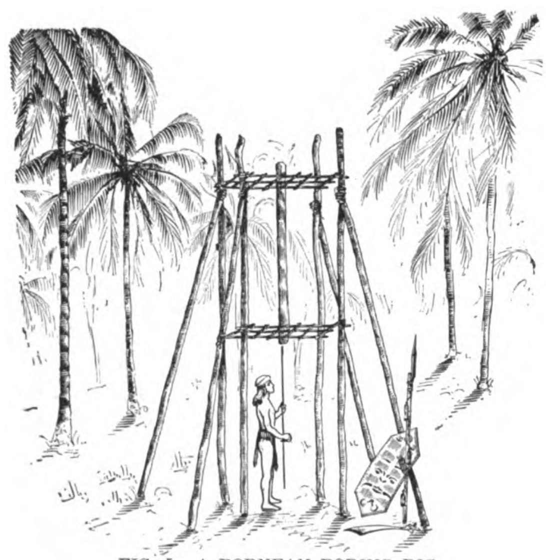


FIG. 5. A BORNEAN BORING RIG

as the Dyak has no instruments to insure a perfect vertical to the raw material, he simply takes a log much thicker than the finished blow-pipe he wishes to make.

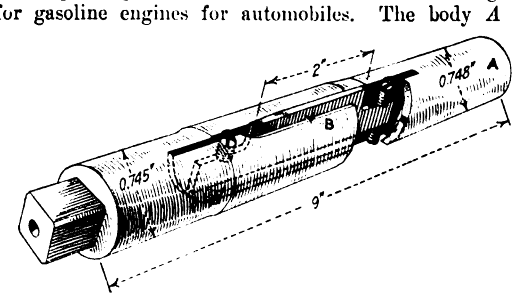
When through, he takes a thin rattan, which grows abundantly in the forest. He works this up and down in the blow-pipe till a high polish is obtained. The smaller the bore the more effective the weapon. There are blow-pipes over 7 ft. long with a 5-mm. bore.

It is unnecessary to point out that the head-hunter mechanic is no pieceworker and that time is no object to him.

Reamer for Piston-Pin Hole

By Nathan B. Hord

The piston-pin reamer here illustrated is a tool designed for gasoline engines for automobiles. The body *A* is a piece of cold-rolled steel with a piece of hacksaw blade *B* for the reamer cutter made to the given dimensions. After assembling the reamer, the body is ground.



REAMER FOR PISTON PIN

Special Machines for Drilling and Milling Fuse Parts

SPECIAL CORRESPONDENCE

SYNOPSIS—The many screw holes, powder passages and wrench flats in the parts of either time or detonating fuses have been responsible for the development of some unusual machines for this work. A group of these built by the Langelier Manufacturing Co., Providence, R. I., for both drilling and milling are shown herewith.

The machine shown in Fig. 1 drills simultaneously the four crossholes in the neck of the domed nut, Fig. 3. This nut is of brass; the drills are No. 36 (0.1065 in.) and are run at 2,500 r.p.m. The output is 8 pieces per minute, or 480 per hour. This machine was also used, with slight alterations to the chucking parts, for drilling the four No. 37 (0.104 in.) holes located at quarters in the beveled face of the fuse body, Fig. 11. The output in this case is 600 per hour.

The pieces are located by a jig having a drilling guide bushing for each of the four spindles. It is adjustable on its axis and is provided with a compression spring and stop arrangement that automatically pushes the jig ahead from between the drills to a position where the pieces can be put in or taken out by the operator. A pressure spindle actuated by a foot pedal holds the pieces in the jig during the drilling. The operator places a piece on the end of the spindle and presses the foot pedal down till the piece stops at its drilling position, where it is held while the holes are drilled.

All the drill spindles are fed by the crank hand lever that transmits motion with a segment gear to a wheel that carries a feed cam for each spindle. These cams engage with rolls mounted on the ends of feed yokes, the outer ends of which have clamp connection to the sleeves on the outer ends of the drilling spindles. The wheel has adjustable stops for drilling the depth required. The clamp connection permits a longitudinal adjustment to the spindles for the shortening of the drills by grinding.

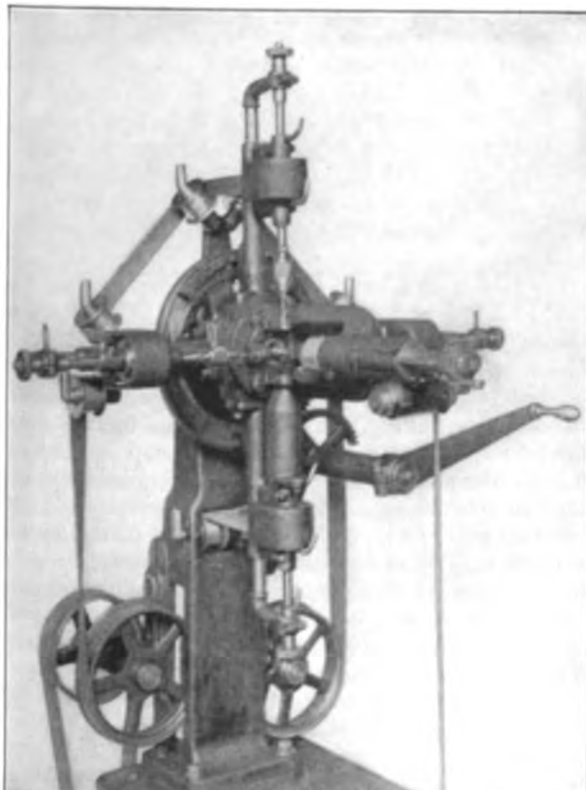


FIG. 1. DRILL FOR FOUR CROSSHOLES

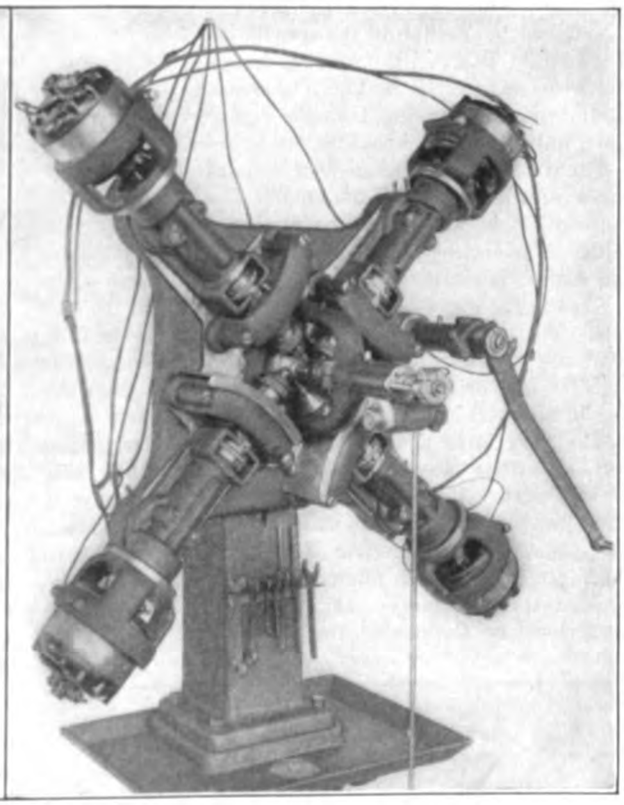


FIG. 2. MILLER FOR FOUR WRENCH FLATS

The spindles run in phosphor-bronze bearings and are driven by pulleys mounted on the ends of the bearings, thereby avoiding the running pressure of the belt upon the spindles. The floor space occupied by this machine is 35x35½ in.; its height is 5 ft. 6 in.; weight, 700 lb.

TWO FUSE-BODY MILLERS

The machine shown in Fig. 2 mills the four flats seen in cross-section *BB* of Fig. 3. The end mills are 0.106 in. in diameter and run at 5,000 r.p.m. The output is 8 per minute, or 480 per hour.

The milling spindles run on ball bearings, and each is driven by a ¼-hp. motor through floating connections to secure free running. The spindles are adjustable

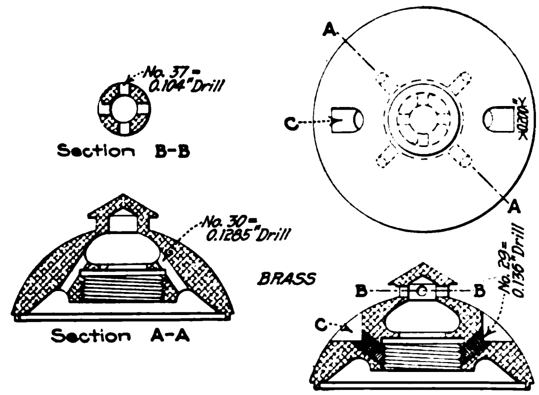


FIG. 3. THE DOMED NUT

longitudinally, and an index graduated in thousandths is provided for fine adjustments to depth of cut. The feed is obtained by oscillating the spindle heads on fulcrums located 12¾ in. from the working center of the machine. The cross-section *BB* in Fig. 3 shows straight cuts, but the milling arcs produced are so slight and the portion being milled so narrow that the cut is practically straight.

The fulcrums are located in eccentric bearings, the throw of which permits the spindle heads to be moved outward so as to make room to remove or insert the mills. The cutting feed is produced by spiral cams having contact laterally with the spindle heads, compression springs in the opposite side being used to return the cutters. The spiral cams are actuated by pinions meshing with one centrally located gear at the rear gear of the machine and driven by a segment gear mounted on the end of the feed-lever shaft.

The work is located on the end of a plunger that is recessed on its face to fit the lip on the circular base of the work. The plunger has also spring pins that enter two of the angular holes so as to bring the cross-holes, shown in cross-section *BB*, Fig. 3, in line with the milling spindles. The plunger is provided with a compression-spring arrangement that pushes it ahead to a position where the pieces can be put in or taken out by the operator. The pieces are held on the end of the plunger during the drilling by a pressure spindle actuated by a foot pedal.

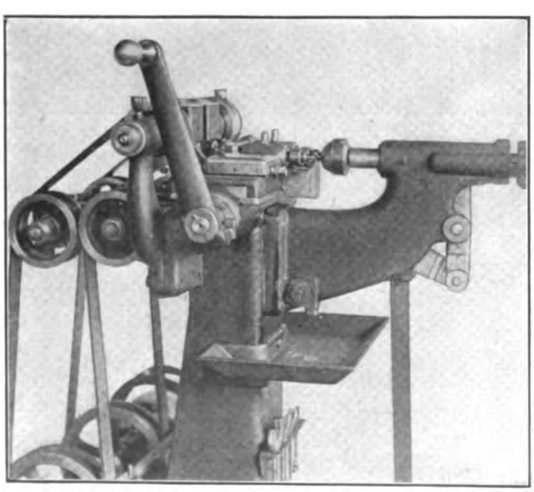


FIG. 4. MILLER FOR TWO WRENCH SLOTS

In operation the piece to be milled is placed on the end of the plunger and turned until the locating pins fall into the angular holes. The work spindle is then advanced with the foot pedal, which pushes the work to its milling position and holds it during the milling. After returning the feed lever the operator removes his foot from the pedal and takes out the milled piece. Guards are provided on the two lower spindle heads on account of chips. The floor space required is 36x33 in.; height 5 ft. 6 in.; weight, 1,200 lb.

Milling Wrench Notches

The two wrench notches *C* in the nut, Fig. 3, are milled simultaneously by the machine shown in Fig. 4. The end mills are 0.200 in. in diameter and are run at 2,500 r.p.m. The output is 5 pieces per minute, or 300 per hour. The milling spindles run in double taper adjustable phosphor-bronze bearings in crossheads mounted on saddles that feed crosswise to the axis of the spindle upon a long slide. They are fitted with ball thrust bearings, and the crossheads are adjustable longitudinally, so that the mills can be set to their required cutting depth. The spindles are driven by spiral gears from separate driving shafts belted over idler pulleys to a countershaft fastened to the column at the rear of the machine.

The feed is by a hand lever mounted on the end of a shaft located lengthwise in the center of the saddle slide. The shaft has short lengths of right- and left-hand threads of coarse pitch that mesh with segment nuts fastened to each of the saddles. Rotation of the shaft will cause the milling heads to feed toward or away from each other in unison. An adjustable stop is provided to limit the amount of feed. The nut is held and located in its milling position by a pressure spindle.

The head of the spindle is recessed to fit the tongue on the base. It also contains two small locating plungers that enter two of the four lower angular holes previously drilled, so that the cuts will be milled midway between the holes. The work spindle is actuated by a foot pedal having a link, lock toggle and segment-gear connection to the spindle. It also has an adjustable stop for the spindle movement of the milling position. A spring abutment bar having a sliding movement and located between the milling spindles is used to hold the work against the pressure spindle while it is advanced to and from its milling position.

The operator locates the work on the head of the pressure spindle and holds it until it comes in contact with the abutment bar. Then he advances the work to its milling position by depressing the foot. The milling is done by moving the hand lever about one-third of a turn downward. After the hand lever is returned to its starting position, the foot pedal is released and the hand held in a position to catch the work as it falls off the head of the spindle and breaks contact with the abutment bar. The floor space is 24x30 in.; height, 40 in.; weight, 600 lb.

The machine in Fig. 5 drills the six angular holes in the aluminum domed nut, Fig. 2. The two upper holes are drilled with No. 29 drills (0.136 in. in diameter) at a speed of 1,875 r.p.m.; the four lower holes with

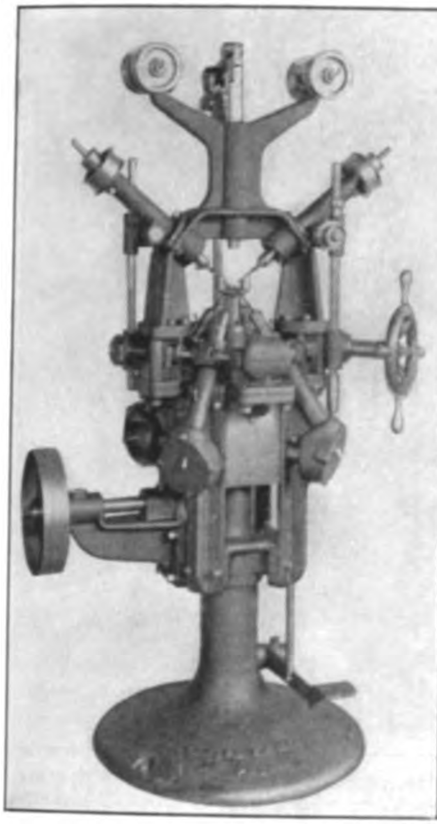


FIG. 5. DRILL FOR SIX ANGULAR HOLES

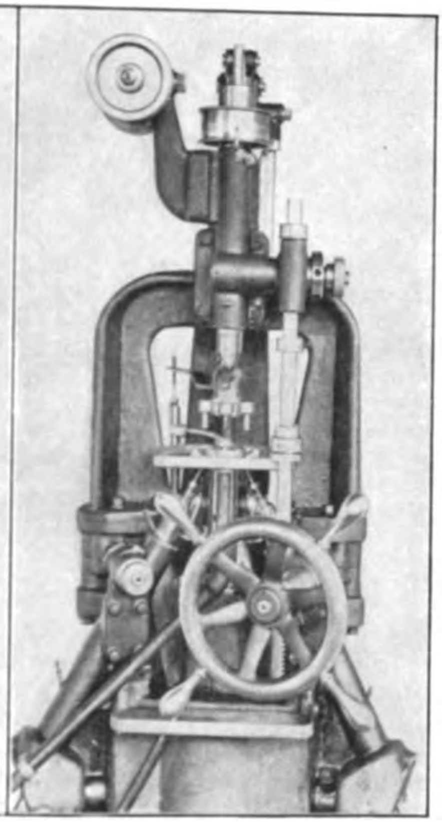


FIG. 6. DRILL FOR FOUR TAPER HOLES

No. 30 drills (0.1285 in. in diameter) at 2,000 r.p.m. The output is 3 per minute, or 180 per hour. A jig with six guide bushings locates the nut. It is set on the top of a post that is adjustable vertically and located on a center common to all the spindles. The piece is held by a pressure plunger actuated by a foot pedal.

The four lower spindles are equidistant and converge to a common center, as do the upper spindles, which are located diametrically opposite each other, but between two of the four lower spindles. The lower spindles are driven through bevel gearing by the main driving pulley, which is belted to a separate countershaft. The upper spindles are driven directly by the countershaft.

All the spindles are fed by the pilot handwheel at the right by a bevel gearing and rack and pinion mechanism. The two upper spindle feeds may be disconnected from the lower so that the drilling positions of each can be adjusted. Each spindle is also provided with a drill collet that is adjustable longitudinally for finer settings and also for making up for the shortening of the drill by grinding. An adjustable stop is used on the vertical feed rack for limiting the drilling depths.

A working table, fastened to the top saddle, but not shown, surrounds the jig on all sides. All gearing is incased, and suitable guards prevent the chips from falling on the lower spindles. The machine is driven by a two-speed countershaft that runs at 500 r.p.m. It occupies a floor space of 42½x28 in. and stands 70 in. high, its weight being 1,150 lb.

The machine shown in Fig. 6 is for drilling the four taper-reamed angular holes at an angle of 29 deg. to the vertical and the No. 24 (0.152 in.) holes in the aluminum upper ring, Fig. 7. The angular holes are drilled with a special drill corresponding to the form of the hole, which is 0.089 in. in diameter on the small end, the other end being tapered to a 12-deg. included angle. These drills are run at 2,500 r.p.m. The No. 24 (0.152 in.) drill was run at 1,875 r.p.m. The output is 2 per minute, or 120 per hour.

The upper ring, Fig. 7, is located in a jig that has four drill guide bushings. It is set on the top of a post that is adjustable vertically. The piece is held by the pressure from a foot pedal. The lower end of the pressure plunger is provided with a locator which carries two guide pins that enter the jig. It also carries a drill guide bushing for the upper drilling spindle.

The four lower spindles are located 72 deg. apart and converge to a common center. The upper spindle is located midway between the first and fourth lower spindles. The four lower spindles are driven through bevel gearing by the main driving pulley, shown at the left of the machine. The upper spindle belts direct to the countershaft. All spindles are fed by the pilot handwheel in connection with a bevel gearing, rack and pinion.

The upper spindle feed can be disconnected from the lower, so that the drilling position of each can be adjusted. Each spindle is also provided with a drill collet that may be moved longitudinally for finer adjustments and for making up for the shortening of the drills caused by grinding. A movable stop on the vertical feed rack limits the drilling depths. A flared-edge pan surrounds the jig on all sides.

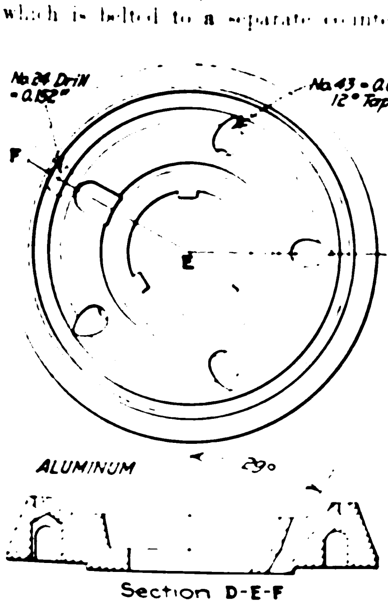


FIG. 7. THE UPPER FUSE RING

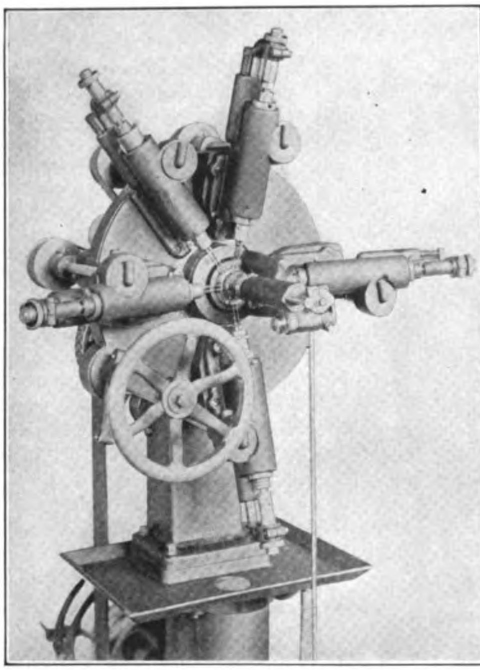


FIG. 8. A 10-SPINDLE DRILLING MACHINE

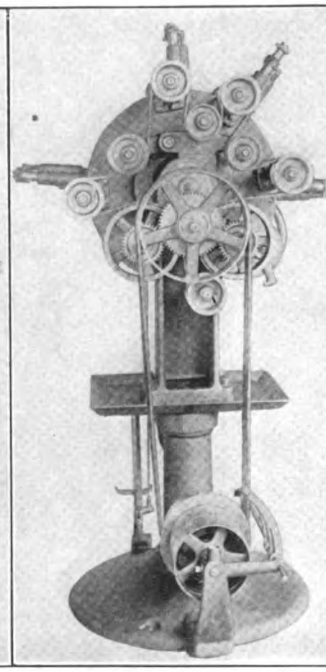


FIG. 9. REAR VIEW OF DRILLER

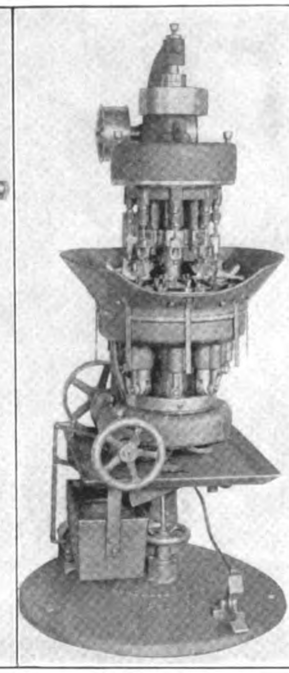
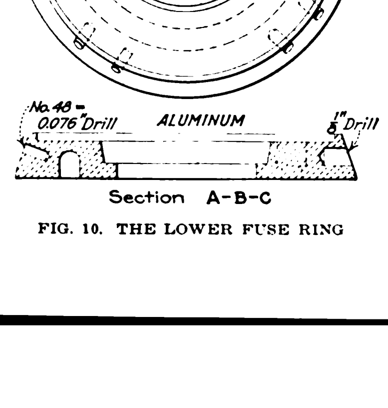


FIG. 12. DRILL FOR THE BODY

An automatic oil feed has a shut-off that supplies oil to the drills only when cutting. The machine occupies a floor space of 37x28 in.; its height is 5 ft. 9 in.; weight, 1,400 lb.

Side-Hole 10-Spindle Machine

A 10-spindle machine is shown in Figs. 8 and 9. It was designed for drilling simultaneously five groups of two holes each in the beveled face of the lower ring, Fig. 10. Four of the groups are drilled with a No. 48 (0.076 in.) drill, the two holes in each group being 0.348 in. apart and perpendicular to the beveled face. The two holes in the fifth group are ⅛ in. in diameter, 0.315 in. apart and parallel to the circular face. The ⅛-in. drills are run at 2,000 r.p.m. and the No. 48 at 2,500 r.p.m. The output is 6 pieces per minute.



Section A-B-C

FIG. 10. THE LOWER FUSE RING

The work is located in its drilling position by a jig that has a set of two drill guide bushings for each drilling head. It is adjustable on its axis and is provided with a compression and stop arrangement that pushes the jig ahead from between the drills to a position where the pieces can be put in or taken out by the operator. The work is held in the jig during the drilling by a pressure spindle actuated by a foot pedal. All the main drilling spindles are fed by the handwheel at the front of the machine. The handwheel shaft has a pinion that meshes with a rim gear located inside and concentric to the faceplate to which the drilling heads are fastened.

The rim gear carries a segment cam for each spindle head. The cams engage with rolls on the inner ends of the feed yokes, the outer ends of which are clamped to the adjusting sleeves on the outer ends of the main driving spindles. An adjustable stop is used on the handwheel shaft for drilling to the required depth. The main drilling spindles run in sliding sleeves to which a multiple drilling head of two spindles is attached at the inner ends.

The drilling spindles in the multiple heads have adjustable screw collets. The spindles are driven by spiral gears, the driver extending to the rear, and have pulleys on their ends. In order to obtain belt contact, an endless belt is driven by two cork inserted driving pulleys geared to the main driving pulley and belts to the countershaft on the base of the machine, one of the intermediate pulleys being used as a belt tightener. The floor space occupied is 44x40 in.; the height is 5 ft. 10 in.; the weight, 1,661 lb.

For drilling the 0.152-in. hole 0.705 in. from the vertical center line in the upper face of the aluminum body, Fig. 11, at the rate of about 12 pieces per minute the machine shown in Fig. 12 is used. Another ma-

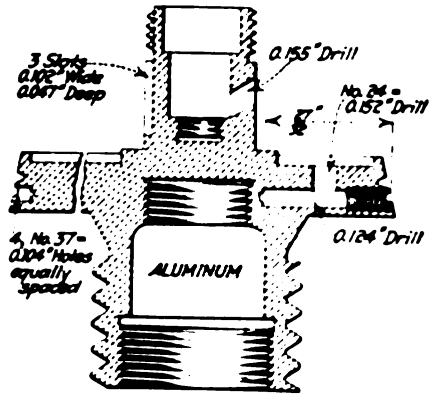


FIG. 11. THE ALUMINUM BODY

chine of the same type, with suitable fixtures, drills also the angular hole 0.155 in. into the side of the stem at the speed of about 12 per minute.

The machine is continuous and semiautomatic in operation. It consists of eight unit spindles disposed equally around and contained in a monoblock casting rotating from left to right around a main vertical shaft, bringing each unit successively in front of the operator for loading and unloading. Each unit has its own drill spindle and driving mechanism, as well as its own work-holding table fixture and table slide. The spindles are driven at about 3,200 r.p.m. by a cotton (fabroil) cut gear meshing with a cut steel heat-treated pinion on spindles. The spindles are stationary as to position.

The work tables are fed upward by a stationary cam around the machine base. This continues until the hole is at proper depth, when the table quickly recedes, pausing at the lowest position to give the operator sufficient time to take the drilled piece out and insert a new blank. The work is held down at each station automatically by a revolving steadyrest with a presser foot that bears firmly against the work as it is raised up against the steadyrest by the table-slide actuating mechanism described, in advance of the drills, during the drilling and until the work has been withdrawn. The steadyrest has hardened bushings that support the drills close to their cutting ends. The floor space required for this machine is 41x28 in.; height, 6 ft.; weight, 2,250 lb.

The machine shown in Fig. 13 is standard, but is adapted for drilling a $\frac{1}{8}$-in. hole $\frac{27}{32}$ in. deep in the flange of the body, Fig. 11, of a Russian fuse. The machine is entirely automatic in operation, except the chucking and ejecting. The output is 12 per minute, or 720 per hour.

This fuse body is made of pressed cast aluminum, finish-turned before being drilled. Aluminum has a tendency to clog and stick to the drill. To avoid this, the feeding of the drills is divided into three steps: The first feed gives half the depth of the hole; the second, three-quarters; and the last, the full depth. The bodies are held in position for drilling by means of a special vise *A*, Fig. 14, having one fixed and one movable jaw. The vises are opened and closed automatically, but can be closed instantly by the operator after the body is put in by the foot pedal shown at the front of the machine.

The ten vises *A* and drilling heads are arranged in units, mounted radially and equidistant upon a continuously rotating carrier, the vises being loaded and unloaded as they pass the operator. The carrier revolves upon a stationary central post driven in and screwed to the top half of the bed. Inside this post is a revolving shaft, driven by a pulley mounted upon its lower end inside the bed and in turn belted over a quarter-turn idler pulley, on the end of the bed, to a separate countershaft.

The carrier is driven by a wormshaft meshing with a large worm gear mounted upon the lower end of the carrier. Fastened to the pulley inside the bed is one of a pair of miter bevel gears that drive the wormshaft by belting. This construction allows a ready means of changing feeds and speeds for different pieces to be drilled. A belt tightener is provided.

Upon the upper end of the shaft is a large bevel gear that meshes with each of the bevel fiber pinions that drive the drilling spindles *C*. The bevel pinions run upon sleeves in the spindle heads *B* and drive the spindles by means of keyed driving collars fastened to the pinions. The feed is accomplished by yokes *D* that clamp to phosphor-bronze bushings *E*, in which the spindles run.

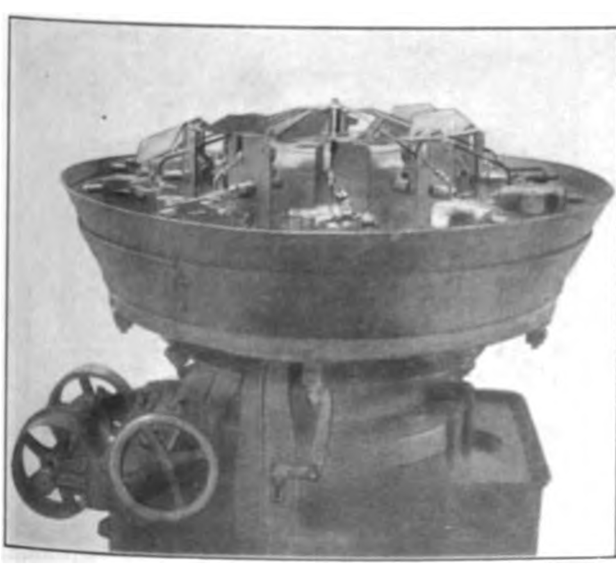


FIG. 13. CONTINUOUS DRILLING MACHINE

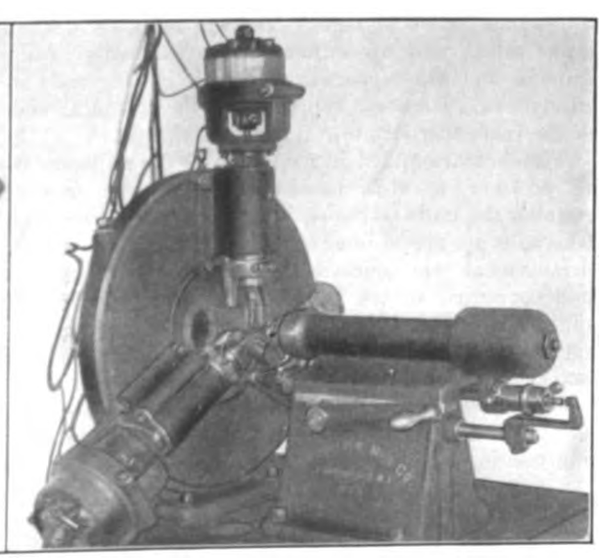


FIG. 15. THREE-SLOT MILLER

On the inner end of the yokes is a roll that contacts with a stationary circular cam fastened to the central post. When the drilling-head carrier *B* revolves around the cam, it causes the spindles *C* to feed in or out. The time taken for a spindle head *C* to travel its cycle is ample

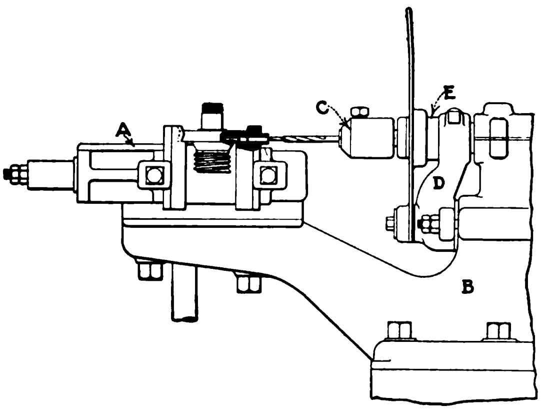


FIG. 14. DETAIL OF DRILLING UNIT FOR PRESSED-CAST ALUMINUM BODIES

to produce any practical feed or speed for drills up to ¼ in. in diameter.

Cutting lubricant is distributed to each drill by individual pipes leading from one main stationary oil pipe that passes up through the central driving shaft and is connected to a force pump fastened to the bed of the machine. The carrier is provided with perforated plates for separating the chips from the lubricant, which is filtered before passing to the reservoir in the lower bed. The floor space is 52x59 in.; the height is 50 in.; the weight, 4,000 lb.

Milling Wrench-Slots

Fig. 15 shows a machine for milling at one operation the three slots spaced equidistant in the neck of the body, Fig. 17. The end mills are 0.102 in. in diameter and run at 5,000 r.p.m. The output is 2 pieces per minute, or 120 per hour. The spindles run on ball bearings, each being driven by a ¼-hp. motor that has floating connections to the spindles. The end mills are held in screw collets that are adjustable longitudinally in the spindles and are supported near their cutting ends by steadyrests. These are supported by the extending ends of the yokes that clamp to the spindle sleeves.

The slots are milled in one cut, and the mills are removed from the cut at the end of the feed, so as to avoid running the mills in the slots on the return of the feed. The mills are moved in or out of the slots by a foot-pedal arrangement that connects to a rim gear located inside and concentric in the faceplate standard to which the milling heads are fastened. The rim gear carries a segment cam for each head, these cams actuating the in and out motion to the spindles by rolls fastened to the yokes that clamp to the spindle sleeves. This clamping permits the milling spindles to be adjusted to their working position. Finer regulation is made with the collets. An adjustable stop is also provided for the rim-gear movement, so as to obtain universal adjustments to the mills, which is very desirable, as it avoids setting each mill separately.

The work is held and located in its milling position by a pneumatically operated chuck mounted on a crosshead with a feed slide. The chuck consists of a projecting expanding mandrel that is opened or closed by the compressed-air cylinder mounted on the rear end of the crosshead. It grips the work in its largest bored end and has a drawing effect that seats the work against the chuck both radially and axially.

The chuck is opened and closed by a compressed-air cylinder, the piston being connected directly to the shell of the expanding mandrel. The air to the cylinder is controlled by a piston valve, which is operated by contact and adjustable dog. The feeding is done by hand by the crank lever shown at the front of the crosshead, and an adjustable stop is provided at the rear for limiting the length of the feed in both directions.

The operator places the work on the projecting end of the mandrel, holding it while he advances the crosshead a small amount. This causes the chuck to grip the works. He presses down the foot lever, which advances the end mills to their cutting depth, and then continues the feeding up to the stop.

Releasing the foot pedal causes the mills to move out of their cuts and returns the crosshead to its starting position, in which the chuck is open and the milled piece can be removed from the chuck. The floor space for this machine is 38x38 in.; height, 65 in.; weight, 1,400 lb.

Another standard machine specially equipped is shown in Fig. 16. This has heads for drilling two No. 37 (0.104 in.) holes 0.652 in. apart in the brass bottom-plug

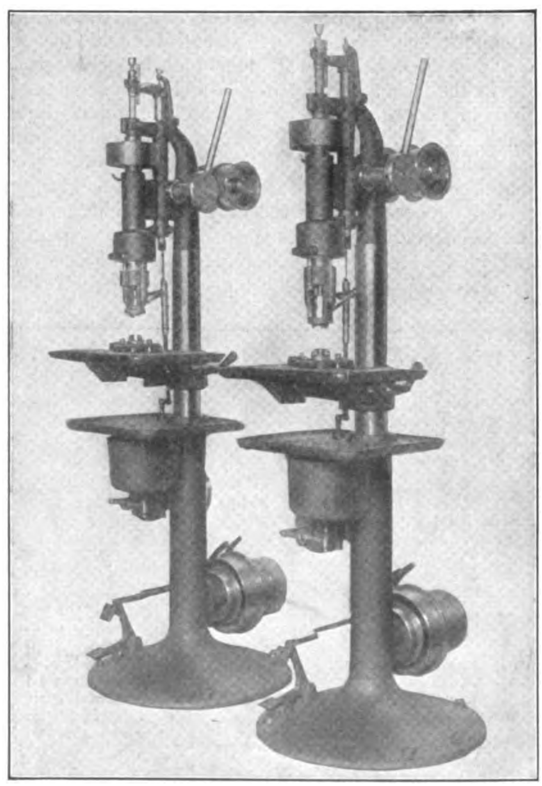


FIG. 16. SPECIALLY EQUIPPED DRILLING MACHINE FOR BOTTOM PLUG AND CHAMBER SLEEVE

body, Fig. 17, and four No. 36 (0.1065 in.) holes 0.376 in. apart in the brass chamber sleeve, Fig. 18. The drills are run at 1,900 r.p.m.

Both pieces are part of a Russian fuse. The output for the chamber sleeves is 15 per minute, or 900 per hour; for the bottom-plug body, 12 per minute, or 720 per hour. Both pieces are centered by a spring steadyrest having a sliding fit on the cylindrical end of the drilling head. In the lower end of the steadyrest is a disk carrying the bushings for accurately starting the drills and also projecting prongs that exactly locate by contact the pieces to be drilled. The pieces are approximately located on the table by a shouldered seat fastened to it.

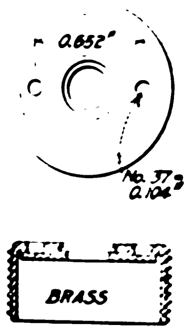


FIG. 17. BOTTOM PLUG BODY

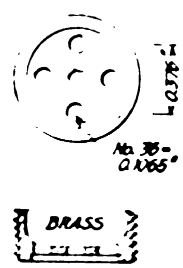


FIG. 18. BRASS CHAMBER SLEEVE

When the output of one piece is sufficient to keep a machine continuously in operation, a machine and head are furnished as a unit. If not, one or more heads with different layouts of spindles can be made to fit interchangeably in one machine. The drill heads with their steadyrests are self-contained and are easily and quickly interchanged. The feed is by a hand lever in conjunction with a rack and pinion. The floor space is 24x30 in.; height, 5 ft. 10 in.; weight, 700 lb. These machines are built by the Langelier Manufacturing Co., Providence, R. I.

Manufacturing with the Oxyacetylene Torch

By Frank H. Nayor

The welding of broken parts by the oxyacetylene method has become, or is rapidly becoming, universal. The preheating of metals by the oxyacetylene flame and running metal into blow-holes in castings or even putting on metal in worn or undersized places are also quite common and are satisfactory when carefully done. The illustrations here given show examples of oxyacetylene welding that can be classed as manufacturing.

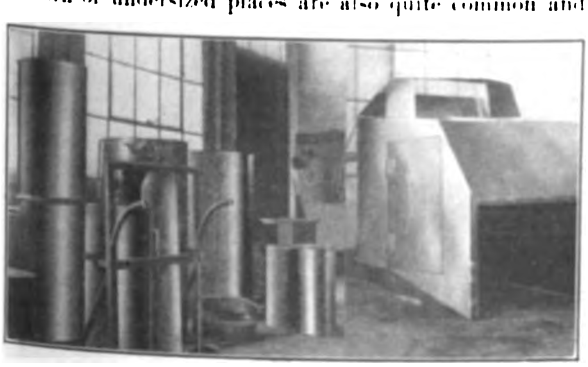


FIG. 1. WELDED SHEET METAL CYLINDERS   FIG. 2. WELDED AUTOMOBILE BODY

Fig. 1 shows some large cylinders made from sheet steel and joined together by welding. An interesting piece of work is illustrated by Fig. 2, which shows a special motor-car body that is cut and assembled from sheet metal by the use of cutting and welding oxyacetylene torches.

In building this body the various parts were first cut out to shape, then held in position where assembled and the corners only of the various pieces welded together. When each part was in position with the observation tower on top, all of the joints were welded.

Machine-Tool Shipments From Port of New York

	January	February	March
Argentina	$19,191	$3,456	$13,880
Australia			131,290
Australia and Tasmania	163,154	50,737	
Barbados			26
Bermuda			64
Bolivia			
Brazil	2,303	224	3,862
British East Africa		61	
British South Africa	3,309	11,417	4,838
British West Africa	2,564	310	1,020
British Honduras			
British East Indies, other			
British West Indies, other		4	
British India	4,293	1,957	3,763
British Guiana			6
Canada			
Chile	1,805	802	2,845
China		2,729	
Colombia		126	706
Costa Rica		531	864
Cuba		6,998	13,286
Danish West Indies			8
Denmark	6,371	7,125	12,758
Dutch East Indies		1,973	796
Dutch West Indies		1,702	1,000
Dutch Guiana			
Ecuador		346	245
Egypt	135		43
England	922,973	1,415,751	2,132,616
Finland		7,956	3,177
France	523,380	946,312	1,638,559
French China			
French Oceania	3,061		
French West Indies			
Gibraltar			1,015
Guatemala		222	203
Greece			544
Honduras			729
Hongkong		47	
Italy	342,856	563,947	632,007
Jamaica		23	49
Japan	87,538	6,235	5,066
Mexico	6,623	1,031	4,463
Newfoundland and Labrador		1,430	1,706
Netherlands	4,480	28,432	32,234
New Zealand		35,310	4,494
Nicaragua			36
Norway	22,350	6,055	61,493
Panama	1,063	16,937	2,211
Peru		325	6,805
Philippine Islands	199	575	160
Portugal		87	395
Portuguese Africa		95	1,302
Russia in Asia	2,586	27,588	
Russia in Europe	403,601	80,040	188,345
Salvador		71	1,399
Santo Domingo	503	147	9
Scotland	10,150	61,662	27,746
Spain	23,174	202,038	111,943
Straits Settlements	1,787		
Sweden	5,142	7,757	16,953
Switzerland	5,559	4,379	
Trinidad and Tobago		500	
Uruguay	1,235	110	89
Venezuela	1,100	53	1,930
Total	$2,581,665	$3,505,613	$5,069,638
Grand total			$11,156,916

Punches and Dies for Making Car-Fender Guard Details

By Robert Mawson

SYNOPSIS—These jig and fixture data pages show cast-iron punches and dies used for making a carrier arm outer standard and corner iron of a car-fender guard. The stock is worked hot, being heated in an oil-fired furnace. The article is of especial interest because of the novelty of this use of cast-iron press tools.

In the manufacture of car-fender guard details the Narragansett Machine Co., Providence, R. I., uses cast-iron dies for bending and forming some of the parts. The parts shown are a carrier arm and its corner iron. The manufacture of the first is perhaps of more interest than the second, for it is complicated in shape and requires more operations to produce. The stock is ½x2 in. oval rolled steel.

The first operation forms a hook on one end. This is then bent to an eye. The second bending operation finally forms it into the shape shown in Fig. 7. It is then ready to assemble with the corner iron, Fig. 10, into the finished carrier arm of Fig. 12. The holes for assembling are drilled and the pieces are fastened together by rivets. The use of cast iron for these tools is seen by referring to Figs. 2-A, 8-A and 11-A. In each case either all or the greater part of the tool is of cast iron.

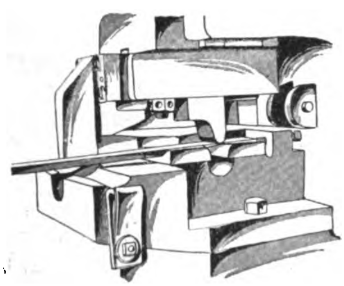


FIG. 2

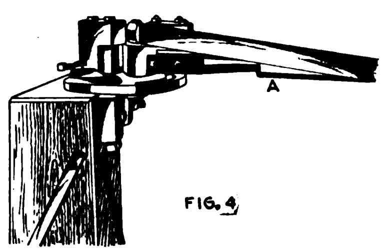


FIG. 4

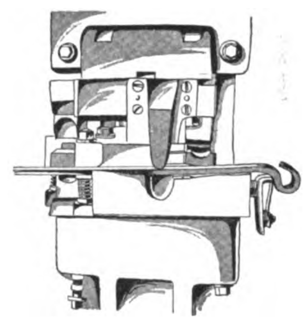


FIG. 6

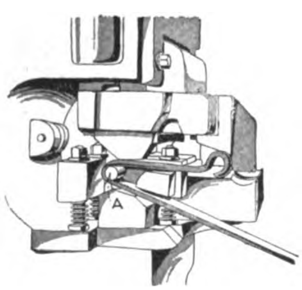


FIG. 8

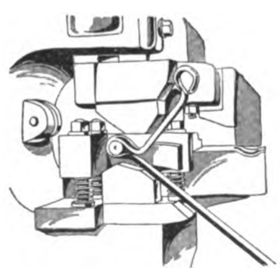


FIG. 9

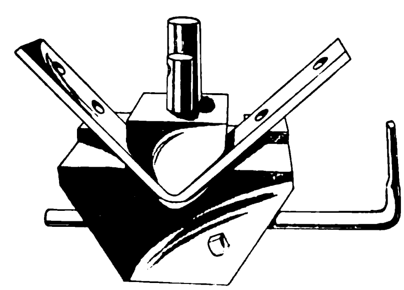


FIG. 11

PUNCHES AND DIES FOR MAKING CAR-FENDER GUARDS, WITH THE WORK SHOWN IN POSITION

FIGS. 2 AND 2-A

Operation—First bending to the shape illustrated in Fig. 1. The stock is placed between the punch and die, being located by an adjustable stop. The punch is then allowed to descend, forming the end of the stock into a loop. This bar is placed in the machine, Fig. 4, the loop fitting over a pin, as shown. The arm A is drawn around and attached to a form block, which, coming in contact with the end of the bar, forces the end to a closed loop, as in Fig. 3.

FIG. 6

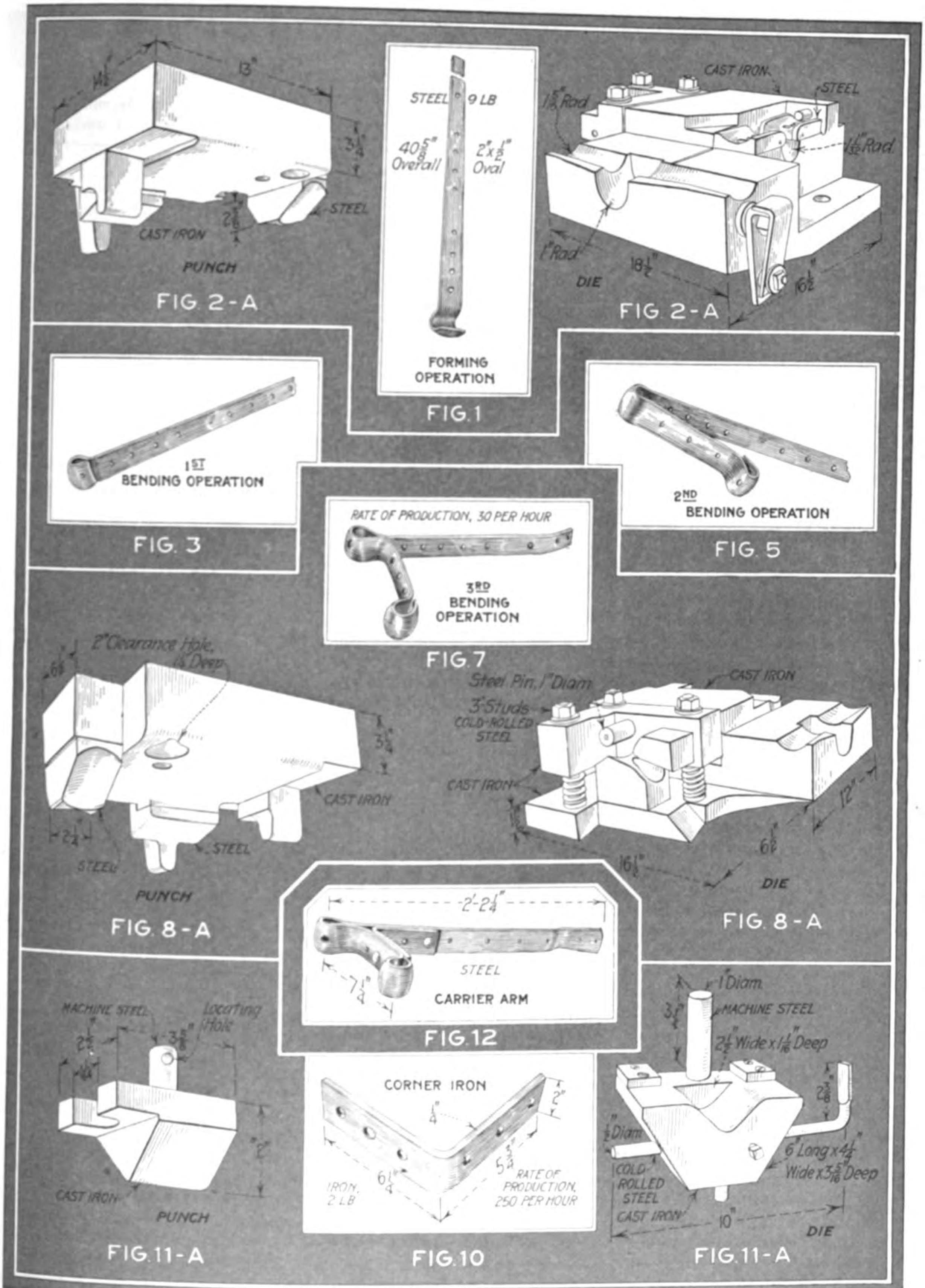
Operation—Second die-bending operation to the form illustrated in Fig. 5. The bar is placed on the die, as shown, being located against the adjustable stop at the end. The punch, forced down with the press, forms the bar to the required shape. The carrier arm is then ready to be bent to its final shape, after which it is assembled with the corner iron into the finished carrier arm.

FIGS. 8 AND 8-A

Operation—Bending the bar to the shape seen in Fig. 7. The bar is placed on the pin A, which fits into the loop. The punch, being forced down, pushes down the bar; and as the side of the punch comes in contact with the spring-actuated die, it is also forced down. This movement allows the punch to bend the bar around the die guide block, thus forming the loop in the carrier arm. Fig. 9 shows the piece still in the punch and dies after being formed to the correct contour.

FIGS. 11 AND 11-A

Operation—Bending carrier-arm corner iron, Fig. 10. The stock, which has been cut to length, is placed on the die, being located by the adjustable stop at the end. The punch is forced down, guided by a pin in the die, around which a notch in the punch fits. The carrier arm and corner iron are then drilled. The two units are fastened together with rivets to form the part, Fig. 12.



DETAILS OF PUNCHES AND DIES FOR MAKING CAR-FENDER GUARDS

Laying Out Blanking Dies

By W. B. Greenleaf

Before laying out a blanking die I always cut two or more blanks from cardboard and try various positions, to be sure to cut the metal with as little waste as possible. I find that it pays to take a good deal of care and trouble at this point, for very often a layout that seems to be the most economical is very far from being so.

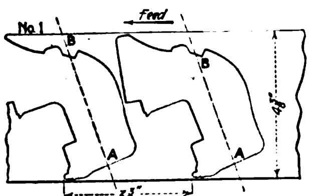


FIG. 1

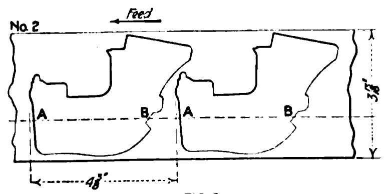


FIG. 2

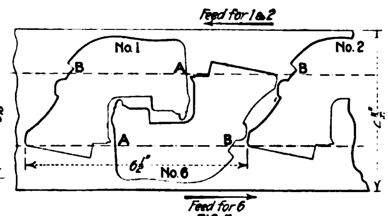


FIG. 3

FIGS. 1 TO 3. THREE WAYS OF LAYING OUT A SHEET-METAL PISTOL STOCK

Figs. 1, 2, 3 and 4 show various trials with this particular piece, in the order in which I made them; I also made at least as many more in between. It will be seen that Fig. 4, the one used, gives 240 blanks and Fig. 1 only 189 from a 36x96-in. sheet, this being a gain of nearly one third. In other words 2⅜ tons of metal will go as far as 3 tons with the first layout. That difference would more than pay for twice as much labor or even in the steel used, in one as the other. As a matter of fact, however, a saving in metal usually means a saving of labor also, as more blanks are obtained from the material handled. In this case the labor at the shear is a little less for Fig. 4, as there are fewer sheets and practically the same number of strips to the sheet at the press. Fig. 1 cuts 9 blanks from each strip in one pass, while Fig. 4 gets 12 blanks but requires two passes through the press, which about evens matters up.

One point to be watched carefully in trying for the best layout is to see that the models are all placed in exactly the same position relative to the strip, for of course they necessarily come that way from the press. In handling an irregular piece like this one shown, I always draw a line (A-B in the illustration) in the same position on all my models and then see that these lines are always parallel with each other in the various trials. If the piece has at least one long straight edge, this can be used and the line is unnecessary.

There is another point which should not be overlooked when the strip has to be passed through twice—this is the stop. If the ordinary stop is used, it will be a source of trouble and delay, for on the second pass, it will enter the hole left by the first pass and stop the strip.

I avoid this trouble by placing the stop in the longest opening of the piece and making it long enough nearly to fill this opening. It then bridges over the shorter opening left by the reverse side of the blank in the first pass. This arrangement is clearly shown in Fig. 4.

It is also necessary to raise the stripper higher than usual, so that the stop may be extra thick and taper down to the usual thickness at the point. If this is not done, the metal will spring down enough for the edge of the first pass opening to catch.

Figs. 5, 6, 7 and 8 show various other layouts for saving metal, with the exception of Fig. 5. I worked over Fig. 5 for some time but could not find a way to avoid excessive waste.

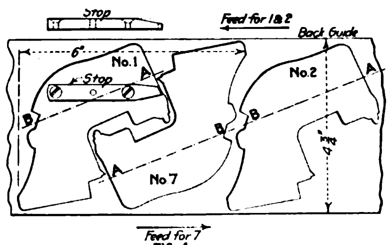


FIG. 4

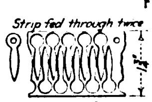


FIG. 6

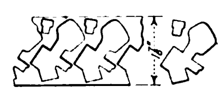


FIG. 7

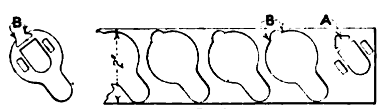


FIG. 8

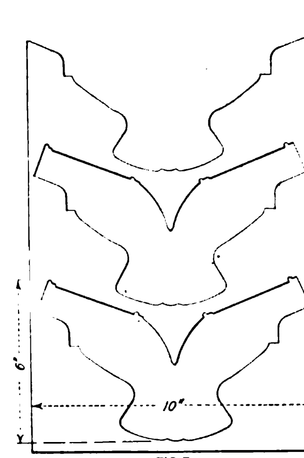


FIG. 5

FIGS. 4 TO 8. OTHER EXAMPLES OF LAYING OUT WORK

Fig. 8 shows a way to get sharp points *BB*. It is old, but may be new to some. If the blanking die were made the shape of the piece, the points would break down and be rounded. To avoid this, the piercing die *A* is put in and the blanking die shears through this opening, as indicated by the dotted line. The resulting points are like needles.

Rules for Power-Plant Tests

The report of the Power-Test Committee of the American Society of Mechanical Engineers has just appeared in a pamphlet of 215 pages, 6x9 in. Included are boilers, reciprocating steam engines, steam turbines; pumping machinery; compressors, blowers and fans; complete steam power plants, locomotives; gas producers; gas and oil engines and waterwheels.

The report represents the work of many prominent members of the society for a number of years, and a permanent committee has been appointed to interpret the rules when called upon to do so. The information has been carefully prepared and is given in considerable detail.

Rational Design of Foundation Anchor Plates*

By Terrell Croft

SYNOPSIS—In this article are given formulas for the designing of anchor plates and bolts. Two methods have been used in practice. Both are described in detail. Tables are also given and illustrations of the plates and bolts and the methods of using them.

The functions of anchor plates are, it has been stated, two—(1) to hold the bolt head or nut of the anchor bolt from turning; (2) to transmit the stress imposed on the bolt to an ample area of masonry of the foundation.

In the design of anchor plates simple forms should be adopted. This is particularly true when the plates are to be of cast iron, which is the material most frequently employed, so that the patterns will involve a minimum of labor. There is no necessity for the complicated shapes sometimes encountered. The design should preferably be such that no coring is necessary in the molding. Furthermore, where a line of anchor plates is being made for bolts of different diameters, the plates should increase in size by regular increments as the bolt diameters increase; that is, the plates should be proportioned in accordance with the loads which will be imposed upon them, as will be explained in the following paragraphs.

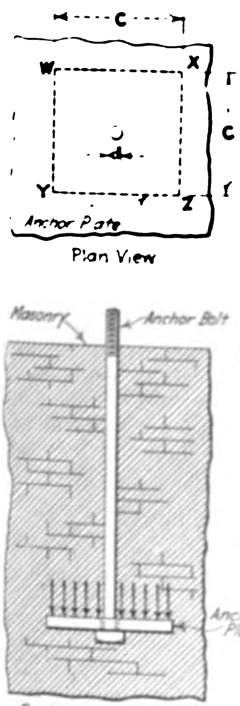


FIG. 1. ANCHOR PLATE AND BOLT SET SOLID IN MASONRY WITHOUT CASING

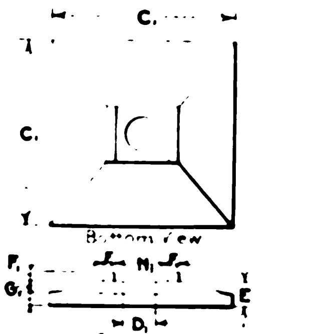


FIG 2. FOUNDATION ANCHOR PLATE WITH LUGS TO PREVENT NUT FROM TURNING

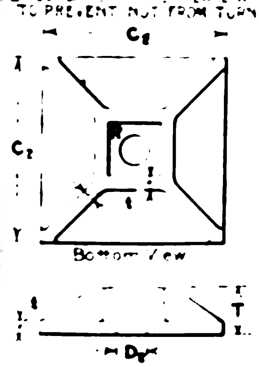


FIG 3. ANCHOR PLATE WITH RECESS TO ACCOMMODATE NUT

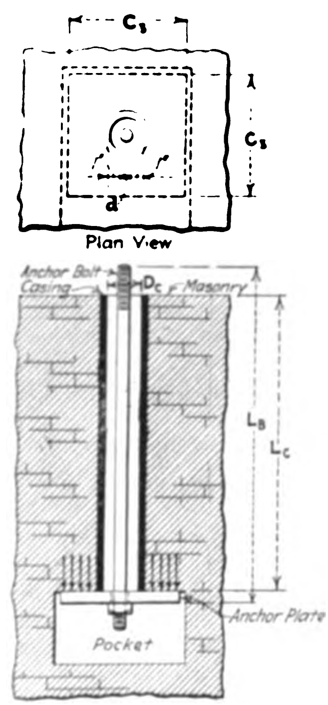


FIG 4. ANCHOR PLATE AND BOLT IN FOUNDATION WITH CASING

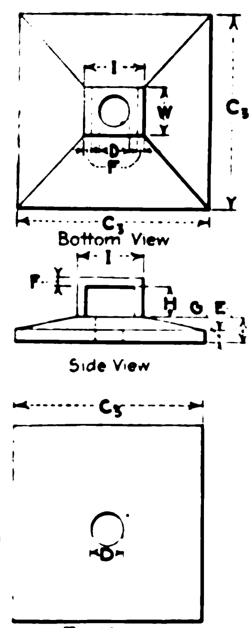


FIG. 5. CONSTRUCTION FOR FOUNDATION ANCHOR PLATE WITH POCKET FOR NUT

RATIONAL DESIGN OF FOUNDATION ANCHOR PLATES

Anchor plates are usually square, Fig. 1, because the patterns for this form are readily made and also because the pockets, where such are provided in foundations, are ordinarily of this shape. Hence a square plate is accommodated more effectively than a round one would be. Round anchor plates may be and have been used under certain conditions.

Methods of Proportioning Plates

Two different methods of proportioning foundation anchor plates have been used in practice. By the first method all dimensions are determined by employing empirical formulas for which the diameter of the anchor bolt is used as a basis. By the second method the bearing area of the plate $WXYZ$ (Fig. 1) is computed in such a way that it will be great enough so that the safe crushing strength of the material against which the plate presses will not be exceeded when the bolt is stressed to its safe tensile strength. Thus the length of side C may be determined. Then the other dimensions of the plate are figured by using empirical formulas. An example of each of the foregoing methods will be given, and then additional formulas—(23) and (30)—in accordance with the second method will be suggested whereby anchor plates may be proportioned to satisfy any required condition. Proportions for two complete lines of plates designed in accordance with these formulas—(23) and (30)—are given in

Table 1. One line is adapted for use in "built up" masonry foundations, while the other is for monolithic concrete foundations.

An example of design based on anchor-bolt diameter is expressed by the following equations—(1) to (6-A)—

TABLE 1. PROPORTIONS OF FOUNDATION ANCHOR PLATES USED WITH CASINGS

(All Dimensions Are in Inches)

d	D	C_1		F	E	G	H	W	I
Diameter of of Bolt	Diameter Bolt Hole	Length of Side For Brick or Stone Foundations	For 1:2:5 Concrete Foundations	Thickness of Nut Pocket Wall	Thickness of Plate at Center	Thickness of Plate at Edge	Inside Height of Nut Pocket	Outside Width of Nut Pocket	Outside Length of Nut Pocket
1/2	5/8	4 1/2	3	3/16	1/2	1/4	5/8	1	1 1/4
5/8	3/4	5	3 1/2	1/4	5/8	5/16	3/4	1 3/16	1 7/16
3/4	7/8	6 1/2	4	1/4	3/4	3/8	7/8	1 3/8	1 5/8
7/8	1	7	4 1/2	5/16	7/8	7/16	1	1 9/16	2 1/16
1	1 1/8	8	5	3/8	1	1/2	1 1/8	1 3/4	2 1/4
1 1/8	1 1/4	9	6	7/16	1 1/8	9/16	1 1/4	1 15/16	2 11/16
1 1/4	1 3/8	10	6	1/2	1 1/4	5/8	1 3/8	2 1/4	3 1/8
1 3/8	1 1/2	11	7	1/2	1 3/8	11/16	1 1/2	2 7/16	3 5/16
1 1/2	1 5/8	12	7 1/2	9/16	1 1/2	3/4	1 5/8	2 5/8	3 1/2
1 5/8	1 7/8	13	8	5/8	1 5/8	13/16	1 7/8	2 13/16	4 1/16
1 3/4	2	13 1/2	8 1/2	5/8	1 3/4	7/8	2	3	4 1/4
1 7/8	2 1/8	14 1/2	9	11/16	1 7/8	15/16	2 1/8	3 3/16	4 11/16
2	2 1/4	15 1/2	9 1/2	3/4	2	1	2 1/4	3 3/8	4 7/8
2 1/4	2 1/2	17 1/2	10 1/2	13/16	2 1/4	1 1/8	2 1/2	3 3/4	5 1/4
2 1/2	2 3/4	19	12	7/8	2 1/2	1 1/4	2 3/4	4 1/8	5 5/8
2 3/4	3 1/8	21	13	1	2 3/4	1 3/8	3 1/8	4 5/8	6 3/8
3	3 3/8	23	14	1	3	1 1/2	3 3/8	5	7
3 1/4	3 5/8	24 1/2	15	1	3 1/4	1 5/8	3 5/8	5 3/8	7 3/8
3 1/2	3 7/8	27	16	1	3 1/2	1 3/4	3 7/8	5 3/4	7 3/4
3 3/4	4 1/8	28 1/2	17 1/2	1	3 3/4	1 7/8	4 1/8	6 1/8	8 1/4
4	4 3/8	30 1/2	18 1/2	1	4	2	4 3/8	6 1/2	8 1/2

from the article by A. D. Williams in *American Machinist,* Vol. 27, page 1715. The symbols refer to those of Fig. 2, all dimensions being in inches.

d = Diameter of bolt (diameter of rod, not diameter at root of thread) (1)

$C_1 = 8d$ (2)

$E_1 = 0.5d$ (3)

$F_1 = 0.375d$ (not over 1 in.) (4)

N_1 = Width of nut or heads across flats $+ 1/8$ to $3/8$ (square nuts or heads are usually used on lower ends of bolts) (5)

$$D_1 = \begin{cases} d + 1/8 \text{ for } 7/8 \text{ bolts and smaller} \\ d + 1/4 \text{ for } 1/4 \text{ to } 2\tfrac{1}{2} \text{ bolts} \\ d + 3/8 \text{ for } 2\tfrac{3}{4} \text{ and larger bolts} \end{cases} \qquad (6)$$

Depth of washer below top of foundation $= 50d$ (6-A)

All dimensions are to be made to the nearest eighth of an inch.

An example of design based on the diameter of the bolt and the safe bearing strength of the foundation material (S. H. Bunnell, *American Machinist,* Vol. 26, page 869) is outlined in the formulas—(7) to (11)—which follow. The symbols refer to Fig. 3, all dimensions being in inches.

d = Diameter of bolt (7)

C_2 = Length of side computed as outlined later (8)

$T = C_2 \div 4$ (9)

$t = (C_2 \div 20) + 1/8$ (10)

$D_2 = d + 1/8$ up to $1\tfrac{1}{8}$ bolt and $+ \tfrac{3}{16}$ above (11)

The proportions given in Table 2 apply to Fig. 3 and were computed by using the preceding formulas—(7) to (11). The bearing area of the plate was calculated in each case so as to provide a pressure of 50 lb. per sq.in. on the foundation masonry when the bolt is stressed to 10,000 lb. per sq.in. sectional area at the root of the thread. The square recess R should be so proportioned that the bolt head or the nut will fit loosely in it. This design has the feature of simplicity to recommend it, inasmuch as the pattern requires no corework. It is not, however, as convenient a design for applications where the anchor bolts are to be removable; that is, where they have nuts on their lower ends.

Anchor-plate dimensions should preferably be based on the diameter of the anchor bolt at the root of the thread rather than on the outside diameter of the rod

TABLE 2. ANCHOR-PLATE PROPORTIONS

(All Dimensions Are in Inches)

Size of Bolt	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/2	3
C_2	6	7 1/2	9	10	11 1/2	13	14	15	18	20	27	32
T	1 1/2	1 7/8	2 1/4	2 1/2	2 7/8	3 1/4	3 1/2	3 3/4	4 1/2	5	7	8
t	7/16	1/2	9/16	5/8	3/4	3/4	13/16	7/8	1	1 1/8	1 1/2	1 3/4
d_2	3/4	7/8	1	1 1/8	1 1/4	1 7/16	1 9/16	1 11/16	1 15/16	2 3/16	2 11/16	3 3/16

of which the bolt is made. That this is true is obvious from the fact that the tensile strength of the bolt is determined by the area at the root of the thread and not by the cross-sectional area of the unthreaded rod. In Table 3 are given the sectional areas of rods of different diameters and also the areas at the roots of standard U.S. threads. The equations which follow for proportioning anchor plates recognize the fact that the ratios

TABLE 3. AREAS AND DIAMETERS OF U. S. STANDARD THREADED RODS

d Diameter of Rod	A Area of Rod	a Area at Root of Standard Thread	Q^2 Ratio of a to A, that is, $\frac{a}{A} = Q^2$
1/2	0.196	0.126	0.646
5/8	0.307	0.202	0.658
3/4	0.442	0.302	0.684
7/8	0.601	0.420	0.670
1	0.785	0.550	0.700
1 1/8	0.994	0.694	0.698
1 1/4	1.227	0.893	0.730
1 3/8	1.485	1.057	0.712
1 1/2	1.767	1.295	0.734
1 5/8	2.074	1.515	0.732
1 3/4	2.405	1.746	0.725
1 7/8	2.761	2.051	0.743
2	3.142	2.302	0.743
2 1/4	3.976	3.023	0.756
2 1/2	4.909	3.719	0.745
2 3/4	5.940	4.620	0.778
3	7.069	5.428	0.767
3 1/4	8.296	6.510	0.787
3 1/2	9.621	7.548	0.784
3 3/4	11.045	8.641	0.783
4	12.566	9.993	0.792

14.534 ÷ 20 = 0.7267 = Average.

between the overall diameters of the rods and the diameters at the roots of the threads vary for different sizes of rods. The following discussion indicates how compensation is made for this condition.

Ratio of Diameter of Rod at Threaded End

The ratio of the diameter of a threaded rod at the root of the thread to the diameter of the unthreaded rod may be expressed by the equation

$$\frac{d_r}{d} = Q \qquad (12)$$

Hence,

$$d_r = Qd \qquad (13)$$

Where

d_r = Diameter at root of thread of U.S. standard threaded rod in inches;

d = Diameter of the unthreaded rod in inches;

Q = Ratio of d_r to d.

The ratio of the cross-sectional area of a threaded rod at the root of the thread to the cross-sectional area of an unthreaded rod will (since areas vary as the square of the diameters), it follows from equation (12), obviously be expressed thus:

$$\frac{d_r^2}{d^2} = Q^2 \qquad (14)$$

The last column in Table 3 gives, then, the values for Q^2 (Q^2 = ratio of area at root of thread to area of round rod unthreaded) for the rods of different diameters.

These values for Q^2 vary from 0.646 for a ½-in. rod to 0.792 for a 4-in. rod, with an average of 0.727. However, in the equations which follow, in which the average value of Q^2 is used, 0.723 is taken rather than the true average value (0.727), so as to favor slightly the smaller-diameter bolts. How these values of Q^2 are applied will be shown in a paragraph under equation (22).

An expression for the safe tensile strength of an anchor bolt is

$$S_b = 0.7854 d_r^2 T \qquad (15)$$

where

S_b = Safe working tensile strength of a round anchor bolt in pounds;

d_r = Diameter of a U.S. threaded bolt at the root of the thread;

T = Safe unit tensile strength of the material of the bolt in pounds per square inch.

The expression for the safe bearing strength of masonry upon which an anchor plate without a casing presses is (refer to Fig. 1)

$$S_{m1} = M(C^2 - 0.7854 d^2) \qquad (16)$$

where

S_{m1} = Safe bearing strength of the area of the masonry pressed upon by any anchor plate not associated with a casing, in pounds;

M = Safe unit bearing strength of the masonry or material upon which the anchor plate bears, in pounds per square inch;

C = Length of side of the square anchor plate used without a casing, in inches;

d = Outside diameter of the bolt, in inches.

Safe Bearing Strength of Masonry

An expression for the safe bearing strength of masonry upon which an anchor plate with a casing presses is (Fig. 4)

$$S_{m2} = M[(C_2^2 - 0.7854(d+2)^2] \qquad (17)$$

where all of the symbols have the meanings previously noted, except

S_{m2} = Safe bearing strength, in pounds, of the area of the masonry pressed upon by an anchor plate with which a casing is used;

C_2 = Length of side of the square anchor plate used with a casing, in inches.

The internal diameters of the casings ordinarily used around anchor bolts are equal to the diameters of the bolts + 2 in., which accounts for the expression $(d + 2)$.

Equations for the safe proportions of an anchor plate used on a bolt without a casing, as in Fig. 1, may be determined thus: Obviously, if the bolt is stressed to its safe strength when the anchor plate exerts the safe pressure on the masonry,

$$S_b = S_{m1} \qquad (18)$$

or, substituting (15) and (16) in (18),

$$0.7854 d_r^2 T = M(C^2 - 0.7854 d^2) \qquad (19)$$

or, simplified,

$$C^2 = 0.7854\left(\frac{d_r^2 T}{M} + d^2\right) \qquad (20)$$

But from equation (13) $d_r = Qd$; therefore,

$$C^2 = 0.7854\left(\frac{Q^2 d^2 T}{M} + d^2\right) \qquad (21)$$

or

$$C = 0.886 d\sqrt{1 + \frac{Q^2 T}{M}} \qquad (22)$$

But since Q^2 may, for all practical purposes—see paragraph under equation (14)—be taken as 0.723, the working equation becomes, in inches,

$$C = 0.88\ d\sqrt{1 + \frac{0.723 T}{M}} \qquad (23)$$

The proportions for anchor plates designed in accordance with equation (23) have not been computed for this article, inasmuch as the majority of anchor plates are probably not set without casings, as in Fig. 1, but are used with casings, Fig. 4, in which case equation (30) applies. It should be noticed that, if the anchor plate presents ample bearing area when used with a casing, it will have a considerably greater factor of safety when used without the casing, as in Fig. 1.

The equations for the safe proportions of an anchor plate when it is used with a casing follow. If the masonry upon which the plate presses and the anchor bolt are both to be stressed to their safe load, then

$$S_b = S_{m2} \qquad (24)$$

or, substituting (15) and (17) in (24),

$$0.7854 d_r^2 T = M[(C_2^2 - 0.7854)(d+2)^2] \qquad (25)$$

or

$$C_2^2 = 0.7854\left[\frac{d_r^2 T}{M} + (d+2)^2\right] \qquad (26)$$

But from equation (13) $d_r = Qd$; hence,

$$C_2^2 = 0.7854\left[\frac{Q^2 d^2 T}{M} + d^2 + 4d + 4\right] \qquad (27)$$

or

$$C_2 = \sqrt{0.7854\left[d^2\left(\frac{Q^2 T}{M} + 1\right) + 4(d+1)\right]} \qquad (28)$$

But since the working value of $Q^2 = 0.723$,

$$C_2 = \sqrt{0.7854\left[d^2\left(\frac{0.723 T}{M} + 1\right) + 4(d+1)\right]} \qquad (29)$$

or

$$C_2 = 0.886\sqrt{\left[d^2\left(\frac{1 + 0.723 T}{M}\right) + 4(d+1)\right]} \qquad (30)$$

in inches.

Safe Working Strength of Bolts

The safe working tensile strength of mild-steel bolts has, for the computations of the values of C_2 in Table 1, been taken at 7,000 lb. per sq.in.; that is, the value of 7,000 was substituted for the symbol T in equation (30).

The safe bearing strength of masonry—M in equation (30)—for the first column under C, Table 1, was taken as 70 lb. per sq.in., this being the safe compressive load permitted for dimension stones in cement mortar under the Chicago building laws, which apparently are more stringent than those applying in other cities. For example, in New York a safe compressive load of 300 lb. per sq.in. is permitted on Haverstraw brick laid flatwise. The values in the second column under C_2 in Table 1 were computed on a basis of a safe load of 200 lb. per sq.in., which may be taken as a safe permissible load for concrete foundations of a 1 : 2 : 5, or richer, mixture.

The method of designing a line of anchor plates the proportions of which are given in Table 1 (see Fig. 5 for the anchor plate) was first to compute the length of the side of the plate C_3 by utilizing equation (30). Then the minor dimensions were computed by using the empirical formulas given in Table 4. In so far as is known there is no refined method, which will stand the test of practicability, for computing the thickness of a cast-iron anchor plate. The plate must be heavy enough so that it will not crack, even if it is stressed severely by being forced against an uneven surface. Practice has shown that, if the thickness of the plate at the center is equal approximately to the diameter of the bolt in inches, it will be strong enough; hence the thickness of the plates of Table 1 was figured on this basis. The other proportions indicated in Table 4 were also selected largely

TABLE 4. CONSTANTS USED IN DERIVING ANCHOR-PLATE PROPORTIONS

Symbol	Dimension Designation	How Proportioned (All Dimensions in Inches)
d	Outside diameter of bolt (not diameter at root of thread)	Determined by probable load that will be imposed on it
D	Diameter of bolt hole	= d + [illegible] in. when d is [illegible] in. or under; [illegible] in. when d is 1 in. to 2½ in.; [illegible] in. when d is 2¾ or over
C	Length of side	= Computed with equation (30)
F	Thickness of pocket wall	= 0.375d
E	Thickness of plate at center	= d
G	Thickness of plate at edge	= 0.5E
H	Inside height of nut pocket	= Thickness of rough nut + [illegible] in. when d is [illegible] in. or under; [illegible] in. when d is 1 in. to 2½ in.; [illegible] in. when d is 2¾ in. or over
W	Outside width of nut pocket	= Width of rough nut across flats + [illegible] in. when d is [illegible] in. or under; [illegible] in. when d is 1 in. to 2½ in.; [illegible] in. when d is 2¾ in. or over
I	Outside length of nut pocket	= W + 2F

on the basis of what experience has indicated to be satisfactory.

Where such procedure appears desirable, one may, when designing a line of anchor plates, use the exact value of Q^2, as tabulated in the fourth column of Table 3, for each diameter bolt. These exact values of Q^2 would be substituted in either equation (22) or (28). This should, theoretically at least, give results of somewith greater accuracy than does the method—equations (23) and (30)—used for the computation of the C_3 values in Table 1. However, since Table 3 may not in many cases be available, the working equations given in (23) and (30) are the more convenient forms. They are sufficiently accurate for all practical work, inasmuch as the other variables that enter into the problem will probably introduce greater errors than will the application of this approximate working value (0.723) for Q^2.

Saw Guard on Hand Miller

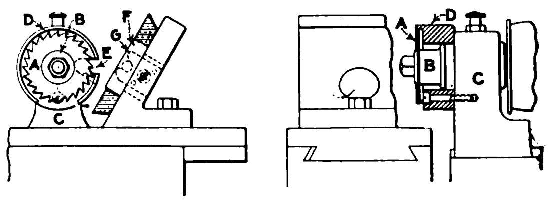
By D. Baker

This guard was designed to keep the operator's fingers from coming in contact with a saw running at high speed. The guard was put on a bench miller used for sawing off the end of a brass pin that was screwed into the side of a time-fuse ring.

The illustration shows the saw at A, on the saw arbor B, while C shows the miller head. The guard D is made of a piece of cold-rolled steel 1½ in. in diameter, turned out as shown for clearance for the saw, and it fits over the front bearing of the machine. When held in position by the one screw shown, the guard overlaps the saw about $\frac{1}{32}$ in. At E the guard is cut away for clearance, to permit the pin on the work to pass through to the saw, the cut being filed away on an angle so as to allow the scrap to drop away readily, as shown by the dotted line.

In operation the time-fuse ring is placed over the stud F, and the end to be cut off is located in proper position by the slot in a hardened piece G. It is held in place with the left hand while the right hand operates the lever that carries the table with the work, forward against the cutter.

In first trying out this machine we used the regular commercial screw-slotting cutters, but they dug into the



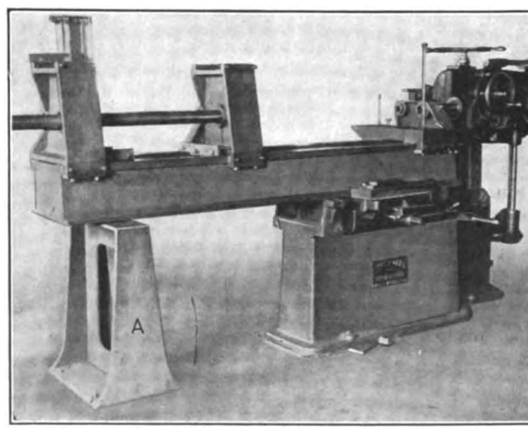
SAW GUARD ON HAND MILLER

work and clogged up with chips. We overcame this trouble by grinding clearance on the sides and reverse rake on the teeth, so that the teeth would have a tendency to throw the chips away rather than to gather them in. The capacity of the machine is from 6,000 to 10,000 pieces in 10 hr.

Supporting an Overhanging Table Fixture

By E. A. Thanton

In boring out bearing holes in Millholland turret lathes the work is done on a boring mill with a table too short to support the overhang of the work and fixture. The method of remedying this condition is shown in the illustration. The cast-iron support A is placed close to



SUPPORTING AN OVERHANGING TABLE FIXTURE

the outer end of the overhang, and rollers are provided so that it will move easily across the top of the support, according to the way the machine table is run. Leveling screws, resting on iron plates, are placed near the four corners of the bottom of the support, so that it may be adjusted to the correct height and leveled.

Methods and Tools Used in Machining Tractors

EDITORIAL CORRESPONDENCE

SYNOPSIS—Some of the tools used for machining elements employed on tractor machinery are shown. The jig for drilling the balance weights is of the indexing type, thus machining the holes in the correct alignment. An interesting babbitting die for making white-metal bearings is also shown. An indexing jig is used for machining a six-sided turret. This tool is first utilized for drilling the holes in the correct position and later employed for rough-boring and facing operations. A fixture for milling four sides of a casting squarely is also of interest.

The A. B. Farquhar Co., Ltd., York, Penn., manufactures a variety of tractor and agricultural machinery. Fig. 1 illustrates a jig used for drilling the balance weights for crankshafts. The casting is previously milled along the surfaces, which fit against the sides of the crankshaft webs. The balance weight is then placed in the jig, being forced against the wall *A* with the setscrew *B*. The jig is swung over to the two position for drilling, the locations being obtained by the pin *C* in bushed holes *D*. The drills are guided through bushings *E* so that the holes will be in the correct alignment. A view of the jig, with the casting in position ready for drilling, is shown in Fig. 2. It illustrates the method employed to locate the casting, how it is held, and the indexing arrangement.

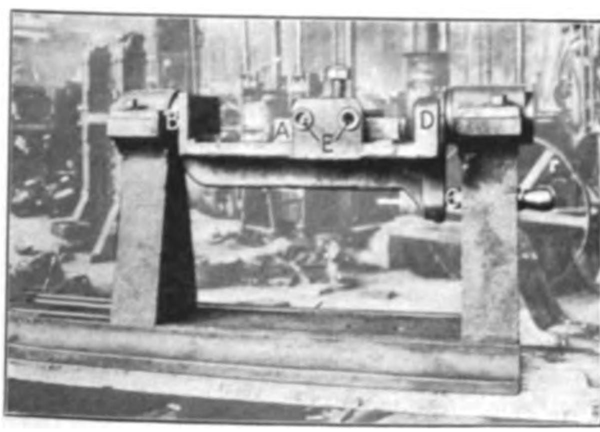


FIG. 1. DRILL JIG FOR BALANCE WEIGHTS

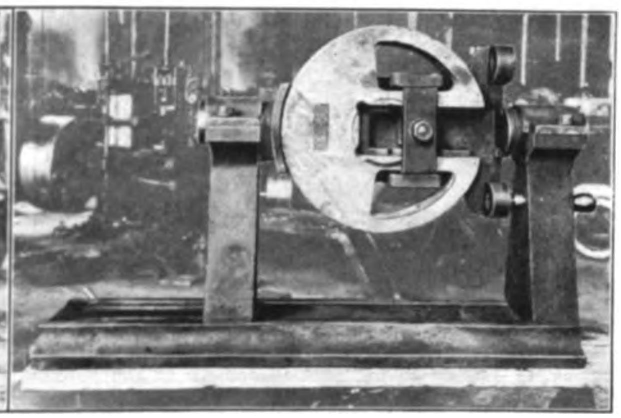


FIG. 2. JIG WITH CASTING IN POSITION

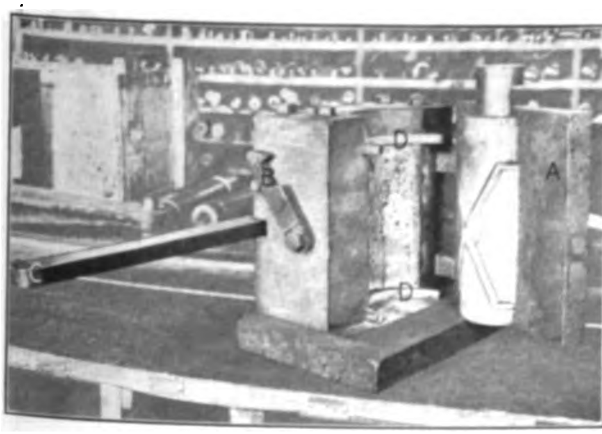


FIG. 3. BABBITTING DIE OPEN

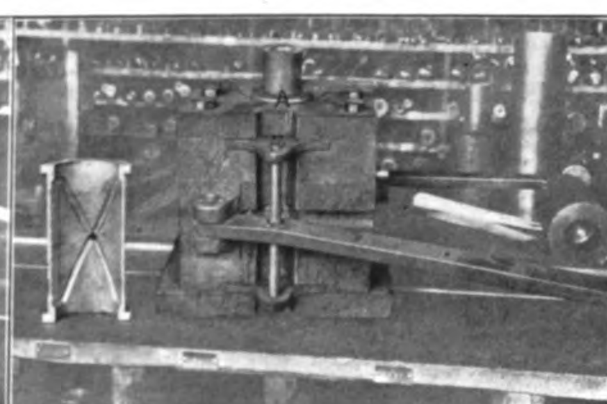


FIG. 4. BABBITTING DIE CLOSED

Babbitting Die for Bearings

On some of the steam- and gas-tractor engines certain of the bearings are made of white metal. The die used for making these bearings is shown in Fig. 3. The cover *A* is swung back and held with the latch *B*. The molten metal is then poured into the mold and the bearing made.

After the metal has solidified, the cover is opened, which draws the handle *C* forward. This forces out the ejectors *D* and pushes out the finish-molded bearing. The die, closed, is shown in Fig. 4. The metal is poured into the tool at *A*. One of the molded bearings is shown at the left of the die, and its good appearance is worth noting.

The A. B. Farquhar Co. has recently been doing some special work, a part of which was making horizontal turret lathes.

FIG. 5. JIG WITH CASTING REMOVED

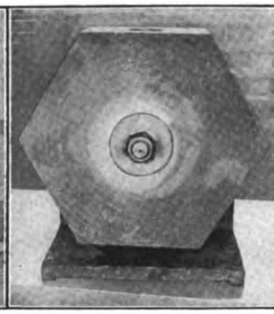


FIG. 6. DRILL JIG WITH CASTING IN POSITION

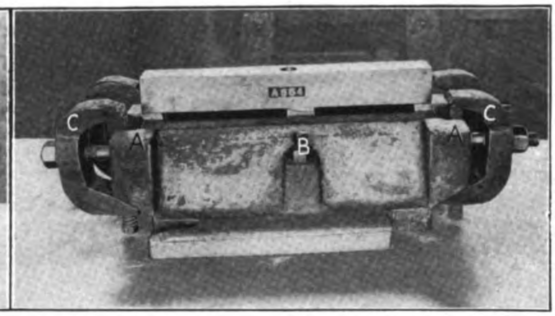


FIG. 7. MILLING FIXTURE FOR SIDE BLOCKS

Fig. 5 shows the jig used in drilling the turret. The ring *A* is removed from the main body of the jig and the turret casting placed in it, being located by the machined recess in the jig. The various holes are then drilled, the tool being guided through bushings *B*.

The ring *A* is placed in the jig as shown and the casting inserted in the jig, which is located by the arbor *C*, the latter fitting into the hole previously bored. The casting is held in position with the washer and nut. The jig is then placed on the table of a Bullard boring machine and the turret holes rough-bored and the surfaces faced. The various positions are obtained by index pins which fit into bushed holes. By this method the turret holes are machined in alignment with the previously drilled holes. The turret is attached to the machine for the final boring of the holes.

Fig. 6 shows the jig with the turret casting in position ready for the boring operation.

Milling Side Blocks

The fixture used in milling the four sides of the side blocks is shown in Fig. 7. The rough casting is first placed on the blocks at *A* and rests on the adjustable screw *B*. Owing to the beveled surface at the bottom, the clamp *C* when tightened not only holds the casting but also draws it down to the locating surfaces.

The upper surface is then milled and the casting placed in the fixture as shown, being located on finished pads. The part is held down with the clamps as described. A gang of milling cutters is then fed over the casting and the upper surface and sides are straddle-milled. In this way the four sides are machined in alignment with two settings of the fixture.

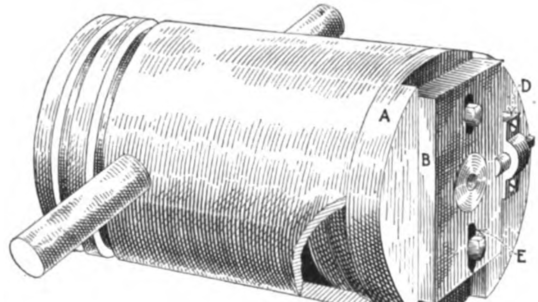
Correcting Errors of Boring in Wristpin Holes

By O. M. Chapman

In the machining of pistons for either gasoline or Diesel oil engines too much attention cannot be paid to having wristpin holes in perfect alignment with the center line of the piston. It is possible to bore wristpin holes within 0.003 to 0.005 in. of square with the center line of pistons up to 18 in. in diameter or over; but when a positively accurate job is wanted, the following method is advisable:

Make up an aligning arbor to fit the finished wristpin holes in the piston. The protruding ends of the aligning arbor should be of a suitable length and ground to a uniform diameter for indicating purposes. The work is then ready to mount on the adjustable center shown in the illustration and to be ground on the outside after it is trued up with the wristpin hole.

The adjustable center has a disk *A*, which can be of any convenient size to suit the piston. This disk has a place milled central to receive the part *B*, which carries a hub with a center. The plate is secured to the disk by two or more bolts *E*. The part *B* is moved on the disk by an eccentric, which is carried in a bearing *D* bolted to *A*. Elongated slots should be milled in *B* to facilitate the adjustment of the center. A slot should also be milled in *B* to receive the eccentric. The outside diameter of the fixture should be turned to fit the pistons after the fixture has been completely assembled with the eccentric set at its neutral point. A slot should be milled in the outside edge of the plate *A* to facilitate its removal after grinding a piston.



PISTON-ALIGNING FIXTURE FOR CORRECTING ERRORS IN WRISTPIN HOLES

The bottom end of the piston should be bored a suitable distance and size to accommodate the adjustable center, which is so placed that the eccentric will throw the piston to correct any error. The aligning arbor should be checked with an indicator while rotating the piston on the grinder centers, until the same reading on the dial of the indicator is obtained at each contact. The bolts are then tightened in the adjustable center, and the piston is ready to be ground.

This fixture has worked out very satisfactorily and is recommended to anyone who is looking for a method of finishing pistons accurately. And it should not be forgotten that it is lack of accuracy in such details which prevents the best results being secured under trying conditions. The best results require good workmanship at all times.

Specifications for Purchase of Leather Belting

SYMPOSIUM OF DISCUSSION

SYNOPSIS—A discussion of the article published on page 683, from the viewpoint of the leather-belting manufacturer and users. The difficulty of formulating satisfactory specifications is pointed out, variations in hide leather are outlined, and the desire of the manufacturer to produce a reliable product is emphasized. Tensile strength, pliability, thickness and weight are discussed in detail.

The Manufacturer's Viewpoint

BY LOUIS W. ARNY*

The article appearing on page 683, entitled "Specifications for Purchase of Leather Belting," is remarkable for the intelligence with which the author has dealt with a subject that is so little understood and concerning which there is so much misinformation. From the point of view of the leather-belting manufacturer there are but few corrections to be made and few additional thoughts to offer.

Though leather belting is one of the oldest means of power transmission, there has never been discovered or invented a real substitute for it. Its flexibility and its ability to adapt itself to the pulley, the large quantity of power which it will transmit under favorable conditions, the readiness and cheapness with which it may be repaired or altered, the fact that it may be made endless, the small amount of attention it requires and, further, its remarkable durability and length of life, its salvage value when no longer serviceable as a belt, all commend it strongly as a most satisfactory instrument.

The general disposition to reduce to specifications all the purchases of well-organized concerns has led to efforts to prescribe minutely not only the points of quality, but the methods of manufacture. These efforts have proved such obvious failures that a consideration of the subject is timely and may be profitable.

The real point of difference between the belt maker and those who have prepared the specifications is that the technologist is ignorant of the material and the product, and that the belt maker, with an intimate practical knowledge of the manufacture of leather belting, the material of which it is made and usually of its practical use, is deficient in a knowledge of the technology of the subject. Hence, they (technologist and manufacturer) "do not speak the same language." Until the belt maker can lay aside his business long enough to take up the study of the scientific side of the use of belting or until the theorist will devote several years to a practical study of tanning, currying and beltmaking, they cannot hope to view the subject from a common standpoint.

The fundamental error of the technical people is the presumption that leather is a homogeneous product of the same quality throughout, like so much iron or fabric. The practical currier and belt maker know that every hide is as individual as the animal on which it grew, that its quality is beyond the reach of cultural effort, that no two hides are exactly alike any more than human faces are alike and that every strip of leather cut from a given hide is different in thickness, texture, strength, stretch and wearing qualities. It seems impossible to prescribe in figures any stated requirements that will secure the best and reject the least fit. The "feel" of the expert currier remains superior to any specifications that any engineer has been able to formulate. Further, it is impossible for the belt maker to submit to any physical test every strip of leather that he intends to put into a belt, or even one strip from every hide, and the latter test would be worthless even were it feasible.

THE NEED OF PRACTICAL KNOWLEDGE OF LEATHER

There is no method known by which one not trained in the school of practical experience can determine from its appearance whether a given strip was located within ten inches or twenty inches of the backbone; in fact, there are many stories current of the ludicrous mistakes certain engineers have made in identifying even the backbone itself, and there are few of them who could differentiate with any certainty between a well-finished belly or shoulder strip and "the first cut off the backbone." It is similarly impossible to determine from the appearance of the belt whether the leather is tanned with all bark or part bark and part extract (even experts may be deceived in some results of exclusive extract tannage), whether the butt was classified as No. 1 or No. 2, whether the hide was a packer native steer, a country hide or a South American, whether the strips were stretched in straight-edge clamps, by hand or by power, or even whether they have been stretched at all.

This confirms the conclusions of your correspondent that the inclusion in specifications of requirements that cannot be identified or proved in the finished product are futile and serve only to complicate the problem. As he says, it is not a question of how the belt was made, but of the service that it will render. Of course, the underlying thought is that a belt made according to stipulated methods which are thought to be the best will produce better results; but in stipulating methods that are not necessarily the best and the use of which cannot be determined by any examination of the product and in calling for material that cannot be identified the buyer is compelled to depend as his only resource upon his confidence in the ability and the honesty of the seller, and he might better have relied upon such confidence in the first place rather than waste his time on impossible specifications. It is notorious in the leather-belting trade that many large buyers have some very poor belting in their storerooms and in their shops, notwithstanding the very rigid specifications which many of them have adopted. Those who have been more fortunate in securing good service can attribute it more to the ability and honesty of the belt maker than to any merit in the specifications under which the belting was bought.

*President, National Association of Leather Belting Manufacturers.

Instead of depending upon the honor of the seller, they in a manner absolve him from responsibility by setting up their specifications and their inspection and testing departments, and then buy from the lowest bidder at prices that make it manifestly impossible that they should get the qualities they specify. It is not intended to excuse the seller who contracts to deliver one thing and substitutes another; but there is never much sympathy wasted on the poor fool who in the hope of getting something for nothing loses his money by betting that the pea is under a given shell, when the disclosure shows it to be elsewhere. The sympathy of the leather-belting trade does not go out to the Government because it has been deceived, when its published prices of contracts awarded show that it sometimes pays less for its finished belting than the material specified would have cost in the rough.

Importance of Buying from Dependable Houses

There may be invented for the purchase of leather belting, specifications that will be practical and that will accomplish their purpose, but it is quite certain that those in use at this time are not accomplishing this purpose. Until this invention is made, the only method by which the intelligent buyer, desirous of spending his money to the best advantage, can hope to secure satisfactory qualities of leather belting is by buying recognized brands of belting from dependable houses and taking good care to pay them enough money for it to have it made right. It will be observed that there are two propositions here, the first to buy from houses in whom the buyer has confidence.

There are 150 manufacturers of leather belting scattered over this country, practically all of them honorable, reliable men, with a keen appreciation of the desirability of making permanent customers by rendering good service, and an arrangement could be made with any of them by which a really superior product would be delivered; but the second proposition is more important, that there shall be paid for leather belting such prices as will enable the maker to make it right and to maintain his qualities. The buyer has no right to expect to get something for nothing, or much for little, or to get more than his dollar should actually buy. When he buys on specifications that he cannot enforce, he is simply placing temptation in the path of the seller, who would much prefer to play fair, and inviting him to commit a fraud. The ethics of the leather-belting trade are as good as those of any other line of manufacture, better than most others, but the men engaged in the line are human and are ready to defend themselves against sharp practice if necessary. As long as belting is bought on price, the shops will be full of poor stuff that cannot possibly render service, regardless of the specifications under which it has been bought.

Most of the belting manufacturers have standard grades and classifications, making a range of belting suitable for every duty. Most of them have established prices on these several grades, which prices form a standard market price that is always subject to the keen competition of 150 manufacturers. There is never any difficulty for any buyer accurately to determine this market price, and there is never the possibility that competition will permit this price to go too high. From the very nature of the case there never can be a combination on price among the leather-belting manufacturers, though there is an "open-price association" through which information is disseminated regarding the prices at which sales have been made. There is therefore absolutely no reason why any buyer should not be able to purchase leather belting that will give maximum service, if he will place himself in the hands of some good belt maker and will pay him a fair market price.

Tensile Strength—Any dependence upon a test for tensile strength in belting leather has always been unwise (a) because of the wide divergence in the tensile strength of corresponding strips cut from different hides of the same class and also of different parts of the same strip; (b) because the least desirable of the strips that may be cut from a good hide—those near the belly—will usually show the greatest tensile strength; (c) because the most desirable strips that may be cut from the hide—those immediately over the backbone—usually show less tensile strength; and (d) because the greatest possible load to which a belt may be submitted in the transmission of power bears so small a proportion to its tensile strength.

Nor is it necessary that the "ultimate tensile strength should be as high as possible." A belt of any appropriate width and quality never breaks from lack of strength, but always because of an accident, a lack of elasticity or of a rotten condition due either to old age or lack of care. When a properly tightened belt in good condition is overloaded beyond its capacity to transmit, it jumps the pulley, if it can; and this point is reached long before the strain upon it makes any approach to the ultimate tensile strength of its weakest strip.

It does not seem to be understood by engineers that the qualities of tensile strength and stretch are inseparable, that when by any means the stretch is reduced, the tensile strength is reduced with it and that the strip of satisfactory tensile strength necessarily shows a large "stretch." It is quite true, as stated, that belts of approved quality will show an elongation much in excess of the 8 to 12½ per cent. specified and that under a tension of 2,000 lb. most of them will show an elongation of from 20 to 30 per cent. It is further true that belts showing an elongation of 30 per cent. under a tension of 2,000 lb. will usually produce better practical results, as belts, in transmission qualities and in length of service than those which stretch but 8 per cent., though the latter may be less troublesome in the matter of tightening while they last. But, as stated, these facts bear but little relation to the elongation in service under a tension of 100 to 200 lb.—not nearly so much as does the matter of the placing of the belt upon the pulley under that proper degree of tension which is necessary if the belt is to transmit its load properly; but this factor is one generally under the immediate control of the engineer and not of the belt maker, and hence an appropriate point for the engineer to start at in his specifications.

Pliability—Buyers have always been willing to accept a feeling of firmness and even hardness as an indication of good quality, and a few years ago, in an effort to meet the demand, belting leather was finished much harder than at present. The fashion in belting has changed, and leather with a solid but mellower "feel" today has the call; for ordinary transmission such leather is more suitable. But the question of pliability is closely connected with that of the diameters of the pulleys over which the belt is to run, and one that is sufficiently pliable to run to the best advantage over a 6-ft. diameter pulley may be entirely unsuitable and unsatisfactory over a 6-in. diameter pulley.

It is probably more rational to consider that a good hide tanned to show a gain of about 60 per cent. and curried and stuffed to show no loss in weight is in best condition for the widest range of transmission, so far as its pliability is concerned, and that any adaptation to small pulleys which may be desirable should be made in the thickness of the belt rather than in any attempt artificially to increase its flexibility. Attention should be called here to the fact that, as with tensile strength and stretch, the least flexibility is to be found in the best part of the hide—over the backbone—and the greatest flexibility will be found in the least desirable part of the hide—the belly. The effort to set up a test of bending over a 1-in. rod is futile so far as backbone cuts or belly cuts are concerned, and it is extremely doubtful whether any test can be devised that will convey accurate information regarding pliability to one who does not know leather.

THE IMPORTANT FACTORS OF THICKNESS AND WEIGHT

Thickness and weight are two most important factors that should be dependent one upon the other. It is true that the weight can be increased; but it is doubtful that "white lead or other heavy material" is ever used, the most common resource being a heavy grease stuffing, which instead of being a detriment is an advantage to the belt and can be criticized only on the score that it may be constructively an attempt to deceive.

Single leather belts are made in medium, heavy and extra-heavy weights or thicknesses, the actual weight specifications per square foot varying slightly with the different makers. In doubles the practice varies, all makers offering light, medium, heavy and extra-heavy double belts, but some making them definite fractions of the inch in actual thickness without regard to the weight and others to specified weights for each thickness. There has been so much talk about weight that buyers have absorbed the idea that the best belt must weigh approximately 16 oz. per square foot for singles and 32 oz. for doubles. It is obvious that, so far as the quality of material only is concerned, a belt weighing 14 oz. may be just as "good" as one weighing 16 oz., or that a light double belt may be just as "good" as the heavy double belt. A specification of weight then does not secure for the buyer any better quality, but only more quantity.

The question of weight is not one of quality, but of adaptation for the service; and it should be understood by belt users that the principle involved is a thick belt for large diameters, a medium-thick belt for medium diameters and a thin belt for small diameters. As leather belting is usually made, this would dispose of the question of pliability, would secure the best possible pulley contact and transmit the largest load. It might serve to clarify this point if the belting manufacturers would issue a table showing the brands of their belts as adapted to given pulley diameters; but until there is secured some more uniform practice in designing pulleys, belts and power requirements of machines, the manufacturers would be courting trouble.

There is an opportunity for the greatest possible service to all concerned in the formulation of some standard practice in the calculation of the power transmission of all kinds of belting, which could be generally accepted by engineers, designers and belt manufacturers and in accordance with which all machinery could be built. At present every designer is a law unto himself, and he oftentimes places upon his machines pulleys of such narrow widths and small diameters that no belt can transmit the required load in a satisfactory manner—an endless source of trouble to the owner, the operator and the maker of the belt.

It is quite probable that the leather-belting manufacturers would be glad to coöperate with any of the mechanical-engineering societies which would undertake this task, or that they might establish their own engineering bureau to determine these points so little understood, as suggested by your correspondent; but in the meantime nothing is to be gained for the buyer by the imposition of absurd specifications, for in the present trend of thought on the part of the belting manufacturers the feeling is that such business as is covered by these silly specifications is not worth having. In a number of recent cases some of the best houses have refused to bid on contracts where the specifications were impracticable.

Substituting Second- for First-Grade Belting

By CARL G. BARTH

I have read the article on page 683, "Specifications for Purchase of Leather Belting," with a great deal of interest, for it is indeed high time that something be done to get developed and put into general use some such rational specifications and tests as the writer suggests.

I fear that the present state of the art of selling and buying leather belting is even worse than the writer of the article has presented it; for from what I have had occasion to see of it during the last 15 years I should judge that the average salesman in the business has about as much chance for a blessed existence in the hereafter as has a camel of passing through the eye of a needle, unless his final judge will make a full measure of allowance for the adverse conditions under which he labors and against which his own oft-tried honest efforts to improve them have only too frequently redounded to his material disadvantage.

I have in mind the fact that in many industries those intrusted with the purchase of leather belting know absolutely nothing else about the matter than to award a contract to the lowest bidder who says he will furnish good belting; and that the shop management is so lax that no systematic attention is paid to the belts, so that the whole institution is left in ignorance about the true state of affairs.

I have it from a prominent manufacturer, now dead some eight or nine years, that the cut-throat competition in the business had brought about a condition of affairs, some years before I came in touch with him, that led to a suggestion that all manufacturers combine to cease the making of first-grade belting and that they simply offer second grade for first grade, so as to get on a more equal basis in their competition with one another, in connection with the lower prices for which the majority of purchasers had been led to believe that they were entitled to first-grade belting.

The general condition of the market is such that most purchasers are getting only second-grade belting while believing that they are getting first grade; and this because the would-be-honest salesmen have practically all given up getting the purchasers to pay the necessary price for first-grade belting, as some of the originally less

scrupulous among them have been able to make the purchasers believe that they could offer first-grade belting for the same price as the absolutely honest among them demanded for their second grade.

This is of course only a review of what has happened in all cases of sharp competition, and it seems a pity that manufacturers and salesmen who wish to be honest—and surely they are greatly in the majority—should not be able legally to combine to maintain their honesty and in connection with this to avoid the temptation that comes with monopolistic combinations.

However, they can greatly improve their lot by combining to develop rational specifications and methods of testing, for such would enable them to compete fairly and squarely on the merits of their product.

In spite of the higher price the best belting now made is by all odds the most economical in the long run, if reasonable care is taken to prevent accidents to belts. Hence, in the distant future when all users get to understand this and to act upon it the belt manufacturer may be confronted with the problem of finding a market for his inferior grades of belting, which he now must produce and sell along with his best grade, in order to keep the price of the latter from soaring too high.

Specifications of a Large User

By C. B. Auel*

It must be admitted, as stated in the article on page 683, that there is room for improvement in leather-belting specifications generally, and to this simple statement of fact nearly everyone will agree, whether from the standpoint of consumer or manufacturer. However, we are inclined to feel that the article, while containing certain incontrovertible features, does not lead very much nearer to the ideal specification.

As something that has met requirements for several years past, having been slightly modified since its original publication, we offer our own belting specification. It may be of interest to your readers to indicate how it was developed. We first wrote out what we knew about the subject, as well as what we could obtain from various books; after that we communicated with a considerable number of large consumers of belting like ourselves, requesting similar information and stating what our object was in so doing. When the replies were received, the data were tabulated in suitable form, so that a composite belting specification was the result, but of course one prepared wholly from the standpoint of the consumer. Copies of this tentative specification were then submitted to many of the belting manufacturers throughout the country, with a letter inviting their frankest comments, regardless of whether such were favorable or otherwise. In consequence much added information was obtained, though the replies were extremely varied, some stating the matter should be left wholly to the belting manufacturer, others changing or modifying the temporary limits that had been set, suggesting new paragraphs, etc. The final result was the specification given here.

Criticism of the specification as it stands may be made by some belting manufacturers in that the laps for double belting could be safely reduced from 4 in. to 3 in. and the weights specified altered to allow a variation both above and below the figures set, say 5 per cent. and 3 per cent. respectively, instead of permitting a variation above only, as has been done by the use of the word "minimum."

Reference to the specification will, we believe, show that it has been prepared along the lines indicated; that is, neither from the wholly "theoretical" nor the purely "practical" side, but as a compromise between them.

Without going into any detailed discussion of the article in question, a few comments on some of the statements made may be in order. While it is true that it is desirable to state the essential features of a specification such as "explicit requirements based on the service expected" and "definite tests to show whether the requirements are met or not," it may be pertinent to ask what these should be as applied to belting used in a work having a considerable number of belt-driven machine tools and where belting after its purchase can only be turned into stock for general use. As to

Westinghouse Electric & Manufacturing Company

East Pittsburgh, Pa.

LEATHER BELTING

1—This specification covers miscellaneous sizes of leather belting for general use.

I—PHYSICAL PROPERTIES

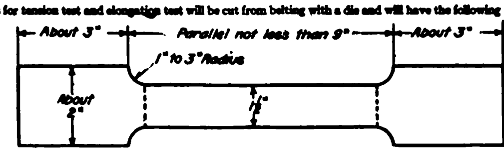
2—The belting must be of the best quality oak-tanned leather, free from all ingredients in any way injurious to the life or wearing qualities of the belt, or that simply add to its weight. Material

3—Belting must be cut longitudinally and no piece of hide must exceed 54 inches in length. Widths less than 7 inches are to be cut within 15 inches of the center of the hide; widths 7 inches and over are to be cut from the center of the hide; neither shoulder, belly, side, nor flank stock, nor any padding nor shimming will be permitted. It must be of uniform thickness and width, and be perfectly straight from end to end. Location of Cuts

4—Laps must not be less than 4 inches or more than 8 inches, excepting that in single belting 8 inches and over in width, the lap may be 1 inch longer than the width of the belting; no lap should be within 4 inches of the end of a strip. Laps must be thoroughly cemented, and when pulled apart the exposed surfaces must not show any resinous, vitreous, oily or watery condition; no rivets will be permitted. Laps

5—Belting must have an ultimate tensile strength, both in the leather and in the splice, of not less than 3600 pounds per square inch and must not show an elongation in 2 inches to exceed 13½ per cent when measured under a load of 2250 pounds per square inch for one hour. Tests

Test pieces for tension test and elongation test will be cut from belting with a die and will have the following dimensions:



6—Belting must not crack open on the grain side when doubled strongly by hand with the grain side on the outside, nor must it show piping or raising on the grain side when similarly treated with the grain side on the inside.

7—When belting is required for any special purpose, the manufacturer will be notified as to the nature of the work, maximum horse-power, speed, etc.

II—WEIGHTS

8—Belting not waterproofed must come within the following range of weights which must be guaranteed to be not more than 10 per cent in excess of the actual weight of the leather. Weights

Width	Minimum Wt. Per Sq. Ft. Single Belting	Double Belting
1" to 2"	13 oz.	24 oz.
2¼" to 4"	14 oz.	26 oz.
4½" to 5½"	15 oz.	28 oz.
6" and over	16 oz.	28 oz.

III—MARKING

9—The belting must be marked every 10 feet with the manufacturer's name, trade mark, or equivalent identification mark. Marking

IV—REJECTION

10—The Westinghouse Electric & Manufacturing Company reserves the right to reject any portion or all of the material which does not conform to the above specification in every particular, and to return the rejected material to the manufacturer or seller for full credit at price charged f.o.b. point of delivery specified by the purchaser. If the material is to be replaced, a new order will be entered at prices, terms and conditions acceptable to the purchaser. Rejection

*Director of standards, processes and materials, Westinghouse Electric and Manufacturing Co.

the further statement that "tensile strength should be specified in pounds per inch of width," we cannot see that the use of "per square inch" involves any detrimental feature that "per inch of width" does not. Tensile strength in a belt is not so important compared with some other features, since practically all properly selected and installed belts are operated well within their factor of safety.

Regarding the statement that the best brands of belting show from 16 to 25 per cent. stretch, we venture the statement based on our own experience and methods of testing that the best brands, when ready for the consumer, do not show such maximum stretch.

It would certainly be desirable, as the article states, if a definition for "pliability" could be worked out, perhaps combining it with "piping," but in this connection it is advisable to point out that the best portion of the hide—the center of the back—is less pliable than is the poorest portion, which is the belly. What is needed as much as pliability is a soft finish for good pulley contact.

"Weight" is specified not only to prevent the use of light-weight stock, but also to eliminate objectionable and excess filling, and it indirectly involves thickness, which need not therefore be mentioned; though if not, something should be said as to uniformity or tolerance in thickness.

Experience on the part of belting manufacturers, as well as of consumers, shows that for best average results as to wear, strength, etc., the leather should be selected from certain portions of the hide only and will then approximate certain weights per square foot with certain resulting tensile strengths per square inch. If, as seems to be suggested in the article, such features as weight and thickness were both to be removed from a belting specification and "strength per inch of width," in effect, substituted for them, it would seem to remove desirable safeguards, especially to the small consumer, who is not always so situated as to be able to make tests for tensile strength and who is therefore more nearly dependent on weight, thickness and visual inspection tests against the use of belly, flank or other undesirable portions of the hide.

A Few Suggestions

By N. G. Near

The writer of the article on page 683 hits the nail squarely on the head. There is no reason why specifications cannot be considerably bettered; and as I have had some little experiences with belting and have delved into belting and transmission economics, perhaps I can write something helpful.

Strength—"Tensile strength should be specified in pounds per inch of width" is the logical specification, but the buyer should state at the same time the pulley diameter, the speed in feet per minute and other conditions that might be deleterious to thick belts or belts made of other materials than leather. I know one manufacturer, for instance, who will not sell woven belting for a drive on which there is a finger shifter, and he will not allow his belting to go onto pulleys that are too small.

Stretch—In my experience I have found that stretch is not so serious as often painted. If a belt is properly cared for and kept in a properly pliable condition, it need not be maintained as tight as where it is not pliable, but is dry and hard. Here, again, much depends upon conditions. If the drive is a vertical one, there should be as little stretch as possible. If the drive is horizontal and if the distance between centers is great, the matter of stretch is of little moment. We have many examples of leather drives that have operated for 18 and 29 years without being touched by a knife.

Pliability—A good rough-and-ready specification for pliability is, "The belt must be so pliable that it will run——inches slack on——foot centers and transmit——horsepower while running at a speed of——feet per minute. It is well, of course, to give the pulley sizes and speeds and state which is the driving and which the driven pulley. Where the drive is a small one and the belt a narrow one, it would hardly pay to give all details of this kind; but where there are many drives of this type in a given shop, pliability could easily be tested in this way on *one* drive, and it would be taken for granted that all belting in the batch is equally pliable.

Thickness—Since a thin belt will transmit proportionately more power per square inch of section than will a thick belt, this is an important item. Where belting is bought by the pound, considerable money can often be saved by specifying a thin belt (tolerance to be stated with the thickness) and running it on wider pulleys.

Weight—Weight is important on horizontal drives, but not on vertical drives. On horizontal drives the heavier the belt the better, especially for short drives, for then little difficulty is experienced in permitting the belt to run slack and embrace a large arc of contact on each pulley. A heavy belt runs more steadily, does not flap, wabble and wave. Still, as the author states, belting should not be sold or bought by the pound. Strength is the most important thing, and on that the price should be based. The only reason why a belt of zero weight would be desirable is that such a belt would be immune to the effects of centrifugal force; but since such belts are impossible and weight is inevitable, let us use belts that are heavy rather than light. For horizontal drives, therefore, I should specify heavy belts.

Piping—This is an insignificant point and need not be thought of if the directions of the manufacturer of belting are followed. Thin belts should be used on pulleys of small diameter. The larger the pulleys become in diameter the thicker may be the belt. Here are rules that I have recommended in this connection:

For single-ply belts $\frac{3}{16}$ in. thick, pulley should not be less than 6 in. in diameter.

Double-ply belts $\frac{3}{8}$ in. thick, pulley should not be less than 10 in. in diameter.

Triple-ply belts, $\frac{9}{16}$ in. thick, 3-ft. minimum diameter.

Four-ply belts, $\frac{3}{4}$ in. thick, 4-ft. minimum diameter.

Scientific Management Course

With the aim to acquaint those interested with the most recent developments in the theory and practice of scientific management, Frank B. Gilbreth announces the fourth summer course from July 31 to Aug. 12.

The course is open to professors of engineering, business administration, psychology, economics and other subjects allied to management. There are no fees and those desiring to attend should make application to Frank B. Gilbreth, 77 Brown Street, Providence, R. I.

Preparing for Manufacturing Munitions in the U. S.

By A. B. Chester

All who have given any thought to the question of industrial preparedness recognize its importance. A very valuable part of military preparedness is the governmental encouragement during times of peace to the munitions industry. It is of course needless to point out the inestimable value to the Germans of the Krupp establishment. The same kind of establishment might be built up in this country, say at the Bethlehem Steel Co., the Midvale Steel Co., the Crucible Steel Co., the Remington Arms Co., and so on. In order to do this, however, it will be absolutely essential for these factories to enter the world market for ammunition and other war supplies.

It seems to me that our Government and our Government representatives should encourage and assist in every possible way the obtaining of orders by such companies in foreign countries. In this way we can provide in the munitions industry a large body of trained workers that would enable us not only to produce large quantities of munitions at the beginning of war, but rapidly to expand to meet the colossal demands of modern war for guns, ammunition, etc. The trained worker, it seems to me, is a tremendous asset.

A Perpetual Industrial Inventory

An industrial inventory is very desirable, because if properly taken and properly analyzed, it will show our capacity for production of various war supplies. I very much doubt whether it would be feasible to draw up and keep alive any plan for immediately developing our maximum output. Indeed, such development would be impossible within any short period of time, as has been abundantly demonstrated by England, France and the United States. It does seem to me, however, not only possible, but desirable and even necessary to make plans for the immediate placing of definite orders as soon as war breaks out. The firms with which these orders are to be placed should be determined in advance and full drawings, specifications, tools, fixtures, gages, etc., should be on hand and ready for delivery to the manufacturers with whom the orders are to be placed. This procedure, together with and in addition to the orders that could be immediately placed with private concerns engaged normally in the manufacture of war munitions, would give us a very large immediate increase of output and would form a solid basis for further expansion.

Few private concerns, except those normally engaged in the manufacture of munitions, will be prepared to turn out complete articles such as guns and gun carriages, projectiles, cartridges, powder, etc. It will therefore be necessary to provide in advance places where the various component parts shall be delivered for final assembly. Such places would naturally be in the vicinity of such industrial centers as Philadelphia, Pittsburgh, Chicago, etc.

Centralized Assembling Plants

Take, for instance, the manufacture of shrapnel. There is at the Frankford arsenal in Philadelphia a small plant for the manufacture of shrapnel. In case of war the arsenal would be taxed to the limit of its capacity and would immediately commence to expand. Its permissible expansion is, however, very definitely limited. In Philadelphia and vicinity there are large numbers of machine shops, each of which could be called upon to manufacture one or more parts of the shrapnel.

It would seem to me a good plan to have the capacities of such shops examined by the officers at the Frankford arsenal and a decision reached as to the orders for components of the shrapnel that would be placed with these various firms. In the vicinity of Philadelphia, but separate from the Frankford arsenal, could be established an assembling plant to which the parts of the shrapnel manufactured by the shops in the vicinity should be delivered. This new assembling shop should have the free run of the Frankford arsenal and benefit by all its experience. In this way, without interfering at all with the output and enlargement of the arsenal, a new plant with very considerable capacity could soon be built up. It seems to me that all plans for such an assembling shop could easily be made in advance. The same thing could be done for the manufacture of shells in the vicinity of Pittsburgh and other cities.

Conversion Table for Changing Pounds Into Kilograms

By H. Le Roy Brink

It is necessary on all foreign shipments to have the packages marked with weight in pounds and kilos; and as our foreign trade has been increasing right along on account of the war, this table is being used considerably. It occurred to me that some of your subscribers who are shipping material to Europe and South America would appreciate your publishing this table in the form which has been found so convenient.

As will be noticed, weights are shown from 1 to 99 lb., and by simply changing the decimal point any amount can be figured. A few examples are also given on the table as guides to its use. Decimals are carried out to the last figure, so that large amounts will be as accurate as possible when this table is put in use.

CONVERTING POUNDS INTO KILOGRAMS

	Pounds									
Pounds	0	1	2	3	4	5	6	7	8	9
0	0	0.4536	0.9072	1.3608	1.8144	2.268	2.7216	3.1752	3.6288	4.0824
10	4.536	4.9896	5.4432	5.8968	6.3504	6.804	7.2576	7.7112	8.1648	8.6184
20	9.072	9.5256	9.9792	10.4328	10.8864	11.34	11.7936	12.2472	12.7008	13.1544
30	13.608	14.0616	14.5152	14.9668	15.4224	15.876	16.3296	16.7832	17.2368	17.6904
40	18.144	18.5976	19.0512	19.5048	19.9584	20.412	20.8656	21.3192	21.7728	22.2264
50	22.68	23.1336	23.5872	24.0408	24.4944	24.948	25.4016	25.8552	26.3088	26.7624
60	27.216	27.6696	28.1232	28.5768	29.0304	29.484	29.9376	30.3912	30.8448	31.2984
70	31.752	32.2056	32.6592	33.1128	33.5664	34.02	34.4736	34.9272	35.3808	35.8344
80	36.288	36.7416	37.1952	37.6488	38.1024	38.556	39.0096	39.4632	39.9168	40.3704
90	40.824	41.2776	41.7312	42.1848	42.6384	43.092	43.5456	43.9992	44.4528	44.9064

Examples:

1 lb. = 0.4536 kg.
10 lb. = 4.536 kg.
100 lb. = 45.36 kg.

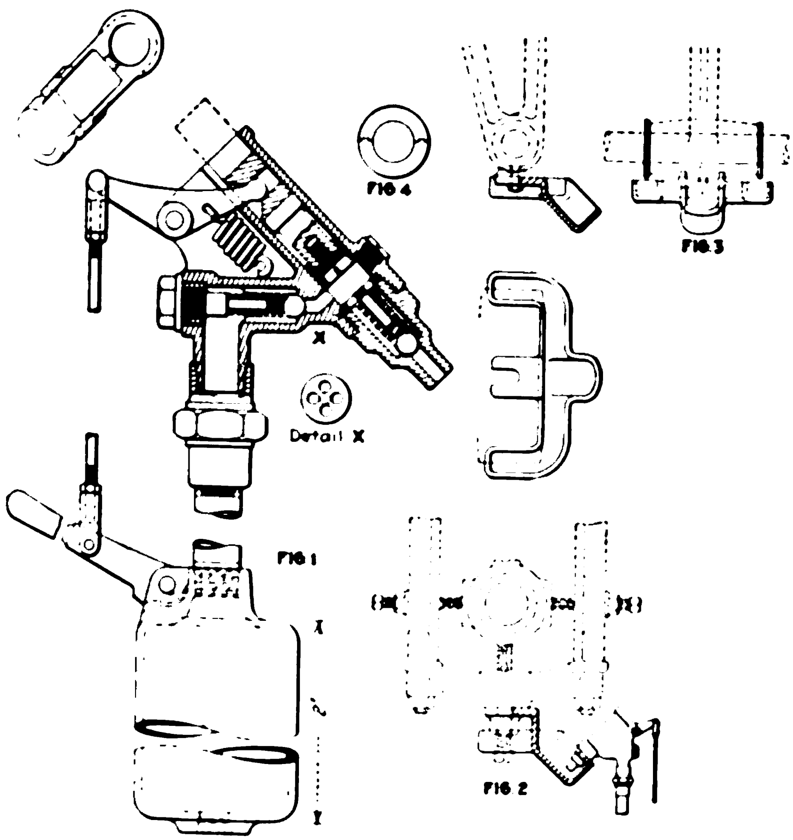
237 lb. to kg.:
200 lb. = 90.72 kg.
37 lb. = 16.78 kg.
237 lb. = 107.5 kg.

6,784 lb. to kg.:
6,700 lb. = 3,039.12 kg.
84 lb. = 38.10 kg.
6,784 lb. = 3,077.22 kg.

Letters from Practical Men

Oil Drip and Hand Pump

Factories with line and countershaft bearings experience considerable difficulty in caring for the dripping oil. Where roller or self-oiling bearings are in use, there is generally very little trouble. Some shaft hangers are furnished with a small drip cup at each end of the bearing, others with a single cup long enough to take the drip from both ends; but these usually are so small and shallow that they are practically of very little use.



DETAILS OF IMPROVED OIL DRIP AND HAND PUMP

In many instances they are replaced by large tin cups, which are difficult to attach and unsightly. The floor under plain bearings is generally oil soaked, and machines located under them get covered with oil. This condition, of course, applies to bearings that do not get regular attention. It is seldom that they are cared for until absolutely necessary.

When pulleys are located so that the hubs are in contact with the bearings, oil works over the hubs, arms and rims and finally saturates the belt. Oily belts form a good proportion of the troubles of the shop and are not only a source of expense, but sometimes the occasion of serious delays.

Bearings with plain ends, as shown in Fig. 3, allow the oil to work back and drip from the center. Some now in use, however, have a groove on the under side near the ends, forming lips from which the oil drips into the cups proper. The pulley hubs are plain, and the oil works over them as described; but if they were furnished with a groove near the end of the hub, it would prevent this trouble. This remark refers to pulleys with solid hubs. For pulleys with split hubs the only satisfactory solution is to use an oil collar.

The split oil collars, Fig. 4, used in connection with the proposed drip guards in Figs. 2 and 3 will prevent the oil from working onto the hubs of pulleys. It drips from the collars into the guards and collects in the central well.

The collars are made of cast iron and are not finished, except the sides, which are ground, the dovetails being cast so that they will engage their slots without machine work and with a minimum of hand labor. A shallow groove can be chipped in the end of the bearing to engage a pin, not shown, driven into one-half of the oil collar, to prevent turning where high speed would be likely to throw the oil. The collars, being in halves and $\frac{3}{32}$ in. thick, can be easily applied to the shaft, and the alignment of the pulleys can be readily adjusted.

The oil drip guards, Figs. 2 and 3, can be made to suit different lengths of bearings by having pattern-boarded and loose pieces to fit between the well and the ends. The lug for the supporting guard is made loose and can be adapted to line or countershaft bearings, as may be required. The central well collects the oil from both ends of the bearing, and the oil is removed by using the hand pump, shown in Fig. 1, operated from the floor. This method obviates the necessity of the oiler's carrying a ladder around the shop.

The pump is very cheaply made, easily cleaned, with ball valves of limited travel and a plunger with double cup leathers. It is operated by pressing down on the handle on the receiver, when the spring attached to the plunger lever returns the handle to the position shown in Fig. 1.

The receiver has a pet-cock in the bottom and can be easily emptied. A small hole should be drilled in the top of the receiver for a vent. The pump is comparatively light, so that it is easily carried. The operator can empty a large number of drips in a very short time. A pump and a few of these guards have been made, and this method of caring for oil drips has proved very satisfactory.

A. D. Vance.

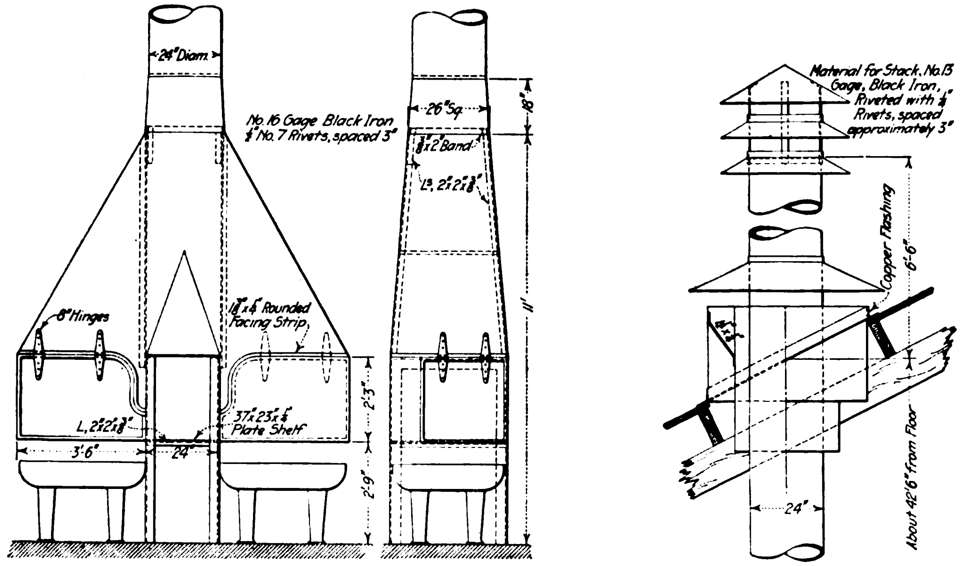
Warren, Ohio.

Canopy for Removing Gases from Blacksmith Fires

The illustration shows a canopy for forges in smith shops. It was developed on account of the state inspector's taking exception to the amount of gas in the blacksmith shop. The arrangement of the forges is shown in Fig. 1.

The canopy supports are two inverted V's made of 3/8x3x3½-in. angle iron. Two handy shelves for tools are made possible by this construction, as can be seen.

Each blacksmith has an opening, or space from the forge up to a point about 5 ft. above the floor. The back, or far side, directly at the back of his fire, is closed by the plate, which hangs on hinges but can be swung up if desired. A 27x28-in. plate hangs down also at the blacksmith's right when facing the fire, and can be swung up out of the way when necessary. The canopies have worked very nicely and removed the gases to a considerable extent.



FIGS. 1 AND 2. CANOPY FOR REMOVING GASES FROM BLACKSMITH FIRES

A canopy is made from No. 16 black iron. It combines a square and then a round section 24 in. in diameter.

Fig. 2 shows the outlet above the roof, with the thimble to prevent the roof's catching fire, and also the hood and ventilators above. Copper flashing is used to make a rainproof fit.

JOSEPH K. LONG.

Renovo, Penn.

Engineering Journals and the Masses

Means of communication are now so perfect and the domain of engineering knowledge has recently been so greatly enlarged that technical engineering periodicals are finding an ever larger sphere of influence and are filling an ever larger need. Not only do they describe and illustrate discoveries and processes, sometimes even before the latter are perfected, but they provide that medium of popular discussion and that "theater of the thinker" wherein the crude facts of everyday engineering practice may be sifted into a record of all that is most worthy to enter permanently into the solid technical literature of the country.

This country is busier now than it has ever been in its history, and the masses have neither the time nor the means to purchase books or patronize libraries. Ten dollars' worth of engineering periodicals places every working family in direct touch with the great sources of current intelligence and practice. Moreover, it is certainly better to distribute the interest in mechanical and engineering progress throughout the year than to serve it to the public in the heavier book form, to be devoured *en masse*.

Indeed, in no other form than the magazine can all the scientific labor of the world be gathered up and distributed so cheaply, and it finds ten readers where in book form it would one.

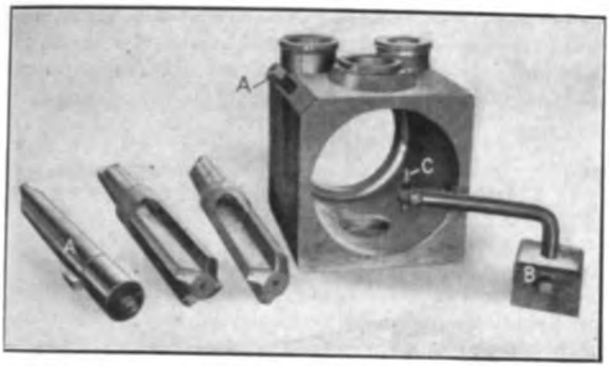
The present-day technical journal of America stands in the very front rank as an agent of progress and is demonstrably equal to any popular technical magazine in the world. I am naturally more familiar with this class of periodical literature than any other, and I make this statement without qualification or reservation. That its work has been proved to be good and that it is truly educating its readers are shown by the constant demand for a higher standard of excellence in this democratic form of literature.

R. D. GATEWOOD.

Philadelphia, Penn.

Boring Jig for Pistons

The illustration shows a jig used in machining the wristpin holes in pistons at the plant of A. B. Farquhar Co., Ltd., York, Penn. The piston is first turned and faced to the correct dimensions. It is then slid into the jig, being located by the shoulder shown at the rear. The setscrew A is tightened to hold the piston in position. The piston-pin holes are drilled and reamed, the tools



JIG FOR BORING PISTONS

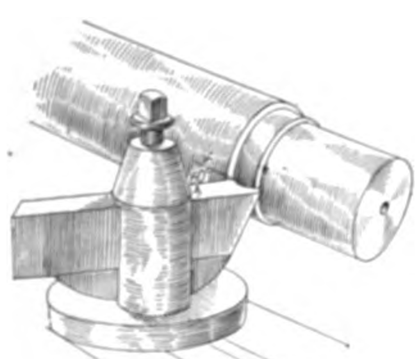
being guided through the bushings seen on top of the jig. The bar *A* is inserted in the jig, guided by the bushings, and the inside faces of the bosses are machined.

The height block *B* is used to test the machined surfaces, and the upper and lower bosses are tested by the two ends of the steel pin *C*. The height block can be slid into the open end of the piston with the facing bar still in position, thus enabling the operation to be performed quickly and conveniently. A. TOWLER.

New York City.

Turning Without Chatter

Grind up a tool of any standard high-speed stock, as shown, and set it at an angle of about 60 deg. so there will be no chatter. I find this method very



BEST WAY TO TAKE A FINISH CUT

successful on nickel-steel shafting, taking one cut instead of two, as formerly. This answers very well in our class of work. M. JACKER.

Stockton, Calif.

Table of Piston-Ring Data

The accompanying table is a collection of ring data that are complied with to a great extent in the machinery division of the United States navy yard, Boston, Mass. While these data are not official, they run very close to the average make of rings found in the commercial and naval engines of small caliper.

The standardizing of piston rings has not been given a great deal of publication, but this table is adaptable to ordinary snap rings that are to be rough-turned and bored, cut and drawn together, and finished to the diameter of the cylinder.

TABLE OF PISTON-RING DATA

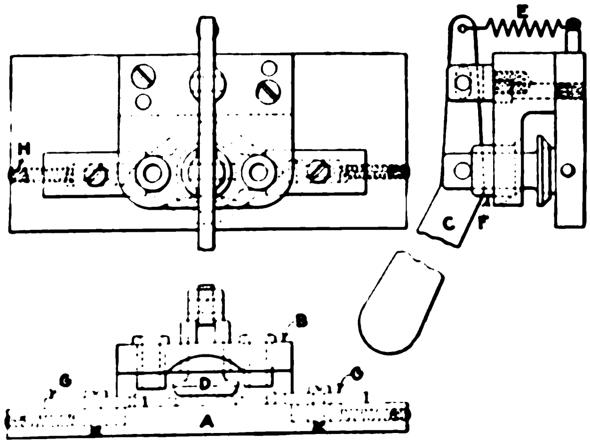
Diameter of Cylinder, In.	Rough-Turn Diameter of Ring, In.	Rough-Bore Diameter of Ring, In.	Amount to Cut Out, In.	Width of Ring, In.	Thickness of Ring, In.
2	2[illegible]	1[illegible]	[illegible]	[illegible]	[illegible]
3	3[illegible]	2[illegible]	[illegible]	[illegible]	[illegible]
4	4[illegible]	3[illegible]	[illegible]	[illegible]	[illegible]
5	5[illegible]	4[illegible]	[illegible]	[illegible]	[illegible]
6	6[illegible]	5[illegible]	[illegible]	[illegible]	[illegible]
7	7[illegible]	6[illegible]	[illegible]	[illegible]	[illegible]
8	8[illegible]	7[illegible]	[illegible]	[illegible]	[illegible]
9	9[illegible]	8[illegible]	[illegible]	[illegible]	[illegible]
10	10[illegible]	9[illegible]	[illegible]	[illegible]	[illegible]
12	12[illegible]	11[illegible]	[illegible]	[illegible]	[illegible]
14	14[illegible]	13[illegible]	[illegible]	[illegible]	[illegible]
16	16[illegible]	15[illegible]	[illegible]	[illegible]	[illegible]
18	18[illegible]	17[illegible]	[illegible]	[illegible]	[illegible]
20	20[illegible]	19[illegible]	1	[illegible]	[illegible]
22	22[illegible]	20[illegible]	1[illegible]	1	[illegible]
24	24[illegible]	22[illegible]	1[illegible]	1[illegible]	[illegible]
30	30[illegible]	28	1[illegible]	1[illegible]	[illegible]
36	36[illegible]	33[illegible]	2	1[illegible]	1[illegible]

While the data in the table will not conform to all classes of work, they will be found to cover the general requirements on gasoline and steam engines and will be of especial value and guidance to the machinist in whose hands the construction of rings is placed.

Winter Hill, Mass. N. I. MOSHER.

Drill Jig for Flanges

The illustration shows a drill jig for flanges, but it can be adapted to drill other parts of like description. The tool is made with a base plate *A*, on which the bushing plate *B* is fastened. The handle *C* carries the piece *D*, which is centered by the guide bushing *F*. When pres-



DRILL JIG FOR FLANGES

sure is taken off the centering piece *D*, it is raised by means of the spring *E*. The sliding V-blocks *G*, with suitable springs and adjusting screw *H*, locate the part to be drilled. A. ELTING.

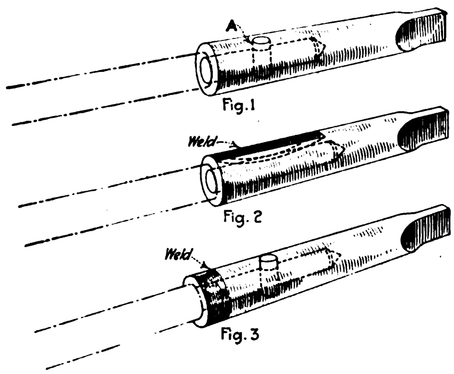
New York City.

Securing Loose Shanks on Adjustable Reamers

Reamer service in our plant is severe. We use adjustable inserted-blade reamers, with a nut at each end of the blades. The back nut must be put on from the driving end of the reamer and is smaller in diameter than the large end of the taper shank. It is therefore necessary for the taper shank to be made as a separate piece that is secured in place, after the nut is on. The manufacturer

uses a pin driven through the socket and shank, as illustrated in Fig. 1. This method is not a success, because the pins shear off at the point *A*.

We have remedied the trouble to our own satisfaction by welding with the electric arc, as shown in Figs. 2 and 3. Both ways are successful. It is probable that the mode shown in Fig. 3 would be better suited for the oxy-acetylene torch. The tool is somewhat distorted after



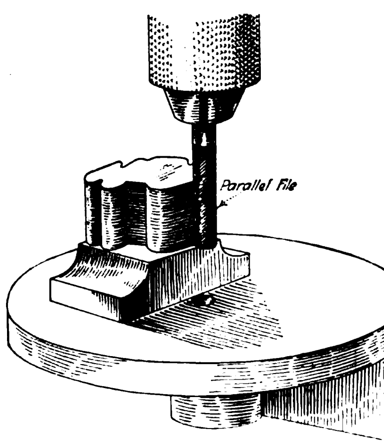
METHOD OF SECURING LOOSE SHANKS ON ADJUSTABLE RUNNERS

welding, but can be readily straightened between centers and the excess metal turned off. The reamer is then ready for use without danger of being back in the toolroom for repairs after reaming a few holes.

Mansfield, Ohio. R. A. WILLIAMSON.

Filing Punches in Drill Press

In fitting a punch to a die, the top of the punch is covered with a layer of solder about $\frac{1}{32}$ in. deep. The punch and die are put in the press, and an impression of the die is made on the solder on the end of the punch. This is placed in the miller and rough-



FILING PUNCHES IN THE DRILLING MACHINE

milled to shape. After the milling operation is finished, the solder is removed and a light shearing impression taken about $\frac{1}{32}$ in. deep on the punch. The work is then taken to the drilling machine and the punch filed to size. Round parallel files from $\frac{1}{16}$ to ½ in. in diameter can be obtained in any supply house.

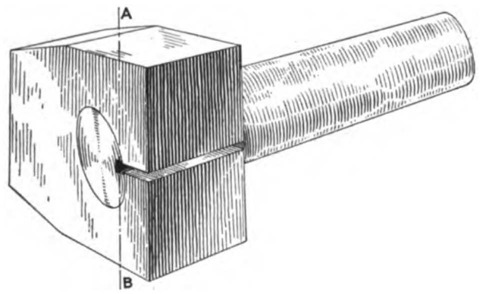
I have found this method much faster than the ordinary way of hand filing in the vise and also more accurate. It is of course of no use for female square corners. WILLIAM CUNNINGHAM.

Chicago, Ill.

Closing In Large Keyways

In a place where I worked a few years ago several hundred shafts were rejected because the keyways were cut a little too wide. They were to be a standard size to fit pulleys and keys furnished by another company, so it looked like replacing the whole lot.

As an experiment a block of machine steel, as shown, was carefully bored to fit the shaft and sawed through one side. The corners opposite the slotted side were



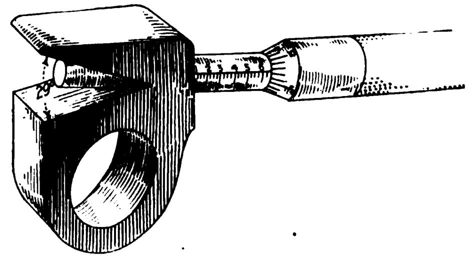
CLOSING IN LARGE KEYWAYS

beveled to center line. With the shaft inserted with the keyway at the saw slot, the hydraulic pressure was applied through the line *AB*. After a few trials the right pressure was found to be about 80 tons. This closed the keyway in just the right amount and changed the diameter of the shaft so little as to be negligible. The whole lot was treated this way and passed the inspector with flying colors. H. HOWARD.

Watertown, Mass.

Improvised Thread Gage

A tool had to be provided for gaging large thread tools. As a suitable vernier could not be obtained within the allowable time, the device shown in the illustration was made and met the requirements nicely.



A THREAD GAGE

The complete tool cost but one-half as much as a reliable thread-tool vernier. It is also convenient to handle and gives accurate readings, as 0.001-in. graduations on the micrometer head represent about 0.00025 in. on the width of the tool point. OLIVER MARTIN.

Chicago, Ill.

Discussion of Previous Question

How To Square the Heads of Bolts in a Lathe

On page 403 you show a stunt for squaring the heads of bolts in the lathe. Without being unduly critical, it would seem as if it were pretty crude in this day and generation—particularly for the "large number" mentioned. The accompanying illustrations will show what has been the usual practice in similar cases that have

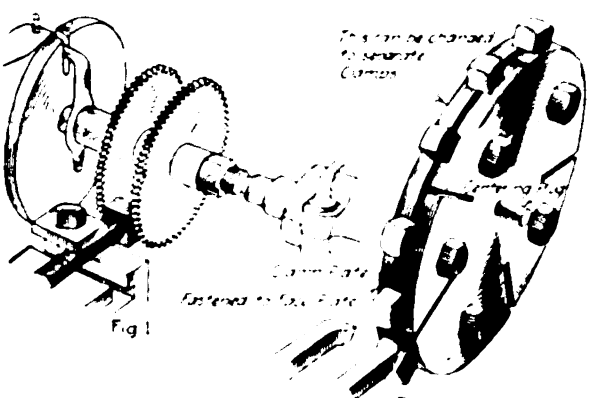


Fig. 1 Fig. 2

HOW TO SQUARE THE HEADS OF BOLTS IN A LATHE

come to my notice. The method shown in Fig. 1 is preferable, but if it were impossible to get a couple of saws, which is extremely unlikely, the scheme illustrated in Fig. 2—which is a lathe job pure and simple—is satisfactory. It would seem more desirable to go to the trouble of making fixtures as shown and then be able to turn out the bolts quicker and better than to bother with them singly.

Hartford, Conn. GEORGE R. RICHARDS.

Opportunity for Machine Tools in Holland

Upon reading Ludwig W. Schmidt's article on page 505 the initiated will agree to its truth on broad lines, as they will be able to credit divers assertions with their real value. For the would-be exporter who still lacks experience the article seems a bit too general.

That the exports of American machine tools to Holland have risen from an average of about $80,000 a year to nearly $200,000 is no reason for the American exporter to pat himself on the back. The credit belongs mainly to the alert managers of some big Dutch firms who opened offices in New York last year. Many Dutch merchants are constant readers of the *American Machinist* and carefully watch its advertising columns (which shows the quickest way to attract attention). The Consulate General of the Netherlands is also willing to give helpful hints to interested parties. However, do not bother these firms if there is no stock on hand for immediate sale. They are here with desks cleared for action, and at present they may be regarded as the only desirable mediums for war business. The question of these connections in time of peace will be discussed later.

Indications point to the fact that Holland will soon have to begin to buy again in larger quantities. As her previous sources will be dry for some time to come, the Dutch buyers will have to turn to the United States for supplies. The question at once arises as to how long the Dutch will turn to the United States, the anxious buyer being a phenomenon of abnormal times only.

If half the Commerce Reports are true, the American is yet a clumsy exporter at best. The American manufacturers should exercise great care in their efforts to retain their share of the trade with Holland, driven to them by the efforts of some Hollanders and by temporary circumstances. The American should study his foreign markets and get rid of the notions he has about educating such markets. It is he who must adapt himself to the situations abroad. The German is a past master in the act of adaptability. He will at the first opportunity gladly relieve the Dutch of looking for supplies abroad after the war.

It is said that the Dutch manufacturer is well able to see the value of the newer and speedier machines, but his conservative and saving disposition will not allow him to buy them. This, I believe, is the greatest fallacy of Mr. Schmidt's article. By analyzing this statement the would-be exporter will find a way to determine beforehand whether his articles are fit for the Dutch market or not.

The Dutch manufacturer is of neither a conservative nor a saving disposition; but he is not in business for fun, and usually he is found to be an apt and slow-going mathematician. Reckoning that labor in Holland can be had at 40 per cent. of the American price, a few calculations will give a scientific base for comparing American with foreign products and will indicate the limit beyond which no price may go, however superior the machine, and be acceptable to the Dutch market. The first thing the Dutch manufacturer is interested in is the *Rentabiliteits-rekening* (computation of interests); and where the speedier machine only comes up to the cheaper, old and trusted lathe, the human part of the outfit will have the preference.

Bearing in mind that business in Holland is slow and that success comes only to him who waits, the beginner will not have much difficulty in choosing one of the ways discussed herewith.

The method of direct correspondence and advertising being usually impracticable at such a distance, the first way to be considered is opening in Holland a branch office managed by a smart American salesman. Usually and wrongfully (referring to others outside the machinery line) he will settle in Utrecht, this being the center of gravity of the railway system. Amsterdam or Rotterdam, with their shipping facilities, though not so central, will prove to be more suitable. Their surroundings,

especially Rotterdam's, are substantial fields in themselves; and as Holland is only a small country, any big town is practically central.

After having started actual work, the salesman will find out that his profession, here much envied, is often looked down upon in Holland. After having traveled a few times to Euschedé or farther still on the same small errand, the outside courtesy of the unmovable Hollander, who seems to have unlimited supplies of time, will wear on the American. He will also notice that the big machinery importers are really big, even to American conceptions, and that they will not stand for any substantial outside rivals. Last, but not least, the field is limited, and it will be never more than a side line to any manufacturer.

A better way is to make common cause with one or more, if possible, of the big machine-tool jobbers. Though substantial profits are not excluded, it is a very haphazard way, the dealers having most of the trump cards. They usually have as many agencies on hand as they care to have—and at their own terms. They furnish the public in immediate need at their own price, seldom going beneath a fixed scale of profits. Their interest is sometimes, but more often not, that of the tool manufacturer. Such jobbing concerns are in the habit of answering one inquiry with several propositions by the different firms they represent. It is often amusing to an inquirer to receive bids on the same machine from different jobbers, the smaller firms often making far more acceptable offers, but as a rule they cannot deliver at once.

The bigger concerns back themselves with their beautiful, well-supplied machinery halls. Their methods are not beloved, but they can deliver the goods in a pinch; and the appreciation has to be shown in hard cash.

These practices are too well-known to the American manufacturer to require further discussion. The German method of securing continuous profits out of a small market at hardly any expense will need all the imagination of the American reader who has not traveled abroad. It might be remarked that the Hollander differs more from the business man of the United States than does our Brazilian brother.

The American question, "Who is he, anyway?" may be often fully answered in dollars and cents. But in Holland, schooling, breeding, family and social standing are the important factors. The money the Hollander is really interested in is his own. Things American grow overnight, but everything in Holland is the product of slow cultivation, and business connections are the same. The Germans and several English firms situated too far from the Dutch border to do their own traveling foster these connections by means of local agents.

An advertisement in the *Telegraaf, Het Nieuws van den Dag* or the *Nieuwe Rotterdamsche Courant* for an agent, preferably a gentleman commanding sufficient spare time, will bring forth instructors of technical colleges, city engineers and inspectors who gladly will spend their surplus of energy in building up their own and part of your business. They are men of small means, but highly respected. While selling, they are able and willing to give appreciated advice. One machine sells another; and where the American is far more liberal than the German or English competitor, it is easy for him to make his man sell that first machine.

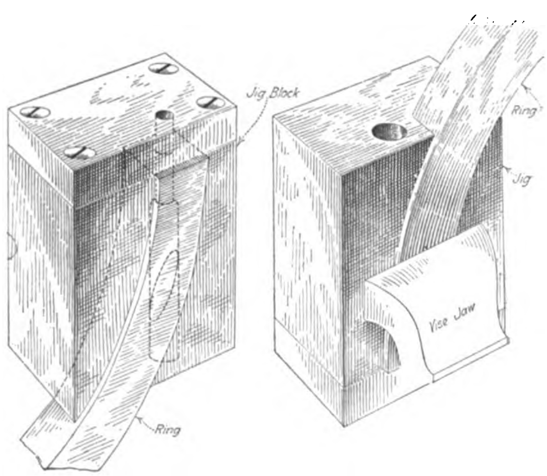
The German or Englishman seldom supplies his agent with anything else than the catalogs on hand. Printing expenses in Holland are low, and by presenting a good Dutch edition to the agent and a machine for demonstration it will not be hard to beat the opponents at their own game. Such machinery can be intrusted without fear. Though Dutch capital is small compared with the amounts here, it is as good; and so it is always safe to allow credit. Social conditions do not tolerate any serious dishonesty. The American has also to bear in mind that he must not play any tricks on his small representatives, if things do not seem to move quick enough. Dutch law by no means protects the richer man; and it does not take much money in Holland to put up a legal fight, if wronged. These agencies are usually given for a term of five years and often exclusively for Holland and its colonies. If the "main-representative," as the agent is styled, comes half up to expectations, German firms usually give him another term and make him win.

The big merchants in Holland know that they cannot beat the small machinery agents of their market. When an American tool manufacturer has not been successful with the big firms, there is no reason why he should not put his foot in the Dutch stirrup, by pushing it steadily in that systematic, inexpensive, penetrating way.

Brooklyn, N. Y. JAN SPAANDER.

Oil-Ring Difficulties

In reply to the article by Harold E. Greene, on page 513, regarding difficulties in oil-ring manufacture, I will try to explain how I avoided these troubles in the same kind of shopwork. I recall that one of the most important things in a shop is to have all machines in



THE RING AND THE JIG

good working order. This practice would have prevented the loose spindle of the press. Having an order for some rings somewhat similar to those described by Mr. Greene, I used the following method of machining: First, all the rings were turned the proper size, then cut in the miller. The holes for the bolts were drilled after a jig had been made, as shown in the sketch. This

jig was made in a short time from a piece of close-grained cast iron.

Drilling the holes in this manner saved the extra lathework required to make the ferrules that Mr. Greene secured in the large hole to hold the bolt head. It also overcame the necessity for making counterboring tools, as the drill was ground so that it acted as a countersink. A countersinking operation was also avoided. Of course, the body hole was drilled last, which meant changing drills, but this was a small matter compared with doing the work the other way.

All holes were run to proper depth by setting the stop on the spindle of the press. Counterbored holes for the heads of bolts were put on only one end of the rings, so that the rings would be balanced very closely. The holes for tapping were drilled only deep enough to tap properly, as this left the ring so much stronger than drilling them through. Distance pieces the thickness of the milling cutter that had been used to saw them were made and inserted to make the rings true. By manufacturing all rings in this way it was found that they were interchangeable.

I should like to have Mr. Greene's views on my method, as I do not want him to think that I am too critical.

New York City. F. C. Wolf.

Grinding Die-Setting Pins

I notice that Mr. Greenleaf, on page 691, comments on the subject of die-setting pins, or what are often called pillars. Hardened and ground pillars running in hardened and ground bushings, while they may be the most expensive, will surely give the best results, especially if used on a die that is built for cutting thin stock. The punch for such a die is made a good fit to the die; therefore, pillars that fit well and wear well are desirable. However, in nine shops out of ten the practice is to use hardened and ground pins running in a reamed hole in the punch holder.

Mr. Greenleaf speaks of squaring a plate to the drill-press spindle by means of a sweep and indicator. This is the method employed to get the best results possible on the drill press; and if the spindle of the press is in good condition, a plate may be squared and a hole drilled and reamed fairly square. A drill-press spindle that is free from play is a rarity, however. If there is shake in the spindle, it is impossible to square it to anything and quite as impossible to drill and ream a hole squarely.

The best method of machining the holes for the pillars of a pillar die is to clamp the shoe and punch holder to an angle plate in the miller, then drill, bore with boring bar and ream all the holes without disturbing the set-up. When set up on the miller, the job should be squared to the spindle by means of sweep and indicator.

Newark, N. J. Gustave A. Remacle.

Clearing Chips from Deep Holes

The article of C. C. Lynde, on page 776, is interesting and helpful, doing an old thing in a little different way.

It has been my practice either to magnetize the drill or take a piece of tool-holder steel of the tungsten variety and magnetize it for the same purpose. An advantage in using the kind of steel mentioned is that it holds the magnetism much better than does ordinary carbon steel. If the drills are of high speed, it is more valuable for the purpose. It is true that the chips will cling to the drill; but that is not a serious objection, as they can be removed by the hand or a brush while the drill is in motion.

A rather amusing incident in dealing with the property of magnetism was brought to my attention by a glass manufacturer some time ago. It seems that a rather large piece of steel or iron had fallen into the glass furnace and its presence was causing trouble, so the man took the matter up with an electric company, which suggested that he use an electromagnet for removing the piece.

He acted upon the advice, and his feelings when he found that it was of no avail can be imagined.

When it was explained to him that the magnetic properties of iron are not present when the temperature is as high as in a glass furnace he understood what was wrong. E. T. Strong.

Columbus, Ohio.

What's the Matter with Our Methods of Threading?

The article by P. W. Abbott on page 173 of Vol. 44 of the *American Machinist* contains some valuable hints, but there are several points to which exceptions can be taken.

The first statement, that "accurate work cannot be done with the commercial taps and dies sold by the tap and die manufacturers at the present time," can be seriously questioned. Perhaps Mr. Abbott is not in touch with the latest product of the tap and die manufacturers, as the writer personally knows of several concerns that are producing taps and dies well within the limits that Mr. Abbott considers necessary for good work.

The statement that round adjustable or button dies are the most economical has been proved to be wrong by several firms that are constantly testing the products of a large number of screw machines.

In commercial threading, the button die was the first step and met with indifferent success; then came the spring die, which was some improvement over the button die, and the acorn die. Button dies can be sharpened only by using special emery wheels, which are small and easily fractured. This operation requires a great amount of time and care. The spring die can be sharpened easily, but the amount of surface to be ground is large. The acorn die presents but little surface, which can be easily and quickly ground.

There are cases where it pays to use opening die heads, particularly on long threaded parts. More pieces are spoiled by backing a die off the work than in any other way. There are two questions that cannot be decided in an off-hand manner—the matter of using either a solid or an opening die and whether a roughing and finishing cut or a single cut may be necessary. There are a number of considerations that enter into the problem—namely, the make of machine, the length of the thread, the nature of the stock, the speed at which the machine can be run (both forward and reverse) and the nature of the lubricant.

Threads can be cut faster with an opening die, because there is no reversing; so that while there are instances

where it may take more care and time to get an opening die head to working properly than it does to use a solid die, the increased production will more than repay the time spent in setting up.

Mr. Abbott speaks of inaccuracy of threads being due to the wear of die heads, yet he overlooks the fact that

TABLE 1. TAP-DRILL SIZES—75 PER CENT. DEPTH OF THREAD

Tap Size	Threads per In.	Diameter of Drill	Drill	Tap Size	Threads per In.	Diameter of Drill	Drill	Tap Size	Threads per In.	Diameter of Drill	Drill
1/16..	72	0.0490	3/64	1/4	32	0.2195	7/32	15/16	12	0.8562	55/64
1/16..	64	0.0472	3/64	1/4	28*	0.2152	3	15/16	9	0.8292	53/64
1/16..	60	0.0462	56	1/4	27	0.2139	3	1	27	0.9639	31/32
5/64..	64	0.0629	1/16	1/4	24	0.2094	4	1	14*	0.9304	15/16
5/64..	60	0.0619	1/16	1/4	20	0.2012	7	1	12	0.9187	59/64
5/64..	56	0.0607	53	5/16	32	0.2820	9/32	1	8	0.8782	7/8
3/32..	60	0.0774	5/64	5/16	27	0.2764	J	1 1/16	8	0.9407	15/16
3/32..	56	0.0763	48	5/16	24*	0.2719	I	1 1/8	12*	1.0437	1 3/64
3/32..	50	0.0742	48	5/16	20	0.2637	17/64	1 1/8	7	0.9858	63/64
3/32..	48	0.0734	49	5/16	18	0.2583	F	1 3/16	7	1.0483	1 3/64
7/64..	50	0.0898	43	3/8	27	0.3389	R	1 1/4	12*	1.1687	1 11/64
7/64..	48	0.0890	43	3/8	24*	0.3344	Q	1 1/4	7	1.1108	1 7/64
1/8...	48	0.1046	37	3/8	20	0.3262	21/64	1 5/16	7	1.1733	1 11/64
1/8...	40	0.1006	38	3/8	16	0.3141	5/16	1 3/8	12*	1.2937	1 19/64
1/8...	36	0.0979	40	7/16	27	0.4014	Y	1 3/8	6	1.2126	1 7/32
1/8...	32	0 0945	3/32	7/16	20*	0.3887	W	1 1/2	12*	1.4187	1 27/64
9/64..	40	0.1162	32	7/16	14	0.3679	U	1 1/2	6	1.3376	1 11/32
9/64..	36	0 1135	33	1/2	27	0.4639	15/32	1 5/8	5½	1.4478	1 29/64
9/64..	32	0 1101	35	1/2	20*	0.4512	29/64	1 3/4	5	1.5551	1 9/16
5/32..	40	0.1318	29	1/2	13	0.4250	27/64	1 7/8	5	1.6801	1 11/16
5/32..	36	0.1291	30	1/2	12	0.4187	27/64	2	4½	1.7834	1 25/32
5/32..	32	0.1258	1/8	9/16	27	0.5264	17/32	2 1/8	4½	1.9084	1 29/32
11/64..	36	0.1448	27	9/16	18*	0.5083	1/2	2 1/4	4½	2.0334	2 1/32
11/64..	32	0.1414	9/64	9/16	12	0.4812	31/64	2 3/8	4	2.1314	2 1/8
3/16..	36	0.1604	20	5/8	27	0.5889	15 mm.	2 1/2	4	2.2564	2 1/4
3/16..	32	0.1570	22	5/8	18	0.5708	14.5 mm.	2 5/8	4	2.3814	2 3/8
3/16..	30	0.1550	23	5/8	12	0.5437	35/64	2 3/4	4	2.5064	2 1/2
3/16..	24	0.1469	26	5/8	11	0.5364	35/64	2 7/8	3½	2.5966	2 19/32
13/64..	32	0.1726	17	11/16	16*	0.6266	5/8	3	3½	2.7216	2 23/32
13/64..	30	0.1706	18	11/16	11	0.5989	39/64	3 1/8	3½	2.8466	2 27/32
13/64..	24	0.1625	20	3/4	27	0.7139	23/32	3 1/4	3½	2.9716	2 31/32
7/32..	32	0.1883	12	3/4	16*	0.6891	45/64	3 3/8	3¼	3.0753	3 5/64
7/32..	28	0 1839	13	3/4	12	0.6687	17 mm.	3 1/2	3¼	3.2003	3 13/64
7/32..	24	0.1781	16	3/4	10	0.6525	21/32	3 5/8	3¼	3.3253	3 21/64
15/64..	32	0.2039	6	13/16	12	0.7312	47/64	3 3/4	3	3.4252	3 27/64
15/64..	28	0.1995	8	13/16	10	0.7150	23/32	3 7/8	3	3.5502	3 35/64
15/64..	24	0.1937	10	7/8	27	0.8389	27/32	4	3	3.6752	3 43/64
...	..	......	....	7/8	18*	0.8208	53/64	...	...	......	....
...	..	......	....	7/8	14*	0.8054	13/16	...	...	......	....
...	..	......	....	7/8	12	0.7937	51/64	...	...	......	....
...	..	......	....	7/8	9	0 7667	49/64	...	...	......	....

* Society of Automobile Engineers Standard.

TABLE 2. THREADING SPEEDS FOR OPENING DIES*

Size	Threads per In.	R.P.M.	Lin.Ft. per Min. on Outside Diameter	Cu.In. Removed per Min.
United States Standard				
1/4	20	1062.0	69.5	0.5896
5/16	18	691.5	56.5	0.6004
3/8	16	453.0	44.5	0.6025
7/16	14	297.5	34.0	0.6009
1/2	13	224.5	29.0	0.6084
9/16	12	169.5	25.0	0.6085
5/8	11	128.7	21 0	0.6147
11/16	11	117.0	21 0	0.6201
3/4	10	88.5	17.0	0.6177
13/16	10	81.7	17.0	0.6225
7/8	9	61.7	14.0	0.6170
15/16	9	57.6	14.0	0.6276
1	8	40.6	10.6	0.5948
Society of Automobile Engineers Standard				
1/4	28	2081.5	136.0	0.6138
5/16	24	1223.4	100.0	0.6191
3/8	24	1019.5	100.0	0.6290
7/16	20	607.0	69.5	0.6276
1/2	20	531.0	69.5	0.6334
9/16	18	381.0	56.5	0.6300
5/8	18	343.0	56.5	0 6345
11/16	16	247.0	44.5	0 6348
3/4	16	226.4	44.5	0 6369
13/16	14	149.0	34.0	0 6386
7/8	14	139.0	34.0	0 6407
1	14	130.0	34.0	0 6412

* These tables are figured on the theory that the amount of metal removed per minute should be the same for all sizes; 17/32 in.-20 U.S.F. threaded at 500 r.p.m., which is 69.5 lin.ft. per min. actual practice at Wells Brothers Co. on tap-wrench handles, is used as a basis. The material is screw stock.

in an opening die with the lands supported directly over the cutting edges and with a bearing at least four times the length of the thread there is little chance for wear. The die should be made with a hob that is just as close to size—pitch diameter, root diameter and lead—as is necessary in the screw to be produced. Having the hob oversize or undersize starts the whole trouble, particularly in the lead. If the screws wanted must be within ±0.001 in. or ±0.002 in. in lead and pitch diameter, then the hobs for making the dies must be within these limits.

Regarding lead, Mr. Abbott states: "There is just one thing that affects lead, and that is the tools doing the thread cutting. If the taps, dies or chasers have the correct lead, the work will also be correct." There are a number of other reasons why a die will not cut correct lead, and among them may be mentioned: Different kinds and grades of material, dull dies, uneven relieving, broken teeth in the die, different lubricants, different cutting speeds, a pull or a push on the die, a burr at the back edge of the lands, shortening or lengthening the chamfer, more or less hook on the lands, cutting a larger or smaller pitch diameter than that of the hob which made the die, cutting oversize or undersize stock, variations in diameter, crooked stock, variation of cutting speeds, nonalignment of machine.

The suggestion by Mr. Abbott that there should be a lead-testing fixture in every department is excellent. One that has given good satisfaction and is inexpensive is shown in the latest catalog of a leading tap and die manufacturer.

Taps ought not to be straightened after hardening. They should come out of the hardening and tempering baths within the prescribed limits or else be rejected. Time that is spent in trying to straighten such taps is thrown away. The U.S.S. taps now made by the best manufacturers are large enough on the outside diameter so that there is no interference with the outside diameter of screws, and the hobs for the dies are made so that the contact of the screw with the tapped hole must come on the pitch diameter. This is well shown on the line drawing of a ½-13 U.S.S. screw and tapped hole. It is assumed that the screw will be made 0.002 in. under basic on the outside and the tap at least 0.002 in. over basic on the outside. The hole is drilled to give 75 per cent. depth of thread.

The old-fashioned way of each manufacturing concern having a standard of its own, so that its customers will be obliged to buy all repair parts from one source, has nearly gone by, so that it seems to the writer that there is no need for the so-called Cadillac form of thread.

There is no doubt that the size of hole to be tapped depends somewhat upon the size of drill used, and Table 1 gives correct sizes of drills that will give 75 per cent. depth of thread, which gives an ample margin of safety (practically 2 to 1) and is economical in tapping. Table 2 gives threading speeds for opening dies. It is based on the actual practice of Wells Brothers Co., Greenfield, Mass., where tap-wrench handles are threaded with 17/32 taps, 20 U.S.F. thread at 500 r.p.m., which gives 69.5 lin.ft. cutting speed. Another size, ⅝ in.-20, was run at 80 ft. and 1 in.-16 at 62 ft. per min.

Greenfield, Mass. CHARLES E. SWART.

Improvised Taper Boring Bar

I am greatly interested in the article by Howard Brady, on page 320. No doubt, the bar described would do the job if light cuts were taken and the compound slide rest had the screw taken out, which would leave the rest free to move according to the taper of the bar. Otherwise, I am afraid that if the turner carried out the instructions as printed, "Put the feed on and sit down," he would find some trouble. R. L. HASELGROVE.

Amersham Common, England.

Editorials

Fairness in Hiring Men

Firms that in hiring men use the methods described on page 779 have evidently much to learn in managing a business. The best men will not submit to any such third-degree treatment except in cases of dire necessity and then only until they can obtain work in more desirable shops. Managers who really understand modern methods of securing and retaining employees know that such treatment does not pay; they have found that a man-to-man attitude—an exchange of information regarding points which both need to know—secures the best men and the best work.

The old czar-like type of employing agent has no place in modern establishments. The largest and best plants today understand this fully, and men seeking employment receive courteous treatment from office boys and clerks. It is just as easy in the first place and, secondly, it gives a new workman a much better impression of the shop he is to work in. This feeling is reflected in his work and in his whole attitude toward his employer.

Aside from all other phases of the question—and there are many—the cost of changing men runs up into thousands of dollars per year for any large firm. Realizing this fact, wise employers make every legitimate effort to keep a man even after he has not succeeded in his first job. Some shops try a man on at least three different kinds of work before finally letting him go as unsatisfactory.

These modern firms are also learning to cut out as much of the red tape of employment records as possible. Only essential questions are asked, and all proper inquiries regarding the job or the shop are fully answered.

The keeping of records of unsuccessful applicants is an involved point. If kept solely for future reference to save time and used only in a legitimate manner, there seems little harm in it. If used to prevent employment there or elsewhere because of a fancied dislike or for personal characteristics, it might easily work harm and injustice. When hiring men, as in so many other of life's activities, it is a great gift to be able to put yourself in the other man's place and view the situation from his standpoint. By remembering that the applicant selling his services is no more an object of charity than you are when you sell your product it is perhaps easier to get a more rational perspective on the whole transaction. There are at least two sides to this matter, as to other questions, and it is well to study all sides.

Ways of Saving Shells

Numerous comments have called the attention of the readers of the *American Machinist* to the foolish demands of ordnance officials representing various governments for which shells are now being made in the United States. Another phase of the subject that requires just plain commonsense (and in these matters commonsense seems to be the most uncommon sense) is the saving of good shells that are condemned to the scrap pile. There are perhaps half a million shells that would now be at the front, where they are wanted, were it not for a lot of foolish regulations imposed in many cases by men who have no idea what conditions a shell must fill.

We do not mean that shells defective in material, too light in weight or otherwise impossible to make serviceable should be passed as serviceable, but we do most emphatically mean that all shells that can be made serviceable at a price which will show a saving over replacing them with new shells should be made to pass.

More shells are condemned because they are light in weight than for any other one reason. There are several methods of increasing the weights of shells without in any way detracting from their serviceability. In Canada the copper driving band is closed cold into the driving-band groove. If such shells be light in weight—as much as 5 drams in the case of the 18-pounder and 2 oz. in the case of the 4.5-in.—they can be brought to weight by using the simple expedient of heating a new rough copper driving band to as high a heat as the copper will stand and, while still hot, pressing it under normal pressure into the driving-band groove. The weight can also be increased by subjecting the cold copper to greater pressure in the banding press. There is, however, some danger of injuring the shell when this is done, so it is just as well to avoid increasing the pressure. We have seen shells, the bands of which were pressed at high pressure, with the bases cracked entirely around so that they fell away when the shell was removed from the banding press. Repeated cold pressing at the regular pressure (about 1,200 lb.) will without injury increase the weight of a shell.

The weight of shells can be increased by compressing the metal in the base plates. This is done under the steam hammer, before the base plates are finished. The weights of shells can also be materially increased by extra coats of varnish in the inside. The weight that can be made up in this way depends on the size of the shell and the number of coats given.

Instructions given to some government inspectors preclude the heating of the copper band just before pressing it on. Why, is not apparent, for driving bands are heated red hot before pressing in the United States arsenal at Frankford, Penn., and even in Woolwich itself driving bands are heated before pressing. In any case the copper driving bands are heated red hot to anneal them before they are shipped from the copper mill where they are made. The only difference, therefore, would be the shrinkage stresses in the copper band after cooling on the body of the shell. This would merely give it a firmer grip on the shell body and would only amount to enough to reach the yield point of the copper. There might possibly be some difference in the hardness of the hot and cold pressed bands. If there were, would it be sufficient to cause any trouble?

Many shells are condemned when practically all the work is done on them, because the bases are small in diameter. We refer to that part of the shell below the copper driving band. The only part of the shell that

bears on the barrel of the gun is the copper driving band. The base of the shell should not and does not bear on it.

In the case of the 3.3-in. high-explosive shell the base is 0.01 in. less in diameter than the bore of the gun for the high size and 0.02 in. for the low size. The tolerance here then is 0.01 in. Any shell that is below 3.28 in. in diameter on the base is rejected. This seems to be a foolish requirement. Of course, where articles are made to limits, the limits once established should be adhered to; but there often are ways in which pieces can be made to conform to arbitrary requirements and still be serviceable.

Work that is too small can be increased in size. This is true of the bases of shells. The base of the shell acts to a great extent as a gas check and not in the capacity of a bearing. If a small base can be brought to sufficient size to act as an efficient gas check, the desired end has been accomplished. With shells that are not too far under size, if a roller with sharp V-grooves of about $\frac{1}{32}$-in. pitch running round it be pressed radially against the base while the shell revolves in a lathe, the metal, displaced by the points of the sharp V-ridges of the roller, rises up above the surface and increases the diameter of the base so that it will fulfill its function as a gas check. When the shell is painted, the insignificant grooves are filled by the paint, and for actual use the shell is just as good as one accurately made to standard sizes.

Large numbers of shells have been condemned because the fuse-hole thread is too large and an equally large number because the thread is rough and imperfect in places. The tolerance here is 0.006 in.—large as viewed by the manufacturer accustomed to interchangeable work. In spite of that there are a number of shells with threads which will not pass inspection because they are too large. These shells are scrapped. There is no reason for this condemnation as the nose of the shell can easily and cheaply be closed in cold in a die, so that the thread can be retapped and pass inspection. Shells in which the threads are not too rough or broken can be salvaged in the same way by closing the nose and retapping. Many of the shells in which the thread for the fuse has failed to pass inspection would be passed if the inspectors were mechanics and allowed to use a mechanic's judgment.

We appreciate that it is not always possible to get mechanics for inspection work, but the men higher up in the inspection department of the government should not only be intelligent, but should be mechanics. It would then be a simple matter to lay aside such shells as fail to pass the under-inspectors and from time to time have them surveyed by inspectors who know the meaning of the term "good enough." These over-inspectors should be kept posted on the various methods by which shells that otherwise would be scrapped could be saved. It should be a part of their duties to inform manufacturers of all new developments in the art of saving shells.

Co-operation Between Consuls and Technical Press

On page 785 the *American Machinist* referred to the wide variety of information needed by American manufacturers in order that they may successfully hold foreign markets. To furnish this information, the United States Consular Service should canvass manufacturers at home and obtain from them lists covering the information they need in their particular lines. With this in hand, the Washington authorities could print blank forms intelligently, asking for this information and send these blanks to the various consulates. The consulates would then require the services of well-paid investigators whose duty it should be to get this specific information and, having once obtained it, to keep it up to date as market changes took place.

There are about 260 different varieties of manufacturing industries in the United States, each of which requires approximately the same kind of data. If the Government will furnish American manufacturers with really reliable and practical information, the work will be of tremendous importance.

In ordinary times our exports, or sales to foreign countries, amount to about 2,400 million dollars yearly.

The world's imports, or purchases, are in round numbers 20,000 million dollars. A substantial increase in our foreign exports should be easily attained if we act promptly and intelligently. The present increase in our exports is partly made up of articles sold at largely increased prices and war munitions. Both of these exports will of course cease when the war ends.

As a small item of assistance the various branch bureaus connected with the Consular Service in the United States should employ translators for all the foreign languages and thus enable an American manufacturer to answer inquiries intelligently in the language of the inquirer.

The *American Machinist* for many years has sent copies of its issues to the principal consulates in all parts of the world, since it has always believed that they are in close touch with the foreign consumer. As publishers of technical journals we are of course mainly interested in putting our own product before worth-while readers and obtaining their subscriptions. Possibly this hints at one field in which the Consular Service can aid by giving helpful suggestions. They will be gratefully received if offered.

It is doubtful if even American business men and manufacturers fully appreciate the gravity of the ocean-freight situation. To consider our trade relations with South America only: Prior to the war, freight rates to Buenos Aires, Argentina, were about $4 per ton. Recent rates have actually reached $40 to $50 per ton, varying with the commodity.

The average purchase price of a freight steamer before the war was about $50 per ton capacity. So the freight charges for a single 30-day voyage are now equal to the cost of the vessel.

The trade routes to South America and everywhere else must be kept open. Immediate action of some kind is necessary. It is probable that before these comments are printed the House of Representatives will have passed the bill to establish Government owned or controlled steamship lines. The Senate will then become the battleground and that body the one upon which Americans must exert pressure.

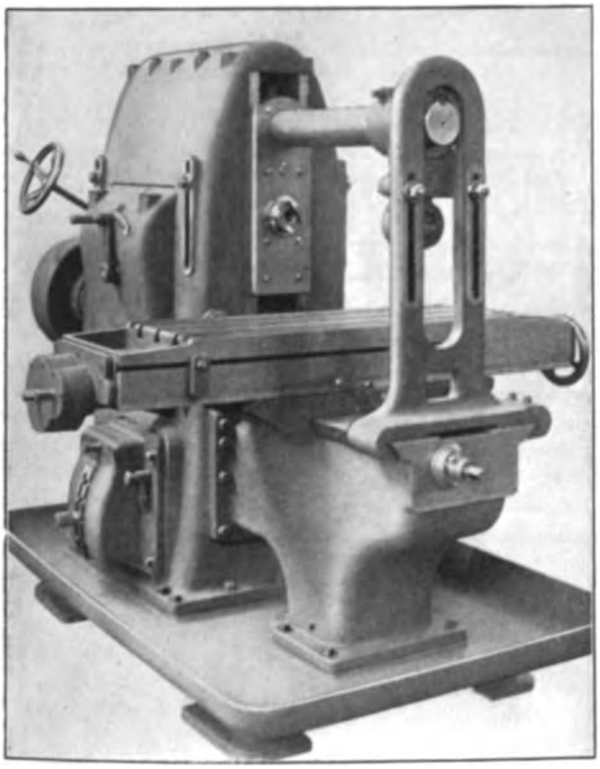
The situation is so critical that every seaworthy vessel within our jurisdiction should be utilized at once. Naval colliers, army transports, all other usable Government vessels and coastwise steamers whose cargoes can be handled by the railroads—all these should be employed immediately in American foreign trade.

Shop Equipment News

Manufacturing Miller

In the design and construction of the manufacturing miller shown it was the aim to make the height and load-supporting features of the table particularly rigid and constant, and to maintain the open-side principle of the knee-type machine.

The column is of heavy box-section design. The guides are four separate box sections. The front-head guides are finished on their inner edge, forming a narrow guide for the spindle head, with a ratio of width to length of



MANUFACTURING MILLER OF LINCOLN TYPE

Vertical range of spindle above table—high position—11¼ in.; low, 1¼ in., hand adjustment and dial graduated to 0.001 in.; table width, 13 in., table adjustment in line with spindle, 12 in.; spindle, 3¼ in., 5-hp. motor height of column, 69 in.; floor space, 65x65 in., weight, 4,200 lb

spindle head of 5 to 1. Steel gears are used throughout the machine, the driving gears being of spur form.

When a countershaft is used, the machine is driven through a three-step cone, and a wide variety of spindle speeds is available. Back-gear ratios of 5.9 to 1 and 2.8 to 1 are also provided.

In the operation of the table a lower splined shaft runs direct from an inner-feed bearing. Since the feed-gear box is driven by a chain adjustment is provided to take up the slack owing to wear. The feed gear meshing with the splined shaft rocks around the splined-shaft gear and allows ½ in. vertical adjustment of the feed-gear box.

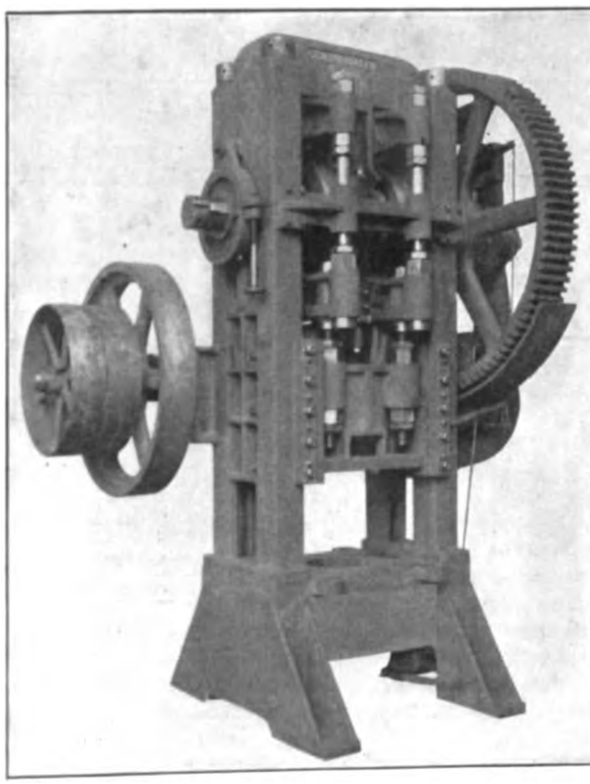
The table screw is of extra-large diameter, is splined for two keys and driven by a reversible clutch. The clutch is so arranged that the direction of the feed is against the driving clutch. The table is constructed on the narrow-guide principle. The feed trip is of the lever type, placed at the center and front of the table. The start, stop and reverse are made with one lever, which operates a push-pin that must be pushed in before the table feed directions can be reversed.

The feed box is of the apron type, cast in one piece. The gear system is of tumbler-gear design. The feed changes, of which there are eight, are obtained through two levers.

The machine is made in a number of sizes and represents a recent development of the National Transit Pump and Machine Co., Oil City, Penn.

General-Purpose Press

This machine was designed for an all-round blanking or drawing press. The frame has large openings in the side columns, which are a great convenience at times.



GENERAL-PURPOSE PRESS

Die space, 14 in. from bottom of outer slide to bed; from bottom of inner slide to bed, 15 in.; stroke, outer slide, 4 in.; inner slide, 8 in.; ram adjustment, 4 in.; will draw and lift out a shell 3½ in. deep; shaft, 6½-in. diameter in bearings and 7½-in. on crankpin, gear, 70-in. pitch diameter and 8-in. face; blank-holder rods, 2½ in. in diameter; height of press, about 12 ft.; floor space, 4x6 ft.; weight, about 22,000 lb.

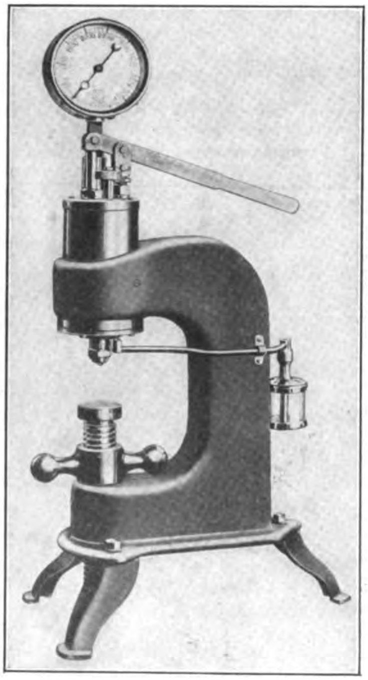
The frame is a four-piece tie-rod construction, held together by four steel rods shrunk into position. The frame is in sections, tongued and grooved at the joints, and may

be taken apart. The rods that operate the blank holder may be removed without disturbing the other parts. They pass through guide brackets that keep them in perfect alignment. There are two large disks on the shaft with bearings on the yoke above to take the thrust. The yokes covering the cam rolls have oil pockets and felt wipers. A consolidated jaw clutch is provided, but a friction clutch may be had if desired. The gear is lubricated from the end of the shaft in addition to oil cups. Ample adjustment is provided throughout for wear.

The press is made by the Consolidated Press Co., Hastings, Mich.

Brinell Hydraulic Hardness-Testing Machine

In the development of the instrument shown it was the purpose of the Pittsburgh Instrument and Machine Co., Pittsburgh, Penn., to provide a portable Brinell



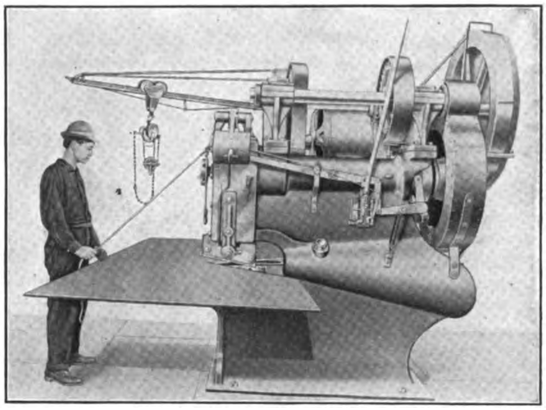
HARDNESS-TESTING INSTRUMENT

hardness-testing machine operated on the hydraulic principle.

The Brinell principle is so well known that the illustration does not require any explanation.

Pneumatic Punch or Shear Trip

This device is intended for use in punching or shearing large sheets, where it is impossible for the operator to reach the regular trip. A small air cylinder is bolted to the side of the press frame, and the piston is connected by levers to the trip lever. The piston action is controlled by a balance valve that throws the machine into motion, while a spring connected to the other end of the valve returns the piston and stops the machine, so that one pull on the tripping cord held by the operator has the same effect as one pressure on the tripping treadle. The device is easily attached and operated from the shop air line.



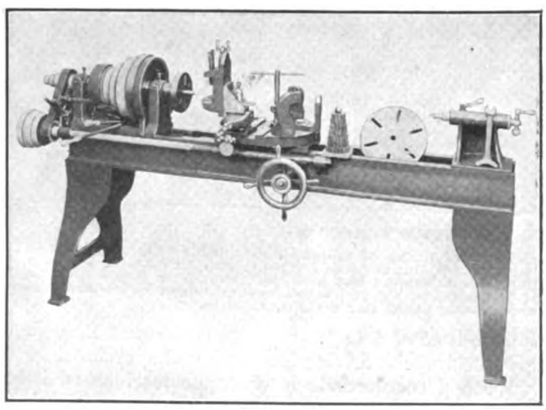
PNEUMATIC PUNCH OR SHEAR TRIP

When necessary, the operator may work the cord with his foot, leaving both hands free to handle the sheet.

This device is made by the Baird Pneumatic Tool Co., Topeka, Kan.

Universal Garage Lathe

This lathe has been designed especially for use in garages and similar shops where a large variety of machine operations are to be performed, such as turning, cylinder boring, drilling, milling and slotting. The carriage is of special design, the top forming a turntable turret, which carries the cross-slide, a milling vise and other attachments. One end of the table is round and the other square, the latter carrying the cross-slide, as



COMBINED ENGINE AND TURRET LATHE FOR GARAGE AND GENERAL WORK

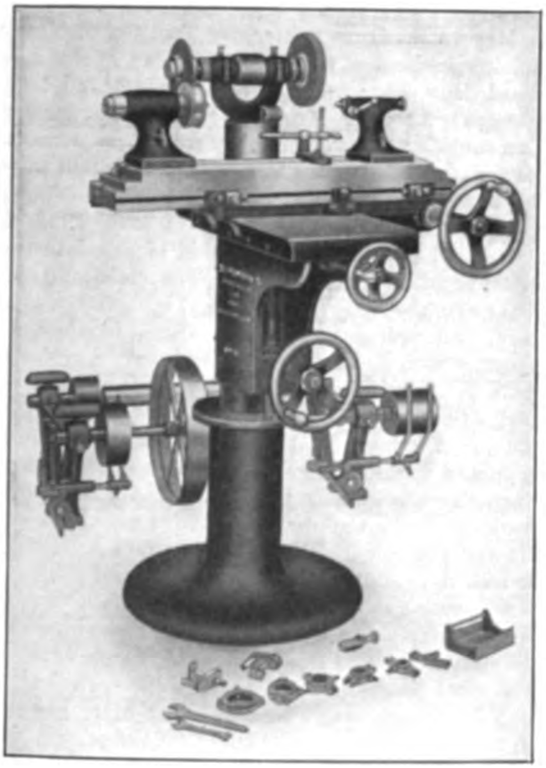
Swings 17 in. over ways, 10 in. over carriage; length of bed, 7 ft.; distance between centers, 52 in.; front bearings, 3½x2⅛ in.; hole through spindle, 1$\frac{3}{16}$ in.; back gearing, 3½ to 1; cuts threads, 8 to 30 per in.; weight, 1,400 lb.

shown. The carriage is worm driven, and there is a power feed on the cross-slide. A 3-step cone is provided; and as there is a reverse in the head, in addition to internal back gears, only a single-belt countershaft is required. The two levers shown operate the back gears

and the reverse. Both belt and gear feed can be used and threads cut in the usual manner. This lathe is built by Samuel K. Landis, Lancaster, Penn.

Universal Grinder

In the design of the universal tool and cutter grinder illustrated the primary considerations were to provide a tool capable of accommodating an exceptionally wide range of work and so to proportion the parts as to insure rigidity of both the table and the head.



UNIVERSAL TOOL AND CUTTER GRINDER
Spindle bearings, 1 in. in diameter, 2[illegible] in. long.

Micrometer adjustment is supplied. The headstock is fitted with bronze bearings, and the spindle is tapped and bored to take the wheel arbors. The countershaft of special design is of the pull-shaft type, easily operated.

It will be observed that in general the machine is developed along standard lines, the table and work controls being conveniently located.

It is a late product of the Simmons Machine Co., Albany, N. Y.

Shell Boring and Turning Lathe

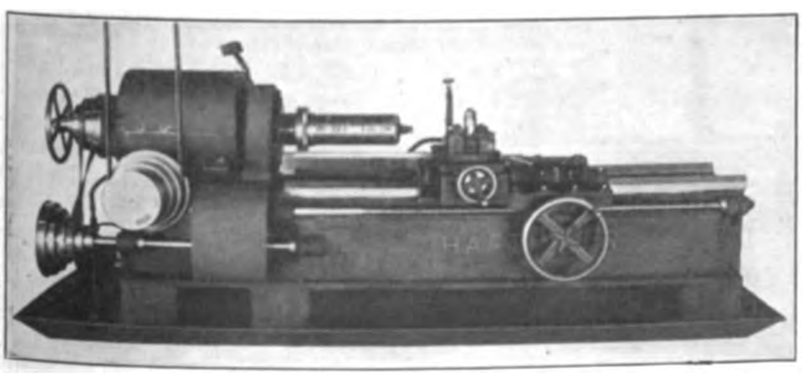
While essentially of the single-purpose type, the lathe shown has been made sufficiently universal to accommodate the various kinds and sizes of shells, ranging from 6 to 12 in. in diameter, and capable, with some elaboration, for some other more or less limited uses.

The headstock and bed are cast integral. The spindle is of forged high-carbon steel, 6⅝ in. in diameter at the front bearing. For shell work it extends out over the ways and carriage to form a boring bar for internal work or an expanding arbor for external work. The spindle is mounted in ball bearings of the radio-thrust type of a size designed to give durability and accuracy. Mounted with the ball bearings is a floating sleeve or collar, which with the oil film acts as a cushion against shocks and chatter.

Upon the spindle is a wormwheel having a phosphor-bronze rim into which engages a quadruple-thread worm. The worm is mounted on the coneshaft and is driven either clutched directly to the coneshaft or through back gears. With the four-step cone this supplies eight speed changes. An oil pocket, which spreads out over the entire head, is designed to give ample lubrication for the worm.

With the reduction obtained in this way the belt cone can be run at high speed, thus enabling a 3-in. belt to apply ample power. It is calculated to belt from the cones directly on a lineshaft, passing over the lathe at a right-angle and thus providing a convenient shop arrangement for handling work to and from the machine. The upper driving cone on the lineshaft is connected by means of a friction clutch which possesses a brake for quick stopping.

The feed mechanism is operated through cone pulleys, providing six changes. Suitable gears reduce the speed to that necessary for the feed screw. This screw operates through a nut under the apron, which moves the carriage forward and back. On the outside of the nut is milled a spiral gear that meshes into a spiral on the handwheel shaft. When the nut is held stationary by means of a friction, power traverse is obtained; when the friction is released, hand traverse is the result. Power quick-return for the carriage is furnished.



SHELL BORING AND TURNING LATHE
Swing over V's, 24 in., over bed 26 in., over carriage [illegible] in.; depth of bed, 20¾ in.; diameter of front spindle bearing, [illegible] in., rear bearing, [illegible], tool slide, 12 in. wide, length of carriage on ways, 12 in., lead screw, 2 in. in diameter; floor space, 5x12 ft., weight, 10,000 lb.

For turning, a four-tool turret post is usually supplied. A special form, in which the tool post is also the tool holder, may also be secured. This form is designed to avoid the overhang of the tool post and tool holder. If desired, the usual form of carriage, embodying the regular cross-slide, may be supplied. The regular form of tailstock may also be applied, as well as other regular attachments.

The lathe shown is a recent development of the Hart-Parr Co., Charles City, Iowa.

Adjustable Drawing Table

The board of the drawing table shown can be adjusted at any angle, thus making it comfortable in operation for both short and tall draftsmen.

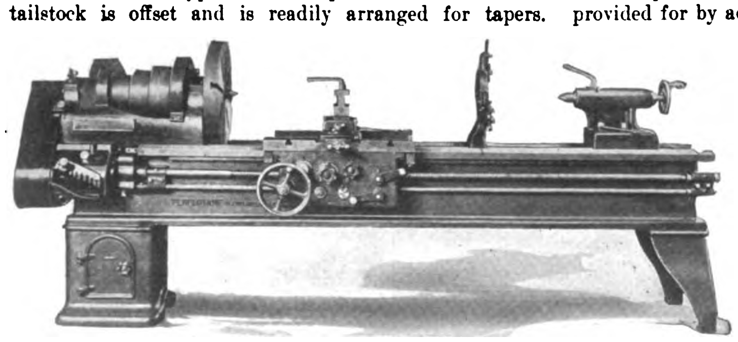
One nut locks both of the board supports located in the rear. The frame is made of cast iron, the lower cross-rod providing a foot rest. The cabinet, made of white pine, has three drawers and a special bottle holder.

ADJUSTABLE DRAWING TABLE
Size of board, 33x55x1¼ in.

The table is a recent product of G. A. Almorth, 966 Grand Ave., New Haven, Conn.

Quick-Change Engine Lathe

The general design and construction of the lathe illustrated follow standard lines. The headstock is of the solid full-webbed type, and the apron is inclosed. The tailstock is offset and is readily arranged for tapers.



DOUBLE BACK-GEARED QUICK-CHANGE ENGINE LATHE
Swing over shears, 20⅝ in.; swing over carriage, 14½ in.; hole through spindle, 2⅛ in.; diameters of cone pulleys, 7.9 and 11 in.; width of driving belt, 3½ in.; width of carriage bridge, 7¼ in.; length of carriage bearing on bed, 27⅜ in.; weight, 3,215 lb.

The machine is equipped with double back gears, which in connection with the three-step cone pulley provide a wide range of spindle speeds. The quick-change feed box provides a range of feeds of 4 to 28 threads per inch.

In addition to the size illustrated the machine is made in two smaller sizes. It is a recent product of the Rockefeller Motor Co., Cleveland, Ohio.

Bullard "Maxi-Pay" Wage Plan

On May 13 the Bullard Machine Tool Co., Bridgeport, Conn., inaugurated a wage-payment plan known as the "Bullard Maxi-Pay Wage Plan." It is founded on a recognition of three great principles in wage payment and cost accounting: First, that production, not wage rate, is the foundation of low cost; second, that skill in producing a specialized product can only be attained through long association with that product; and, third, that skill acquired through a long period of association produces work of superior quality. The statement of the company says:

"Skill and proficiency are the actual foundations of low cost of production—not a low hourly wage rate.

"Skill at the machinist trade may be acquired by years of application in any of a thousand shops, but proficiency in the construction of a highly specialized product, like ours, can be attained only by long association with that product, through which may be developed a knowledge of its workings and an appreciation of the exacting requirements and the construction of the various details which enter into it.

"The longer a man is with us the better is his work, because of his development in skill and his greater knowledge of the special needs in the building of our machines, and, in the final analysis, that man's work costs less even though his hourly wage be considered high, because of its superior quality and the great efficiency with which it has been produced."

The striking features of the plan are the division of all employees into six classes, fixing a minimum wage rate for each class, advancing wage rates in recognition of ability, with the maximum rate dependent upon that ability, and keeping the "continued-service bonus" of 10 per cent. now in force. Thus the plan provides a wage rate that is limited only by the ability of the workman and his particular occupation. Change of occupation is provided for by advancement along definite lines to those who show ability. The provisions in each classification are as follows:

Class AA. Subforemen and leaders in charge of working gangs of mechanics. Maximum rate per hour, dependent on ability. Minimum rate per hour, 55c. Continued-service bonus of 10 per cent. as now in force. Foremen and shop executives will, as far as possible, be selected from Class AA.

Class A. Skilled mechanics of demonstrated first-class ability. Maximum rate per hour, dependent on ability. Minimum rate per hour, 50c. Continued-service bonus of 10 per cent. as now in force. Vacancies in Class AA will be filled from Class A.

Class B. Mechanics of good average ability. Rate per hour, 45c. Continued-service bonus of 10 per cent. as now in force. Class B men will be advanced to Class A when qualified, as shown by efficient and intelligent service.

Class C. Mechanics of limited experience, who by efficiency, interest and service may merit advancement. Rate per hour, 40c. Continued-service bonus of 10 per cent. as now in force. Class C men will be advanced to Class B when qualified, as shown by efficient intelligent service.

Class D. Apprentices, both special and regular. Apprentice wage schedules will be advanced approximately 10 per cent. Continued-service bonus of 10 per cent. as now in force. Class D men, upon completion of apprenticeship, will be advanced to the class for which they qualify.

Class E. Unskilled labor from all classes. Minimum rate per hour, 25c. Maximum rate per hour, dependent upon ability and occupation. Continued-service bonus of 10 per cent. as now in force. In the employment of unskilled labor, preference will be shown to those who can speak and write English and who show qualities which will later warrant advancement. Class E men showing adaptability will be given first opportunity to become skilled by advancement to Class D.

Making British 8-In. Shells in 4½ Hr.—Erratum

The drilling machine shown in Fig. 4 on page 751 was erroneously credited to W. F. & John Barnes Co. instead of to the Barnes Drill Co., as it should have been.

PERSONALS

H. M. Cleaver, for a long period manager of publicity of the Niles-Bement-Pond Co., has been transferred to the Pond works, Plainfield, N. J., to assume new duties.

John G. H. Marvin, for many years president, treasurer and general manager of the L. & I. J. White Co., Buffalo, N. Y., has resigned, and expects to take a well-earned rest before becoming associated with new interests.

H. C. Urbauer has become superintendent of Defiance Screw Machine Products Co., Defiance, Ohio, succeeding S. Thompson, who has relinquished the superintendency to devote his entire time to his office of president and general manager.

W. M. Nones, for some time past secretary and general manager of the Norma Company of America, has been elected president and treasurer and at the same time will continue to be actively in charge of the general management.

Joseph E. Vincent, Jr., for a number of years connected with Wheelock, Lovejoy & Co. and the Swedish Iron and Steel Corporation, has organized the Iron, Steel, Metal and Alloy Co., New York City, of which he is general manager.

OBITUARY

George Reeves, president of the Reeves Brothers Company, Alliance, Ohio, died in Miami, Florida, on April 10.

William J. Fitzsimons, general manager of the Fitzsimons Co., Youngstown, Ohio, died suddenly in that city on May 4, aged 44 years.

Dr. Elmer L. Corthell, president of the American Society of Electrical Engineers and a prominent electrical and consulting engineer for many years, died in Albany, N. Y., May 16, following an operation. He began his engineering work in Providence, R. I., in 1867. He was 76 years of age.

William Stanley, founder of the Stanley Electric Co., acquired some years ago by the General Electric Co., and one of America's pioneer electrical engineers, died in Great Barrington, Mass., May 14, aged 58 years. Mr. Stanley founded his business in Pittsfield, Mass., in 1890, and since that time had been conspicuous in the development of electrical apparatus.

BUSINESS ITEMS

Sherritt & Stoer Co., Inc., 603 Finance Building, Philadelphia, have been appointed the exclusive sales agents of the Gardner Machine Co. for the Philadelphia district.

The Keystone Equipment Co., with offices at Philadelphia and New York City, has just taken title to the patents, good-will and business rights of the Colton Combination Lathe Tool.

In the form of a celebration upon the completion of its new factory addition in New Britain, Conn., the Fafnir Bearing Co. held an entertainment and dance for the employees and friends on May 13. One floor of the new building provided ample room for the purpose, over 800 people attending.

On May 1, the Cleveland offices of the Niles Tool Works Co. were removed from the Rockefeller Building to the Perry Payne Building, at 730 Superior St. The new quarters provide a showroom and store which is stocked with Pratt & Whitney machinery, small tools and gages. This company also represents the Niles-Bement-Pond Co. for its entire line.

In connection with the exportation of shipments to Scandinavian countries, to arrange for which it is necessary to secure letters of assurance in Washington, D. C., it will no doubt be of interest to manufacturers to know that Richard D. Micou, Mills Building, Washington, D. C., who acts as Washington correspondent of the "American Machinist," is in a position to look after the issuance of these letters and the attending details.

Buffalo Engineering Society

The final meeting of the season of the Engineering Society of Buffalo brought together, in the Hotel Statler on the evening of May 3, more than 200 of the members.

At the present time, by a sturdy growth, the membership numbers 450. This membership comprises the various branches of professional engineering—mechanical, electrical, chemical and civic engineering being splendidly represented.

All the present officers were re-elected. They are John Younger, president; W. A. James and Jesse G. Melendy, vice-presidents; Wm. Dollar, treasurer; and W. J. Gamble, secretary.

FORTHCOMING MEETINGS

Master Car Builders' Association. Annual meeting, June 14-17, Atlantic City, N. J. Joseph W. Taylor, secretary, Karpen Building, Chicago, Ill.

American Railway Master Mechanics' Association. Annual meeting, June 17-21, Atlantic City, N. J. Joseph W. Taylor, secretary, Karpen Building, Chicago, Ill.

American Society for Testing Materials. Annual meeting June 27 to July 1, 1916, Hotel Traymore, Atlantic City, N. J. Edgar Warburg, secretary, University of Pennsylvania, Philadelphia, Penn.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Wednesday each month. J. A. Brooks, secretary, Brown University, Providence, R. I.

New England Foundrymen's Association. Regular meeting second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. J. H. Warder, secretary, 1735 Monadnock Block, Chicago, Ill.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Technical League of America. Regular meeting second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York, N. Y.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	May 19, 1916	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$15.00	$15.00	$9.50
No. 2 X Northern Foundry, New York	20.75	20.75	14.25
No. 2 Northern Foundry, Chicago	19.00	19.00	13.00
Bessemer, Pittsburgh	21.95	21.95	14.55
Basic, Pittsburgh	18.95	18.95	13.45
No. 2 X, Philadelphia	20.50	20.50	14.25
No. 2, Valley	18.50	18.50	12.75
No. 2, Southern Cincinnati	17.90	17.90	12.40
Basic, Eastern Pennsylvania	20.50	20.50	13.25
Gray forge, Pittsburgh	18.70	18.70	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger and plates ¼ in. and heavier from jobbers' warehouse at the places named:

	New York				
	May 19, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Steel angles, base	3.50	3.15	1.85	3.25	3.10
Steel T's, base	3.55	3.15	1.90	3.25	3.10
Machinery steel (bessemer)	3.50	3.15	1.80	3.25	3.10
Plates	4.50	...	...	3.65	3.50

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse at the places named:

	New York				
	May 19, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
No. 28 black	3.65	3.65	2.60	3.20	3.20
No. 26 black	3.55	3.55	2.50	3.10	3.10
Nos. 22 and 24 black	3.50	3.50	2.45	3.05	3.05
Nos. 18 and 20 black	3.45	3.45	2.40	3.00	3.00
No. 16 blue annealed	4.70	4.45	2.35	3.70	3.60
No. 14 blue annealed	4.60	4.40	2.25	3.60	3.50
No. 12 blue annealed	4.50	4.30	2.20	3.50	3.45
No. 10 blue annealed	4.55	...	...	3.55	3.40
No. 28 galvanized	5.65	5.65	4.00	5.50	5.50
No. 26 galvanized	5.35	5.35	3.75	5.20	5.20
No. 24 galvanized	5.20	5.20	3.55	5.05	5.05

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot for carload lots f.o.b. mill:

	Black		Galvanized	
	May 12, 1916	One Yr. Ago	May 12, 1916	One Yr. Ago
¾ to 2 in. steel butt welded	70%	81%	50½%	72½%
2½ to 6 in. steel lap welded	68%	80%	48½%	72½%
Diameter, In.				
¾	3.45	2.19	5.69	3.16
1	5.10	3.23	8.42	4.68
1¼	6.90	4.37	11.39	6.33
1½	8.25	5.23	13.61	10.18
2	11.10	7.03	18.32	10.18
2½	18.72	11.70	30.13	16.09
3	24.48	15.30	39.40	21.04
4	34.88	21.80	56.14	29.98
5	47.36	29.60	76.22	40.70
6	61.44	38.40	98.88	52.80

From New York stock the following discounts hold:

	Black	Galvanized
3½ to 6 in. steel lap welded	61%	36%
¾ to 3 in. steel butt welded	64%	42%

Malleable fittings, Class B and C, from New York stock sell at 30 and 5% from list price. Cast iron, standard sizes, 55%.

Bar Iron—Prices are as follows in cents per pound at the places named:

	May 19, 1916	One Month Ago
Pittsburgh, mill	3.25	2.50
Warehouse, New York	3.50	3.15
Warehouse, Cleveland	3.25	3.25
Warehouse, Chicago	3.10	3.10

Bar Steel sells at $3.50 per 100 lb. from warehouse, New York.

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-size lots, the following quotations hold:

	May 19, 1916	One Month Ago
New York	List price plus 20%	List price plus 20%
Cleveland	List price plus 20%	List price plus 20%
Chicago	List price plus 10%	List price plus 10%

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York			
Today	One Year Ago		
$6.00	$3.75@4.00	Cleveland... $6.30	Chicago... $5.00

In coils an advance of 50c. is usually charged.

Drill Rod—Discounts from list price in New York are as follows: Standard, 65%; extra, 60%; special, 55%.

High Speed Tool Steel containing from 10 to 18% tungsten sells as follows per pound in New York:

Billets ....$2.35 Bars $3.00

METALS

Miscellaneous Metals—The present quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	New York		
	May 19, 1916	One Month Ago	One Year Ago
Copper, electrolytic (carload lots)	30.50	30.00	19.00
Tin	49.00	50.00	39.50
Lead	7.50	7.75	4.20
Spelter	13.50	19.87½	14.00
ST. LOUIS			
Lead	7.50	7.75	...
Spelter	13.37½	19.25	...

At the places named, the following prices in cents per pound prevail:

	New York				
	May 19, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Copper sheets, base	37.50	37.50	24.00	38.50	36.50
Copper wire (carload lots)	37.50	36.50	21.50	32.50	37.00
Brass rods, base	44.50	41.50	20.50	38.00	38.00
Brass pipe, base	46.50	44.50	23.50	44.00	46.00
Brass sheets	44.50	40.50	20.50	38.00	38.00
Solder ½ and ½ (case lots)	30.62½	37.87½	28.50	35.50	34.50

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York		Cleveland	
	May 19, 1916	One Month Ago	May 19, 1916	One Month Ago
Copper, heavy and crucible	25.00	24.50	26.00	25.00
Copper, heavy and wire	24.50	24.00	25.00	24.00
Copper, light and bottoms	22.00	20.50	21.00	24.00
Lead, heavy	6.00	6.00	6.50	7.00
Lead, tea	5.50	5.50	5.50	6.00
Brass, heavy	14.50	14.50	20.00	20.00
Brass, light	12.50	12.00	13.50	13.00
No. 1yellow rod brass turnings	15.25	15.25	15.50	14.50
Zinc	12.00	13.00	15.00	16.00

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
$\frac{1}{16}$ to $\frac{7}{32}$	35.50	36.00	36.50	37.00	38.00
¼ to $\frac{5}{16}$	35.25	35.75	36.25	36.75	37.75
⅜ to 1⅞	35.00	35.50	36.00	36.50	37.50
1$\frac{15}{16}$ to 2⅞	35.75	36.25	36.75	37.25	38.25
Rounds					
3 to 3$\frac{7}{16}$	36.50	37.00	37.50	38.00	39.00
Squares					
3	36.50	37.00	37.50	38.00	39.00
Rounds					
3½ to 3$\frac{15}{16}$	36.25	36.75	37.25	37.75	38.75
Squares					
3$\frac{1}{16}$ to 3$\frac{15}{16}$	36.25	36.75	37.25	37.75	38.75
Rounds—Squares					
4 to 4$\frac{15}{16}$	37.00	37.50	38.00	38.50	39.50
5 to 6$\frac{15}{16}$	38.00	38.50	39.00	39.50	40.50
7	38.50	39.00	39.50	40.00	41.00
Flats	36.50	37.00	37.50	38.00	39.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Antimony—Chinese and Japanese brands are quoted in cents per pound for spot delivery, duty paid:

	May 19, 1916	One Month Ago
New York	35.00	45.00
Cleveland	50.00@55.00	50.00@55.00
Chicago	45.00	45.00@50.00

Copper Bars from warehouse sell as follows in cents per pound:

	May 19, 1916	One Month Ago
New York	43.00	41.00
Cleveland	37.50	31.50
Chicago	38.50	37.25

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places named:

	New York	Cleveland	Chicago
Best grade	60.00@65.00	58.75	60.00
Commercial	30.00@35.00	21.00	28.00@30.00

Copper Sheets—In New York from warehouse hot rolled 16 oz. (large lots) base per lb is 39c., cold rolled 14 oz and heavier add 1c., polished takes 1c. per sq.ft. extra for 20-in. widths and under, over 20 in., 2c

Zinc Sheets—The following prices in cents per pound prevail.

Carload lots, f.o.b. mill 24 50

	In Casks May 19, 1916	In Casks One Month Ago	Broken Lots May 19, 1916	Broken Lots One Month Ago
New York	26 00	26 00	26 50	26 50
Cleveland	26 50	26 00	27 00	26 50
Chicago	26 50	26 50	27 00	27.00

SHOP SUPPLIES

Nuts—From warehouses at the places named, on fair sized orders the following amount is deducted from list

	New York May 19, 1916	New York One Month Ago	Cleveland May 19, 1916	Cleveland One Month Ago	Chicago May 19, 1916	Chicago One Month Ago
Hot pressed square	$2 50	$2 75	$3 00	$3 50	$3 25	$3 25
Hot pressed hexagon	2 50	2 75	3 00	3 75	3 25	3 25
Cold punched square	2 00	2 50	2 65	3 00	3 00	3 00
Cold punched hexagon	2 50	3 00	3 25	3 75	3 50	3 50

Semifinished nuts sell at the following discounts from list price

	May 19, 1916	One Month Ago
New York	50-10%	[illegible]
Cleveland	6[illegible]	70-10%
Chicago	65%	70%

Carriage Bolts—From warehouses at the places named the following discounts from list price are in effect

	New York	Cleveland	Chicago
⅜ by 6 in	4[illegible]	[illegible]	6[illegible]
Larger and longer	3[illegible]	40-1[illegible]	50[illegible]

At this rate the net prices are as follows

Length, In	New York ¼	New York ½	New York ¾	Cleveland ¼	Cleveland ½	Cleveland ¾	Chicago ¼	Chicago ½	Chicago ¾
1½	$0.53	[illegible]	[illegible]	$0.43	[illegible]	[illegible]	$0.3[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	45	[illegible]	[illegible]	42	[illegible]	[illegible]
2½	63	$2 12	$[illegible]	[illegible]	$1 39	$3 63	46	$1 [illegible]	$4 25
3	68	[illegible]	[illegible]	[illegible]	1 [illegible]	[illegible]	50	1 [illegible]	4 50
3½	73	2 48	6 [illegible]	60	1 64	4 36	[illegible]	1 91	4 75

Machine Bolts—From warehouses at the places named the following discounts hold

	New York	Cleveland	Chicago
⅜ by 4 in and smaller	50%	60 and 10%	60 and 10%
Larger and longer up to 1 in. by 30 in	40%	50 and 5%	50 and 10%

At this rate the net prices per 100 follow

Length In	New York ¼	New York ½	New York 1	Cleveland ¼	Cleveland ½	Cleveland 1	Chicago ¼	Chicago ½	Chicago 1
2	$0.89	$2.32	$9.60	$0.67	$1.46	$6.08	$0.64	$1.74	$7.20
2½	93	2 48	10 14	70	1 [illegible]	6 [illegible]	67	1 [illegible]	7 60
3	97	2 63	10 [illegible]	73	1 66	6 [illegible]	70	1 [illegible]	8 00
3½	1 01	2 79	11 22	77	1 77	7 48	73	2 08	8 40

Wrought Washers—From warehouses at the places named the following amount is deducted from list price

New York ... $4 00 Cleveland $6 00 Chicago $6 00

At this rate, the net prices follow

Diameter, In	New York	Cleveland	Chicago
[illegible]	$10 00	$[illegible]	$[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	7 40	5 40	5 40
[illegible]	6 [illegible]	4 [illegible]	4 [illegible]
[illegible]	[illegible]	3 [illegible]	3 [illegible]
[illegible]	[illegible]	3 [illegible]	3 [illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	3 [illegible]	3 [illegible]
⅞, 1, 1⅛	[illegible]	[illegible]	[illegible]
1¼, 1⅜, 1½	[illegible]	[illegible]	3 [illegible]
1⅝, 1¾, 1⅞, 2	[illegible]	[illegible]	[illegible]
2¼, 2½	6 [illegible]	4 [illegible]	4 [illegible]

For cast-iron washers the base price per 100 lb is as follows

New York $2 50 Cleveland $2 00 Chicago $2 10

Rivets—The following quotations are allowed for fair sized orders from warehouse

	New York	Cleveland	Chicago
Steel [illegible] and smaller	4[illegible]	45-10[illegible]	5[illegible]
Tinned	4[illegible]	45-10	52[illegible]

Button heads ⅝, ¾, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.

New York.... $5.25 Cleveland.... $3.85 Chicago.... $3.50

Cone heads, same sizes

New York.... $5.35 Cleveland.... $3.95 Chicago.... $3.60

For the following sizes, the extras over the above prices in cents per 100 lb are as follows

1⅛ to 1¾ in. long, all diameters	$0.25
⅜ in. diameter	0 [illegible]
½ in. diameter	0 [illegible]
1 in. long and shorter	0 [illegible]
Longer than 5 in.	0 [illegible]
Less than kegs	0 [illegible]
Countersunk heads	0 [illegible]

Nails—Wire nails f.o.b. Pittsburgh sell at $[illegible] [illegible] galvanized, 1 in. and longer, $[illegible] [illegible] over [illegible] and shorter, $2 50. These prices are to regular customers and delivery is made at the mill's convenience. From warehouse wire and cut nails sell as follows:

	Wire May 19, 1916	Wire One Month Ago	Cut May 19, 1916	Cut One Month Ago
New York	$3.15	$2.90	$3.15	$2.70
Cleveland	3.05	2.95	2.95	2.85
Chicago	2.85	2.70	2.85	2.70

Copper Rivets and Burs sell at the following rate from warehouse:

	Rivets May 19, 1916	Rivets One Month Ago	Burs May 19, 1916	Burs One Month Ago
Cleveland	List price	List price	List price	List price
Chicago	List price	List price	List price	List price
New York	20% from list	20% from list	List price	List price

MISCELLANEOUS

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire	
[illegible]	10.00
No. 8, [illegible] and No. 10	11.00
[illegible]	12 50
No. 12	13 50
[illegible] No. 14 and [illegible]	15 00
No. 18	16 50
No. 20	17.50

Special Welding Steel	
[illegible]	33 00
[illegible]	30 00
[illegible]	28 00

Cast-Iron Welding Rods	
⅛ by 19 in. long	22.00
[illegible] by 12 in. long	26.00
¼ by 19 in. long	20.00
½ by 21 in. long	20.00

Vanadium Wire in Coils or Sticks	
[illegible]	15.50
[illegible]	15.00
⅛	14 00
[illegible]	12 00
[illegible] and larger	11.00

Tin Plates—The following prices are in effect from warehouses at the places named:

			New York May 19, 1916	New York One Month Ago	Cleveland May 19, 1916	Cleveland One Month Ago	Chicago May 19, 1916	Chicago One Month Ago
Coke tin plate, 14x20								
100 lb			$6 25	$6 00	$5 40	$5 40	$5.60	$5.50
I C 107 lb			6 40	6.15	5 55	5.55	5.75	5.65
Terne plate, 20x28								
Base Wgt	Net Wgt.	Coating						
100 lb	200	8	$10 50	$10 00	$9 10	$9 10	$8.90	$8.90
I C	214	8	10 80	10 30	9 35	9 35	9.25	9.25
I. X	270	8	12 80	12 30	11 60	11 60	11.40	11.40
I C	218	12	12 00	12 00	10 50	10 50	10.75	10.75
I. C	221	15	13 00	13 00	10 50	10 50	11 60	11 60
I. C	226	20	13 50	13 50	12 50	12 50	12.50	12.50
I C	[illegible]	25	14 25	14 25	13 50	13 50	13.75	13.75
I C	236	30	15 50	15 50	14.50	14 50	14.75	14.75
I C	241	35	17 00	17 00	15 75	15.75	15 85	15.85
I C	246	40	19 00	19.00	16.75	16.75	17.10	17.10

Seamless Drawn Tubing (Iron Pipe Sizes)—The base price per pound from warehouse is as follows.

	New York	Cleveland	Chicago
Brass	43 50	44.50	42.50
Copper	48.00	44.50	43.50

For immediate stock shipment the following quotations hold.

Diameter, In	Copper New York May 19, 1916	Copper New York One Year Ago	Copper Cleveland	Brass New York May 19, 1916	Brass New York One Year Ago	Brass Cleveland
¼ to 2½	51 00	22 50	44 50	46 60	19 50	44 50
3	51 00	22 50	44 50	46 60	19 50	44 50
3½	52 00	23 50	44 50	47 50	20 50	44 50
4	53 00	24 50	45 50	48 50	21 50	45 50
4½	55 00	26 50	47 50	50 50	23 50	47 50
5	57 00	28 50	49 50	52 50	25 50	49 50
6	58 00	29 50	51 50	53 50	26 50	51 50
7	60 00	31 50	51 50	55 50	28 50	51 50
8	62 00	33 50	55 50	57 50	30.50	55 50

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks.

	Apr. 29	May 6	May 13	May 20
Prompt furnace	$2 25	$2 25@2.40	$2 00@2 25	$2 25@2 40
Prompt foundry	3 75	3 75	3.50@3.75	3.50@3.75

Cotton Waste—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	11 00@13 00	11 00@14 00	11 00@13 50
Colored mixed	8.00@10 00	7 50@11.00	8.00@10 50

Sal Soda sells as follows per 100 lb.:

New York .... $2 05 Cleveland $2 25
Philadelphia .... 1 80 Chicago 1 90

Roll Sulphur in 360-lb bbl. sells as follows per 100 lb.

New York .... $2 75 Cleveland.... $2.75 Chicago.... $2.75

Linseed Oil—These prices are per gallon:

	New York	Cleveland	Chicago
Raw in barrels	$0 76	$0 76	$0 80
5-gal cans	.86	.86	.90

Boiled, it is 1c per gal. higher.

White and Red Lead, in cents per pound, sell as follows:

	Red Dry	Red In Oil	White Dry and In Oil
100-lb keg	10.50	11.00	10 50
25 and 50-lb kegs	10.75	11.25	10 75
12½-lb keg	11.00	11.50	11 00
1- to 5-lb. cans	12.50	12.50	12.50

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

Bids will be received by Bureau of Supplies and Accounts, Navy Dept., Washington, D. C., until June 6, for furnishing and delivering at Portsmouth, N. H., 18-in. turret lathe, 1½x 18-in. turret lathes, milling machine and 2-spindle drill presses.

We have been advised that D. J. Sullivan, 660 Cottage St., New Bedford, Mass., will construct a garage at New Bedford. Estimated cost, $10,000.

We have been advised that the Winter Bros. Co., manufacturer of taps and dies, plans to construct a 1-story, 40x 125-ft. addition to its plant at Wrentham, Mass.

Bids will be received until June 6 by Navy Department, Washington, D. C., for 2 drilling machines and 1 chucking outfit under Schedule 9633 for Newport, R. I.

Fire, May 9, damaged the foundry of the New London Marine Iron Works at New London, Conn. Loss, $5,000.

MIDDLE ATLANTIC STATES

The Lehigh Valley R.R. contemplates shops on the flats west of the Chemung River, Athens, N. Y. E. B. Ashby, New York, N. Y., Ch. Engr.

The Simplex Seamless Tube Corporation, Buffalo, N. Y., recently incorporated by A. W. Sawyer, Charles A. Hamlin, and others, will construct a factory at Buffalo for the manufacture of seamless tubes.

A 2-story factory will be constructed at 102 Broadway, Buffalo, N. Y., by the Star Plating Works, manufacturer of copper plating.

The Engle Aëroplane and Motor Co., D. S. Morgan Bldg., Buffalo, N. Y., recently incorporated with $750,000 capital stock, by Albert J. Engel and O. J. Weimert, Buffalo, and M. Mauran, Niagara Falls, has absorbed the Coombs Aëroplane Co., Inc., and taken over that company's plant at Dewpew, N. Y., a suburb of Buffalo. The new company will equip the plant for the manufacture of powerful and speedy flying boats of the latest design and aëroplanes for sport, pleasure and business purposes.

The Crescent Tool Co., Foote Ave. and Harrison St., Jamestown, N. Y., is enlarging its plant.

The Nathan Manufacturing Co., 101 Park Ave., New York, N. Y., manufacturer of patented injectors, has awarded the contract for the construction of a new plant at Flushing, N. Y. (Borough of Queens). Estimated cost, $500,000.

Plans have been prepared by F. Grad, American National Bank Bldg., Newark, N. J., for a 3-story addition to the jewelry factory of John F. Schrink & Son, Emmet St., Newark. Estimated cost, $25,000. Noted May 4.

Henry Gobert, Newark, N. J., plans to construct a 1-story brick garage at 239-41 Central Ave., Newark, N. J. Estimated cost, $11,000.

The Hyatt Roller Bearing Co. has awarded the contract for the construction of a 9-story reinforced-concrete factory at 5th and Middlesex St., Newark, N. J. Estimated cost, $235,000.

The Niles-Bement-Pond Co., Plainfield, N. J., manufacturer of machinery, is having plans prepared by Harris & Richard, Arch., Drexel Bldg., Philadelphia, Penn., for an addition to its plant.

The Steel Car Forge Co., Ellwood City, Penn., a subsidiary of the Standard Steel Car Co., is building a new machine shop.

The Kutztown Foundry and Machine Works, 1421 Chestnut St., Philadelphia, Penn., will build an addition to its plant at Kutztown, Penn.

The Evans Mould and Machine Co., Uniontown, Penn., has awarded the contract for the construction of a new foundry.

The Myerberg Lighting Co., 418 North Calvert St., Baltimore, Md., will establish a factory for the manufacture of lighting fixtures.

The contract has been awarded for the construction of a garage and repair shop at Brooklyn, Md., for William Smith.

Bids will be received by Bureau of Supplies and Accounts, Navy Dept., Washington, D. C., until June 6, for furnishing and delivering 36-in. triple geared lathe at Washington.

Isaac T. Mann, Washington, D. C., plans to construct a 3-story service plant.

SOUTHERN STATES

According to press reports a brick garage and machine shop will be constructed at Danville, Va., by J. C. Holmbe.

The Carter Iron Manufacturing Co., Charleston, W. Va., plans to construct a factory at Paden City, W. Va.

The Universal Plow Co., Florence, Ala., plans to construct a foundry for the manufacture of malleable iron.

Robert Burrows, Jr., Johnson City, Tenn., is in the market for garage equipment, including air compressors, tanks, etc.

The Nicholson Furnace Co. plans to construct a factory at Louisville, Ky., for the manufacture of furnaces.

MIDDLE WEST

Plans have been prepared for the construction of a 2-story, 76x250-ft. garage for the Summit Auto Garage Co. at Akron, Ohio. Estimated cost, $30,000.

Bids are being received by McLaughlin & Hulsken, Arch., 610 Savings Bank Bldg., Lima, Ohio, for the construction of a pattern shop at Bucyrus, Ohio, for the Carroll Foundry Co. Estimated cost, $25,000.

The United Steel Co. is constructing additions to its plant at Canton, Ohio. Estimated cost, $1,500,000.

We have been advised that the contract has been awarded for the construction of a factory for the American Tool Works at Cincinnati, Ohio.

The W. S. Bidle Co., 1411 East 45th St., Cleveland, Ohio, has been granted a permit for the construction of an addition to its plant at Cleveland for the heat treating of steel.

The Crucible Steel Forge Co. will build an addition to its plant on Carnegie Ave., Cleveland, Ohio.

The contract has been awarded for the construction of an addition to the factory of the Cuyahoga Stamping Machine Co., East 152nd St., Cleveland, Ohio. Estimated cost, $5,000.

Plans have been prepared for the construction of a 3-story addition to the garage of A. R. Davis Motor Co., at 2020 Euclid Ave., Cleveland, Ohio. Estimated cost, $20,000.

Plans are being prepared for the construction of a 1-story garage at Cleveland, Ohio, for the Balle Bros. Co. Estimated cost, $20,000.

The National Lamp Works is constructing an addition to its plant at 1764 East 45th St., Cleveland, Ohio. Estimated cost, $7,000. Noted May 11.

The National Screw and Tack Co. will construct an addition to its factory at 7300 Stanton Ave., Cleveland, Ohio. Estimated cost, $16,000.

Bids will be received until June 1 for the construction of a plant at the foot of West 65th St., Cleveland, Ohio, for the Northern Blower Co., 4515 Storer Ave., Cleveland. Estimated cost, $20,000. Noted May 11.

The Park Drop and Forge Co., 730 East 79th St., Cleveland, Ohio, has awarded the contract for the construction of an addition to its factory at Cleveland.

The contract has been awarded for the construction of a 2-story, 60x10-ft. factory at Cleveland, Ohio, for the West Steel Castings Co., 805 East 70th St., Cleveland. Noted May 18.

The contract has been awarded for the construction of a 2-story factory on East 40th St., Cleveland, Ohio, for Warwick Bros., manufacturer of japanning and enameling.

The H. J. Harrold Tool Co. is constructing a 40-126-ft. addition to its plant at Columbiana, Ohio. Noted Jan. 27.

The contract has been awarded for the construction of shops at Columbus, Ohio, for the Hocking Valley Railway Co.

The Moore-Eastwood Manufacturing Co., Dayton, Ohio, is equipping a plant at Dayton for the manufacture of gages, dies, tools, fixtures, etc.

The Kressler Auto Co. plans to construct a 2-story, 100x 200-ft. addition to its plant at Fostoria, Ohio.

The Crown Pipe and Foundry Co. its constructing an addition to its foundry and machine shop at Jackson, Ohio.

The contract has been awarded for the construction of a 3-story, 50x200-ft. garage for J. H. Blattenberg, M. D., 128 South Union St., Lima, Ohio. Estimated cost, $25,000. Noted May 4.

The Lima-Overland Co. is constructing a factory at Lima, Ohio.

Steiner Bros., manufacturer of tools, jigs, fixtures, special machinery, etc., is enlarging its plant at Lima, Ohio. Noted Nov. 25.

The Humphreys Manufacturing Co., manufacturer of pumps and plumbers' supplies, plans to construct an addition to its plant at Mansfield, Ohio. Estimated cost, $5,000.

The Idea Wheel Co., manufacturer of a patent spring auto wheel, has increased its capital from $50,000 to $150,000, and plans to construct a plant at Massillon, Ohio.

Fire, May 10, destroyed the plant of the Spicer Manufacturing Co., foundry and machine works, at New Philadelphia, Ohio. Loss, $30,000.

The Buckeye Incubator Co. will construct an addition to its plant at Springfield, Ohio.

The Robbins & Myers Co., manufacturer of electric motors, generators and fans, has awarded the contract for the construction of the second unit to its plant at Springfield, Ohio.

The contract has been awarded for the construction of a 1-story, 50x140-ft. garage at Toledo, Ohio, for Harry G. Hammond, 422 West Bancroft St., Toledo. Estimated cost, $10,000.

The Hobart Manufacturing Co., manufacturer of electric coffee mills and meat choppers, is constructing a 3-story, 50x115-ft. addition to its plant at Troy, Ohio.

The Standard Car Construction Co plans to construct a plant at Warren, Ohio. Estimated cost, $1,000,000.

The National Car Coupler Co is constructing an addition to its plant at Attica, Ind. Estimated cost, $100,000. Noted Mar 23 and Apr. 27.

The A-B Stove Co. is constructing an addition to its foundry at Battle Creek, Mich

We have been advised that the contract has been awarded for the construction of a factory at Battle Creek, Mich, for the Rich Twist Drill Co, Chicago Ill. Estimated cost, $45,000. Noted May 4 and 11.

The United Steel and Wire Co is constructing an addition to its plant on Burchard St., Battle Creek, Mich.

Bids are being received by Smith, Hinchman & Grylls, Arch., 710 Washington Arcade, Detroit, Mich., for the construction of a factory for the Hygeia Filter Co. at Hamtramck, Mich.

Work will soon be started on the construction of a factory at Beard and Green Ave., Detroit, Mich., for the Ireland & Matthews Manufacturing Co., manufacturer of sheet-metal goods, 61-79 Iron St., Detroit.

The Michigan Steel Boat Co. is constructing a 4-story factory at Detroit, Mich.

Plans have been prepared for the construction of a factory at Detroit, Mich., for the Saxon Motor Co.

The Trippensee Manufacturing Co., 2679 East Grand Blvd., Detroit, Mich., manufacturer of automobile bodies, plans to construct an addition to its plant at Detroit.

The contract has been awarded for the construction of a 2-story, 100x158-ft. garage and factory at Detroit, Mich., for A. Wegner & Son Co. Estimated cost, $50,000. Noted Feb. 17.

The Superior Veneer and Cooperage Co will rebuild its mill at Escanaba, Mich., which was destroyed by fire

The Argo Motor Co contemplates purchasing a site on Wildwood Ave., Jackson, Mich., and plans to construct a plant

The Reo Motor Car Co is constructing a 1-story, 95x128-ft. addition to its heat treating factory at Lansing, Mich.

The L. O. Gordon Manufacturing Co., manufacturer of cam shafts and other motor specialties, will establish a factory at Muskegon, Mich

The Kawneer Manufacturing Co., manufacturer of metal architectural specialties, plans to construct an addition to its plant at Niles, Mich

The Anti-Friction Lubricant Co. recently organized, will construct a factory at St Joseph, Mich

The Peters Bros Manufacturing Co., manufacturer of ironing machines and tapping chucks, will build an addition to its factory at Algonquin, Ill Estimated cost, $15,000.

Plans have been prepared for the construction of a factory at Aurora, Ill., for the Aurora Metal Cabinet Works.

The contract has been awarded for the construction of a 50x150-ft. addition to the plant of the Chicago Bearing Metal Co., 43rd and Western Ave., Chicago, Ill Noted May 18.

The Cole Manufacturing Co., manufacturer of stoves, 3218 South Western Ave., Chicago, Ill has awarded the contract for the construction of a 3-story factory at 2436 Bross Ave., Chicago. Estimated cost, $75,000 Noted May 18

The Findeisen & Kropf Manufacturing Co., manufacturer of carburetors, will build a 25x110-ft. foundry at 2519 West 21st St., Chicago, Ill.

The contract has been awarded for the construction of an addition to the assembling plant on Michigan St Chicago, Ill., for the Ford Motor Co Estimated cost, $100,000 Noted May 11

The Independent Can Co., Kinzie and Wood St., Chicago, Ill., will construct a 2-story, 25x135 ft factory at 403 North Wood St., Chicago, Ill. Estimated cost, $20,000

Bids are being received by John Ahlschlager & Son, Arch., 111 West Washington Ct Chicago, Ill for the construction of a 1-story garage at 2641 North California Ave Chicago, for H. P Koechneke, 2710 Iowa St. Estimated cost, $10,000. Noted May 18

The American Wire Fence Co is remodeling its factory at Libertyville, Ill., and will install new equipment

The J. I. Case Threshing Machine Co will construct an addition to its plant at Peoria, Ill

Plans have been prepared for the construction of a plant at Peoria, Ill., for the Keystone Steel and Wire Co Estimated cost, $1,750,000 Noted May 4

The contract has been awarded for the construction of a plant at North Cairo, Ill (Cairo post office), for the Pioneer Pole and Shaft Co

The Kankakee Universal Welding Co., manufacturer of wire wheels for automobiles will reconstruct its factory at St Anne, Ill., which was recently destroyed by fire with a loss of $100,000.

The Appleton Wire Works is constructing a factory at Appleton, Wis

Plans are being prepared for the construction of additions to the plant of the Fairbanks Morse Manufacturing Co., manufacturer of windmills and engines, at Beloit, Wis Estimated cost, $400,000. C H Morse, Jr., is Pres Noted May 11.

The Four Wheel Drive Automobile Co plans to construct a 100x175-ft. addition to its factory at Clintonville, Wis

The Nelson Manufacturing Co., manufacturer of tank heaters, plans to construct an addition to its factory at Deerfield, Wis.

The Davidson Manufacturing Co manufacturer of automatic devices and attachments for typewriters will equip a plant at 613 Williamson St., Madison Wis.

The Allis-Chalmers Manufacturing Co., manufacturer of engines and heavy machinery, plans to construct an addition to its plant at Milwaukee, Wis.

Hugo Deuster will contract a garage at 5th and Prairie St., Milwaukee, Wis. Estimated cost, $36,000.

The Universal Foundry Co. is constructing a foundry at Oshkosh, Wis. Robert Ziebell is Pres.

The Warning Sheet Metal Co. has awarded the contract for the construction of a 2-story addition to its plant at Ceape and State St., Oshkosh, Wis. Noted Dec. 23.

The Gorton Fence Co., manufacturer of wire fence, contemplates constructing a factory at Racine, Wis., George Gorton, 1165 13th St., Racine, interested.

Bids are being received by Chandler & Park, Arch., 400 Main St., Racine, Wis., for the construction of a 1-story, 65x250-ft factory at Racine for Perfex Radiator Co., 15th St. Estimated cost, $12,000.

Preliminary plans have been prepared for the construction of a plant at Superior, Wis., for John G. Barsdale, 618 Tower Ave., Superior, manufacturer of motor trucks. Estimated cost, $50,000.

WEST OF THE MISSISSIPPI

The contract has been awarded for the construction of a 300x900-ft. locomotive shop at Burlington, Iowa, for the Chicago, Burlington & Quincy R.R. Estimated cost, $750,000. T. E. Calvert, 547 West Jackson Blvd., Chicago, Ill., is Ch. Engr. Noted May 11.

Ford Motor Co., Detroit, Mich., plans to construct a plant at Duluth, Minn. Estimated cost between $500,000 and $1,000,000.

The Berg Bros. Manufacturing Co., manufacturer of sheet iron specialties, plans to construct an addition to its factory at 2924-27 27th St., Minneapolis, Minn.

The Redell Motor Car Co., Joplin, Mo., recently incorporated with $12,000 capital stock, plans to equip a repair and machine shop in connection with a garage. A. T. Blackwell, Joplin, interested.

The Ford Motor Co. plans to construct a factory at Oak and McGee St., Kansas City Mo.

J. Goldberg & Son plans to construct a 115x150-ft. addition to its steel plant at Independence and Winchester Ave., Kansas City, Mo.

A plant for the manufacture of lawn mowers will be equipped by the Leidecker Lawn Mower Co., Muskogee, Okla. About $14,000 worth of machinery will be required.

WESTERN STATES

Bids will be received by Bureau of Supplies and Accounts, Navy Dept., Washington, D. C., until June 20, for furnishing and delivering one 40 ton traveling crane at Puget Sound Navy Yard, Bremerton, Wash.

Bids will be received until June 13 by Navy Department, Washington, D. C., for 3 precision lathes, and 1 bolt threading machine under Schedule 9625, and 1 planer and matcher under Schedule 9624 for Puget Sound Navy Yard, Bremerton, Wash.

Leach Bros will build a 1-story foundry at 2926 1st Ave., Seattle, Wash., and will install new equipment.

B. Lewis, State Engr., Salem, Ore., is advocating the construction of a nitrate plant at Bonneville, Ore., on the Columbus River, for the manufacture of explosives in time of war and fertilizers in times of peace. L. F. Harza, Engr., Portland, Ore., is interested.

The Motor Ship Construction Co. will construct a shipbuilding plant at Portland, Ore. M. A. Reed, Portland, Ore., is interested.

The contract has been awarded for the construction of a garage at Union Ave. and Weidler St., Portland, Ore., for C. N Nelson.

The Northwest Steel Co. plans to construct a 1-story addition to its plant on Sheridan St., Portland, Ore. Estimated cost, $7,500

Plans are being prepared by R. F. Felchin, Arch., for the construction of a garage and machine shop on J St., Fresno, Calif., for C B Shaver. Estimated cost, $10,000.

The Aluminum Products Co., La Grande, Ill., has purchased a site at 12th St and 1st Ave., Oakland, Calif., and will construct a branch plant.

J Carson plans to construct a reinforced-concrete garage at Quincy, Calif.

The Pinal Dome Oil and Refining Co. has purchased a site on East 1st St., Santa Ana, Calif., and plans to construct a garage and machine shop.

Eliot E Bradley, Fresno, Calif., representing the Studebaker Motor Car Co., plans to establish a garage and machine shop at Visalia, Calif.

CANADA

The General Car and Machinery Co will rebuild its plant at Montmagny, Que., which was recently destroyed by fire with a loss of $300,000

H Morgan & Co., 16 Beaver Hall Hill, Montreal, Que., will construct a garage at Montreal. Estimated cost, $10,000.

The American Radiator Co., Ltd., has been granted a permit for the construction of an addition to its plant at Brantford, Ont Estimated cost, $8,000.

The White Sewing Machine Co., Cleveland, Ohio, has purchased the plant of the Raymond Sewing Machine Co. at Guelph, Ont., and plans to enlarge and equip plant. Estimated cost, $200,000.

E Leonard & Sons, manufacturer of engines and boilers, plans to construct a 70x70-ft. addition to its factory at London, Ont

The Burrows Refining Co., 629 Wellington St., Ottawa, Ont., is having plans prepared for the construction of a nickel refining plant at Ottawa. Estimated cost, $30,000.

The Dominion Stove and Foundry Co. plans to construct an addition to its plant at Penetanguishene, Ont., and is in the market for equipment.

The Electrical Fttings and Foundry Co., Ltd., Preston, Ont., will install new equipment at plant at Preston.

The Metal Shingle and Siding Co., Preston, Ont., is in the market for equipment for plant at Preston.

Fire, May 11 destroyed the plant of the Lampman Pump Works, Peel St., Simcoe, Ont.

The McClary Manufacturing Co., manufacturer of stoves, plans to construct an addition to its plant at 177 King St., W., Toronto, Ont.

Work will soon be started on the construction of a factory at Toronto, Ont., for the Martin Pump and Machine Co., 43 Davies Ave., Toronto. Estimated cost, $15,000.

The Breen Motor Co. will construct a 50x116-ft. garage on Broadway, Winnipeg, Man. Estimated cost, $15,000.

The Canadian Western Steel Co. has taken over the plant of the Redcliffe Rolling Mills at Redcliffe, Alta, and will construct and addition to same. Estimated cost, $15,000. The company is in the market for machinery estimated to cost, $60,000.

GENERAL MANUFACTURING

NEW ENGLAND STATES

The E. F. Bell Shoe Co. plans to enlarge its plant at Bow and Rantoul St., Beverly, Mass.

Plans are being prepared by Jencks & Ballon, Arch., Providence, R. I., for the construction of a 1-story, 60x100-ft. and two 1-story, 19x95-ft. additions to the plant of the Constock-Cheney & Co., manufacturer of ivory goods, at Ivoryton, Conn.

MIDDLE ATLANTIC STATES

An addition will be built to the plant of the C. M. Bott Furniture Co., 170 Leslie St., Buffalo, N. Y.

The Buffalo Weaving and Belting Co., Chandler St., Buffalo, N. Y., manufacturer of cotton webbing and rubber and cotton belting, will build an addition to its plant.

E. S. Ward & Co., 418 Frelinghuysen Ave., and Hugh Smith Co., 210 Central Ave., Newark, N. J., have been consolidated into the General Leather Co. and will construct a plant on Frelinghuysen Ave. for the manufacture of automobile, carriage and furniture leather.

The contract has been awarded for the construction of an addition to the plant of the Maltbie Chemical Co., High St., Newark, N. J. Estimated cost, $25,000.

The Betany Worsted Mills, Passaic, N. J., plans to construct a plant at Wallington, N. J.

Fire, May 8, destroyed part of the plant of the Barbour Flax Spinning Co., Paterson, N. J., manufacturer of threads, twines, etc. Loss, $50,000.

The Gaede Silk Dyeing Co., Paterson, N. J., plans to enlarge its plant.

The portion of the plant of the Dellon Tire and Rubber Co., Trenton, N. J., recently destroyed by fire with a loss of $20,000, will be rebuilt.

Plans are being prepared for a 2-story addition to the plant of Charles P. Cochrane Co., Philadelphia, Penn., manufacturer of carpets.

The Lee Tire and Rubber Co., Pittsburgh, Penn., plans to construct a new plant.

SOUTHERN STATES

The Libby Owens Co., Charleston, W. Va., has awarded the contract for the construction of a glass plant at Kanawha City, W. Va.

The contract has been awarded for the construction of a factory for the J and D. Tire and Rubber Co., Charlotte, N. C. Estimated cost, $500,000. C. C. Coddington, Charlotte, interested. Noted Apr. 27.

The High Point Hosiery Mills, High Point, N. C., plans to enlarge its plant. Estimated cost, $30,000.

The Kelly Button Mills, Klinton, N. C., plans to construct an addition to its plant for the manufacture of hosiery. Estimated cost, $100,000.

S. B. and K. S. Tanner and associates, Rutherfordton, N. C., plan to construct a spinning mill at Rutherfordton.

The T. A. and A. Manufacturing Co., Fayetteville, Tenn., recently organized, plans to establish a plant for the manufacture of sanitary well buckets. E. H. Taylor, Fayetteville, interested.

The Ohio Falls Dye and Finishing Works, 719 East Madison St., Louisville, Ky., plans to construct an addition to its plant and install new machinery. J. J. Brown, Mgr.

MIDDLE WEST

The Miller Rubber Co. is constructing a factory at Akron, Ohio. Estimated cost, $90,00. Noted Dec. 30 and May 11.

The Buckeye Ribbon and Carbon Co., 311 St. and Clair Ave., Cleveland, Ohio, plans to construct a factory at East 55th and Spencer Ave., Cleveland. Estimated cost, $25,000. James Donovan is Pres.

The contract has been awarded for the construction of a factory on West 116th St., Cleveland, Ohio, for Henry A. Lindsley, manufacturer of paper fiber, 1366 West 70th St., Cleveland. Estimated cost, $9,00. Noted Jan. 20.

Bids are being received by Forest City Engineering Co., Engr., 512 Hippodrome Bldg., Cleveland, Ohio, for the construction of a factory at Cleveland for the National Artificial Silk Co., 735 Central Ave. Estimated cost, $300,000. Noted May 18.

Work will soon be started on the construction of a factory at East Norwood, Ohio (Cincinnati post office), for the North Western Chemical Co.

The Emery Candle Co. plans to construct an addition to its plant at Ivorydale, Ohio (Cincinnati post office).

The Kelly Springfield Tire Co., Akron, Ohio, will construct additions to its plant at Wooster, Ohio.

The Schacht Rubber Co. plans to construct a 2-story addition to its factory at Huntington, Ind.

The American Leather Products Co. has been granted a permit for the construction of a factory at 22nd and Montcalm St., Indianapolis, Ind.

Fire, May 8, damaged the plant of the Cadillac Chemical Co. at Cadillac, Mich. Loss between $50,00 and $100,000.

The contract has been awarded for the construction of a packing plant at Elgin, Ill., for the Kerber Packing Co. Estimated cost, $150,000. Noted Apr. 13.

Preliminary plans are being prepared for the construction of an addition to the plant of the Combined Locks Paper Co., Appleton, Wis.

The Federal Rubber Manufacturing Co. plans to construct 3 factory buildings at Cudahy, Wis.

The John Hoberg Paper Co. will construct a 75x175-ft. addition to its plant at Green Bay, Wis.

Plans have been prepared for the construction of an addition to the plant of the Cudahy Packing Co., at Springfield, Ill. Estimated cost, $13,000.

WEST OF THE MISSISSIPPI

W. F. Schnuckle plans to enlarge his broom factory at Duluth, Minn.

The Hastings Commercial Club is interested in the construction of a canning factory at Hastings, Minn. Estimated cost, $60,000.

Plans are being prepared by J. C. Sunderland, Arch., for the construction of a 9-story factory for the H. D. Lee Mercantile Co. at Kansas City, Mo. Noted Sept. 30.

G. W. and R. P. Hart plan to construct a canning plant and cotton gin at Arkadelphia, Ark.

The Rogers Handle Co., Paragould, Ark., plans to construct a factory at Jonesboro, Ark.

The Creechville Farmers Gin Co. plans to install new machinery at its cotton gin at Creechville, Tex.

The contract has been awarded for the construction of a cotton gin at Ringling, Okla., for J. C. Palmer, Orr, Okla. Estimated cost, $12,000. Noted Apr. 20.

B. L. Fields and associates plan to construct a canning factory at Temple, Tex.

The Tynan Gin Co. plans to construct a cotton gin at Tynan, Tex. Estimated cost, $12,000.

WESTERN STATES

The Pacific Western Chemical Co., San Francisco, Calif., plans to construct a plant at Medford, Ore.

The American Sugar Beet Co. plans to enlarge and improve its plant at Oxnard, Calif. Estimated cost, $100,000.

CANADA

The Columbus Rubber Co., 146 Iberville, St., Maisonneuve, Que., will construct an addition to its plant at Maisonneuve. Estimated cost, $20,000.

The Wayagamack Pulp and Paper Co., Ltd., will construct an addition to its plant at Three Rivers, Que. Estimated cost, $11,000.

Work will soon be started on the construction of a chemical plant at Merritton, Ont., for the Riordan Pulp and Paper Co. Estimated cost, $35,000.

The Solid Leather Co. plans to construct an addition to its plant at Preston, Ont. Estimated cost, $25,000.

Plans have been prepared for the construction of an addition to the plant of the Wayagamack Pulp and Paper Co. at Three Rivers, Ont.

Classified Advertising

The Classified Advertising section appears on pages 162, 163, 164, of this issue and will in future appear in the same relative position in the paper.

American Machinist

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WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormay processes, protected by United States patents issued June 22, 1915, and Apr. 18, 1916.

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National Defense and International Peace

Business and Patriotism

A Non-partisan Appeal to the Nation

THE WHITE HOUSE
Washington

April 21, 1916.

To the Business Men of America:

I bespeak your cordial cooperation in the patriotic service undertaken by the engineers and chemists of this country under the direction of the Industrial Preparedness Committee of the Naval Consulting Board of the United States.

The confidential industrial inventory you are asked to supply is intended for the exclusive benefit of the War and Navy Departments, and will be used in organizing the industrial resources for the public service in national defense.

At my request, the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Chemical Society are gratuitously assisting the Naval Consulting Board in the work of collecting this data, and I confidently ask your earnest support in the interest of the people and government of the United States.

Faithfully Yours, Woodrow Wilson

COMMITTEE ON INDUSTRIAL PREPAREDNESS
OF
NAVAL CONSULTING BOARD OF THE UNITED STATES
IN CO-OPERATION WITH
THE AMERICAN SOCIETY OF CIVIL ENGINEERS — THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
THE AMERICAN INSTITUTE OF MINING ENGINEERS — THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
THE AMERICAN CHEMICAL SOCIETY

ENGINEERING SOCIETIES BUILDING
29 WEST 39th STREET, NEW YORK

Advertisement designed by the ASSOCIATED ADVERTISING CLUBS OF THE WORLD and published free by this publication.

Drop Forging the Russian Cruciform Bayonet

By John H. Van Deventer

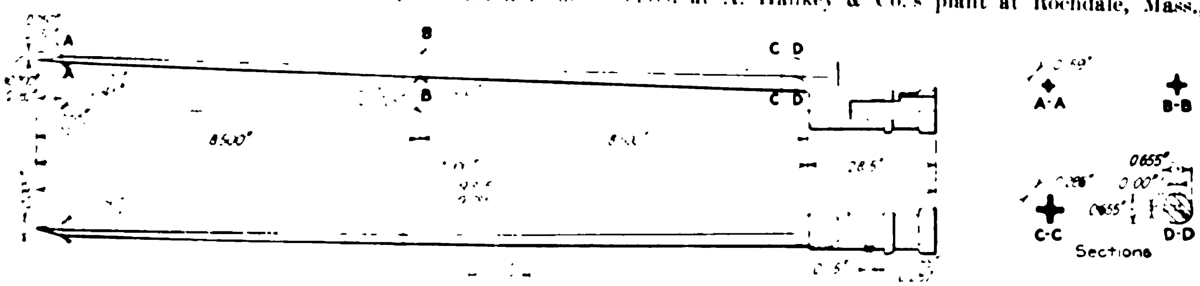
SYNOPSIS—Very little has been published relative to the forging of alloy steels under the drop hammer. This article describes the production of a Russian bayonet forging from a high-carbon chrome-nickel-manganese alloy steel and gives the successive steps in detail, from shearing the rough bars to pickling the finished forging. The machines used, special fixtures and apparatus, drop and trimming dies are shown, and the production time on each operation is also given.

Attempts to produce high-carbon forgings under the drop hammer have been followed by numerous failures, and the adventurous smiths who tried, but did not succeed, went sadly back to slower but surer methods. It is discouraging, for example, to be forced to produce certain edged tools, such as chisels, with the expenditure of many light blows and much labor; but the "cold refining" of the metal which comes under the skillful strokes of the toolsmith just as the work is losing its redness cannot be imitated by the elephantine impact of a ton drop.

Again, as the carbon goes up, the critical temperature comes down, bringing with it the high limit of temperature at which the piece may be worked without decarburizing. Unfortunately, the low limit at which forging is possible does not come down under these conditions, but rather goes up with the higher tensile strength, and thus the working limits of temperature narrow very quickly.

A bayonet forging, due to the exacting requirements that are placed upon the finished article, must retain all the qualities of strength and temper that are associated with high-carbon steel. It must not only possess strength and hardness, but to meet the twisting and bending tests to which it is subjected must have a spring-like temper and flexibility. Thus it will be noticed that the feat of producing a finished forging in two heats is not a mean one.

The process of doing this, as related here, was observed at A. Hankey & Co.'s plant at Rochdale, Mass.,



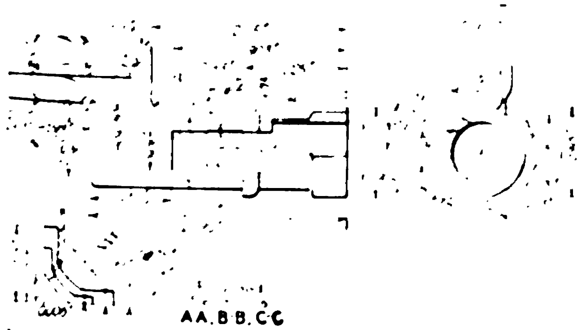


FIG. 1. DETAILS AND LIMITS OF THE RUSSIAN CRUCIFORM BAYONETS

where Russian cruciform bayonets are being manufactured. Not only is the bayonet forged complete in two heats, but the total man-time required for shearing the bars, drawing under the helve hammer, drop forging, trimming, breaking the tong hold, annealing, pickling, washing, neutralizing and baking is but $2\frac{3}{4}$ min. per bayonet—and this includes tending the heating furnaces also!

The composition of the steel used in the Russian bayonet must be such as to give in an annealed test piece the following mechanical test:

Tensile strength	100,000 lb. per sq.in.
Elastic limit	70,000 lb. per sq.in.
Minimum elongation	17 per cent. (in 2 in.)
Minimum reduction of area	30 per cent.

These are fairly stiff requirements in an annealed test piece, and to meet them steel is used having the following composition:

	Per Cent.
Carbon	0.60 to 0.70
Manganese	0.60 to 0.70
Silicon	0.10 to 0.20
Phosphorus not over	0.03
Sulphur not over	0.04
Chromium	0.30 to 0.50
Nickel	0.30 to 0.50

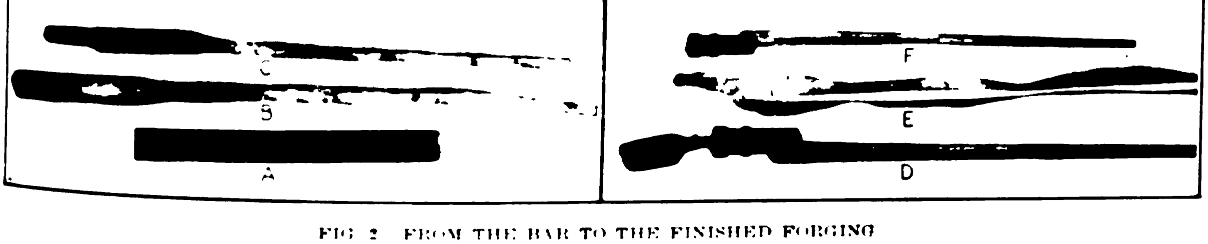


FIG. 2. FROM THE BAR TO THE FINISHED FORGING

The manganese, chromium and nickel make this steel in reality an openhearth spring steel and also have the very desirable effect of increasing the critical temperature that would correspond to the carbon content of a similar steel without them, from 1,800 to 2,000 deg. F., thus giving much wider limits than would otherwise be had.

The operator who takes care of drawing the blade and tong hold also looks after the furnace in which the round blanks are heated to a temperature of 1,700 deg. F. The furnaces for all the forging operations are of the over-fired oil-burning muffle type, the fuel being crude oil vaporized by dry steam at 125 lb. pressure. Less slag-

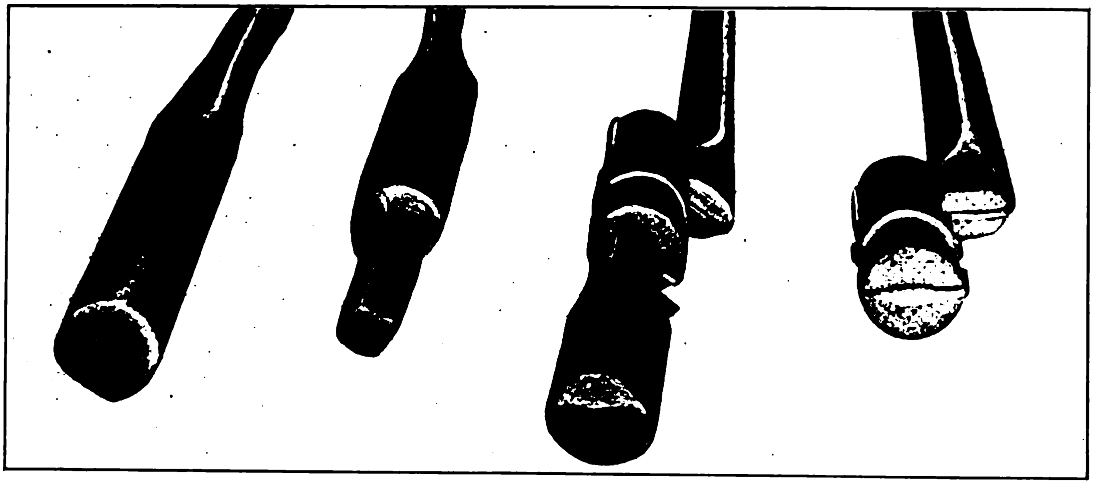


FIG. 3. CHANGES MADE IN THE BAYONET BUTT DURING FORGING

A glance at the limits and details of the Russian bayonet, as set forth in Fig. 1, will show that the forging from which the finished bayonet is made must be held closely to size. A thirty-second of an inch all over is allowed for this finish, and any decarburizing, scaling or etching in the pickle bath must not penetrate beyond this thirty-second-inch skin.

The changes that occur during the process of transforming the $1\frac{1}{16}$-in. round bars into finished forgings are illustrated in Figs. 2 and 3, the latter being an enlarged view of the butt ends showing the tong holds. In Fig. 2, *A* shows an 8-in. length as it is sheared from the bar, this being the correct size of the blank for drawing. At *B* and *C* are seen respectively the blade and the tong hold drawn, both of these draws being made under the helve hammer. At *D* is shown a bayonet that has been dropped and trimmed, but that still retains the tong hold, while the flash, or waste that is forced out between the upper and lower die faces, is shown in its entirety at *E*. The finished forging is depicted at *F*.

An alligator shear chews up the bar into the 8-in. lengths at the rate of 20 bites per minute, the operator merely pushing the stock against a stop each time that the shear blades open.

The metal in a bayonet must be refined, somewhat as is the metal in a chisel blade. As stated previously, the heavy impact of the drop hammer, while it will squeeze the hot material into shape in record time, will not refine it. This is accomplished, however, in the operation that immediately precedes the drop forging—namely, that in which the blade and tong hold are drawn out under the helve hammer. This operation therefore serves a double purpose: First, it closes the grain of the metal, and, secondly, it reduces the stock to a size and shape that are practical for the drop-hammer dies to handle with a minimum number of blows.

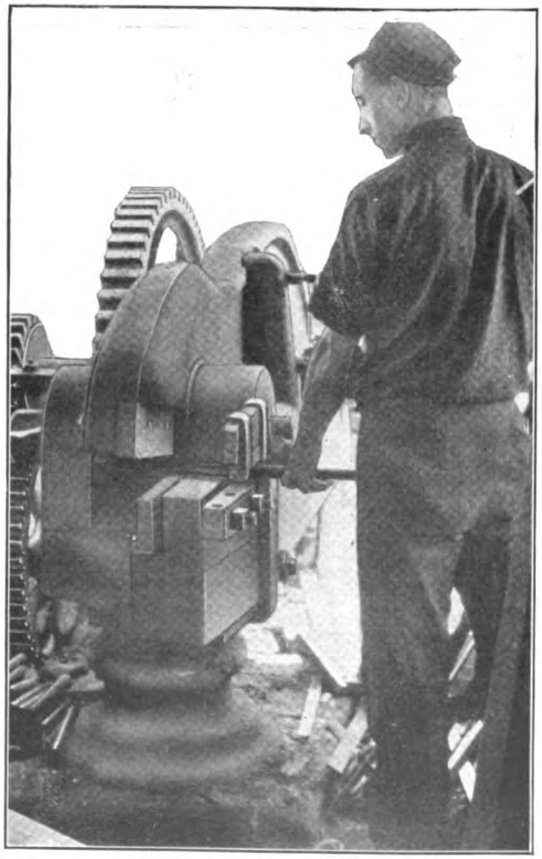


FIG. 4. THE BARS ARE FIRST SHEARED INTO 8-IN. LENGTHS

ging of the firebrick furnace lining is experienced when steam is used than when air is employed for vaporizing.

A number of blanks are kept heating in the furnace at the same time, one being put in each time that one is taken out, so that there is no delay through having to wait for blanks to reach a working heat. The tong hold, which is a square tit on one end of the blank, put on for the use of the drop-forge operator, is drawn first; then the hot blank is placed on an iron block and gripped on the tit end with a pair of tongs with jaws sufficiently long to reach the round stock beyond the tit, thus avoiding the necessity of changing tongs at this point. The blade is next drawn roughly to a tapered square section, the one pass through the dies being sufficient for this, the operator standing as shown in Fig. 5.

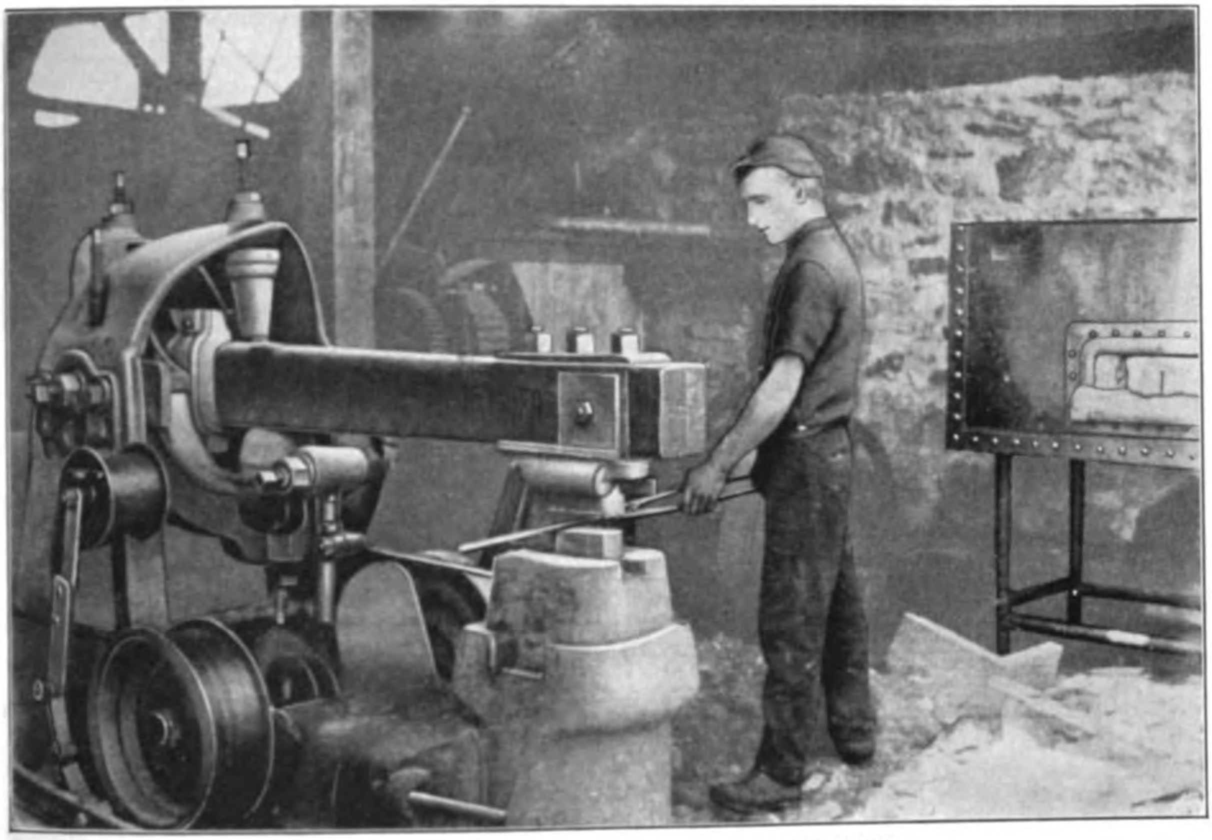
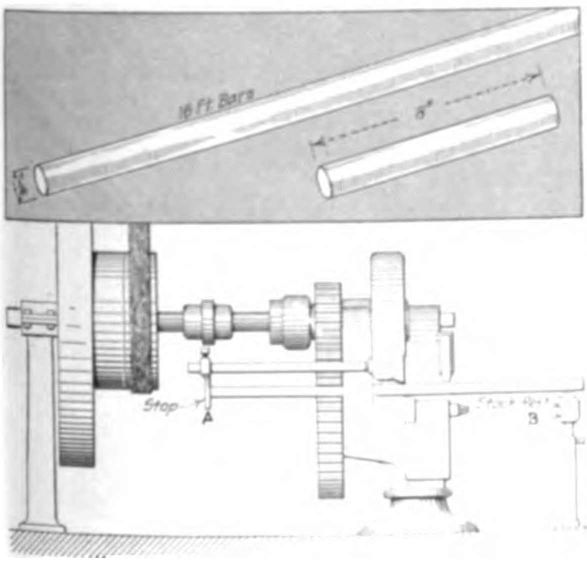


FIG. 5. DRAWING THE BLADE IN THE HELVE HAMMER



OPERATION 1. SHEAR TO 8-IN. LENGTHS

Machine Used—Alligator shear.
Special Tools and Fixtures—Length stop A for stock; [illegible] guide rest B for long bars.
Gages—None.
Production—From one operator and one machine, 700 to [illegible] pieces per hour.
Notes—Machine runs at 20 strokes per minute. The bars of 1½-in. alloy steel average 16 ft. in length.
Reference—See Fig. 4.

It takes a big drop hammer to make a bayonet forging. A 2,000-lb. board drop is employed on this work, and its massiveness is apparent from an inspection of Fig. 6. The weight of the base of this hammer, most of which is underground, is 30,000 lb., and the entire machine with die blocks must weigh close to 25 tons. The full drop of 4 ft. is not required on bayonet work, where the stock is roughed out so as not to leave too great a surplus of metal, and in this case three-quarters of the full length of drop is used.

The operator who looks after the drop forging is a busy man. Not only does he tend his heating furnace, but he also takes care of the edger and two impressions on the drop dies and operates the trimming press as well. All of this is done at one heat and necessitates quick and sure movements. The apparatus is arranged to conserve the motions of the operator as much as possible, the furnace and presses being within easy reach. In forging a bayonet the operator turns to the furnace, grips the heated piece in his tongs, holding it by the square tit, and swings it under the edger. It is shown there in position in Fig. 8, at *B*, ready for the hammer

to descend and make the bend for the hilt and also break down the blade to a taper. In actual work, the operator would retain his tong hold upon the piece during the edging and subsequent operations; but it was necessary to have him step out of the way so that the die might be clearly seen.

One blow is sufficient for edging, after which the piece is swung to the first impression, where a blow or two gives it the shape seen at *C*, Fig. 8. From here it is

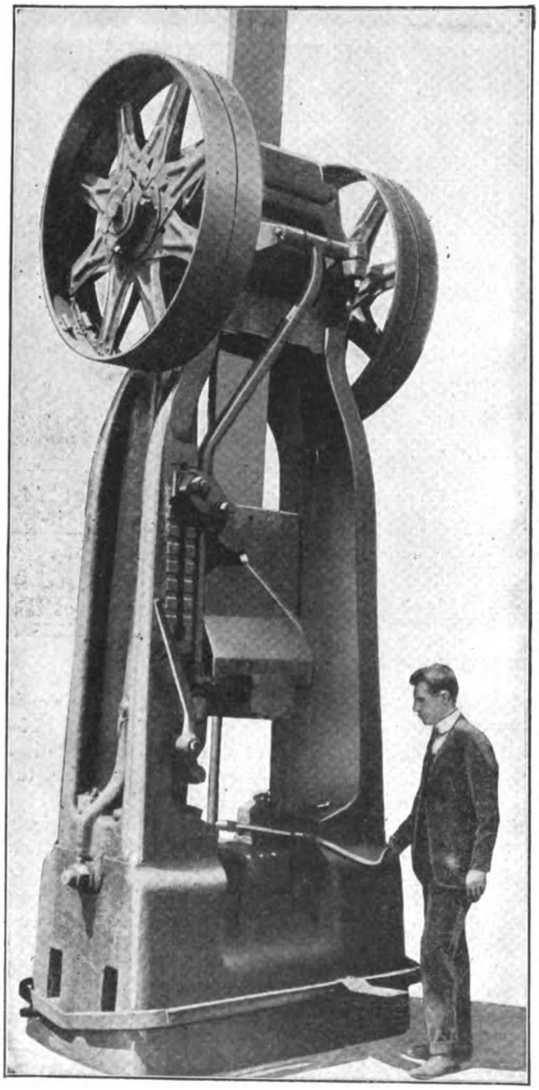


FIG. 6. IT TAKES A BIG DROP HAMMER TO MAKE A BAYONET FORGING

placed in the finishing impression and given one blow, which squares up the flash on the lower side of the forging, so that the piece will not rock when placed in the trimming dies, where it is next put by the operator. It is pushed through the lower trimming die, which is made open on the end, as illustrated in Fig. 10, so that the operator may still retain his hold upon the forging. As soon as it comes from this die, it is swung once more to the finishing impression, this time minus the flash, and is given one blow to correct the shape. The whole process does not require as long as it takes to read its description, as may be judged by the fact that the forging is still red hot after the final blow.

The drop-forge dies and the arrangement of impressions are shown in line drawing on the third operation

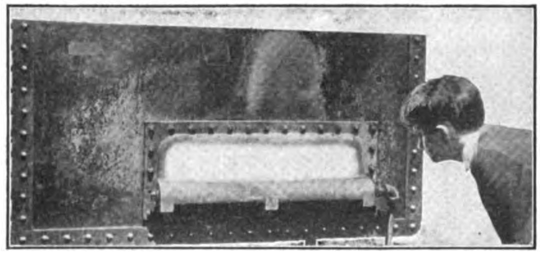


FIG. 7. THE SAFE FORGING HEAT FOR BAYONET STEEL IS BETWEEN 1,800 AND 2,000 DEG. F.

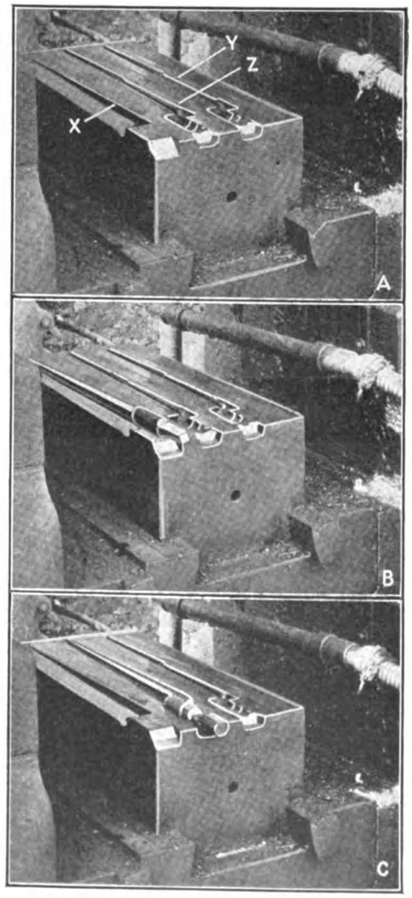


FIG. 8. THE LOWER DIE BLOCK OF THE DROP HAMMER WITH BAYONET IN POSITION

sheet. These dies are solid blocks of crucible steel having a carbon content of 90 points. There is little difference between the roughing and finishing impressions except in the matter of providing for the flash on the finishing impression. In the rougher the corners of the

impression are simply rounded, as shown in sections *AB* and *GH*. The lower finishing impression has a flash gutter milled around it, extending out some $\frac{3}{4}$ in., as in section *CD*. The upper finishing impression not only has this same flash space, but in addition has a land, $\frac{1}{8}$ in. wide, surrounding the outline, as indicated in section *EF*. This is for the purpose of thinning the flash and is omitted from the lower die block so that the flash may be flat on its lower surface and thus not be inclined to rock when placed in the trimming die. These dies were sunk by Hollender & Johnson, of Worcester, and the die blocks were furnished and afterward hardened by the Heppenstahl Forge Co. Hardening a 300-lb. die block of this kind is a fair sized job where the warp across a 23-in. face must be less than 0.003 in. It is done by immersing the block face down in a water bath, submerging the impression surface some 3 or 4 in. and having an air jet agitate the water beneath.

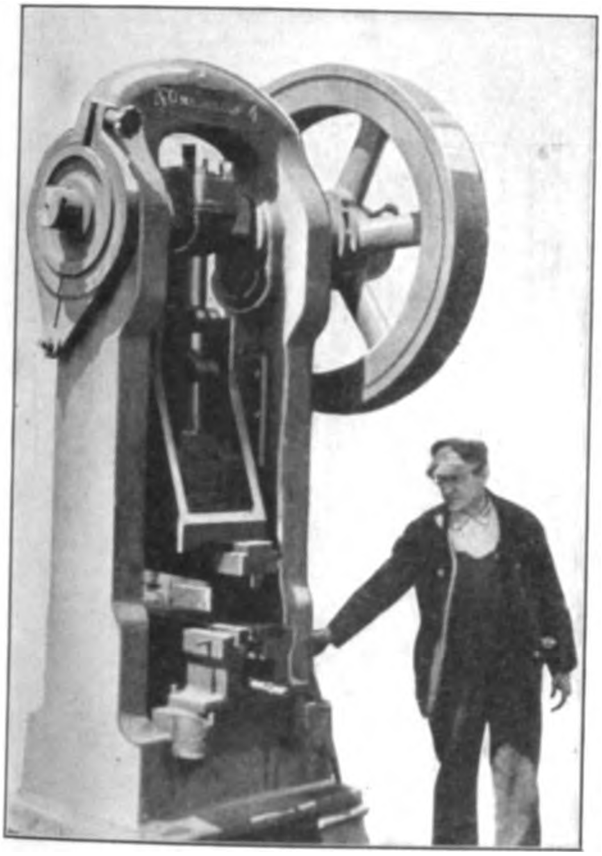


FIG. 9 THE "FLASH" IS TRIMMED WHILE THE BAYONET IS STILL HOT

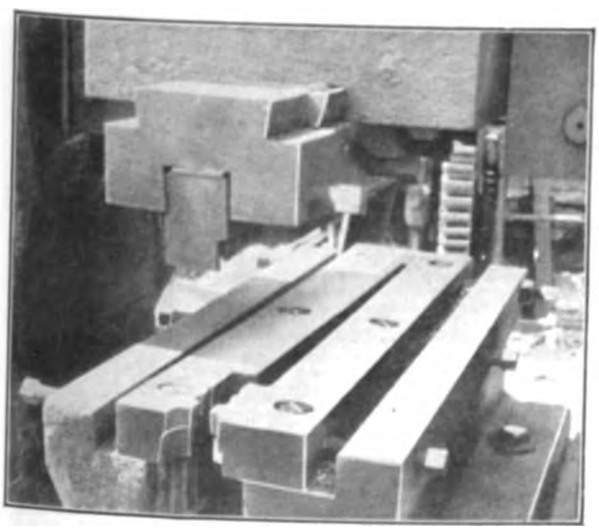


FIG. 10 PUSHING THE BAYONET THROUGH THIS TRIMMING DIE REMOVES THE FLASH

After the severe treatment it receives under the drop hammer, the metal in the bayonet forging becomes exceedingly brittle. This fact is used to advantage in breaking off the tong hold, which is the next operation after drop forging. The bayonet is held by the blade with the tong hold against the corner of an anvil, and a light tap with a hand hammer is sufficient to fracture the tong hold tit. This operation may be seen in Fig. 11.

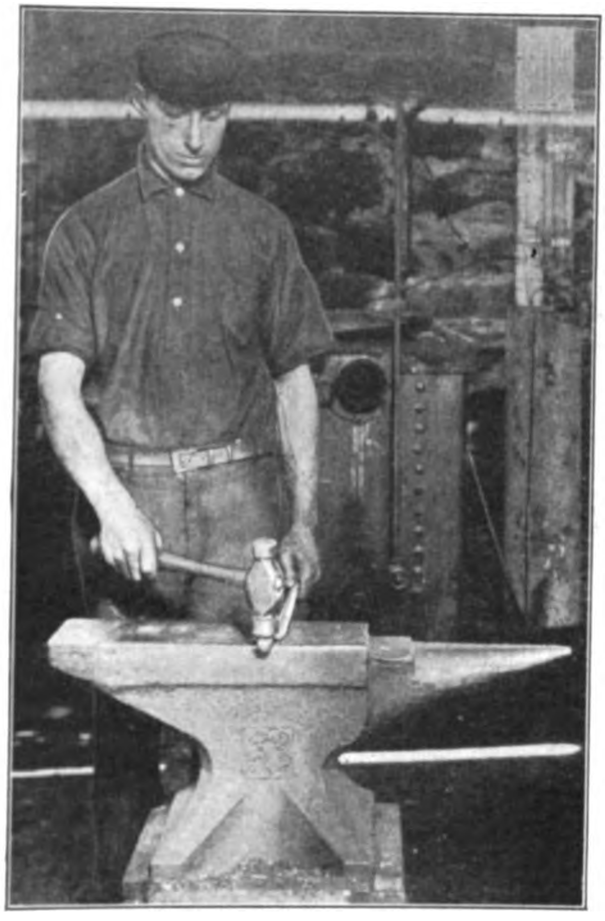


FIG. 11 A LIGHT TAP REMOVES THE TONG HOLD

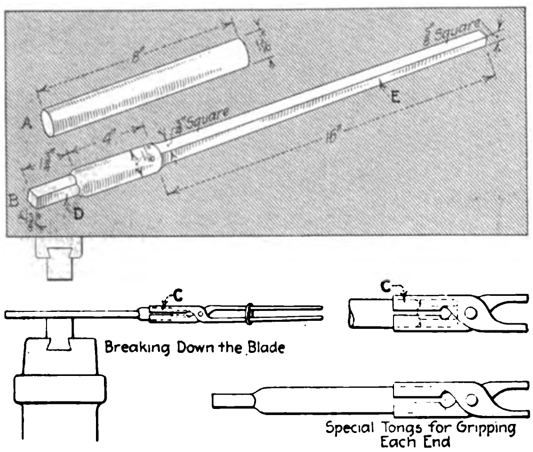
While brittleness was an advantage in the last operation, it is a disadvantage as far as the finished product is concerned and must be removed by annealing. The furnace for this purpose is shown in Fig. 12, and the pyrometers for controlling the temperature may also be seen at the right of this picture. Considerable time was spent by the Hankey company in determining the best form of annealing box for bayonet work; the outcome of their experiments was the use of a rather unusual form of box—an 8-in. steel steam pipe. Six of these pipe containers are placed in the furnace at one time after being filled with bayonets packed in an annealing mixture

consisting of spent charcoal and burnt coke. The pipes are sealed by means of caps and luting and are then brought to a temperature of 1,450 deg. F. in the oil-fired furnace. They are maintained at this temperature for a period of 10 hr., after which the heat is turned off and the furnace and pipes allowed to cool together—a process that takes place overnight. The resulting anneal is very complete, and the forgings are as soft and easy to cut as one can expect material of this chemical analysis to be.

In order to help the cutting tools of the machine shop as much as possible, whatever scale has been formed during forging and annealing is next removed by pickling. The bayonets are placed in wooden frames which are hung in the pickle tank—a wooden tank containing a 3 per cent. solution of sulphuric acid. Kept at the boiling point by means of a live-steam jet, this solution is wonderfully effective and does its work in a few moments. In fact, it would keep on working if not restrained, and for this reason the bayonets are transferred to a washing tank and thence to a neutralizing bath consisting of hot lime water. This use of hot solutions instead of cold ones is a time saver that is overlooked in a great many shops, and I do not know of any place where steam can earn its keep more easily than when put at this kind of work.

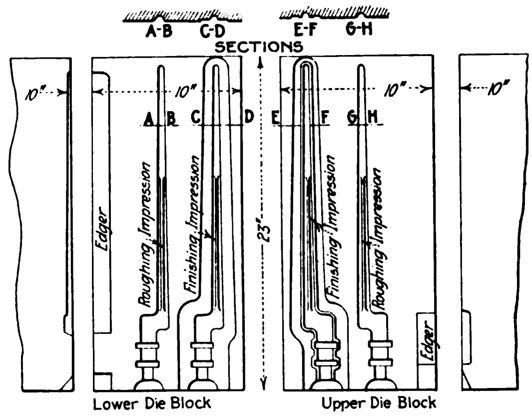
When the bayonets which have been thus treated are not to be machined for some time, they are placed in a steam-heated oven and baked for several hours in order to make sure that the action of the acid has been completely stopped. The inspection of a finished bayonet for smoothness and freedom from pits and scratches is gone about in a most thorough way and is really a critical one, as over-etching due to the acid of the pickle may cause rejections later on.

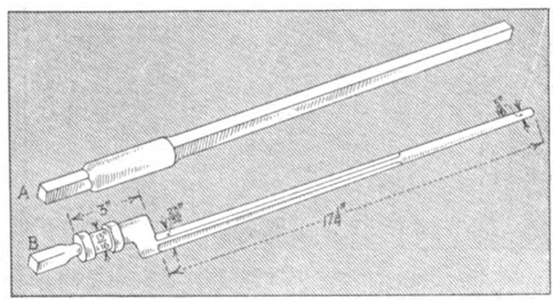
In spite of the comparatively small safe range of forging heat and the remarkably fast production time made on these bayonets the percentage of loss is small, running up to the present at less than 1 per cent. It would seem from these considerations that this process of forging the butt and the blade in one piece is not only conducive to a stronger job than that produced by welding the two, as is sometimes done, but also is considerably less expensive.



OPERATION 2: DRAW TONG HOLD AND BLADE

Equipment Used—Bradley 100-lb. cushion helve hammer; Kenworthy overfired muffle furnace.
Special Tools and Fixtures—Tongs C for gripping both ends of the stock.
Gages—None, although at first the operator used a steel rod to determine the amount of draw.
Production—One operator, tending the furnace and running the hammer, produces 80 pieces per hour, drawing both tong hold and blade.
Note—The stock is first gripped in the tongs, and the square tong hold D is drawn. The piece is then laid on a block, the tongs are transferred to the opposite end, after which the blade E is drawn in one pass between the hammer dies, the operator turning the stock 90 deg. between each blow. One heat serves for both draws. The forging temperature is between 1,800 and 2,000 deg. F.
References—See Fig. 2, B and C, and Fig. 5.





OPERATION 3: DROP FORGE AND TRIM

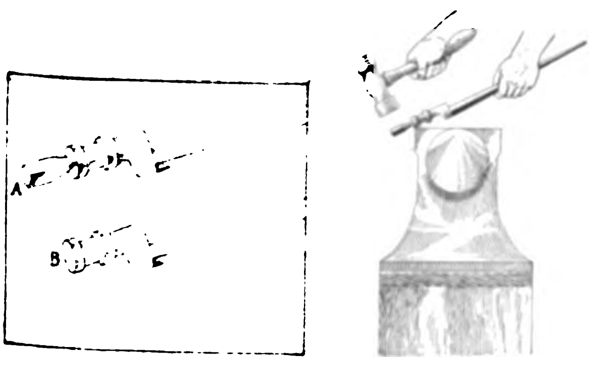
Equipment Used—Kenworthy overfired muffle furnace; Billings & Spencer model D 2,000-lb. drop hammer; Massillon No. 4 trimming press.
Special Tools and Fixtures—Drop-forging dies, trimming dies and a pair of tongs (not shown).
Gages—None used.
Production—One operator, tending the furnace and running both the drop hammer and the trimming press, produces 100 finished forgings per hour.
Notes—The stock, heated in the furnace (1), is gripped with the tongs and transferred to the "edger" (2), where it is bent and broken down with one blow. Then it is transferred to the roughing impression (3) and given one or two blows as required. It is next given one blow in the finishing impression (4) to square up the flash, after which it is swung to the trimming dies (5), and thence is put once more into the finishing impression for a final blow. The operator holds fast to the tongs during all the blows. The forging temperature for this operation is between 1,800 and 2,000 deg. F.
References—See Fig. 2, D, E and F, and Figs. 6, 7, 8, 9 and 10.

It is interesting to notice that the cruciform type of bayonet is used not only by the Russian army, but also to a large extent by the French. The Russians fasten their bayonets permanently to their rifles and use no scabbards, while the French make theirs demountable and provide them with short handles so that they may serve as close-quarter rapiers.

As far as a comparison between the two forms of bayonets—the cruciform type and the saber-blade type—

is concerned, there is not much to choose if one must be pierced by either; as a manufacturing proposition, however, the cruciform type appears to have more reasonable test requirements and more commonsense limits, both of which items are warmly appreciated in any machine shop that desires to show a profit.

FIG. 12. THE ANNEALING TEMPERATURE IS CLOSELY CONTROLLED BY PYROMETERS

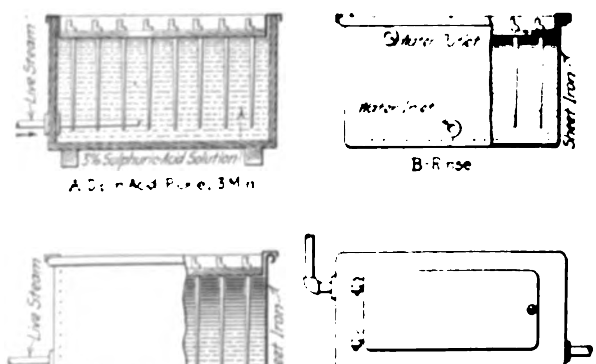


OPERATION 4. BREAK OFF THE TONG HOLD

Equipment Used—Hand hammer and anvil.
Production—From one operator, 400 to 500 per hour.
Note—The stock is very brittle after drop forging and before annealing, therefore the tong hold may be snapped off with a light blow.
Reference—See Fig. 11.

OPERATION 5. ANNEAL

Equipment Used—Kenworthy oversized oil-burning muffle furnace, 8-in. steam pipes for bayonet containers.
Gages—Pyrometers.
Production—Each container or packing box holds 50 bayonets, and six of these are annealed in a heat, giving a production of 300 blades in 24 hr. from one furnace. Operator's time averages 4 hr. per heat.
Notes—The annealing temperature of 1,450 deg. F. is maintained for 10 hr., after which the furnace and containers are allowed to cool during the night. A mixture of spent charcoal and burnt bone is used as an annealing material.
Reference—See Fig. 12.



A. Dip in Acid Pickle, 3 Min.   B. Rinse
C. Neutralize in Hot Lime Water, 3 Min.   D. Bake in Oven 2 Hours at 350° F. to Drive off remaining Acid

OPERATION 6. PICKLE, WASH, NEUTRALIZE AND BAKE IN STEAM-HEATED OVEN

Equipment Used—Pickle tank, washing tank, neutralizing tank and steam-heated oven, perforated wood dipping-boxes.

Gages—Hydrometer for testing strength of acid solution.

Production—Two men can care for all of the operations previously outlined for an average of 400 bayonets per hour.

Notes—The pickling solution is a 3 per cent. solution of sulphuric acid. This is maintained at the boiling point by the injection of live steam. The neutralizing solution is hot lime water. The baking oven is maintained at a temperature of 300 to 350 deg. F. by steam coils. The sequence of operations is in the order given. If the bayonets are to be polished immediately, baking is dispensed with, the machining operations removing the acid.

Finding the Financial Basis of Special Tools

By Dexter S. Kimball*

Though much has been written on the use of special tools in manufacturing processes, there are certain principles governing the economical use of such implements that are not always fully appreciated or understood. Of course, the economic principles involved in the use of special tools are the same as those underlying the use of labor-saving apparatus of any kind. But the facts that these tools are usually made for a specific purpose and that they are in general short-lived necessitate special consideration of the method of defraying their cost.

Standard tools, so called, that can be used for a variety of operations on many kinds of product can be installed with some assurance that they will be useful over a long period of time. There are therefore opportunity and justification for recovering their initial cost by depreciation methods from the profits made on all lines of product in which they are used. It should be noted, however that this may be true also of special tools, so called. A tool may have a very limited range; but if there is assurance that it will be useful over a long period and for a large amount of product, it can be treated financially in the same manner as a standard tool. For the purpose in hand it is indeed a standard tool, and in mass production of specialized product many such machines are to be found. The true distinguishing feature, therefore, is not the character of the work to be performed, but the amount of service that the tool is likely to render. Obviously these limitations are not always very clear, and for this reason the true effect of special tools in reducing productive costs is not always fully understood or applied. The following discussion deals with the problem of special tools that are short-lived or which are used for a limited amount of product.

Special tools such as jigs and fixtures may be made for one of two reasons—namely, to insure accuracy in the product or to reduce the cost of production. Sometimes both results are desirable or necessary. If accuracy in the product is imperative, the question of cost may be a secondary consideration. Thus it may be necessary to manufacture on the interchangeable system without regard to cost, and special tools might increase rather than lessen the cost if the quantity to be produced is limited.

In many instances, however, special tools are resorted to for the purpose of reducing cost, accuracy and duplication of form appearing as secondary advantages. In either case it should be remembered that the special tools must be paid for.

Special Tools Often Made with Vague Idea That They Reduce Cost

In many shops special tools are "just made" without much consideration of the financial principles governing this economic use, but with a vague idea that they will reduce cost. Only too often they are discarded after a short period and long before they have paid for themselves. This is particularly likely to happen where the cost of special tools is carried as an asset on the theory that the interest on the investment that they represent will be more than recovered in the reduction in cost that they effect. Standard tools may be treated in this manner with safety, but special tools, which are essentially short-lived, present a different problem. It is possible, of course, to carry special tools as assets and by liberal depreciation recover their cost through the sales. But this is seldom done intelligently, and often there is no assurance that this depreciation is recovered from the sales of product made with these special tools or from profits made on other articles. In many cases little or no depreciation is charged against special tools; and they remain a hypothetical asset, though really they are worthless and a monument to unintelligent management.

An accurate consideration of special tools must take cognizance of the quantity to be manufactured; and the only safe way to treat special tools is to insure, if possible, that their cost is "buried" in the cost of a definite number of operations, even though this number may be somewhat arbitrarily chosen. The general principles can best be illustrated by a concrete example.

An Example Showing Importance of Quantity

Suppose the labor cost of doing a certain operation on standard tools is \$1, and that by the method of burden distribution in use the burden is one-half the labor cost. Suppose that by making a special tool worth \$36 the labor cost can be reduced to 40c. Then the labor and burden cost for the first case will be \$1.50 and for the second 60c.,

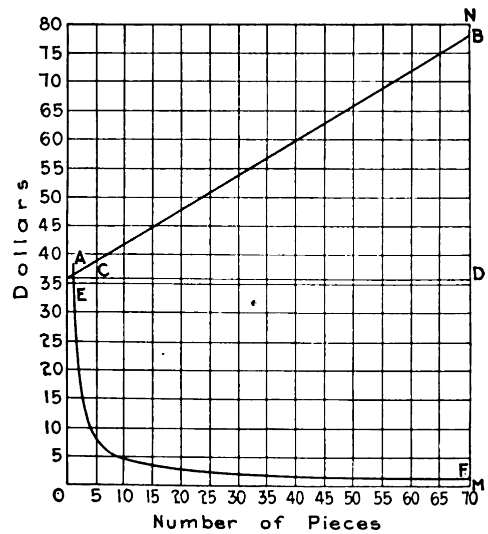


DIAGRAM OF RELATION BETWEEN UNIT COSTS AND QUANTITIES PRODUCED

or a gain of 90c. per piece by using the special tool. The cost of each piece (aside from the material) will be $\frac{36 + (0.60N)}{N}$, where N is the number of pieces made. Since the gain per piece is 90c., it will take $\frac{36}{0.90}$, or 40 pieces, to just pay for the tool; and if exactly this number is made, the unit cost will be \$1.50, or the same as with standard tools. If more than this number is made, the unit cost will be less than \$1.50; and if a lesser number is made, the cost will exceed this amount and the special tool will be the cause of a loss. The importance of some

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knowledge of the number of pieces to be made, even though it be based upon an estimate, is therefore obvious.

These relations are shown graphically plotted. The fixed cost of the tool ($36) is shown by the line *CD*. The total cost of any number of pieces (neglecting material cost) up to 70 pieces is shown by the vertical ordinate of the line *AB*. Thus, for instance, the total cost of 70 pieces is made up of *MD* + *DB*, or $36 + (70 × 0.60). The unit costs are shown by the curve *EF*, and this curve is both interesting and important. It will be noticed that the curve falls very rapidly at first, the greatest gain in unit cost occurring when two pieces are made instead of one and a decreasing advantage being obtained as the number is increased. Thus the unit cost of one piece is $36.60, the unit cost of two pieces is $18.60, the unit cost of five pieces is $7.80 and of 10 pieces $4.20. At 40 pieces the cost has dropped to $1.50, or the same as the cost with standard tools, and beyond 60 or 70 pieces the gain in unit cost is not nearly so marked as in the beginning. Thus the unit cost of 70 pieces is $1.11, while the unit cost of 100 pieces is 96c. and of 1,000 pieces 63.6c. Up to the point where the cost of the special tool is equal to the total labor cost, the cost of the tool is the predominating factor in the unit cost. This situation occurs in this example at 60 pieces. Beyond this point the total labor cost is the predominating factor in unit cost. Thus at 1,000 pieces only 3.6c. need be added to care for the cost of the tool.

Two Important Points

Two important points appear from the foregoing discussion. While this discussion is based on the use of special tools, it should be observed that the argument applies to all kinds of work that are of the nature of preparation or preplanning. The question whether any preparatory work will pay can be answered only through a careful consideration of the quantity to be produced. This statement holds for special tools, patterns, drawings, engineering experimental work, clerical work and all the preplanning features of scientific management, so called. If large quantities are to be made, elaborate preparation can also be made with a resulting decrease in cost.

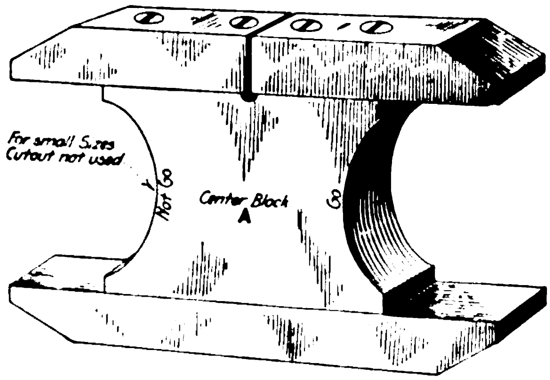
It sometimes occurs, however, that the work of preparation is not permanent and cannot be used again, once the job is finished. Thus the work of preparing a machine, finding clamps and bolts, adjusting fixtures and "getting the job in mind" is usually repeated every time the job is repeated. A brief study of the curve *EF* will show that great gains can be made by doing as many pieces as possible at one preparation, particularly where the number is small. The diagram data were taken at random, but are probable, and the great gain shown by doing even two or three pieces instead of one at each setting is true of nearly all productive processes. The small manufacturer in particular can profit greatly by having a full knowledge of these relations.

Accurate treatment of the finance of special tools is greatly facilitated by the use of a plant ledger ruled especially for this purpose. As the costs of successive jobs are posted up, the allowance or charge for the use of the tool can be included in the costs and entered in the proper account in the cost ledger, thus depreciating the tool till paid for. The plant ledger shows readily also the amount that has been invested in such special tools and indicates what must be charged off as interest on this investment.

Adjustable Snap Gage

By M. S. Henry

The usual form of solid snap gage is expensive to manufacture as well as difficult to keep to size. The accompanying sketch shows a gage which I think has many



ADJUSTABLE SNAP GAGE

advantages. It is not new, but deserves to be better known.

The center block *A* is ground to the maximum and minimum dimensions, the step being on one edge only. The finger pieces are screwed securely to *A*. When the fingers become worn, they are removed and ground on the inner surface and replaced, making the gage again as good as new. The center *A* always retains its original size.

Experience with Shop Signals

By H. V. Haight

The following experience with shop signals may be of interest to readers of the *Machinist* who are considering the installation of devices of this kind:

In our shop we tried both automobile horns and an 8-in. electric gong, but did not find that either of them could be heard very well more than 100 ft. away. We got a good suggestion from the Canadian Pacific Ry. shops in Montreal, to the effect that they were using locomotive whistles with electrically operated valves controlled from the timekeeper's office. It was stated that these whistles could be heard distinctly all over the shop, which is over 1,200 ft. long. We found, however, that the electrically controlled valves were an expensive proposition and as an experiment put in a 1-in. pipe line direct from the power house with a 2½-in. short bell whistle at the end of it. There is a quick-opening valve in the power house. The whistle can be heard very plainly all over the shop, which is 200x325 ft. The whole equipment is very simple and satisfactory.

I have a theory that both the gong and the automobile horn make a noise so much like the ordinary noise of the machine shop that they cannot be readily distinguished. A similar experience with an alarm for a thread miller confirms this belief. The alarm was used to give warning before the spindle reached the end of the travel, to prevent a smash. I arranged a small, mechanically operated gong that made a great noise in the store where I bought it; but after it was installed in the shop, it could hardly be heard 10 ft. away. I think I will try a little compressed-air whistle on the next machine.

Turret-Lathe Fixtures for Textile-Machine Details

By Robert Mawson

SYNOPSIS—The fixtures here shown and described were designed and used on Jones & Lamson flat-turret lathes. They are somewhat simple in their construction, but produce parts accurately and quickly. In two of them an expanding arbor is used to locate and hold the pieces securely.

Herewith are illustrated some of the fixtures used by the Hemphill Manufacturing Co., Pawtucket, R. I., in machining textile-machine details. On page 852 other similar fixtures were shown and described. The fixtures are designed so that the parts may be easily placed in position and held quickly and rigidly. The tools are giving the best of satisfaction, producing parts quickly and accurately.

In the fixture used in performing the first machining operation on the stitch ring the rough casting is placed on three pins. Three setscrews are tightened against the casting to hold it securely.

The location pins may be slid into several positions afterward, being held by screws. This arrangement enables one fixture to take care of various diameters of stitch rings. When the casting is held securely in position, the inside is bored to size. For the second operation the stitch ring is placed on a turned arbor. The nut on the outside of the fixture is then tightened. The pressure exerted by the bolt forces out expansion jaws which, coming against the stitch ring, hold it securely. The various surfaces mentioned are then turned and faced.

The fixture used in machining the 26-tooth gears is provided with a tapered surface inside of which the casting is placed. A plate is put over the tapered surface, and by tightening the three screws shown the plate is forced down. As the pressure is applied, chuck jaws are forced in against the casting, thus locating it centrally and holding it securely for the machining operation.

In machining the fashion wheel the casting is located by a turned stud that fits into a previously bored hole. After the casting is in position, the washer and thumb-nut shown are tightened, holding the part in position. The surfaces mentioned are then machined.

The various fixtures are provided with a turned shoulder that fits accurately into a recess of the faceplate of the Jones & Lamson turret lathe. After the fixture has been placed in position, three setscrews tightened into tapped holes of the fixture hold it securely on the machine. It will be observed that the fixtures illustrated are somewhat simple in their construction, yet strong and rugged.

After the fixture is once in position on the machine, it is a comparatively simple operation to place the casting for the machining operation. Gages are used to test the machined surfaces, so that accurate results may be obtained. Good rates of production, given herewith, are obtained with these fixtures. Similar fixtures could be easily designed for and used on other types of tools.

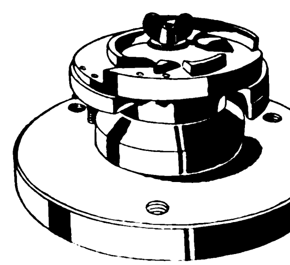
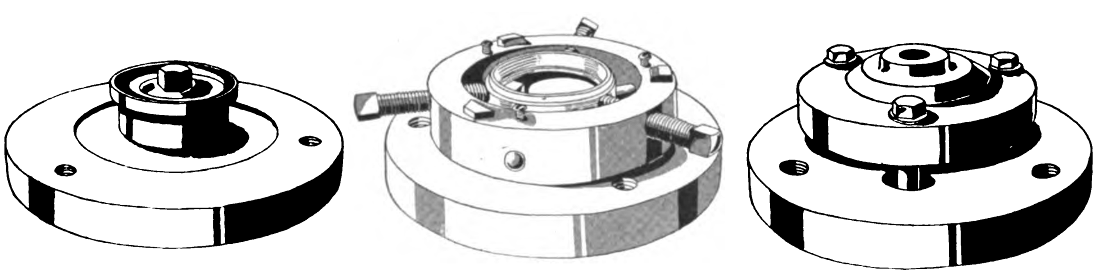


FIG. 8. FIXTURE FOR MACHINING FASHION WHEEL



FIGS. 2, 4 AND 6. TURRET-LATHE FIXTURES FOR MAKING TEXTILE-MACHINE DETAILS

FIGS. 2 AND 2-A

Operation—Second machining of stitch ring, Fig. 1. The casting is placed on a turned arbor that fits into a previously bored hole. The center bolt is tightened, which expands the arbor, thus holding the piece securely.

Surfaces Machined—The outside turned, the edges faced and the beveled surface machined.

FIGS. 4 AND 4-A

Operation—First machining of stitch ring, Fig. 3. The rough casting is placed on three pins, and the setscrews, being tightened against the piece, hold it securely.

Surfaces Machined—Hole bored and recess faced.

FIGS. 6 AND 6-A

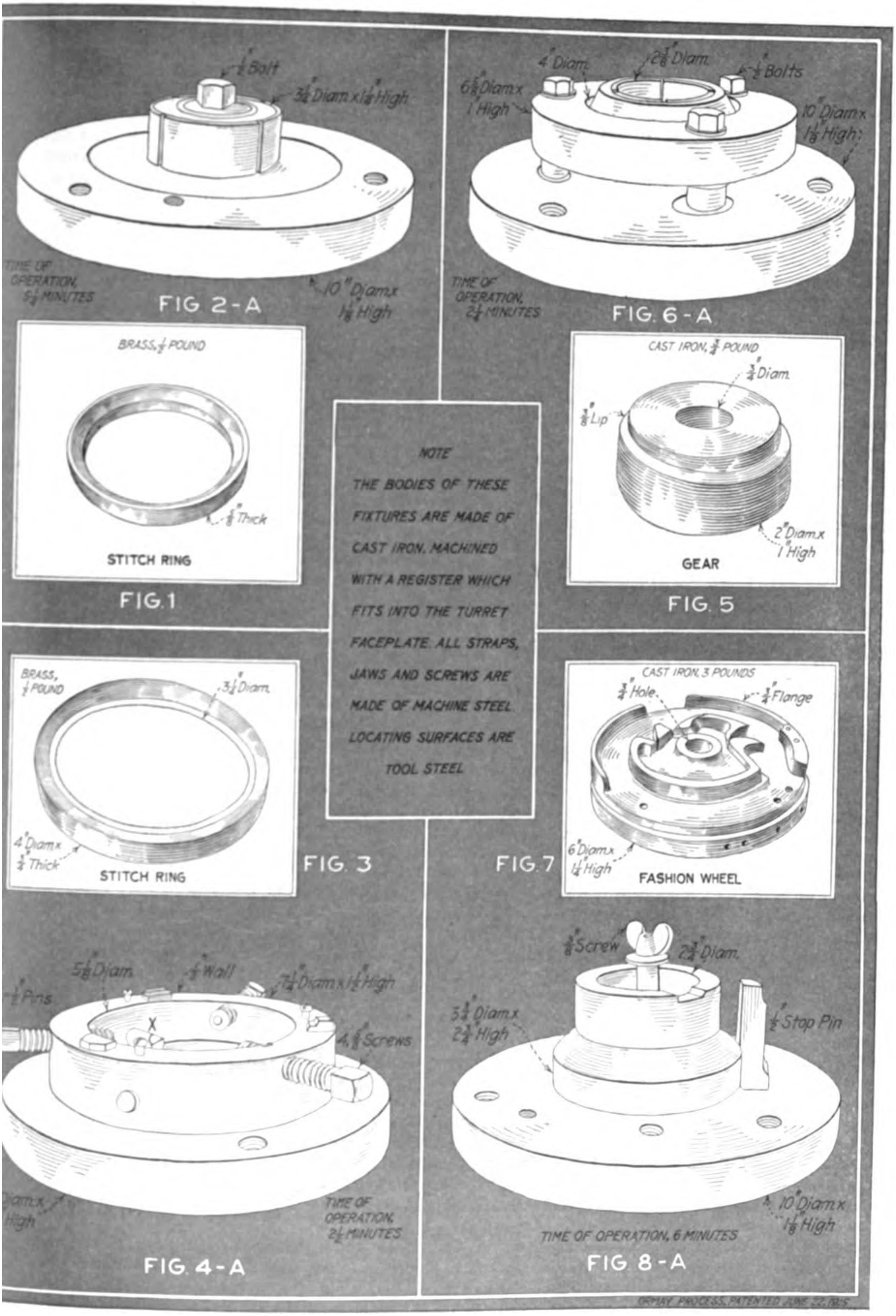
Operation—Machining 26-tooth gear, Fig. 5. The turned blank is slid into the fixture, and the three screws, being tightened, push down the plate on a tapered surface, forcing in the chuck jaws against the gear and holding it securely.

Surfaces Machined—Recess turned, shoulder faced and end surface turned.

FIGS. 8 AND 8-A

Operation—Machining fashion wheel, Fig. 7. The casting is located on a stud that fits into a previously bored hole. The washer and thumb-nut, being tightened against the piece, hold it securely.

Surfaces Machined—Outside turned and shoulder faced.



TURRET-LATHE FIXTURES FOR TEXTILE-MACHINE PARTS

Russian Trade After the War

By R. Martens*

Russia after the war is going to be a far different country, and the trading with that country after the war is going to be far different, owing principally to the fact that the Russian populace, by tens of millions, have received an extraordinary education. The Russian peasants have been drawn far from their home surroundings by the war, which have been unchanged for generations. They have had the opportunity of seeing new sections of Russia, new conditions and new cities. They have seen trench diggers, motor cars, field kitchens, machinery, tools and all sorts of appliances which are used in modern warfare.

The Russian prisoners in Germany and Austria, it is understood, are utilized by those respective governments in building railroads, bridges and canals, and in the construction of towns. The large number of German and Austrian prisoners which are detained in concentration camps at some points, or which, in the case of those in Siberia, are allowed considerable freedom, out of sheer monotony are inclined to teach the Russian peasants the latest methods of cultivating the soil and obtaining the greatest results from the vast but dormant possibilities of the Russian farm land. Hundreds of thousands of wounded have been taken care of in the cities, and when convalescent have had the opportunity of seeing railroads, modern shops, sanitation systems and all of the latest improvements and devices which are a part of a highly civilized community, all of which, before the war, they had never even heard of. These things have left a lasting impression on their minds, for the mind of the Russian peasant is a mind that has extraordinary powers of observation, assimilation and imitation.

It should be further remembered that the sale of vodka has been abolished in Russia and that hundreds of millions of dollars have thereby been saved which would otherwise have been wasted. At the same time, the working capacity of the people has accordingly increased, from the standpoints of efficiency, quality and output. Furthermore, a considerably larger number have been employed in factories and in other constructive work at very good wages, in fact, at wages ranging from two to ten times as high as they have ever received before, with the result that more money is in circulation than has been the case for almost a generation. The populace at large has grown to be richer and the increased wealth is shown by the extraordinary rate of increase in the deposits in the savings banks.

The people are accordingly in a position to purchase small machinery, tools and various comforts which before the war they did not know existed or could not afford to buy. Therefore, it is my contention that the trade after the war will be entirely different from the trade before the war. For every one buyer we had before the war, we will have a hundred buyers after the war. Before the war, there were only certain classes of people who were in a position to buy. For the first time in history a large proportion has a considerable spending capacity.

The war has undoubtedly cost the Russian government a vast sum, but considering that just before the war the national indebtedness of the country was hardly \$25 a head and that it is computed that if the war should last until the end of the year the indebtedness would be only \$50 a head, it will be seen that the debt imposed upon the populace by the war is trivial when compared with the greatly increased buying capacity and with the enormous natural wealth of this vast empire. The spending capacity of the people has not only been increased, but they have at the same time been educated and have learned how to make the land yield more wealth than it has ever yielded before.

Another important difference which will be seen between the trade during the war and the trade after the war is this: The business which is being done now is of a destructive and not of a constructive nature. After the war all this will be changed. Therefore, you business men of America must not consider that the enormous export business which is being done now is genuine business. The product you are now exporting is for purposes of destruction and not of construction, and I want to make this point very strong. Before the war you scarcely heard of Russia, except, perhaps, that the bears walked about in the streets in that country. The war has brought Russia to the front through the millions of dollars which American manufacturers have made on the manufacture of munitions of war.

I want to bring to your attention the fact that this business is financed by the Russian government, and that the product you are shipping is for the use of the government and in very few instances for the use of the populace. I warn you to consider this point very carefully. You talk in this country about preparedness. I agree with you that preparedness is wise, but it is the preparedness for trade which is one of the strongest assets of any nation. By preparedness for trade I mean not immediate selling but the studying of the people where you are going to trade, of their languages, characteristics and the climatic conditions. I want you to realize that Russia has climates ranging from the climate of Greenland to the climate of Cuba and that the trading conditions in the various intermediate climates are different in each case. This vast empire is five times as big as the United States and the trading conditions which must be met are very wide.

Again, I ask you to specialize. Machinery of all kinds is becoming more and more complicated and requires specialists in every line. If you are a manufacturer of motor cars or a manufacturer of wood-working machinery, you select a man to represent you, as a salesman or engineer, who has the best knowledge of the talking points of the machine you have to offer. How far more important it is that you should do the same in an undeveloped country like Russia! You must remember that there will be hundreds of men, representing all countries, who have machines similar to yours to sell, and that the man who is going to get the business is the man who can best talk and demonstrate the selling points of his machine. You must specialize, because there the classes of merchandise are kept much more distinct, and an engineer in Russia will not buy machinery from a firm that sells also watches or typewriters.

Do not offend the Russian buyer by adopting methods of trade that would not be successful in this country. The Russian buyer must not be confused with the buyers in certain parts of the far East where merchandise can be sold regardless of fitness or quality. Russia, especially among the engineering classies, is highly civilized.

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Automatic Manufacturing Miller with Receding Table

SYNOPSIS—In the development of the machine described in this article an intimate knowledge of the requirements of gun-part and similar manufacture was brought to bear. The proportioning of the parts takes care of an extra-large factor of safety, and there is provided a flexible automatic control of the table through the feed unit. The distinctive feature is the receding table, through which cutter marring of the work on the return travel has been eliminated.

The illustrations show front and rear views of the new Pratt & Whitney automatic miller. The story of the development and marketing of this machine is probably the most remarkable and interesting one of its kind the world has ever known. Some time in the early summer of 1914, a foreign representative of the Pratt & Whitney Co. cabled to Mr. Hanson somewhat to this effect: "Please let me have some talking points which will enable me to persuade buyers to pay from one to two hundred dollars more for a Pratt & Whitney Lincoln miller than they have to pay for copies of it made here." As externally the competing machines were duplicates of the Pratt & Whitney Lincoln miller, it was no easy matter to supply "talking points" which would weigh from "one to two hundred dollars" in favor of the genuine machine. Obviously the only thing to do was to furnish a machine which would produce the same work or more in such a manner and at an operating cost that would make comparison with other machines the deciding factor in its favor. At the time he received the cablegram Mr. Hanson, by a peculiar coincidence, happened to be scheming out the preliminary requirements of the automatic miller, but nothing in the way of a complete drawing or even sketch had so far been made.

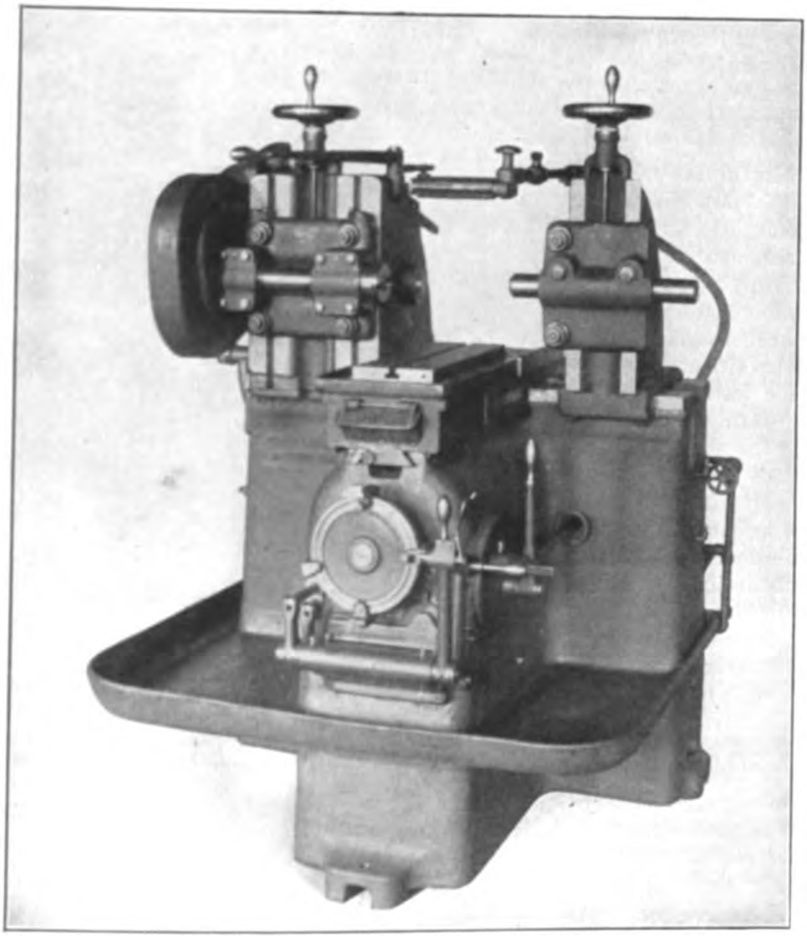


FIG. 1. FRONT VIEW OF AUTOMATIC MILLING MACHINE WITH RECEDING TABLE

With an intimate knowledge of the requirements necessary for gun parts and similar manufacture, preliminary sketches were quickly made of the mechanisms necessary to carry and rotate the spindle, actuate the table and so forth. With these completed, it was a comparatively simple matter to sketch out the approximate external appearance of a machine necessary to house these components. From this sketch a drawing was made which, after slight correction and alteration here and there, furnished the basis for a wash drawing. Photographs of this were then prepared and forwarded, together with specifications.

The foregoing, except as an illustration of rapid thought and work, is nothing remarkable. The remarkable part is that the photographs of a wash drawing of a thought, when reinforced by the Pratt & Whitney reputation, were the means of selling over a thousand automatic millers before even the model machine was completed. Except for a few minor changes the machines being built today are duplicates of the first one which left the factory in Hartford, Conn., early in November, 1914. At this writing, just one year and a half after the first machine was completed, there are 3,000 of these automatic millers at work producing parts of firearms and milled work of a similar character. In the development of the machine the object has been to produce a distinctive manufacturing tool, better adapted to the diversified requirements of manufacturing milling than any machine that has hitherto been available for this purpose.

The automatic miller is of massive construction throughout. In proportioning the various components a margin of safety has been adopted far in excess of what

has been previously considered necessary for a machine to handle work of this type.

The table has a working surface $6\frac{1}{2}$ in. wide by 18 in. long. It is traveled directly in the bed, thus eliminating the additional saddle joint which has proved so destructive to the stability of millers in general.

The table and bed bearing surfaces are of equal length, which is inducive of uniform wear. Proper relation between these bearing surfaces is easily maintained by means of a taper gib.

The travel of the table is 12 in. In addition to a wide range of working feeds the table is provided with rapid traverse in either direction. The rapid traverse is constant. The regular feed variations are obtained through change gearing and are independent of the spindle speeds. The rapid traverse, as well as the regular feeds, is actuated through a feeding mechanism of an entirely new construction, in which a heavily proportioned and powerfully driven cam is utilized. The feed unit is of substantial design throughout, and the movable members that are subject to wear are submerged in oil.

The automatic control of the table through the feed unit is very flexible. The regular feeds, as well as the rapid traverse, are automatically engaged by means of trip dogs. The dog plate upon which the dogs are carried is directly in front of the machine in a most accessible position. Provision is also made for traversing the table by hand when setting the machine.

With the feed control in operation, the work approaches the cutter on the forward rapid traverse, the regular working feed being automatically engaged, as the cutter is about to begin its work. After the milling operation has been performed, the return rapid traverse becomes automatically operative and the table is quickly removed to the original position for reloading. The return travel is such as to eliminate the possibility of the operator's being injured by coming into contact with the cutter. When the cut is intermittent—that is to say, not continuous—the rapid traverse is utilized for quickly passing over the noncutting space, the regular working feed being engaged as the cut is again approached. It can readily be seen that the table thus controlled reduces the nonoperating time of the machine to a minimum and that by doing away with the usual hand-operated return the machines are run with the least physical exertion by the operator. Practically the only function of the operator is to place and remove the work from the machine. Experience has demonstrated that one man can take care of from six to eight machines, depending on the character of the work.

The receding table is an entirely new device by means of which the objectionable feature of the cutter marring the work on the return travel has been completely eliminated. This device is so constructed that, after the milling operation has been performed, the table recedes or drops away from the cutter, thus permitting the work to clear the cutter on the return travel. As the table approaches the end of the return stroke where the work is clear of the cutter, the table is again elevated to its former position—the working height.

The functions of the table in this particular are automatically controlled. While this table has the advantage of not marring the work on the return stroke, the construction is such that this feature has been obtained without sacrificing the accuracy or rigidity of the nonreceding table.

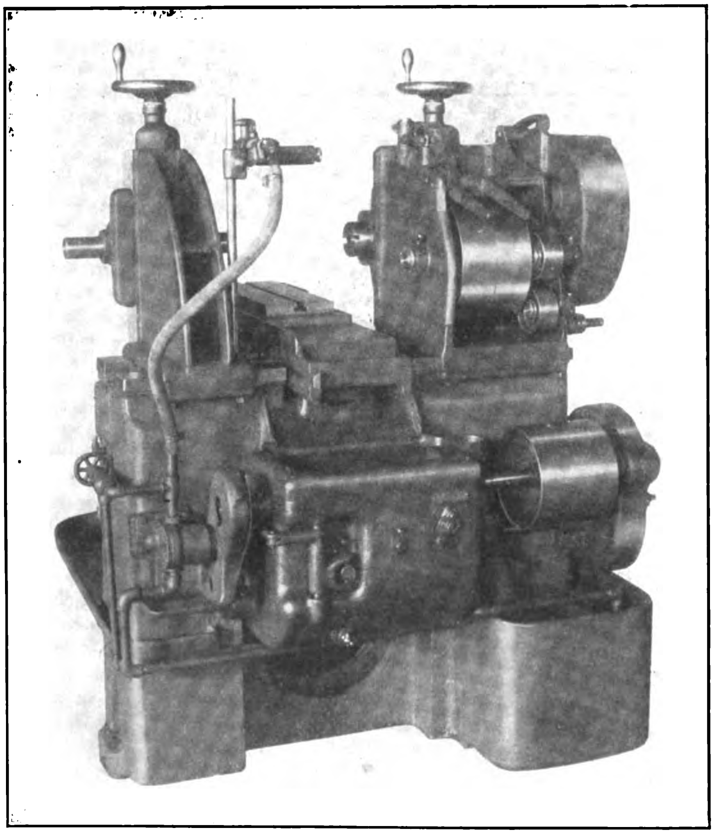


FIG. 2. REAR VIEW OF THE AUTOMATIC MILLING MACHINE SHOWING DRIVING MECHANISM

For longitudinal adjustment the head unit is traveled directly on the bed, while for vertical adjustment the head proper is traveled upon the head column. These adjustments are accurately controlled through precision screws and observation dials. Powerful binders are provided for rigidly clamping the movable members after the required adjustments have been made. The spindle is liberally proportioned so as to obtain the necessary stability. Its bearing surfaces are throughout cylindrical. Bronze bearings are used, of a type that has proved satisfactory for this class of machine.

The greatest distance from the center of the table to the end of the spindle is $8\frac{1}{4}$ in.; the least is 3 in. The greatest distance from the center of the spindle to the

table top is $8\frac{7}{8}$ in.; the least is $1\frac{7}{8}$ in. From head spindle to foot-stock spindle the greatest distance is 17 in.

The spindle drive is by means of a single, constant-speed pulley, through gearing. Variations of spindle speeds are obtained by means of change gears. In order to eliminate the objectionable counter-shaft problem, a loose pulley, clearly shown in the rear view of the machine, enters into the construction of the spindle drive. This permits the machine to be belted direct to the line shaft. A belt shifter is provided, operated by a lever from the front of the machine.

An outboard support for the arbor also enters into the construction of the machine. The end of the spindle of the support is furnished with a hardened and ground bushing for the reception of the arbor end. Longitudinal adjustment is obtained by traveling the support directly on the bed. The vertical adjustment is accurately controlled through a precision screw and observation dial. Powerful binders are provided for clamping the movable members after adjustments have been made.

The proper lubrication of the cutter is well taken care of by a pump that delivers an abundance of lubricant. The pump is gear driven at a constant speed; thus the amount of lubricant delivered does not vary. For distributing the fluid onto the cutter, there is a nozzle that permits the width of the stream to be varied to suit the work in hand. A large pan section surrounds the lower portion of the bed for collecting the lubricant and chips. This pan, as well as the fluid tank, is cast integral with the bed proper. The tank is located in an accessible position where it can be easily cleaned. The fluid is strained and passed through settling chambers in the tank before being returned through the pump. In this way it is freed from foreign matter that is so destructive to pumps.

The operator is protected, as there are no exposed gears or dangerous members that may cause him injury. In this connection it may be well to emphasize that inclosing the gear units through which the spindle and feed changes are obtained prevents their manipulation by the operator. The intention is that the supervisor shall determine the correct speeds and feeds, after which they should remain undisturbed by the operator. Once the speeds and feeds are correctly determined, the machine has, barring accidents, a definite output per unit of time.

The miller weighs 3,750 lb. and occupies a floor space 54 in. square.

Future Machine-Tool Exports

By Carl Gebuhr

What influence will the European War have in the more distant future upon the exportation of American machine tools? This question is being asked by many. It seems to be the general opinion that Europe, after the war, will be in need of many things, and that the United States of America, being the only country to supply them, will continue to experience the present prosperity for some time after peace has been declared. This will undoubtedly prove to be true.

Immense values have been destroyed. They will have to be reconstructed. Whole armies will have to be reequipped, giving work to the arsenals and allied industries for probably many years to come. All railroads have suffered a great deal, and many machine tools will be required to rebuild the ships lost. Almost all the lathes in Europe and other tools that can be used for making war material have been running for the last two years on shell work, probably resulting in the ruin of many of them. As a matter of fact, whole countries will have to be reëquipped; and while all this demand naturally will influence the exportation of American machine tools until such time as Europe has somewhat regained its breath, what will be the outlook for the more distant future?

To understand thoroughly my reasons for not seeing any too bright a future ahead for the exporter of American tools, it will be necessary to recall the underlying force that has always kept this country ahead of all other nations in the construction of machine tools, particularly labor-saving machinery and devices. It was the law of necessity. Years back, the scarcity of labor forced upon this country its predominance in the construction of machine tools, while in succeeding years the ever-increasing wages and cost of production have also been a great factor in the further development of the labor-saving devices.

No such impetus ever existed for overcrowded Europe, with plentiful cheap labor. The great change that the present war probably will bring about and the great danger for the future of the American exporter of machine tools may be that after things have been readjusted the old world will find itself in the same position as this country in being forced by law of necessity into America's essential field. Undoubtedly, one of the reasons that has always allowed this country to find a market for its high-priced machine tools in Europe was the fact that it was practically without competition. Will it be the same after the war?

Three reasons may be advanced for predicting a change in Europe's machine industry—the loss in human labor suffered by all belligerent countries, the strong competition that will set in right after peace has been declared and the tremendous national debts accumulated.

While it is possible that the loss of labor will be felt to some extent in the machine-tool industries of the belligerent countries, it will hardly be as great as is commonly accepted. Of the three reasons given, it will probably turn out to be the one of least importance. Aside from the fact that the losses of human lives shown in the daily newspapers are greatly exaggerated, it should not be forgotten that all countries now at war of necessity had to keep their mechanics at home, so as not to cripple their factories. This is particularly true of the central powers, which are cut off from the rest of the world and have to produce their own war material.

It seems to be only reasonable to assume that all men not easily replaced and necessary for the smooth running of the industrial machine were not drawn, and only those whose places can be taken by unskilled labor had to join the colors. Apparently where most people seem to make a mistake is that, from the general losses suffered by all belligerent nations, they conclude that the machinery industry must have suffered proportionately. If, for instance, the central powers had drawn their men without regard to the efficient working of their factories, could they have supplied all by themselves the immense amount of war material required by the present struggle? Would it not have meant a death blow to their chances if they had crippled their means of keeping up the struggle by reducing the efficiency of their factories?

As the present war is showing, an efficient machinery industry constitutes part of the national defense, and to cripple it, particularly at the time the fight is on, would mean the battle lost. The truth of this statement would seem to be borne out by the fact that several of the allied countries were forced to create special munition ministries to organize the production of war material. All this would seem to allow the conclusion that of all industries in the belligerent countries (except Belgium) the machine industry has suffered the least, since it forms the backbone of the national defense and to break or even cripple it would have disastrous effects; hence, the aërial raids.

The far greater influence upon the future shaping of the exportation of American machine tools will be the extreme competition in the markets of the world, which may be expected after the war, and the tremendous national debts accumulated by all European nations. Those two reasons may force upon Europe that law of necessity which brought to this country its predominance in the construction of labor-saving machinery and devices. Competition will force all countries more than ever before to bring up their industries to the highest point of efficiency, which in view of the higher production costs that may be expected on account of the tremendous national debts can only be accomplished by using more labor-saving machinery. While for some time to come Europe may be forced to buy such machines here, it nevertheless would seem unreasonable to expect the other side to continue buying in this country at considerable prices what they may produce themselves at a much lower figure. It will not be very long before Europe will start in to build up its own labor-saving machinery industry, because the ever increasing demand for such devices will force upon the European machine-tool manufacturer that same duty which made the American manufacturer predominant in the construction of machine tools.

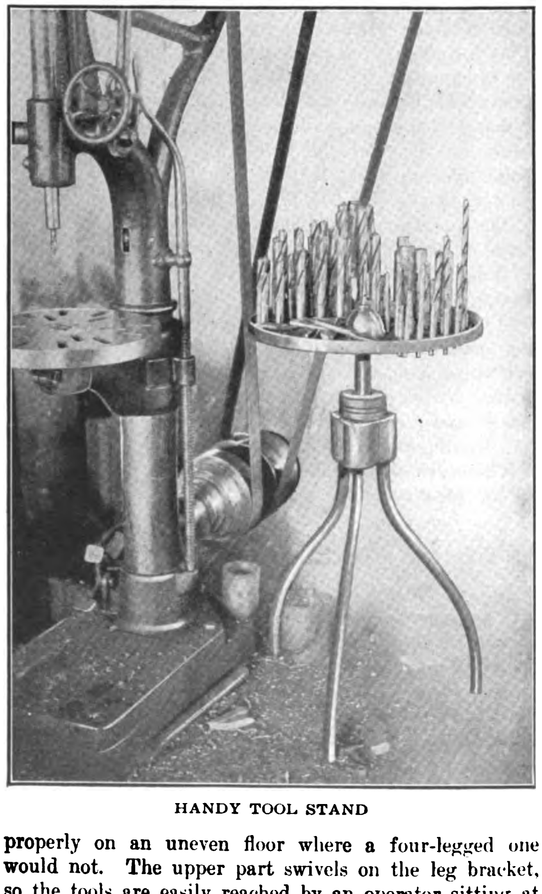
Of course, this does not hold true for all European countries. It will be many years before Russia, for instance, can supply her needs in machine tools, much less enter the markets of the world as a serious competitor. For a few years to come Russia will still represent a good field for the American machine-tool exporter; but as soon as the other European nations become able to enter the competition, it will not be surprising to see this country driven out of the field by a competition that can sell a product of the same quality and capacity at a price that impoverished Russia is in a better position to pay. After this war it will be the duty of all European governments to give the greatest possible aid to their machine industry, since this industry is a part of the national defense. While all this makes the outlook for the American manufacturer rather bright for the immediate future, there may be just so much greater a loss to him later. Apparently the present war has been of great benefit to this country's machine-tool industry, and one may claim that it will continue to be so. However, a closer investigation would show that the longer the war lasts the greater will be the industry loss in the future, because the more the national debts of Europe accumulate the greater will finally be the impetus for the developing of labor-saving machine industry on the other side.

While all appearances tend to point toward a booming business right after the war, there are nevertheless signs that indicate otherwise. It should not be forgotten that Europe within the last two years has bought more machinery than it would have bought in normal times within six years. Although it is claimed that through incessant use almost all those machine tools have been ruined, yet it remains to be seen how far impoverished Europe will go in replacing them with new machines. All governments will lend their aid to the quick reëstablishment of their machine industries, and it may very well be possible that Europe will help itself with what it has and wait for its own factories to resume deliveries rather than continue paying money to this country.

In any case no matter what the immediate future will bring, it seems that the hurtful effect the European War will have on the exportation of American machine tools will be to force upon Europe the necessity of building up its own labor-saving machine industry. While this does not mean that this country will entirely lose Europe as a customer of machine tools, it nevertheless may accelerate what in the normal course it would have taken many a year to accomplish—the final loss of Europe as the main field of export.

Handy Tool Stand

The tool stand shown is used in the shop of the Western Foundry and Machine Works, Topeka, Kan., principally for holding the larger sizes of drills. It is very simple and easily made, and the three legs make it rest



HANDY TOOL STAND

properly on an uneven floor where a four-legged one would not. The upper part swivels on the leg bracket, so the tools are easily reached by an operator sitting at a machine.

Making 3-In. Russian Shrapnel in a Pump Shop

By Ethan Viall

SYNOPSIS—The machines and tools described in this article were nearly all made in the works where they are used, expressly for manufacturing shells. They show what a first-class American plant can do in fitting up for work, even if it is somewhat out of the regular line. The turret lathes were made in the shop—from patterns to the complete machines. With the advantage of not having to do the best possible with a lot of made-over machines, there is little lost motion anywhere.

A large majority of the shops doing shell work of whatever character have either bought machines or have fitted up those already on hand. At the time the Hill Pump Co., Anderson, Ind., decided to do shell work, it was found that machines suitable for its purposes were of both very high price and uncertain delivery. On this account and because it has a large, well-fitted shop and

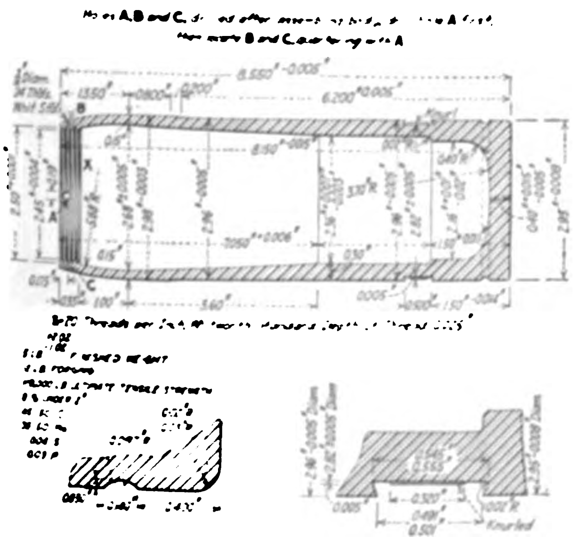


FIG. 1. DETAILS OF 3-IN. SHELL

foundry of its own, this company decided to make for itself whatever equipment was necessary. In consequence two sizes of turret lathes were designed and built, together with all the needed tools and special attachments.

For this reason there is nothing spectacular about the shell work, but it represents good American shop practice. The turret lathes were built in sufficient numbers to supply not only the Hill company's own needs, but those of several others doing the same class of work. These lathes have already been described in detail in these columns, and in this article the shell work done on them, as well as on others specially fitted, will be presented.

At the time the material for this article was obtained a majority of the machines were at work on 3-in. Russian shrapnel shells. The forgings, in the form of cylinders with one closed end, are received from a steel mill. These forgings, as delivered, weigh about 7 lb. 13½ oz. each, and the work done in this shop reduces them to a minimum of 5 lb. 7 oz. or a maximum of 5 lb. 10 oz. The shell is shown in section, Fig. 1, together with the various

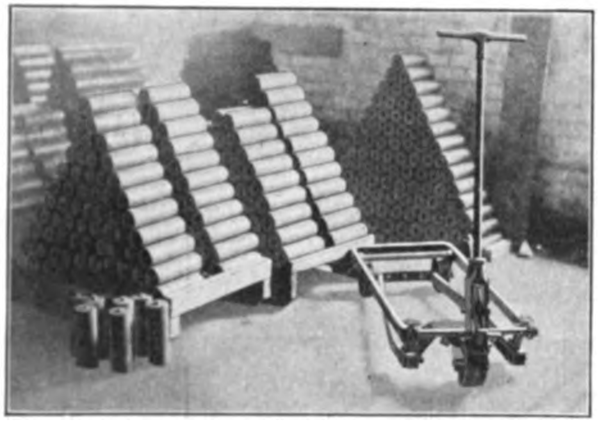


FIG. 2. SHELL FORGINGS ON TRUCK PLATFORMS, AND LIFT TRUCK USED

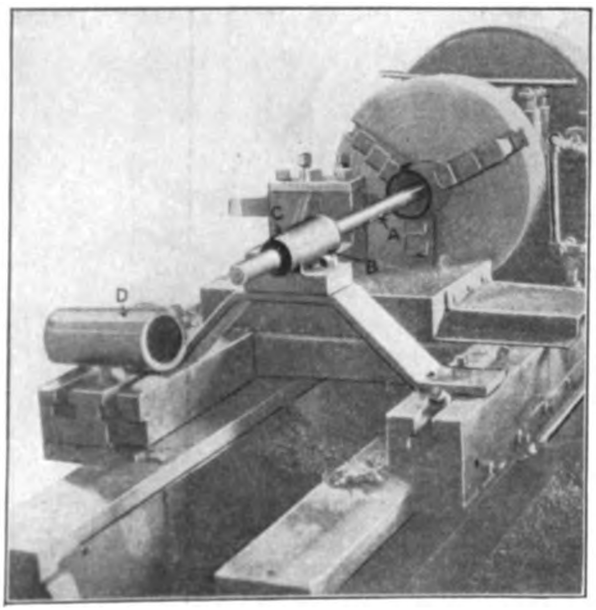


FIG. 3. CUTTING OFF END

Machine Used—Hill motor-driven lathe.
Fixtures—Three-jaw universal chuck and extra heavy tool block.
Gages—Work-setting gage on machine.
Production—40 to 45 per hr.
Lubricant—Soapwater.
Reference—Fig. 4 A

measurements and specifications. Some of the lots of forgings have to be pickled before machining, but often this is not needed.

Disregarding for the time being several inspections, the shop operations proceed in the following order:

1. Pickling (if needed)
2. Cutting off in lathe
3. Machining for centering in drilling machine
4. Centering in drilling machine
5. Scoring for driver in air press
6. Rough-turning
7. Facing base
8. Rough taper boring
9. Roughing out diaphragm chamber and seat
10. Rough - drilling powder pocket
11. Heat-treated
12. Finish taper bored
13. Second roughing of diaphragm chamber and the seat
14. Roughing out powder pocket
15. Finishing powder pocket, diaphragm chamber and seat
16. Finish facing base
17. Nosing
18. Rough-boring and facing open end
19. Finish-boring end
20. Tapping
21. Profiling
22. Grooving for rotating band and crimping seat
23. Dovetailing
24. Knurling
25. Grinding two diameters
26. Grinding end of base
27. Inspection all over
28. Banding

See page 943 for graphical representation of operations.

Several number-stamping operations and the screwing in of a special centering plug after the tapping operation have been purposely omitted from the list. A too detailed account of the various operations will not be given, as many of them have been fully covered previously.

The shell-machining shop is well lighted and well arranged for its single purpose. A good concrete floor makes the trucking an easy matter. The forgings are stacked in double pyramidal piles on wooden truck platforms, Fig. 2. Lift trucks of the type shown are used to move the work from place to place. Both the forgings and a large part of the machined work are thus moved.

rod is made to slide in the holding bracket *B*, and when in gaging position may be locked by a pin that fits into an offset slot at *C*. A trimmed shell is shown at *D*. As

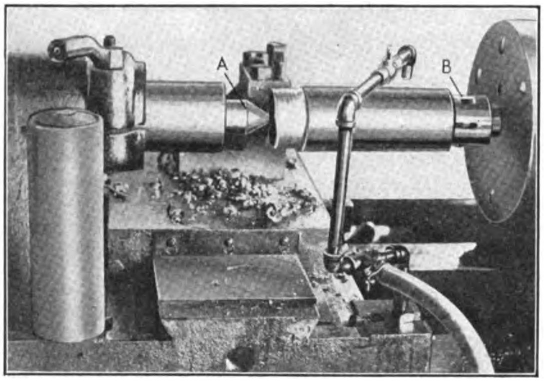


FIG. 7. ROUGH-TURNING

Machine Used—Hill No. 3 motor-driven lathe, 160 r.p.m.
Fixtures Used—Six-blade driver in spindle, No. 2 stellite tool.
Gages—Snap, go and not go.
Production—18 per hr.
Lubricant—Soapwater.
Reference—Fig. 7-A.

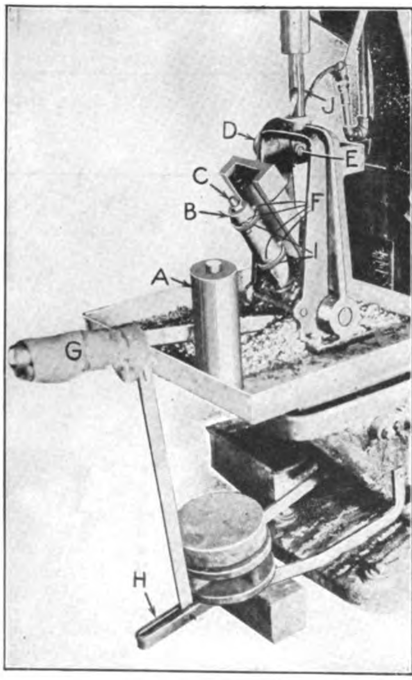


FIG. 4. MACHINING FOR CENTERING

Machine Used—Drilling machine.
Fixtures Used—Special, with expanding mandrel holder, drill with very slight lip angle to provide center.
Gages—Stop on end of mandrel.
Production—55 to 60 per hr.
Lubricant—Soapwater.
Reference—Fig. 4-A.

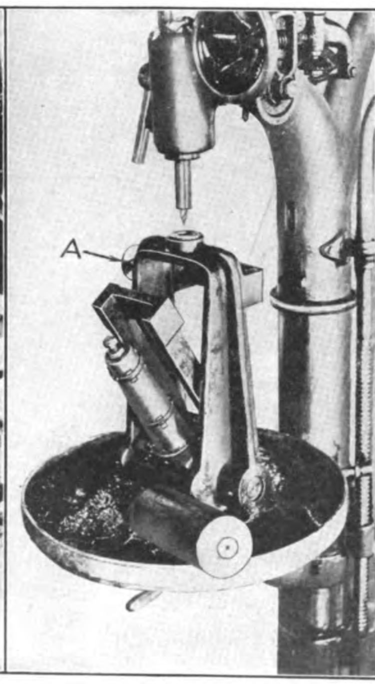


FIG. 5. CENTERING

Machine Used—Drilling machine.
Fixtures Used—Special, with expanding mandrel holder, combination drill and countersink.
Gages—Stop on end of mandrel.
Production—55 to 60 per hr.
Lubricant—Soapwater.
Reference—Fig. 5-A.

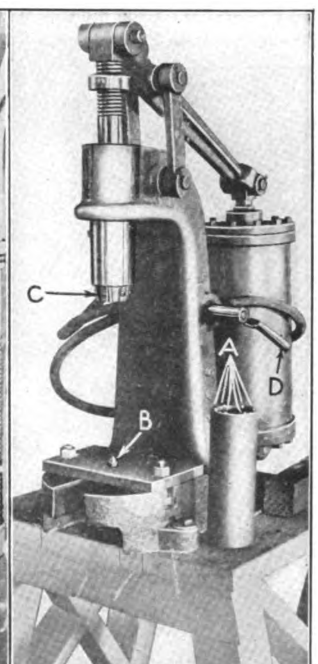


FIG. 6. SCORING FOR DRIVER

Machine Used—Hannifin air press, 100 lb. pressure.
Fixtures Used—Baseplate with center, six-blade scoring tool.
Gages—None.
Production—10 to 15 per min.
Lubricant—None.
Reference—Fig. 6-A.

The first machining operation is to trim or cut off the forging to a length of $8\frac{3}{16}$ in., measuring from the inside. This is done in a Hill motor-driven lathe, Fig. 3. The forging is chucked in a universal, three-jawed chuck. The right setting is obtained by a setting rod *A*, the end of which butts against the inside end of the work. This soon as the work is set and the chuck jaws are tightened, the gaging rod is pulled back out of the way.

After being cut off, the forging goes to the drilling-machine fixture, Fig. 4, and the plug on the bottom, or "button," is machined off to a definite distance from the inside end. One of the forgings is shown at *A*. It is

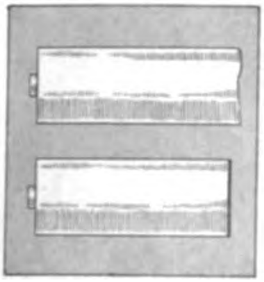


FIG. 3-A. CUTTING OFF END

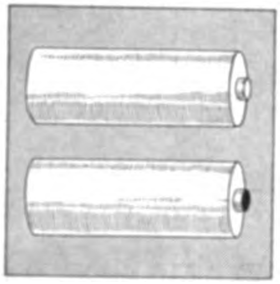


FIG. 4-A. MACHINING FOR CENTERING

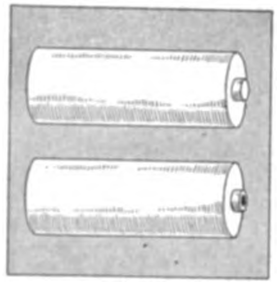


FIG. 5-A. CENTERING

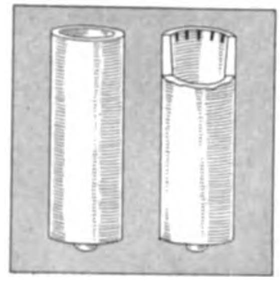


FIG. 6-A. SCORING FOR DRIVER

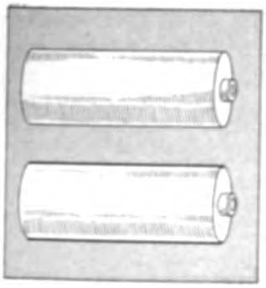


FIG. 7-A. ROUGH TURNING

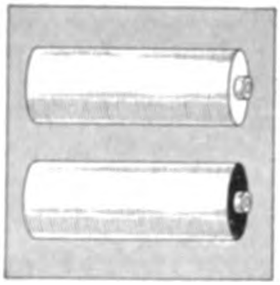


FIG. 9-A. FACING BASE

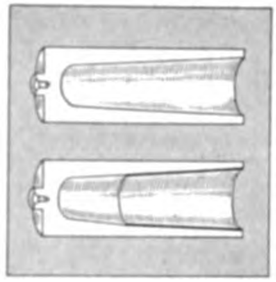


FIG. 11-A. ROUGH TAPER BORING

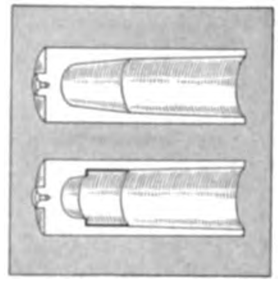


FIG. 14-A. ROUGHING OUT DIAPHRAGM CHAMBER

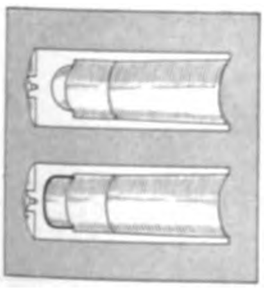


FIG. 16-A. ROUGH DRILLING POWDER POCKET

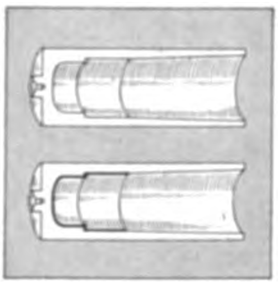


FIG. 20-A. SEMIFINISHING POWDER POCKET

FIG. 24-A. NOSING

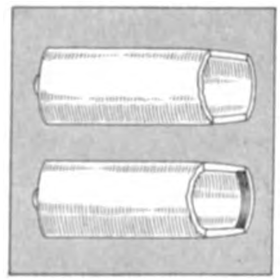


FIG. 26-A. BORING AND TAPPING NOSE

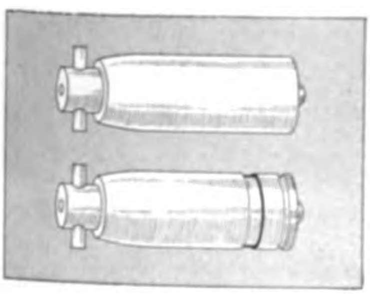


FIG. 28-A. GROOVING AND DOVETAILING

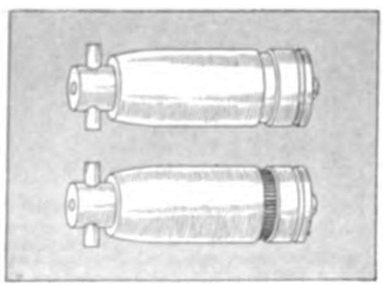


FIG. 30-A. KNURLING

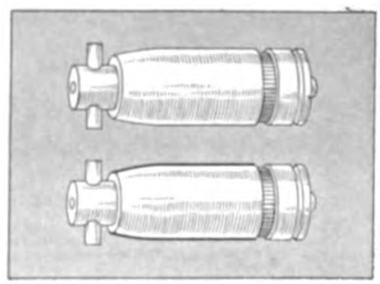


FIG. 31-A. GRINDING TWO DIAMETERS

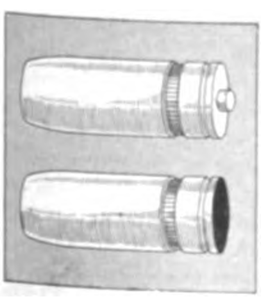


FIG. 32-A. GRINDING OFF CENTER BUTTONS

FIG. 33-A. BANDING

slipped down over the expanding mandrel *B* until the inside end rests on the stop *C*. After the shell is on the mandrel, it is swung up under the bushing yoke and locked by the knurled-head pin *D*, which slides in the hole *E* and enters a corresponding bushed hole in the carrier. The expanding jaws of the mandrel consist of two sets, of three each, like those at *F*. They are moved in or out by a sliding taper pin in the center of the mandrel, which is operated by a cam movement and by the hand and foot levers *G* and *H*. The expanding-mandrel jaws are held in contact with the taper center pin by band springs *I*, which are snapped into recesses milled in the jaw ends.

The drill J works through a steel bushing in the top of the yoke and is ground almost straight on the cutting end. Just enough lip angle is ground on it to leave a slightly hollowed spot for the center drill to operate in.

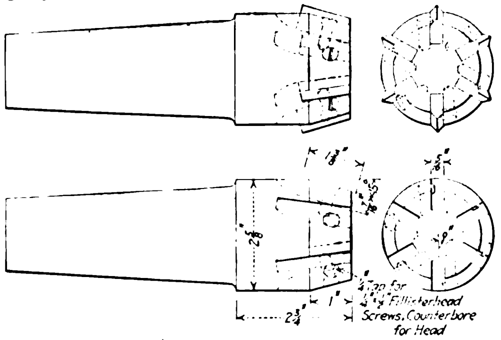


FIG. 8. DETAILS OF SIX-POINT WORK DRIVER

The centering is done with a combination center drill and countersink, using the fixture seen in Fig. 5. This is very similar to the one just shown, except that there is no hand or foot lever used. The action of swinging

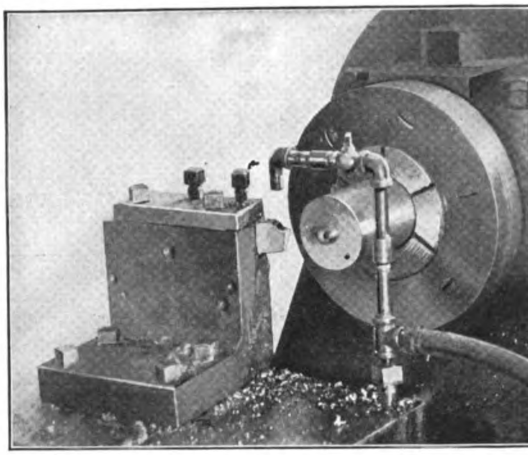


FIG. 9. FACING BASE

Machine Used—Hill No. 3 motor-driven lathe.
Fixtures Used—Regular expanding chuck and tool block.
Gages—One chuck and two carriage stops, go and not go gage for length.
Production—31 per hr.
Lubricant—Soapwater.
Reference—Fig. 9-A.

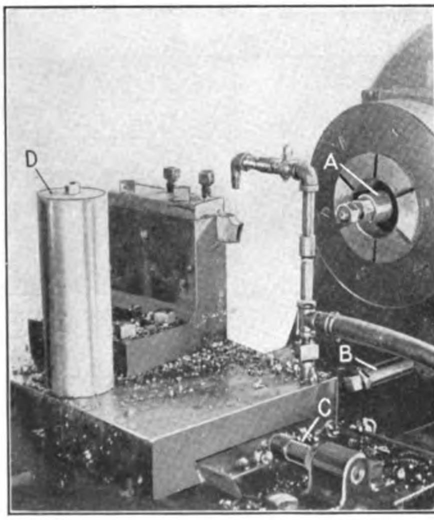


FIG. 10. BASE-FACING LATHE, SHOWING STOP

Machine Used—Hill No. 3 motor-driven lathe.
Fixtures Used—Same as shown in Fig. 9.
Gages—One chuck and two carriage stops, go and not go gage for length.
Production—31 per hr.
Lubricant—Soapwater.

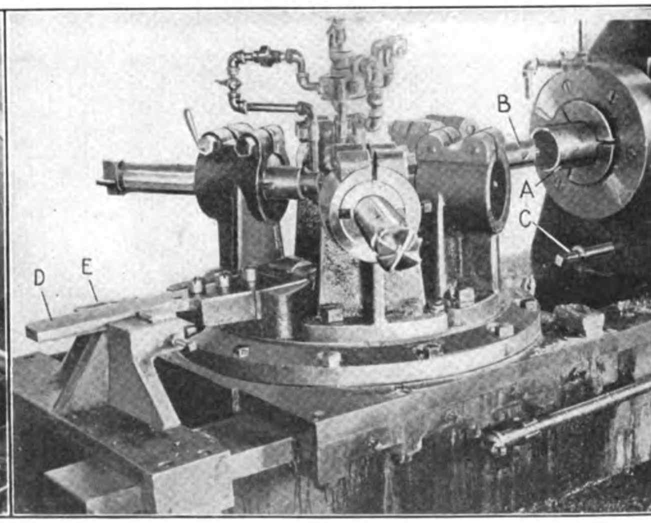


FIG. 11. ROUGH TAPER BORING

Machine Used—Hill No. 3 turret lathe.
Fixtures Used—Profiling attachment for turret, single-point boring tool.
Gages—One chuck and one carriage stop, plug and taper-plug.
Production—21 per hr.
Lubricant—Soapwater.
Reference—Fig. 11-A.

the carrier up under the yoke slides the lower end of the taper pin over a cam underneath and causes the jaws to expand and grip the shell. The carrier is locked in place by a sliding pin A exactly as in the other fixture. As the carrier is pulled toward the operator after the work is drilled, the action automatically releases the jaws, and the shell may be easily lifted off the mandrel.

For the roughing outside work the shell is held between a tail center and a six-point driver in the lathe spindle. To make it easy for the lathe operators to set the shells, the driving points are scored into the open end of the shells in the air press, Fig. 6. One of the shells is shown with the scored points indicated at A. In doing the work the shell is set with its center hole over the locating center B. The scoring tool C is then brought down by operating the valve lever D.

Next comes a lathe operation, which consists in roughing off the outside. The shell is held, as in Fig. 7, between the tail center A and the six-point driver B, shown in detail in Fig. 8. Except for some minor features it is the same as the scoring tool of the previous operation. About $\frac{9}{32}$ in. of metal is removed from the diameter of the forging in this roughing operation, using a No. 2 stellite tool in an Armstrong holder.

For facing the base the shell is chucked as in Fig. 9. In order quickly to set the shells a uniform distance into

the chuck jaws, a special stop A, Fig. 10, is used. Another stop B is provided to butt the carriage against, and the stop C gives the correct distance for feeding in the cross-slide. A shell roughed all over the outside may be seen at D.

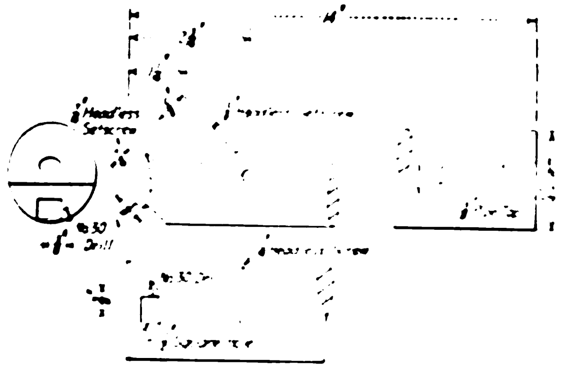


FIG. 12. DETAILS OF TAPER FORMING TOOL

The first machine operation on the inside is to rough taper bore, Fig. 11. The bore is not a straight taper, but from the outside end the shell is bored straight for 1.631 in., then taper for 3.60 in. and straight again for 1.850 in. The shell is held in the lathe chuck, as at A. The boring is done with a single-point tool B, which is shown in detail in Fig. 12. A stop C regulates the carriage travel. The taper boring is really a profile operation, controlled by a master D on the back of the turret.

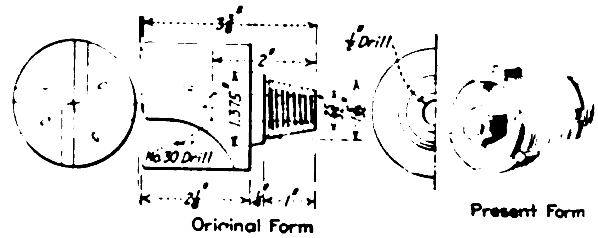
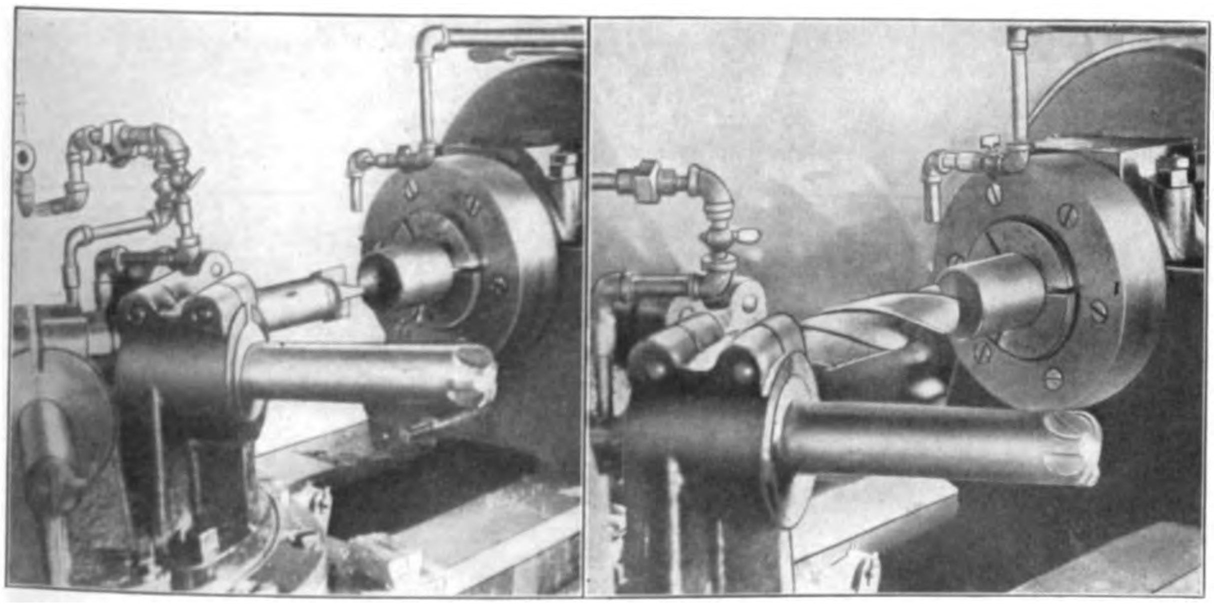


FIG. 15. DETAILS OF ROUGHING TOOL FOR DIAPHRAGM CHAMBER AND SEAT

This master slides between guides in the bracket E, which is bolted to the lathe bed. When other operations are being performed, the master is raised up out of the guides and is carried by the turret, to which it is hinged. Details of this attachment, and the way it is placed on the turret, are given in Fig. 13.

In some cases the taper boring and the next two operations are performed on the same machine; in others the last



FIGS. 14 AND 16. ROUGHING OUT DIAPHRAGM CHAMBER AND SEAT AND ROUGH-DRILLING POWDER POCKET (TWO OPERATIONS)

Machine Used—Bell No. 3 turret lathe. Fixtures Used—One special boring tool and one round cornered drill. Gages—One chuck and one carriage stop, flat steel, double end, go and not go. Production—15 per hr. Lubricant—Soapwater. References—Figs. 14-A and 16-A.

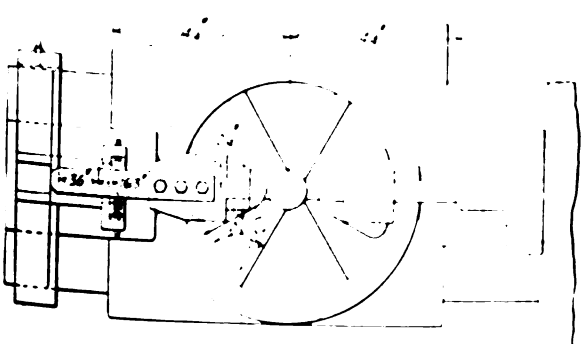


FIG. 13. DETAILS OF TAPER-TURNING ATTACHMENT

two are done on another machine, which accounts for some apparent discrepancies in the set-ups shown. This is also true of some of the finishing operations. However, for convenience we will consider the taper boring as a separate operation and the two operations of roughing out the diaphragm chamber and seat and rough drilling the powder pocket as done on another machine.

Following the taper boring, the diaphragm chamber and seat are roughed out with the tool seen in Fig. 14 and again, in detail, in Fig. 15. When the photograph was taken, a tool similar to an endmill was used; but since then a three-cutter head has been substituted and found to give better results. The latter is also shown.

The rough-drilling of the powder pocket is accomplished with a round-cornered drill, Fig. 16, which is $2\frac{1}{8}$ in. in diameter and is run in to a depth of $8\frac{3}{16}$ in.

The shells have now been roughed outside and inside and are sent to be heat-treated. The heat-treating room is conveniently arranged, as can be seen from Fig. 17. The heating furnace is shown more in detail in Fig. 18. Above, the preheater is full of shells. The shells are preheated to 800 deg. and are then placed in the heating bath in front and heated to 1,500 deg.; 50 deg. is allowed for removal from the bath to the quenching tank. Houghton's quenching oil at 1,450 deg. is used in the tank.

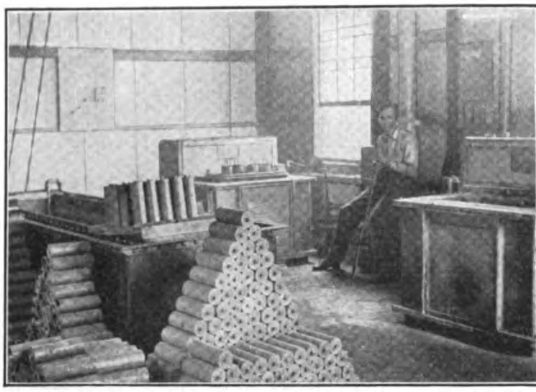


FIG. 17. THE HEAT-TREATING ROOM AND APPARATUS

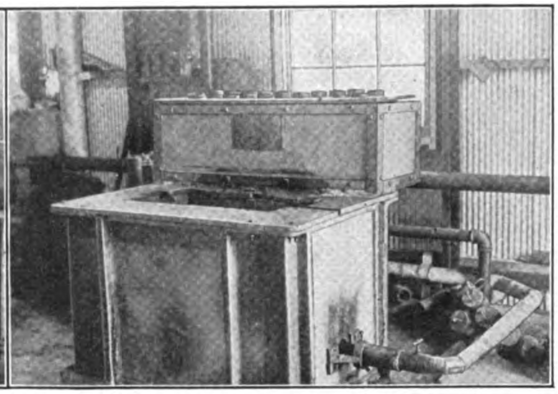


FIG. 18. THE PREHEATING AND HEATING FURNACE

Furnace Used—Tate-Jones.
Special Apparatus—Handling tongs and handled weights, pyrometers and alarm bells for timing.
Production—1 per min., heated 8 min. each.

The drawing is performed in the heater in Fig. 19. The shells are placed in the lead bath and held down by the handled weights, shown. They are drawn to 1,050 or 1,100 deg. and allowed to cool in the air. The degrees of heating and drawing vary somewhat with the different lots of steel, and each lot has to be tested separately and treated accordingly. A chart on the wall shows the operator what treatment to give certain numbered lots.

From the heat-treating the shells are trucked back to the machine shop, where the first machining operations are done on the inside of the shells. The inside finishing work closely approximates the roughing work, and very similar tools are used.

The first operation is finish taper boring, the machine and tools being the same as previously shown. Oil, however, now serves as a lubricant, and the production is 15 per hr.

The diaphragm chamber and seat are semifinished with a tool similar to the roughing tool. The powder pocket is rough-tooled out, as may be seen in Fig. 20 and

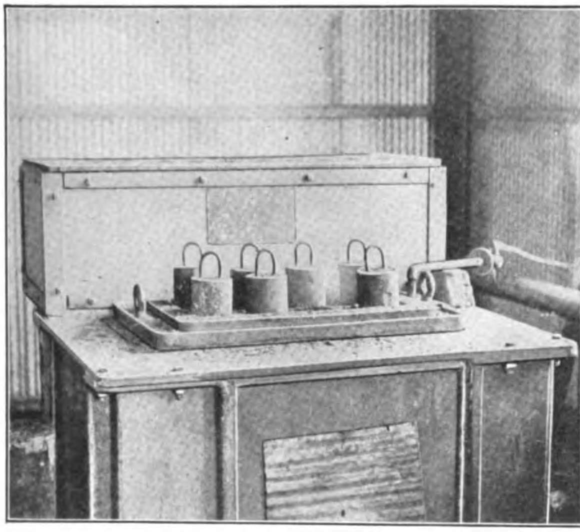


FIG. 19. DRAWING FURNACE AND LEAD BATH APPLIED PRIOR TO FINISHING CUTS

Furnace Used—Tate-Jones.
Special Apparatus—Handling tongs and handled weights, pyrometers and alarm bells for timing.
Production—1 every 2 min., heated 16 min. each.
Note—Drawing temperatures vary with different lots of steel. The variations are charted.

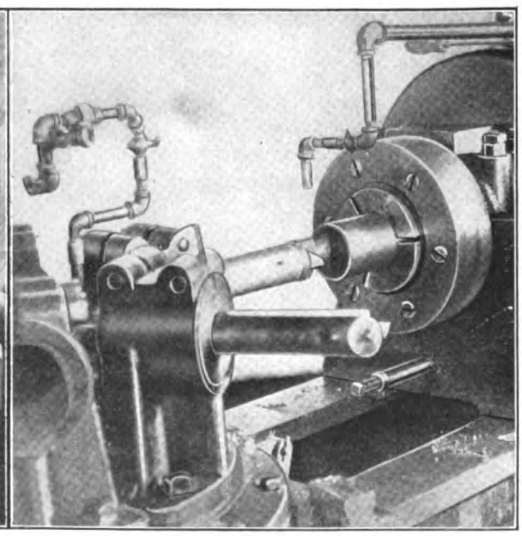


FIG. 20. FINISHING DIAPHRAGM CHAMBER AND SEAT AND POWDER POCKET

Machine Used—Hill No. 3 turret lathe.
Fixtures Used—Special head cutters.
Gages—Plug and flat double end, go and not go.
Production (three operations)—12 per hr.
Lubricant—Oil.
Reference—Fig. 20-A.

in detail in Fig. 21. These two tools are followed by a combination finishing tool, Fig. 22, illustrated in detail in Fig. 23. This tool finishes the diaphragm chamber,

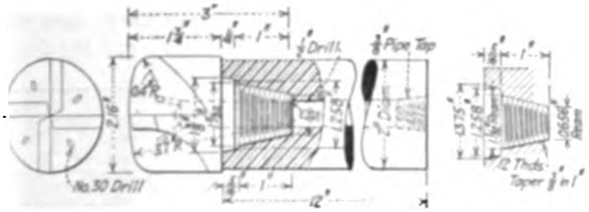


FIG. 21 DETAILS OF POWDER-POCKET ROUGHING TOOL

the seat and the powder pocket all at once. The base is finish-faced, as in the roughing operation, the production being 10 per hr. The heat number is then restamped on the base, and the shell is ready for nosing.

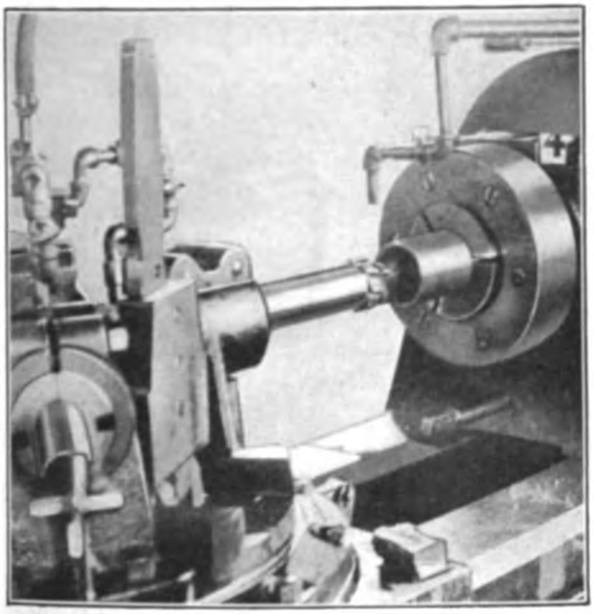


FIG. 22 FINISHING DIAPHRAGM CHAMBER AND SEAT AND POWDER POCKET

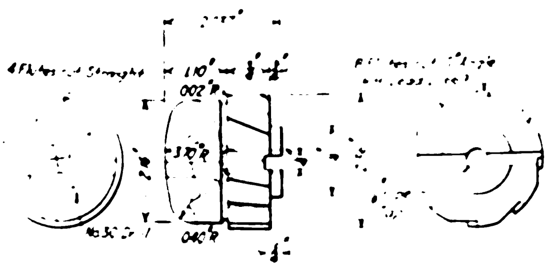


FIG. 23 DETAILS OF TOOL FOR FINISHING DIAPHRAGM CHAMBER AND SEAT AND POWDER POCKET

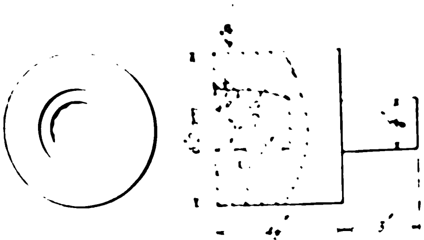


FIG. 25 DETAILS OF NOSING DIE

The nosing operation consists of closing in the open end of the shell, Fig. 24. This is done cold, using a little lard oil to lubricate the closing die. The end is closed in to about $2^{21}/_{64}$ in., the main body of the shell being 3.01 in. in diameter. The closing-in extends back about

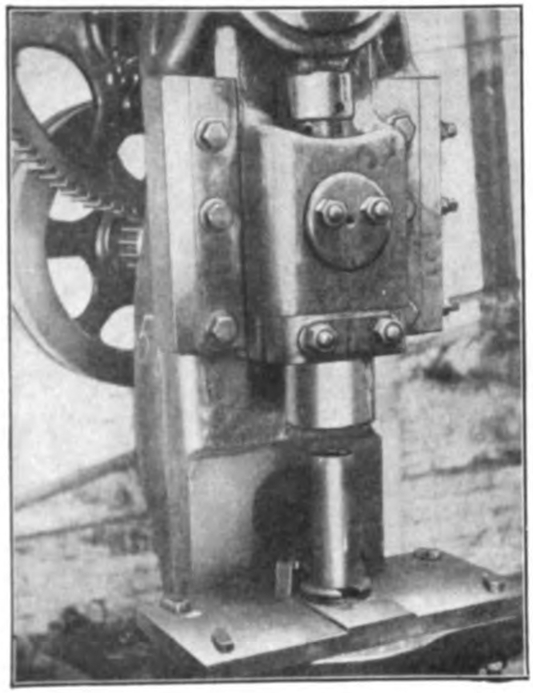


FIG. 24 NOSING

Machine Used—Punch press.
Fixtures Used—Closing die and slotted bed block.
Gages—Two setting stops at back of holder.
Production—300 per hr.
Lubricant—Lard oil.
Reference—Fig. 24-A.

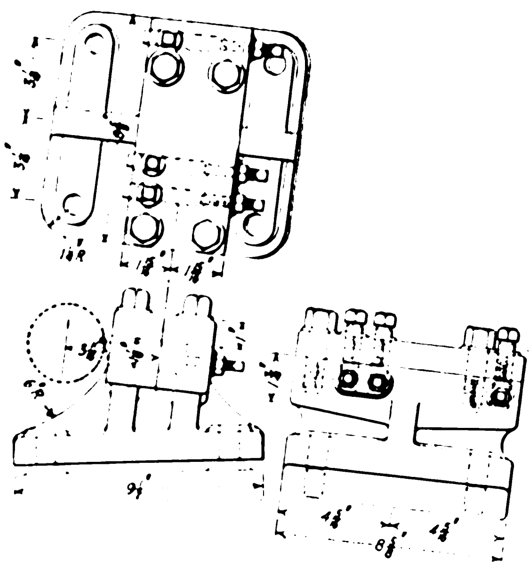


FIG. 27 DETAILS OF PROFILING TOOL BLOCK

$1\frac{3}{16}$ in., the measurements being outside and only approximate. Details of the nosing die are shown in Fig. 25.

The next three operations are completed on the same lathe. The shell is chucked as in Fig. 26, and the nose is rough-bored and faced. It is then finish-bored and tapped. For this work No. 1 lard oil is employed, with about 5 per cent. kerosene in it to make it run right.

A centering plug with a crosshandle for driving purposes is screwed into the shell, giving it two center holes to locate it between centers. It is then placed in a lathe fitted with a heavy tool block carrying three cutting tools that profile the shell as they are fed along parallel to it, turning the shell to three different diameters in different sections of its length. Details of the tool block used are given in Fig. 27. The production is 27 per hr., with soapwater as a lubricant.

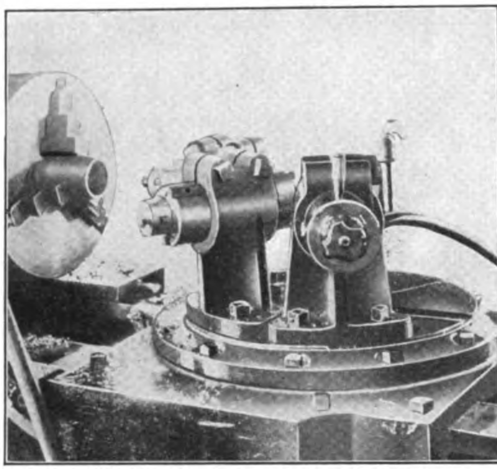


FIG. 26. BORING AND TAPPING NOSE
Machine Used—Hill No. 3 turret lathe.
Fixtures Used—Two single-point boring tools and Murchey collapsing tap.
Gages—Stop back of chuck, carrier stop, plug thread gage.
Production (three operations)—25 per hr.
Lubricant—No. 1 lard oil with 5 per cent. kerosene.
Reference—Fig. 26-A.

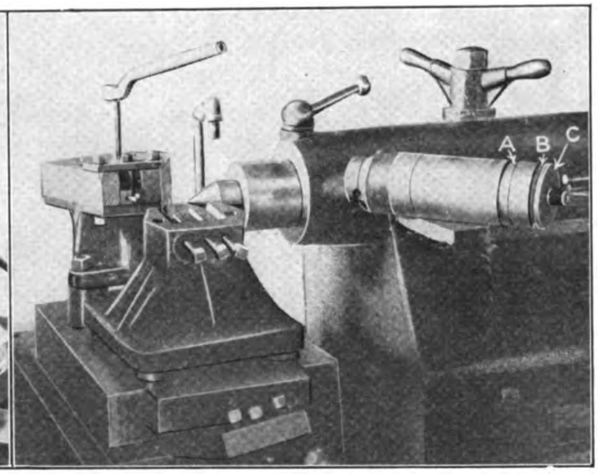


FIG. 28. GROOVING AND DOVETAILING
Machine Used—Lathe.
Fixtures Used—Special three-cutter tool block, special dovetail cutting device.
Gages—Three carriage stops, groove snap gage, dovetail gage.
Production—31 per hr.
Lubricant—Soapwater.
Reference—Fig. 28-A.

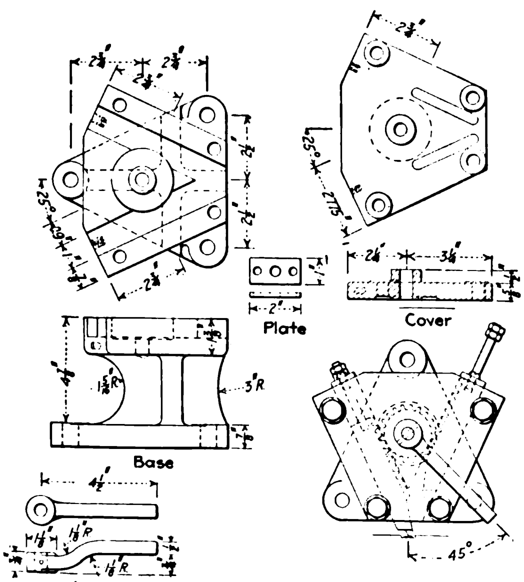


FIG. 29. DETAILS OF THE DOVETAILING TOOL

The grooving and dovetailing for the rotating band are done in the machine in Fig. 28. Besides the band groove, a groove is also cut for crimping in the edges of the cup that holds the propelling charge. Besides these two grooves, the base edge is chamfered. The two grooves and the chamfer are cut with three tools at once, set in the block on the front of the carriage. The clamping top is removed from this block in order to show the position of the three cutters. The grooves and the chamfer are indicated on the shell at *A*, *B* and *C*. The dovetailing is cut with the special crosstool device on the rear of the carriage. This device is shown in detail in Fig. 29. The operation of the dovetailing cutters leaves a slight ridge in the center of the groove for the knurling operation.

From the grooving lathe the shells go to the lathe illustrated in Fig. 30, where the bottom of the rotating-

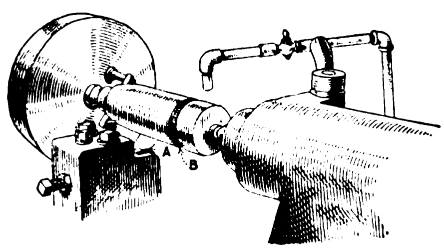


FIG. 30. KNURLING
Machine Used—Lathe.
Fixtures Used—Tool block to hold knurl.
Gages—Snap gage.
Production—60 per hr.
Lubricant—Soapwater.
Reference—Fig. 30-A.

band groove is knurled. The knurl is seen at *A* and the work at *B*.

The shells are ground on two diameters in front of the band groove, Fig. 31. Next, they go to the grinder, Fig. 32, where the buttons are ground off the bases. A shell with the center button still in place is shown at *A* and a ground one at *B*. The grinding fixture is simple and consists of two V-blocks and an adjustable end stop. A

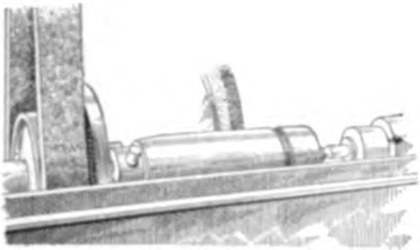


FIG. 31. GRINDING -TWO DIAMETERS

Machine Used Landis grinder
Fixtures Used—None.
Gages—Snap go and not go.
Production—10 per hr.
Reference—Fig. 31-A.

screw clamp holds the shell in place as the operator swings the work back and forth past the wheel.

After this last grinding the shells are thoroughly inspected all over. Careful check is kept in the shop also by inspectors as the shells pass from one machine to another. In addition to this the machine operators have gages to use where needed. Some of the rough and shop gages are shown in Fig. 33 and some of the finish gages in Fig. 34. A few of these are given in detail in Fig. 36, but on account of the large number of similar gages that have already been illustrated in our columns it has not been thought advisable to attempt to show more. The gages illustrated represent the types provided in this shop.

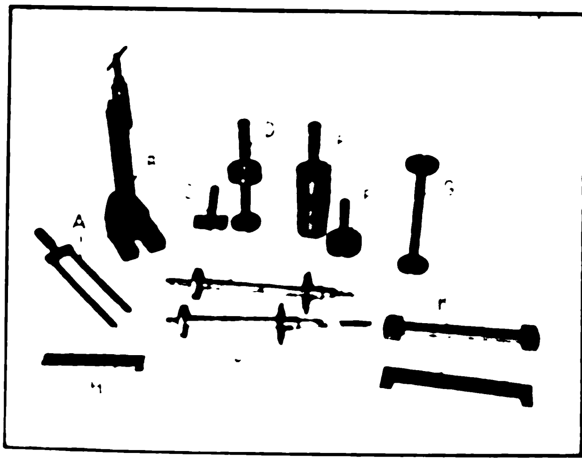


FIG. 33. ROUGH OR SHOP GAGES

A—Rough cut bottom. B—Finish cut bottom. C—Rough taper. D—Rough taper. E—Finish taper. F—Finish taper. G—Lower cylinder. H—[illegible]. I—Rough powder pocket depth. J—Finish powder pocket depth. K—Powder pocket, go and not go. L—Overall rough.

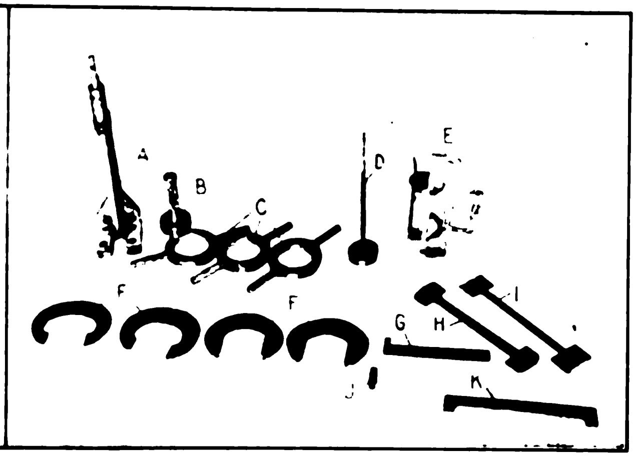


FIG. 34. FINAL GAGES

A—Bottom thickness; B—Go and not go plug; C—Ring diameter. D—Powder pocket depth; E—Wall thickness indicator. F—Go and not go diameter snap; G—Profile; H—Powder pocket, go and not go. I—Diaphragm chamber go and not go. J—Dovetail; K—Overall

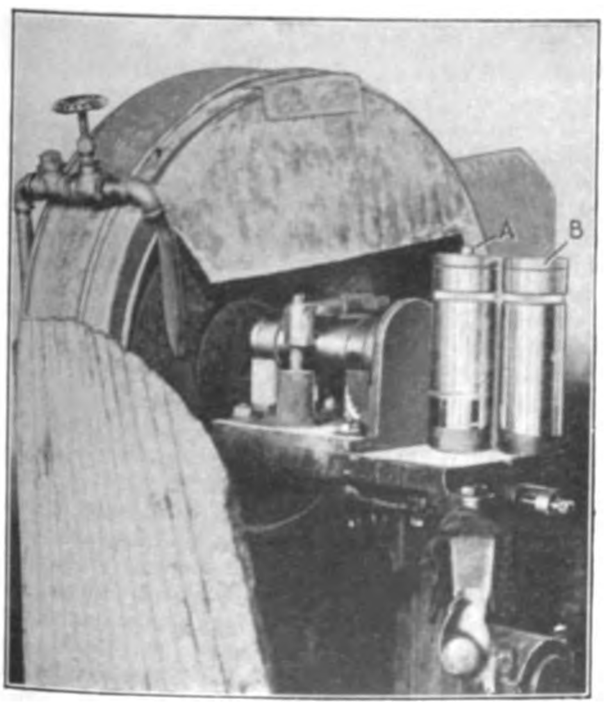


FIG. 32. GRINDING OFF CENTER BUTTONS

Machine Used—Gardner disk grinder.
Fixture Used—Special holder on swing carrier.
Gages Used—Overall.
Reference—Fig. 32-A.

The copper rotating bands are received all ready to slip down over the shell. This work is done by hand, or sometimes the bands need to be lightly tapped down. The shell with a band in place is set into a West banding machine at the rate of 95 per hr. The holder is just high enough to guide the copper band into the groove as the jaws close in around it. An expanding plug or mandrel is placed inside the shell to prevent any possibility of

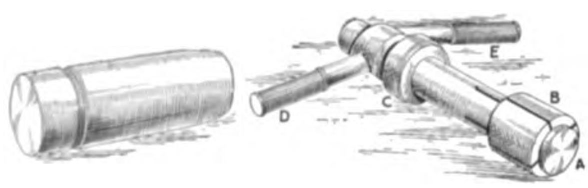


FIG. 35. THE EXPANDING MANDREL

distortion or crushing. This mandrel is shown in detail in Fig. 35. Here the taper center *A* is seen projecting slightly from the end of the expanding sleeve *B*. The mandrel is dropped into the shell until the shoulder *C* rests on the nose. The handle *D* is then held with one hand and the handle *E* turned with the other. This action draws in the taper center expanding the sleeve and supports the inside of the shell just under the band groove, effectually preventing the groove from bulging inward.

This is the last operation in this shop, as the rest of the work is done elsewhere. After the final inspection the shells are shipped out.

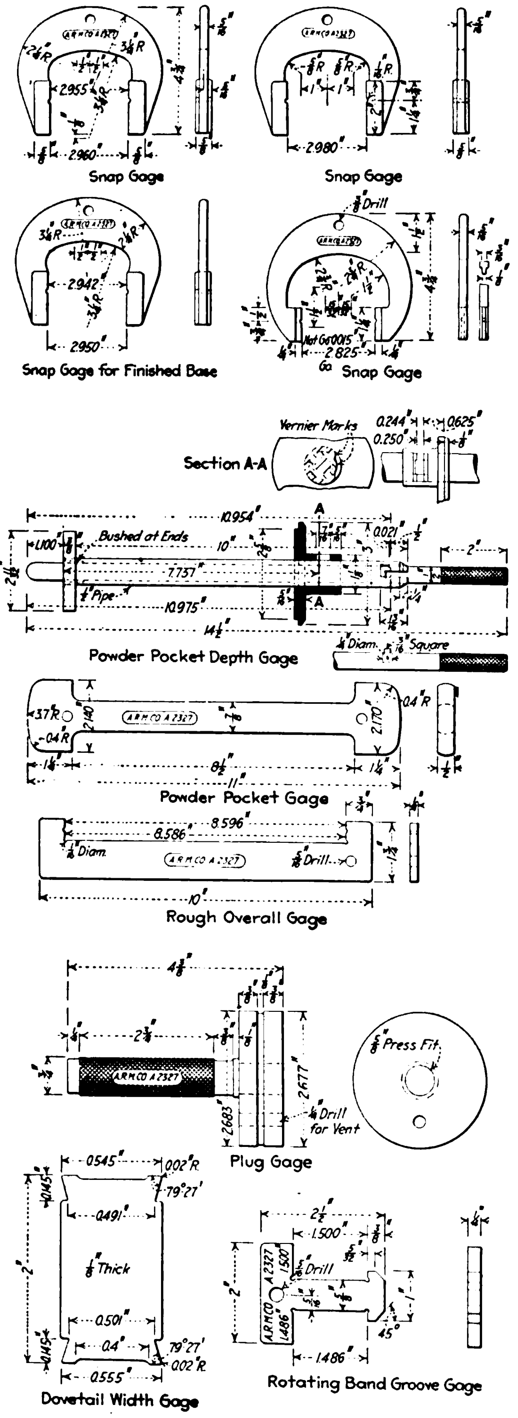


FIG. 36. DETAILS OF A FEW OF THE GAGES, SHOWING TYPES USED

In the foregoing article it was intended to cover the general methods only, inasmuch as the details of the manufacture of the 3-in. Russian shrapnel have been covered in previous articles.

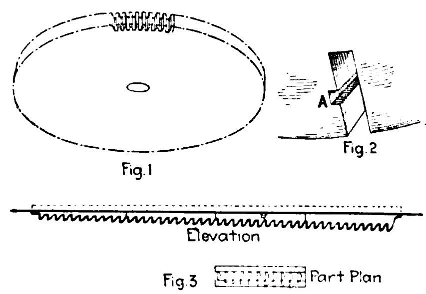
Broaching Special Slots in Turbine Drums

By H. B. McDermid

In manufacturing one type of Parsons turbines the problem of cutting a large number of special slots in connection with the blading work was put up to the boss tool maker for solution. The stock was brass or bronze in the form of disks about 1/4 in. thick, averaging perhaps 30 in. in diameter. Each disk contained a large number of slots; and as there were quantities of the disks to be machined, it was important to devise some method that would permit rapid production.

Fig. 1 shows the design of the piece, and Fig. 2 is an enlarged view of the special slots to be cut. The disk was mounted on a heavy disk or jig of a diameter enough smaller so that the supporting jig or fixture just cleared the bottoms of the slots of the finished piece.

The whole contrivance was then mounted upon the crossrail of a planer, and a spacing device was connected to the regular planer feed system so that with each stroke



BROACHING SPECIAL SLOTS IN TURBINE DRUMS WITH MULTIPLE-TOOTH BROACH

of the planer platen the work was revolved through an angle equal to the spacing of the slots and rigidly held in place during the cutting stroke.

The multiple-toothed broach, Fig. 3, was clamped in place on the planer bed. This broach was made in sections, the first tooth being the shortest and the line of the points of the others forming an acute angle with the planer platen, so that each tooth would remove a chip from the stock and the last one would finish the slot to the desired depth. The section *A* of the tool had side points parallel to the planer bed, for cutting the side notch *A* in the slot, Fig. 2. Its first tooth started the slot, and its last completed the work to finished size. Thus with every stroke of the planer a slot was completed to size, the tool withdrawn, the piece revolved by the feed mechanism through the proper angle, and another cycle of operations started.

The work, being mounted on a tool head, could quickly be adjusted both horizontally and vertically; and once set at the proper height with its vertical center line over the tool, the work could be completed very rapidly, the changing of blanks necessitating the only pause in the job.

It will be noticed that the small side slot complicated this tool problem somewhat, as for a plain slot several other methods might have been used. In this instance only one block was machined at a time, but with a more rigid fixture several might be machined.

Some Recent Developments in Tool-Steel Testing

By R. Poliakoff*

On page 419 the beginning of Mr. Herbert's article, "Some Recent Developments in Tool-Steel Testing," is published. In this article the author refers (p. 421) to my experiments with finishing-operation cuts and reproduces two of my curves. About the work itself he says that it has been published in the Russian language only and expresses the hope that I may be "persuaded to make it available to readers in English." In connection with this I may mention that my "Experiments with Lathe Finishing Tools" was made also the subject of a paper presented to the Manchester Association of Engineers (England), and this paper has been published in the "Transactions" of the association. Following is an abstract:

Considerable attention has been given to the variation in durability with change in the cutting speed when taking roughing cuts with carbon-steel and high-speed steel tools, but very little experimental evidence has been published on the durability of these steels when taking extremely fine or finishing cuts. The paper read by E. G. Herbert before the Iron and Steel Institute in 1910 deals with fine cuts, but these were obtained in trials made in his special tool testing machine and not in a lathe. The experiments referred to in this paper were made in an ordinary lathe and under conditions identical to those prevailing in the workshop. The tests were made with the object of showing the relation between the length or surface machined and the cutting speed for a prescribed degree of tool wear.

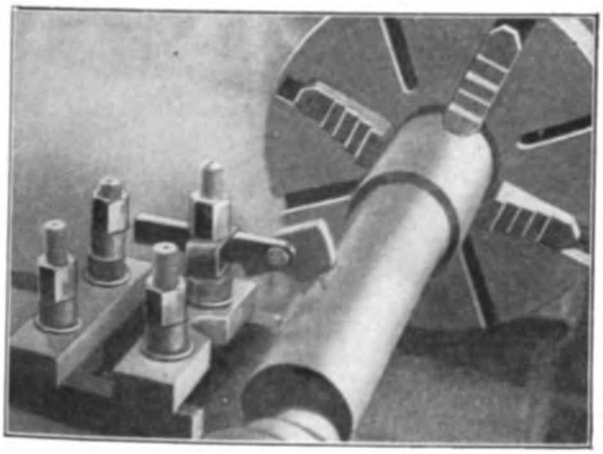


FIG. 1. INDICATOR IN POSITION FOR MEASURING WEAR

To carry out these tests a short piece of steel (part of a locomotive axle containing about 0.38 per cent. carbon) about 1½ in. in diameter was selected in order to give the necessary rigidity, and cutting was continued until the tool reached a predetermined bluntness. To measure the durability after the manner adopted for roughing tools—that is, to continue cutting until the edge of the tools breaks down—was found to be impractical and to judge from the appearance of the bar lacked definiteness. The bluntness was therefore observed as the trial progressed by means of an indicator fixed in the rest immediately behind the tool (see Fig. 1). The indicator was set to zero at the commencement of the cut and pressed against the bar so that as the tool became blunt and lost its cut the radius of the bar increased by a like amount and this was shown by the indicator. The indicator was graduated in two-thousandths of an inch, and the degree of tool bluntness decided upon for these tests was 0.003 in.—that is, about 25 per cent. of the depth of cut. The lathe, however, was not stopped when the indicator attained this figure, but allowed to cut until the gage indicated 0.002 in. As the exact degree of bluntness is difficult to measure when the tool is cutting, the indicator, on the tool being withdrawn, was brought back to the starting point and the bar carefully measured as the saddle was slowly traversed by hand.

The distance from the beginning of the cut to the spot where the indicator showed an increase of 0.003 in. was carefully measured. The indicator was then brought back to the starting point, the bar moved through 90 deg. and

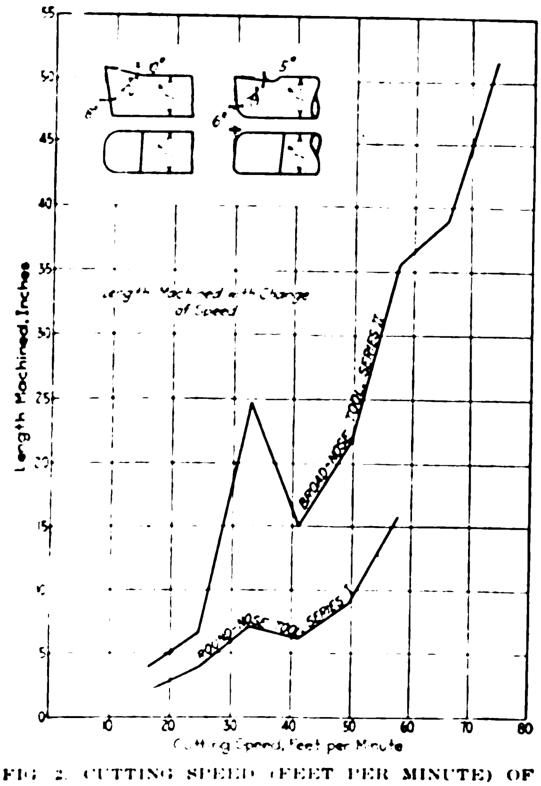


FIG. 2. CUTTING SPEED (FEET PER MINUTE) OF CARBON-STEEL TOOLS

Length machined with change in cutting speed

the foregoing operation repeated. Similarly the distance traversed for the indicator to show an increase of 0.003 in. was observed at 180 and 270 deg. to the first observation. There was very little difference between the four measurements, and the average of these was taken to represent the length machined by the tool ere it attained the prescribed bluntness. A lubricant of soap and water was used in all the tests.

After each test the tool was reground in a universal tool grinder and an oil stone was drawn lightly across the cutting edge to slightly round off the feather edge and prevent crumbling at the commencement of the cut.

Tests with Carbon-Steel Tools—Series I and II were made when taking a cut $^1/_{150}$ in. deep by $^1/_{72}$ in. traverse. The former were carried out with a round-nosed tool having a cutting angle of 80 deg. and at speeds between

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16 and 57 ft. per min., while the latter series was made with a broad-nosed tool having a cutting angle of 85 deg. and at various speeds between 16 to 74 ft. per min.

The results of these trials are shown in Fig. 2 with the cutting speed as ordinate and the length machined as abscissa.

As the diameter of the bar (4.6 in.) was practically the same for both series of trials, the surface machined is

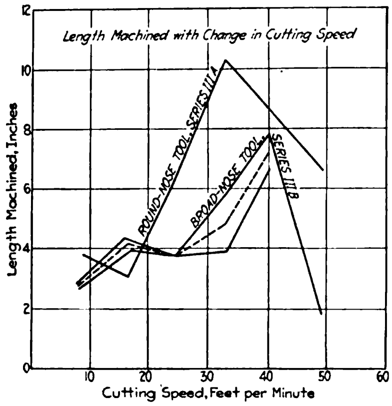


FIG. 3. CUTTING SPEED (FEET PER MINUTE) OF HIGH-SPEED STEEL TOOLS

Length machined with change in cutting speed

directly proportional to the length machined and both sets are comparable.

Tests with High-Speed Steel—Series IIIa and IIIb, also IVa and IVb, were made with tools having a cutting angle of 75 deg. on a bar (same as used in the carbon-steel trials) about 4.2 in. in diameter. The tools used in trials IIIa and IVa were of the broad-nosed type, while the tools used in trials IIIb and IVb were of the round-nosed type (for sketch of tools see Fig. 2). The results obtained

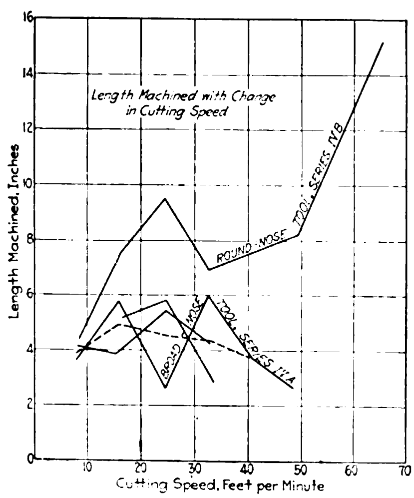


FIG. 4. CUTTING SPEED (FEET PER MINUTE) OF HIGH-SPEED STEEL TOOLS

Length machined with change in cutting speed

in the foregoing tests are shown in Figs. 3 and 4, where the cutting speed is plotted against the length machined. Lines connect the observations of the different sets, and the latter are marked with their series number. The dotted line represents the mean of the observations for the several sets with broad-nosed tools.

If the quality of the finish at different speeds as shown by photographs (not here reproduced) could be represented on a diagram, the latter would take a form very similar to that given for the relation between the cutting speed and surface machined. The number of trials, however, is insufficient to enable any definite conclusions being arrived at, but so far as they go they generally indicate:

1. That carbon-steel tools on the cuts taken are more durable and capable of machining a greater surface than high-speed steel tools (compare Figs. 2, 3 and 4).

2. That the surface machined (for a prescribed degree of bluntness), particularly in the case of high-speed steel tools, is not constant for all speeds, but varies irregularly with the speed (see Figs. 3 and 4).

3. That the quality of the finish improves as the cutting speed decreases. At high speeds the tool appears to pluck and tear the surface, and instead of the cuttings being sharp they are frayed at the edge. This conclusion is supported by an examination of the photographs of the surface of the bar, micro-photographs of the same and photographs of the chips themselves.

4. That the broad-nose carbon-steel tool gives consistently better results than the round-nose tool, whereas in the high-speed steel tests the reverse is the case; that is, the best results are obtained with the round-nosed tool. Below 36 ft. per min. the round-nose high-speed steel tool is generally better than the round-nose carbon-steel tool, but above that speed the latter tool gives the best performance. At all speeds the broad-nose carbon-steel tool machines a greater area of surface than any of the high-speed steel tools.

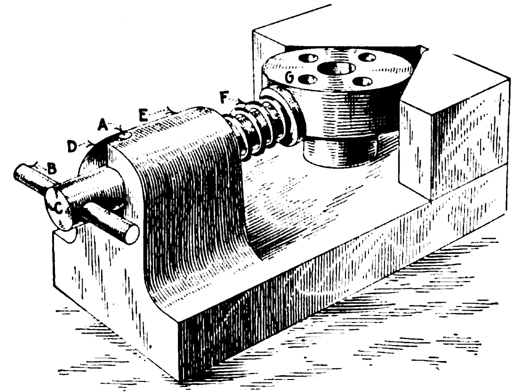
The chemical composition (percentages) of the high-speed steel tool used in these trials is as follows:

C	Si	Mn	S	P	Cr	Wo	Ni
0.61	0.10	Traces	0.01	0.023	4.49	14.45	0.31

Cam Release for Spring Plunger

By W. Burr Bennett

Occasionally, all that is necessary in a jig to hold the work in place is a spring plunger with a heavy spring, as illustrated by the piece G, in which the four small



CAM RELEASE FOR A SPRING PLUNGER

holes are drilled with a multiple-spindle drill head. However, it is somewhat awkward to operate, and considerable strength is required to compress a spring such as that shown at F. The release of the plunger C may be made comparatively easy by milling the inclined plane or cam surface D on the end of bearing E so that the pin A will follow up as the handle B is revolved. Turning the handle back to the limit will lock the plunger against forward movement.

Letters from Practical Men

Locomotive Superheater Flue Testing Machine

The superheater flues are a vital part of the modern locomotive, and in order to test them thoroughly before putting them into the boiler for service the Soo line built a testing machine on a somewhat peculiar design at its Shoreham shops.

This machine was designed by the boiler-shop foreman, M. Seraske. Its outstanding feature is that the flues are tested under actual working conditions by having the pressure applied on the outside. The general

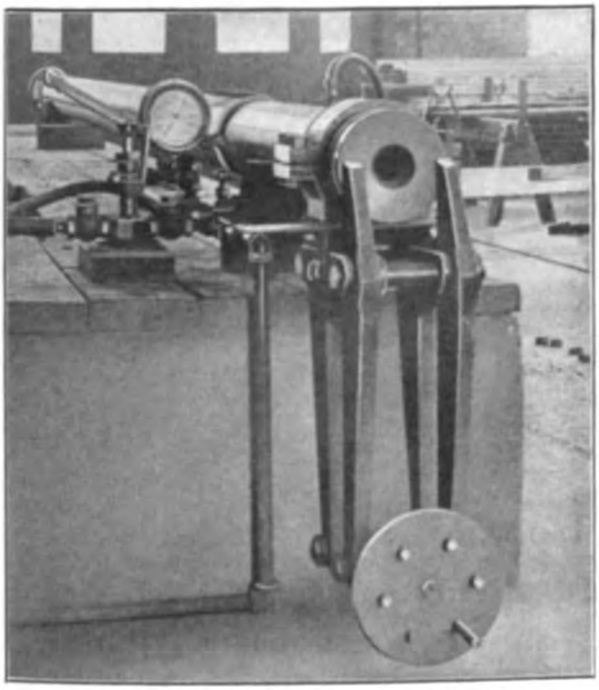


FIG. 1. FRONT END VIEW OF FLUE TESTER

appearance of the machine is shown in Fig. 1, which is a view of the front end from which the flues are inserted.

The cylinder is made of a length of 7-in. double extra-heavy pipe 25 ft. 6 in. long, the inside of which is bored out to $7\frac{1}{4}$ in. in diameter in order to provide a good finished surface for the hydraulic leather packed piston. The front end of the cylinder is closed by a removable cap that is tightened up by a substantial clamp arrangement operated by a screw and handwheel shown at the bottom of Fig. 1. The piston in the back end of the cylinder can be fitted to extension pieces of suitable length, so as to take care of flues from 12 ft. to 25 ft. long. The ends of the flue and also the front end of the cylinder are sealed water-tight by hard rubber rings that are inserted in the cylinder cap and the piston.

After a flue is placed in the cylinder and properly tightened up, the space around the flue is filled with water by simply opening the cock shown on top at the front end of the cylinder. After the cylinder is filled, the pressure is run up by the little hand pump on the left in Fig. 1. The flues are tested at a pressure of about 450 to 500 lb. per sq.in. With this pressure on, the inside of the flue is inspected for leaks through the opening in the cap. An electric light is fastened in a similar opening in the piston on the other end of the flue, Fig. 2. In this manner any leak is readily discovered and welded afterward by the acetylene method.

This machine paid for itself in a short time. Three men can test a set of 34 flues in about $2\frac{1}{2}$ hr. In an old set of flues where numerous pit marks have been welded it is necessary to test the soundness of the welds, as even with the greatest care a flaw is sometimes developed near the point of welding. If these flues are set into the boiler without being tested, it often happens

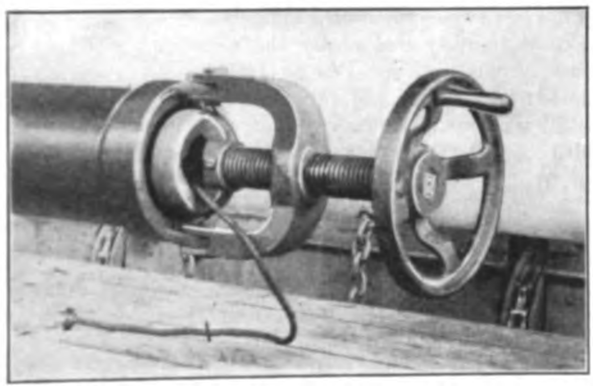


FIG. 2. REAR END WITH LIGHT CORD

that from one to six or more flues have to be removed on account of leaks. The cost of removing and replacing one leaky flue in a boiler is greater than the cost of testing the whole set in the machine described.

Minneapolis, Minn. WILLIAM SEELERT.

The Story of the Berry Baskets

This story teaches the zeal with which Dr. Stratton seizes every opportunity to foist the metric system on the people of this country and the devious methods to which he is prepared to resort in order to accomplish his purpose.

Several Northern states have laws making the dry quart the legal measure for berries and small fruits, the offering of such commodities in baskets of other capacity being illegal, and those so offering them subject to a fine. Some of the Southern states have no such laws, and early strawberries are hence shipped to Northern markets in baskets of smaller capacity, which baskets, while legal at the point of shipment, are illegal at the point of consumption. To remedy this anomalous and troublesome situation, a committee of

produce dealers endeavored to obtain the passage of a law at Washington making the dry quart the only unit of measure for small fruits and berries throughout the country. Upon applying to the authorities at Washington, they were referred to the Bureau of Standards, whose officials framed for them a bill which was subsequently introduced by Senator Lodge of Massachusetts. On cursory reading, this bill seems to be framed to accomplish its intended purpose, but closer examination shows the following little joker within it, due to action of the Bureau of Standards:

Provided that nothing in this act shall prevent the sale of such small fruits and berries by weight or by the liter, half liter, quarter liter, or multiples of the liter.

Not many of our readers will recognize the manner in which the bill, if it were to become a law, would act, but when it is recalled that the liter is about 10 per cent. smaller than the dry quart, it will be seen at once that, since no dealer could afford to use a large quart while others were using a small one, the effect would be to make the liter the actual standard. In other words, while the ostensible purpose of the bill was to make the dry quart the standard, its actual effect would be to make the liter the standard.

In explaining the matter the associate physicist of the Bureau frankly stated: "We would not care to frame a bill that would in any way interfere with the metric system," and, since no weights-and-measures bill can get past the Committee on Coinage, Weights and Measures without Dr. Stratton's approval, that was equivalent to telling the country that no weights-and-measures reform which does not bear the metric label is possible. In this case a most sensible and much needed reform was blocked by the attitude of the Bureau. They have shown themselves willing to legalize the confusion of a double standard if they can accomplish their object, which, first, last and all the time, is to get the metric system in. The grotesque legalizing of two units of measure for the same purpose and the legalizing of the liter for a single purpose shows their professed aim of "uniformity" to be a sham.

F. A. Halsey.

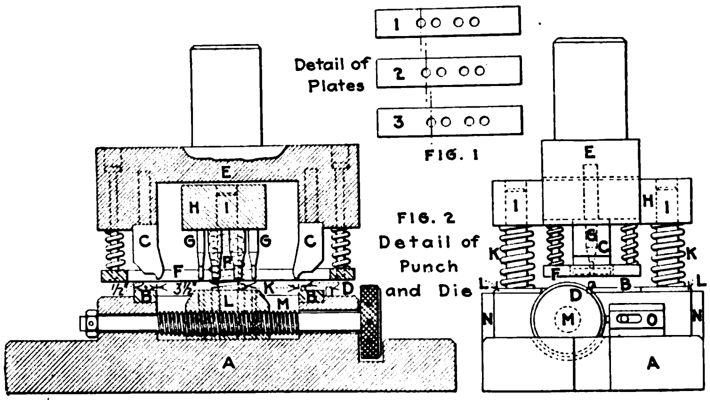
New York City.

Combination of a Press and a Subpress

In punching very accurate plates in which some holes or grooves move up a few thousandths of an inch for each following plate, as shown in Fig. 1, it has been customary to divide the job into two operations. A more recent method was to provide the die block and holder with the punches for the shifting holes, with screws to displace them; but as it stands to reason that the boy who runs the press will forget, once in a while, to turn both screws, the mechanism was often out of repair. The latest method is a union of the two previous ones, by combining two dies, the movable one being the subpress of the fixed part, as will be seen in the illustration, Fig. 2.

The bedplate *A* carries the shear blocks *B*, which in this particular case were ½ in. wide and 3½ in. apart. The parting punches *C* are shaped so that they can be turned the other way to cut on the outside of the blocks, making it possible to blank 3½-, 4- and 4½-in. plates without extra expense.

The parting punch is for trimming the material on the stop side. The disappearing stops *D* are to prevent too much waste, but the accuracy of the piece does not require them. The trimming is an insurance against any mistakes. Besides the parting punches the punch holder *E* also carries the stripper *F*, which flattens the thin material. The slot in the center of the stripper is so shaped that it allows free passage to the punches *G*. The holder *H* of the movable punches is kept in



COMBINATION OF A PRESS AND SUBPRESS

position by two pins *I*, over which the holder can slide up and down, the holes being a close working fit. Two stout springs *K* press the holder *H* against the main punch holder *E*. The guide pins *I* are rigidly placed in the movable die block *L*, which can be moved by the screw *M* between the guide plates *N*. The screw has its bearings in the bedplate. The head of the screw is divided, and turning is prevented by a snap-catch.

To safeguard against mistakes in assembling, the moving punch holder is furnished with a numbering stamp *P*, which makes only an impression in the punchings. The stamp has to be changed for each new lot of punchings.

Jan Spaander.

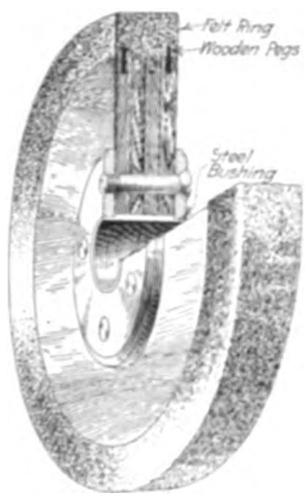
Brooklyn, N. Y.

Felt Polishing Wheel

The illustration shows a type of polishing wheel that has many advantages over the ordinary leather-faced kind, the most important being that it will cut faster and retain its emery coating longer than the ordinary wheel, and it will not glaze as easily. It was originally designed for finishing aluminum and other soft-metal castings, and for this work it is superior to every other type of wheel. It will, however, give excellent results on all kinds of metal, and most workmen prefer it to the leather-faced wheel.

As will be seen from the illustration, this wheel has a thick felt ring mounted on a wooden wheel body. The felt ring must be continuous and should be made of

rather hard hair felt. The body is formed by several thicknesses of wood glued together and so arranged that adjacent layers have the grain running in different directions. To prevent the hole from wearing out of true, it is provided with an iron or steel bushing. The bushing is held in place by a pair of iron disks, which also serve to strengthen the wheel and prevent the clamping nuts from digging into the wood. To mount the felt ring satisfactorily, the wheel body should be made large enough to require the ring to be forced on. Before the ring is put in place, the cylindrical face of the wheel body and the inner face of the ring should be coated with hot glue. The ring should then be put on as quickly as possible. To aid in holding the felt ring in position, steel wire brads may be driven through the felt into the wood, or holes may be drilled and wooden pegs driven in. The brads or pegs should not penetrate more than one-quarter inch into the felt ring.



A FELT WHEEL WILL NOT GLAZE EASILY

Before the emery coating is applied, the wheel should be trued. This may be done in a lathe, the wheel being placed on a mandrel and the high spots on the felt ring removed by a coarse file. The emery coating is then applied in the same manner as in the case of a leather-faced wheel.

The most convenient size of the wheel is 15 in. in diameter, the diameter of the body being 12 in. and the thickness of the felt ring $1\frac{1}{2}$ in. The wheel may be of any width required, and the felt ring may be rectangular, triangular, or half circular in cross-section, as desired. The proper cutting speed for a polishing wheel is 6,000 to 7,000 ft. per min., or 1,500 to 1,800 r.p.m. for a wheel 15 in. in diameter. G. A. ANDERSON.

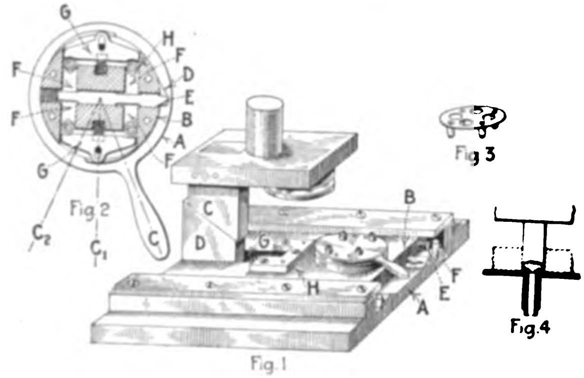
Buffalo, N. Y.

Riveting Studs in a Plate with Safety Dies

The accompanying illustrations are views of a safety riveting die for the piece shown assembled in Fig. 3. In the design of this die two things were kept in mind—the safety of the operator and preventing the parts to be riveted from sticking in the die after the operation.

The assembly of the die is shown in Fig. 1, which clearly brings out all the parts in their respective places. In this illustration *A* is the base plate, in which the die plate *B* works as a slide through the beveled fingers *C* and *D*. With the punch descending, the die plate is made to move under the punch, carrying with it the piece to be riveted. With the upward motion of the punch the finger *D* is released, and the springs *E*, fastened to studs *F*, draw the die plate back to its original position. Finger *C*, by moving into the slot *G* and guide *H*, serves also as a lever pin for the die.

The fixture for the die is shown in Fig. 2. A ring *A* is mounted on the pad *B*. By bringing handle *C* into position C_1 the cam *D* moves the gage pin *E*, which gets the jaws *F* into proper position. By moving the handle into position C_2 the clamps *G* press upon studs *H*, thereby holding them in place during the operation. Moving the handle back to the position *C* releases the studs and enables the riveted piece to be taken out without trouble.



DETAILS OF A SAFETY RIVETING DIE

The studs and the round plate are so held during the operation that after the work of the punch the swaged bushings cannot stick in the die. A. O. ALEXAY.

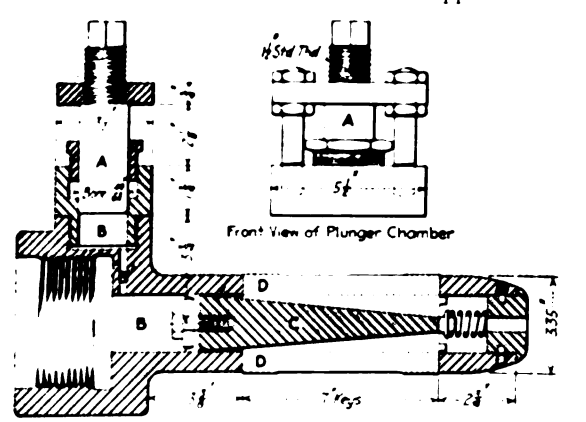
Avenel, N. J.

Hydraulic Expanding Mandrel for 4.5-In. Shells

The accompanying drawing shows a mandrel for holding the 4.5-in. British high-explosive shells while machining the outside. This mandrel will be found useful when the air-operated mandrel cannot be used on account of the lathe not having a hollow spindle.

The operation of the mandrel is obvious from the drawing. The ram *A*, when screwed down on the oil in the chamber *B*, forces the taper member *C* forward, expanding the blades *D*.

The idea of using hydraulic pressure on an expanding mandrel is a new one to me and would appear to have



HYDRAULIC EXPANDING MANDREL

a large range of usefulness for work otherwise difficult to hold.

I am also using a similar mandrel with steel balls instead of oil for the pressure-transmitting medium. The reason for substituting the balls in this case is that

the lathe spindle is of such a design that it is nearly impossible to get an oil-tight joint between the mandrel and the lathe spindle. In order to use the steel balls it will usually be necessary to increase the total length of the mandrel. This makes a longer overhang of the work, so that the oil is the best where it can be utilized.

New Glasgow, N. S. JOHN S. WATTS.

Efficiency in the Pattern Shop

We hear a great deal about ways and means of reducing costs and increasing production in the machine shop or foundry. These plans are continually being brought to the attention of the management of enterprising concerns, but seldom is anything said of the savings that could be effected in the pattern department. Few managers realize the unnecessary expense and delays in production that are caused in the pattern department by not having it in closer touch with the drafting room and the foundry. Costs mount up in the pattern shop for several reasons, but under better conditions could be greatly reduced.

In the first place too little consideration is given in the drawing room to the design of machine parts that are to be cast. Very often the construction of the pattern could be simplified, thereby reducing costs and in a great many cases further decreasing the expense in the foundry without affecting the design of the machine or part.

Frequently machine parts are designed with pockets, projections or undercut portions that make it necessary for the pattern maker to core out under these parts in order to get a casting true to the drawing. This means extra work in the pattern shop and foundry and produces a rough casting, because the drawing room does not consider or does not understand that the design means extra work in patterns and foundry.

Sometimes a drawing goes to the pattern shop for work that is still in the experimental stage. Unless orders pertaining to it are given, the shop makes up the pattern in first-class manner when a much cheaper pattern could have been made to give the casting wanted.

Too often the foreman of the pattern shop thinks that he knows the best way to mold patterns and makes up some complicated work without talking the matter over with the foundry foreman. When the work is received, the foundry foreman refuses to accept it until it has been changed to suit him, and these alterations entail extra costs and delay. Often a pattern is made for a broken part of a machine, when the piece itself could have been sent to the foundry and used for making a mold without further cost.

An example of how these things sometimes get by and run into money recently happened in a fair-sized shop. The machine foreman in rigging up an old lathe for a special job found that the faceplate, which was of cast iron, was cracked on one side. Instead of sending it to a near-by shop to be acetylene welded, he took it into the drawing room to have a sketch made for a pattern. The foreman of the drafting room gave it to one of the boys, who made a standard-sized tracing, all lettered. A blueprint was taken and the pattern ordered. The pattern shop upon receiving the blueprint and order made up a first-class pattern which in a couple of days was sent to the foundry with an order for one casting. The pattern was supposed to be for production, and three castings were made. A week's delay and an excess in costs in all departments that handled this part were incurred because the piece was too small to have much thought given to it.

Thousands of dollars could be saved yearly in large concerns by having an efficiency man—a practical patternmaker—work with the drawing room, pattern shop and foundry, to help them to coöperate. He would show the drafting room the needs of the pattern shop and the foundry, so that the designs might be simplified where possible. He would see that proper patterns were ordered and would consult with the foundry regarding the best method of making patterns. With such a system the work would be carried through with the least delay and the lowest costs. JOHN J. EYRE.

Boston, Mass.

New York Preparedness Parade

The greatest parade in the history of the country, if not the world, was reviewed in New York, May 13, by Mayor Mitchel, Major General Wood and Admiral Usher. The parade was composed of civilians representing 64 trades or professions. It started at 9:30 in the morning, and the last platoon passed the reviewing stand at 9:40 in the evening. At no time was there a break in the line of more than three minutes' duration.

A careful compilation of the number of marchers, made with indicators by representatives of the New York *Times,* fixed the total at 125,683, made up as follows:

Male civilians (excluding bandsmen)	105,674
Women	3,287
National Guardsmen	7,994
Spanish War Veterans	728
Bandsmen	8,000
Total	125,683

This exceeded by 45,000 the largest parade that had ever been given previously, the Sound Money Parade of 1886, and exceeded by 50,000 the Business Men's Parade in 1908. Over 60,000 men had to be refused enrollment because of the inability to pass more than the above number by the reviewing officers within the alloted time.

There were no uniforms, no wheeled vehicles, and no horses except in the National Guard and those used by the Grand Marshal and his staff. But although civilian clothes were worn, almost every marcher carried an American flag, which, besides the battalion colors, made a sight impressive beyond mere superlatives.

The purpose of the parade was to impress upon the country at large, and to the pifflefists in Congress in particular, the overwhelming sentiment for preparedness.

There were 7,000 engineers in line, marching in platoons of 20, each platoon with a leader, and they without any doubt presented the finest appearance of any body of men in line and earned many plaudits from the 1,000,000 spectators who lined Fifth Ave. during the entire 12 hours.

They were led by the Naval Consulting Board, composed wholly of engineers from the national engineering societies. Then followed the delegation from the Engineers' Club; then the other engineers.

It was the first time the engineers of New York ever appeared in a body, and it was a most significant event in many ways. When W. L. Saunders, Thomas A. Edison, and many others will march afoot in the ranks of such a demonstration, it betokens a depth and weight of public opinion which ought to have an effect even on a Congressman.

Discussion of Previous Question

The Suggestion System

On page 561 I noticed with special interest the points raised by J. H. Davis on the suggestion system. I have had experience with suggestion schemes and am strongly in accord with his views. I think every practical man must be in agreement regarding adequate compensation to workmen for suggestions that are accepted by the employer. Also, I agree that, when any individual workman is frequently introducing ideas, he is undoubtedly "worth watching." Sometimes this type of man receives compensation for his ingenuity by being promoted to an official position. Unfortunately the new place is not always so remunerative as the old job. Consequently, this method of compensation has a tendency to make some operators withhold some of their ideas. Many consider the present time only instead of looking to the future, when sooner or later they would have a chance at a bigger job with more money.

Of course, there are some men who take into consideration the title that goes with an official position. But my experience with the average operator is that titles are not usually desired. They do not pay the various household bills.

With regard to suggestion schemes for the small firm, they should be encouraged as much as in a large plant. Instances could be cited where the small shop has aroused itself from the go-as-you-please-way to that of an "up-to-the-minute-shop" through the introduction of an efficient suggestion system. In fact, the system is often of most value when it is adopted in connection with a small firm, because the men pull together and everyone does his best to turn out work efficiently and smartly when his ideas are readily accepted and put into operation. The small-shop foreman, however, must always be ready and willing to listen to the men and should solicit suggestions, because by so doing he will create a spirit of cooperation that is so essential.

A. Eyles.

Manchester, England.

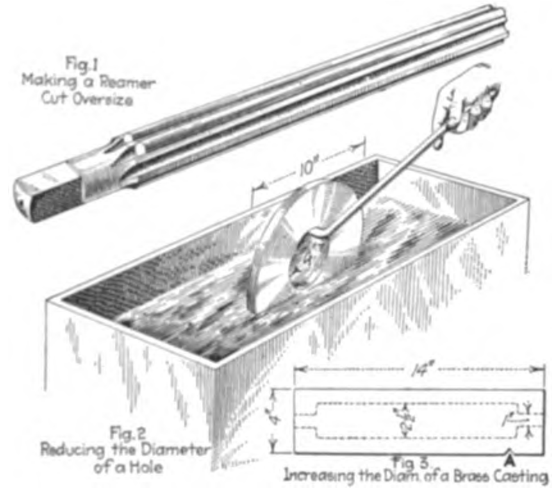
From a Small-Shop Notebook

I have read with interest J. H. Van Deventer's "From a Small-Shop Notebook," on page 588, and would like to submit a few kinks that may also be helpful to small-shop mechanics.

There is another way than the one shown to make a reamer cut larger. This method is to take one piece or, better, two pieces of steel wire, solder one end of each to the top end of the reamer, leaving the other ends free. The size of the wire is governed by the size and number of flutes. It should be chosen to fill the space between the flute and the wall of the hole to be reamed, and adjustment can be had by shimming under the wire with paper.

At one time I had some large steel washers cut from ¾-in. boiler plate, as shown in Fig. 2. By mistake they were made 0.010 in. too large in the bore. Instead of throwing them away I put them into the furnace, heated them to a bright red and then dipped them into cold water, as shown in the illustration, cooling the outside edge first by turning the disk around quickly and leaving a ring of hot metal on the inside next to the hole. The result was that this hole decreased in size sufficiently for us to rebore it.

Mistakes are made as frequently in small shops as in large ones, if not oftener, and Fig. 3 shows a brass



HELPFUL SMALL-SHOP KINKS

casting in which during the finishing cut on the outside diameter the tool dug in as at *A*. The piece had not been faced to length, so by putting it under a hydraulic press and squeezing it endwise we were able to swell it enough to grind the diameter and get rid of the gouge.

Holyoke, Mass. JOSEPH G. NOBLE.

Truing a Lathe Center Without a Center Grinder

On page 821 is shown a method of truing lathe centers without a center grinder. This method is open to criticism. I tried it some 12 years ago and found it wanting. Roughing a center by hand so that it will run within $\frac{1}{64}$ in. of true is a delicate job indeed. Then lapping it with a piece of worn-down emery wheel is some task, if the center runs out true, and also takes a lot of time. It will be anything but round if the wheel is held as shown. It will also be scored unless the wheel is moved to and fro parallel to the horizontal axis of center. This can only be accomplished by setting the compound rest at a proper angle, on lathes that have one.

It does not make much difference if the dead center is sprung a little in hardening, for any error can be compensated for by adjusting the tailstock.

Ours is one of many shops that do not possess a center grinder. We use two live centers. One is hardened and used during the roughing operation. Then the hardened

one is removed and the soft center, which is turned true, is inserted for the finishing operation. I have followed this method for several years, and it leaves nothing to be desired. G. STROM.

Brooklyn, N. Y.

Proposal to Standardize Machine Tools

I was much interested in the report of the discussion at New Orleans of Mr. Miller's paper on "Industrial Preparedness." The point that interested me most was Mr. Alford's suggestion of standardizing machine-tool designs and the resolution to have a committee to consider this feature.

I understand that the idea is to prepare standard designs of machine tools (which would be principally lathes) for the manufacture of munitions and to publish these standard designs and specifications. This looks to me like a most excellent idea because shell lathes, if properly designed, are really simple things to build, and with standard designs available, they could be produced by practically any machine shop, so that even from a standing start they could be turned out in almost unlimited quantities within a few months. This would leave the regular machine-tool concerns free to produce their standard machines, which would be needed in large quantities by the machine shops that were building the shell lathes, both for making the lathes and for toolroom equipment.

I am also satisfied from experience that this would result in a great saving in cost. This is particularly true of the larger shells. We are making 8-in. shells and were offered for this work 30-in. and 36-in. engine lathes having 12-ft. and 14-ft. beds and costing from $2,000 to $4,000, equipped with regular overhead countershafts and regular engine-lathe features. The lathes we are building for ourselves are 24-in. swing with 7-ft. and 8-ft. 6-in. beds and should be produced for about $1,000.

We have done something ourselves toward standardizing shell-lathe construction. We have a standard cross-section of bed which we make in four different lengths, and we find this equally satisfactory for 3.3-in. and for 8-in. shells. We have four or five different designs of headstocks for this bed and some variations of each design adapted to different operations and various sizes of shells, but any headstock can be put on any bed. Right here I might say that all of these headstocks have cast-iron spindles with driving gear cast integral. I think the first thing the committee ought to do is to cut out any business of "hammered high-carbon steel spindles bored from the solid" and also eliminate steel gears and "semi-steel," which after all is only a polite way of saying cast iron. We also have a lot of different designs of saddles for different operations, but all having the same size of dovetails take a cross-slide. Most of these saddles take the one standard apron, which is very simple and cheap to build.

For feed we are using belt feed exclusively, and it is quite strong enough to pull two heavy cuts on the 8-in. shell, reducing it at once from forging size down to ⅛ in. over finishing size. We use standard split steel pulleys on the spindle and a rod for driving the feed, so that we can readily experiment until we get the exact feed that suits best. We use two feeds with jaw clutch between, so that we can have a roughing and a finishing feed.

We are also making thread millers that take the same design of headstock and bed as the lathes. These are double-spindle machines, so that we can true up the counterbore at the same time we mill the thread.

I certainly think that a good move is being made in suggesting the preparation of standard designs of machine tools for shell manufacture. If the Government adopts the proposition to let small contracts for munitions in times of peace, I should think it would be a good plan to arrange so that some of the large shops would make up their own machine-tool equipment for making these peace-time orders. This would insure that a number of shops throughout the country had drawings, patterns, equipment and experience for making the machine tools necessary to produce munitions.

It should be added that before this committee can get very far in their labors they will need to have before them standard designs and specifications of the shells that are to be produced, and as has been pointed out several times in the *American Machinst,* there is room for a good deal of improvement in the design of shells to make them economical to manufacture. It would therefore seem desirable to first secure the coöperation of the War Department in simplifying and standardizing the designs. H. V. HAIGHT.

Sherbrooke, Que., Canada.

Sizes of Tap Drills for Varying Conditions of Work

Perhaps the last sentence in my article on page 775 should be qualified so as to prevent any misunderstanding. Tap action is as follows: A sharp tap tends to throw up what may be termed a slight burr on either side of the cutting point as it cuts the thread in the hole, thereby slightly increasing the amount of thread contact of the screw. With a dull tap this "burr" will be more pronounced as the tap is forced through the hole, which still further increases the amount of thread contact for the screw, especially in the softer metals.

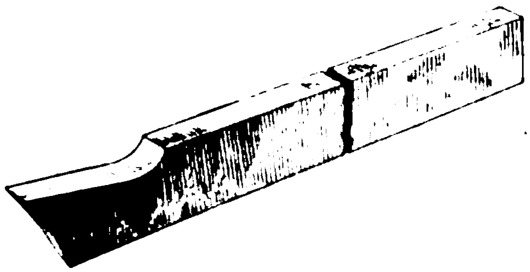
Indianapolis, Ind. O. R. KLEPPER.

Curved-Lip Parting Tool for Planer or Shaper

On page 284 Mr. Roberts illustrates a novel form of parting tool, which he has used with good results on cast iron. Equal results in either cast iron or mild steel are obtained by rounding the face of the tool as shown by the accompanying illustration. This shape has the effect of causing the chips to curl in the direction of their width and thus become narrower than the groove cut by the tool, and they will therefore clear themselves freely. It is usually recognized that the metal in the chips occupies more space than it did before being cut, with the result that, when parting with a square-faced tool, the cuttings wedge themselves in the groove, causing the frequent breakage of parting tools.

A large fillet should always be left at the root of the cutting face. Otherwise, this is the weakest part of the tool, and in the event of breakage the whole end of the tool is lost.

The remarks of Mr. Groocock on tool lubrication—page 296—are very interesting as showing the effect of different lubricants for different materials and operations. For producing a highly finished surface in relieving tool-steel gear cutters a mixture of lard oil and



PARTING TOOL FOR STEEL OR CAST IRON

turpentine may be relied upon when other lubricants fail. This mixture has also proved very successful in producing a smooth thread on tool-steel screws.

Glasgow, Scotland. JOHN HOLDING.

Glass-Cutting Experience

Referring to the article on glass cutting, on page 516, does not Mr. Little give a wrong impression as to the value of the diamond for cutting glass? The diamond as cut for finger-ring settings is about as suitable for glass cutting as the ball peen of a machinist's hammer is for use as a scriber!

My experience has taught me that there is everything in favor of a diamond glass cutter except the two facts that the diamond cutter costs more and that it is more likely to break if drawn sidewise across the glass.

The diamond chips that are mounted in the commercial glass cutters that I have used have all been small thin pieces presenting a knife-like edge to the glass. When carefully handled, they have shown a long life and have given the best of results, cutting a much smoother line than any steel-disk cutter. MYRON E. EDDY.

Rockton, Ill.

Preparing for Manufacturing Munitions in the U. S.

The letter on page 908, by A. B. Chester, has much to commend it. My only criticism is with the second paragraph. The making of munitions for foreign countries has two bad features: It supplies our possible enemies with war material to use against us, and it introduces the temptation to foment the national rivalry between countries in order to sell munitions at a large profit. The country can much better afford to pay a heavy bonus on material it needs for itself rather than have such scandals as were traced to the Krupp and other works a few years ago. Then, too, I fear Mr. Chester lays too much stress on the need for the trained mechanic on much of the work.

The making of heavy and machine guns probably requires skilled men for the most part, but this is not true in the case of shell and similar work, which forms the great bulk of war supplies in the modern battles. The majority of workers on shells in plants that are turning out the largest quantities never saw a shell before. And many of them never saw the inside of a shop before. Modern manufacturing utilizes skillfully designed machines that can be run by inexperienced men.

One great need is to study carefully the designs of shell and fuse parts in order that they may be manufactured rapidly and at minimum cost. This means paying particular attention to tolerances, to prevent their being made any finer than is absolutely necessary to have the part function properly.

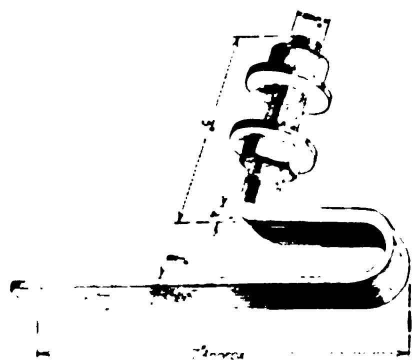
Mr. Chester's plea for the opening of the arsenals for the education of those who must make munitions in time of war is along the right line. Widespread information is of far more value than any secrecy can possibly be.

New York City. FRANK C. HUDSON.

Device To Hold Center Work to Faceplate

The accompanying illustration shows a "hold back" that is much better than the ordinary strap or belt lace. To me it appears better than two devices recently shown, one on page 188 and the other on page 203 of Vol. 44.

In using this device the $\frac{5}{8}$-in. threaded shank is inserted through a hole in the faceplate and adjusted so that the long flat spring end will have just the proper tension to hold the work in place when it is sprung over the tail of the dog. This arrangement is



A SPRING-TAILED "HOLD BACK"

very useful on production work, as the faceplate does not have to be screwed back and forth on the spindle for each piece, and it will fit any ordinary faceplate or lathe dog.

These spring dogs may be made larger or smaller, but the one shown is suitable for use on lathes of from 14- to 20-in. swing.

In removing work from the lathe it is only necessary to swing this spring dog around until it clears the tail of the lathe dog, so the faceplate does not have to be loosened. HERBERT M. DARLING.

Greenfield, Mass.

Fractions, Decimals and Millimeters

The equivalent table on page 172 suggests that perhaps my practice in handling data of this description may prove interesting.

When scrapping catalogs, I take out all data or tables and put between the covers of an old catalog the clippings

that I am likely to want immediately. These data sheets are trimmed to a standard size of 4x7½ in., the cover being about 4¼x7¾ in. The sheets are entirely loose; an elastic band around the covers keeps them together.

Should I go to another shop, perhaps I should need different data. The data sheets that I do not immediately use I keep in stock in an envelope. If I have the matter there, I can remove from the book any data that I do not require, put the sheets back in the envelope and insert new data in the book.

By this method I can locate your table of equivalents of metric and English units in a few seconds.

Wembley, England. J. H. Davis.

Side Shield for Emery Wheels

On page 606 is a query about the objection to the use of the side of emery wheels. The chief reason is that the nature of the material and the shape of the wheel do not enable it to withstand much pressure in this direction with safety, as the wheel is placed under bending strains. When the face is used, the wheel is under compression, to which it is more suited.

As the popularity of the side of the wheel is due to the same reason as that of the disk grinder—the ease of obtaining a fairly true surface without exercising great skill—it follows that the side is used chiefly for the larger surfaces. Now in order to save time and get the same unit pressure a workman will employ greater total pressure than he would on the face, which is just the reverse of what ought to occur.

I have seen wheels worn down nearly to a V-edge by this practice, spoiling the face for most uses. The thing to do is to install a disk grinder—even a small one using 9-in. emery cloth will be found a remarkably handy tool.

As the side of a wheel seldom gets a truing-up, articles ground on it are likely to appear flat when they are not, since the wheel shows a bearing all over the work.

Rochester, N. Y. S. E. Cory.

Blueprints Without Tracing

Mr. Spalding, on page 803 of the *American Machinist*, writes about making blueprints without tracing. I, too, have taken advantage of the fact that very good blueprints can be obtained from drawings made on bond paper with a soft pencil. Light-weight but very tough bond paper was selected. The scheme was found to have disadvantages as well as advantages. The lines rub off very easily, since a soft pencil must be used; and if the drawing is handled very much, it soon becomes smeary and dirty. Such drawings cannot be cleaned with art gum, as can ink tracings.

These pencil drawings are good and economical for such work as jigs and fixtures, where only a few blueprints will be made. The method is also satisfactory where an experimental model of a mechanism or machine is to be made. The drawings can readily be modified as the work of experimenting and testing reveals necessary changes and alterations. Notes can be written upon these drawings; and when the final mechanism or machine to be manufactured is decided upon, they can be used as a guide to make the permanent tracings, after which the pencil drawings are discarded.

Mr. Spalding also states that the usual method of making drawings to be reproduced by blueprinting is to transfer a pencil drawing on heavy paper to tracing cloth or paper, but such has not been my experience. I have designed a number of small, although rather complicated, mechanisms, but have never found it necessary to make pencil drawings of the details before making the final drawings on cloth. An assembly drawing was accurately made on heavy paper with a hard pencil. When the details were to be made, a few light guide lines were made on the tracing cloth with a soft pencil and the drawings made immediately in ink. I have found that such work does not require the service of a draftsman who is exceptional or out of the ordinary.

Middletown, Ohio. W. E. Sharkey.

Sponges That Only Absorb

The article on page 759 is fortunately true of only a small portion of the mechanical fraternity. One of the greatest pleasures in life is telling the other fellow how you thought out some little kink or saved time in doing a job. What a poor place this world would be if there were no chance to tell what you have done or if none of the wise ones could get together and talk over or publish their experiences for the benefit of the rest!

Where would the mechanical world be today, if men like dear old Professor Sweet, or Taylor, or hundreds of others had kept their knowledge to themselves? I imagine that our Eastern friend mentioned by Mr. Godfrey could have given Mr. Middle West a few more valuable hints on how to make munitions, had he but walked through the shop to see how the work was being done.

In all my experience in shop and factory I have never refused to tell a man what I knew about the work he was doing. This has never cost me a cent; but on the other hand, I feel sure that I have gained fully as much as I have given. It all broadens the mind, improves the capacity to think, brings out other ideas, makes friends, helps the other fellow and brings back to you information that you would not otherwise receive. Our Eastern friend has my congratulations on the way he handed it to Mr. Middle West, who I hope will profit by the experience. George G. Little.

Rochester, Minn.

Lapping Holes in Steel

On page 778 N. J. Miano tells his experiences in lapping out casehardened steel bushings. A lead lap is a poor tool with the best of lapping compounds, and with turpentine it is almost impossible to do good work, as this combination produces a sticky, black mass with poor cutting qualities. Even with brass a quick wearing away of the lap material is usually found.

Far better results can be obtained with a coarse-grained, soft, gray-iron lap with a suitable expanding device, using No. 1-F carborundum mixed with a good grade of lard oil to the consistency of a thin paste. The lap should have a number of grooves running longitudinally to retain the lapping medium.

New Britain, Conn. William C. Betz.

Editorials

Changes and Future of Russia

For many years Americans have ignored most foreign markets in favor of the excellent one at home. But the war has brought to our manufacturers a realization of the extent of the oversea opportunities, and headway has already been made in reaching out for foreign trade, particularly in South America.

The Russian market also offers great opportunities to American machinery builders, but is a field that requires careful handling and close study. Interest in its condition and possibilities is rapidly increasing among manufacturers.

The Empire of Russia comprises one-seventh of the land area of the globe; its population is about 170,000,000, the density being about 20 per square mile. (The density in the United States is 33 per square mile.) In 1861 the 20,000,000 Russian serfs were emancipated, which was the first great step toward democracy.

Since that time measures have been taken to place the peasants in the position of independent producers, principally of agricultural products. Russia's industrial advance has been impeded by the religious fervor of the masses, most of whom looked askance at Western industrial development as bringing in its wake all the evils of which their rural life was particularly free. In spite of this the influence and prestige of the manufacturing classes continued to gain headway, until just prior to the war Russia's imports amounted to $700,000,000 per year, or a per capita of about $4.

While Russian tastes are simple, as is commonly the case in communities that are largely rural, the war has effected and is effecting tremendous changes, not only in wants, but also in character and education. The war has brought to Russia many German and Austrian prisoners who, to while away the time, have eagerly grasped the opportunity for manual labor and have taught the rude peasant some of the modern ways of doing things. Similarly, Russian prisoners in Germany have been employed in all kinds of skilled and unskilled labor. Here they have learned the advantages of systematic order from the world's most successful organizers and have gained knowledge that will have its effect on Russia in the years to come.

It is impossible to belittle the marvelous change that this enforced education of the Russian masses will cause in the needs for manufactured articles of these 170,000,000 people. Familiarity with the conveniences of a higher civilization has invariably caused a desire for, and determination to continue to enjoy, such conveniences. The sentiment behind the remark of a high Russian official, to wit, "We ought to make the Kaiser a saint in our church, on account of the blessings this war has brought to Russia," can be easily understood.

At the beginning of the war Russia spent $500,000,000 for vodka, the national drink. An imperial manifesto ordering prohibition has given Russia increased buying capacity to this amount in addition to a marked increase in personal efficiency and output of labor, with its consequent further increase in purchasing power.

There is a strong economic resemblance between Russia and the United States, and the historic friendship between the two nations should prove of valuable assistance in the efforts of American manufacturers to get their proper share of Russia's foreign trade. As has been stated, Russia now imports about $700,000,000 worth yearly. These imports may some day reach $3,500,000,000 yearly, based on the American imports under similar conditions.

The main feature of the Russian market lies in newly acquired tastes of a virile, energetic population. The prospect is indeed alluring.

Reasons for Strict Government Inspections

There are so many phases to the problem of inspection that it becomes a most complicated question. It is difficult when we must guard against accidental or unintentional mistake only; but when we are obliged to draw specifications so as to cover all attempts to "put over" inferior work or material, it is not only more difficult, but inflicts hardships on those who have no intention of being dishonest. This penalty, unfortunately, occurs with almost all rules and laws—those innocent of intent too often suffer with the guilty.

This maxim is particularly true in the case of government specifications. Without excusing many of the hardships imposed upon innocent parties by the inflexible inspection and penalties for delays, we must not overlook the fact that these rulings are the direct result of dishonest dealings in the past. It is unfortunately part of the shameful history of every country that unscrupulous men have not only supplied inferior material for profit, but by their cupidity and greed have sacrificed thousands of lives which were being given to defend their very property. So the many suffer by rigid rules because of the baseness of the few.

Government inspection, as with all other inspection, must be strict, so far as the inspector is concerned. Any discretion leaves him open to influence of one kind or another. There should, however, be a man higher up, with sufficient judgment and authority to say what are allowable variations from standard. Such a man should have authority to remit unjust penalties, just as would be done by a reputable concern in private business. This function cannot, however, be intrusted to a $1,200-a-year clerk or to a political appointee, but must be given to a man with due sense of his responsibility, receiving a salary that removes ordinary temptation.

We all know the faults and frailties of government inspection, specifications and employees. But we too often forget that, in the United States, we, as private citizens and as business men, are the responsible parties. When we come to realize that "the Government" is not a thing apart, with all kinds of money to spend and a

legitimate prey for all, but that it is our Government, that we as individuals pay every cent that it spends, we will come nearer to having it run as it should be. Then, and not till then, shall we have rational inspection and penalties. Then can red tape be laid away and quick action and results be secured.

There are many who have had unpleasant and unprofitable experiences with Government contracts, owing to a variety of causes. Many are naturally resentful and refuse to bid on Government orders. Some even go so far as to say that the Government can go hang before they will supply any more machines for the arsenals. But these men do not realize that the Government's use of those machines is for their protection; that we are so bound together that the injury to one concerns all.

It is of no use to try to imagine that the Government is run perfectly. No government ever has been, and probably none ever will be. But it is our Government. We are a part and parcel of it. We pay the freight, and it is up to us to try to make it better instead of saying we do not want to play the game.

We must remember that the Government is not a political party, no matter who happens to be steering it at the moment. It is the mechanism we have constructed so that we can attend to the business of earning a living. If the mechanism is faulty, let us redesign and rebuild it.

A Criterion of Honesty

A number of years ago the leading financier of the country made the statement before a Congressional committee that money is loaned on character and not on collateral. While we should not expect a Federal bank examiner to be governed literally by this dictum, any banker will agree that the best security for a loan is the integrity of the borrower.

The most important rule of conduct for the business of life is taught every child as an exercise in penmanship—"Honesty is the best policy." It is in fact taught so early that the words mean very little when they are first learned. As children we take for granted that honesty is the best policy. It seems rather unnecessary to make so much fuss over such an obvious statement. Honesty at that age means not to lie for gain, not to steal and not to murder. Being honest looks easy. It is only after we have been in the hurly-burly of competing for a living that some of the maxims learned early in life are revealed in their true meaning. Honesty becomes a new word, not so susceptible of exact definition as we thought. The problem of choosing the honest course of action is sometimes very complex. Only the finest line may separate the honest from the dishonest course.

The young man is fortunate whose powers of discrimination are naturally keen (it is often only a good sense of values that leads to the right decision where the question is complex, and not necessarily superior moral integrity) or who has good advisors to guide him in solving his early perplexing problems. Each correct decision helps, however, to weave the fabric that eventually becomes the habitual garment of the man of character. The cynic will say that strict honesty demands sacrifice of self-interest and is therefore not compatible with material success. This is the saddest bit of sophistry of all. The statement to which we have alluded bears witness to that.

There is no truer criterion of the honesty of an employee than unswerving loyalty to his employer. This is an application of the policy of honesty which young men sometimes fail to make. Loyalty and whole-hearted allegiance to the cause in which we are engaged are the factors that very largely determine our ultimate success.

The Tavenner bill in Congress, to prohibit time study and payment of bonus in all Government plants, is not likely to pass. But the danger from the attempt has by no means gone. The next attack may be expected in the nature of riders to the four great appropriation bills—army, navy, postal and fortifications. These riders when offered, following the precedent of last year, will prohibit any money appropriated in the bills from being used for time study and bonus payment.

Of course, the next step is easily foreshadowed. It will be an attempt to establish the same prohibitions on all Government work done in private plants. Such Congressional action will also be pointed to as proof of the iniquity of the great movement for industrial progress.

The Bureau of Foreign and Domestic Commerce in a press notice quotes approvingly from its special agent, J. A. Massel, as follows: "It is evident that, if one excepts agricultural machinery and possibly a few other lines of minor importance, the American manufacturer has thus far had virtually no market in Argentina for his products in general and for machine tools in particular." That is, ". . . . if one excepts agricultural machinery . . . the American manufacturer has . . . no market in Argentina . . . for machine tools. . . ."

American machine-tool builders will be pleased indeed to know that "agricultural machinery" is machine tools. And what will they think of the reliability of the reports of a "special agent" who writes such an impossible opinion?

As a matter of fact, 40 per cent. of the machine tools in South America were made in the United States. Ninety-nine per cent. of the machines in the largest machine shop in that great continent—the Tafi Viejo shops of the Argentine State Railways, with 5,000 employees—are North American.

A correspondent of the *American Machinist* called attention to the trouble of his agent in Uruguay over some descriptive literature sent down from the United States. The difficulty arose because the weights and measures given were in English units and the origin of the matter was not stated. A letter from the Uruguayan consul in New York clears up the law in the matter. It reads:

"In answer to your communication of the 21st inst., I beg to inform you that according to a Decree signed by the Minister of Industries of Uruguay on Sept. 25, 1915, the law of Oct. 2, 1894, making unlawful the circulation in Uruguay of catalogs and other printed matter where weights and measures other than those expressed in the decimal-metrical system are mentioned has no bearing and does not apply to catalogs and other literature printed by foreign firms in foreign countries."

The point to remember is that catalogs and other printed matter intended for circulation in Uruguay and containing matter expressed in English measures must also state that they were prepared and printed by foreign firms.

Shop Equipment News

Screw Header Supplied with Friction Feed

The primary advantage of the friction feed on the header shown in Fig. 1 is that exact length of stock can be fed at each stroke of the feed lever. This is not possible with the ratchet feed, as the surface of the ratchet cannot be spaced to suit all different lengths of blanks, which results in a waste of stock in imperfect blanks. The friction device, shown in Fig. 2, enables the feed to be regulated, while the machine is running, to give just the amount of stock necessary to make a perfect head without fin or flash, provided, of course, that the punches and dies are in good condition.

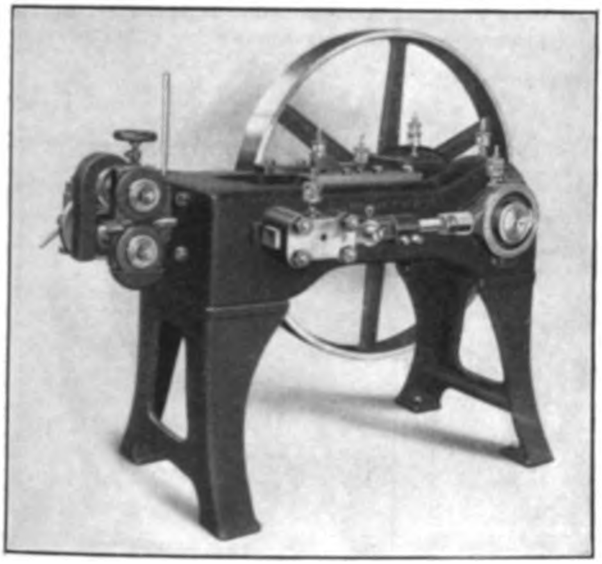


FIG. 1 SCREW HEADER

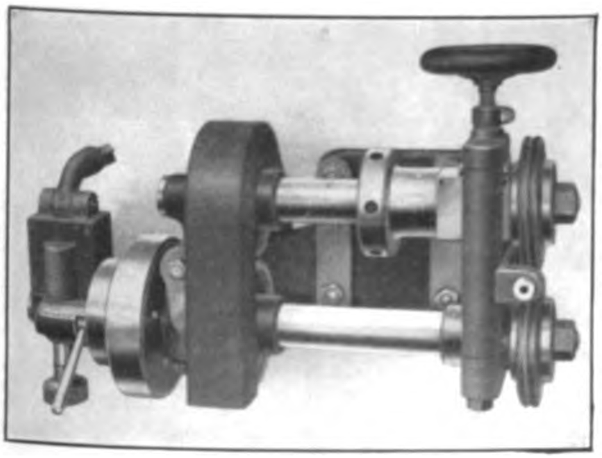


FIG. 2. FRICTION FEED OF HEADER

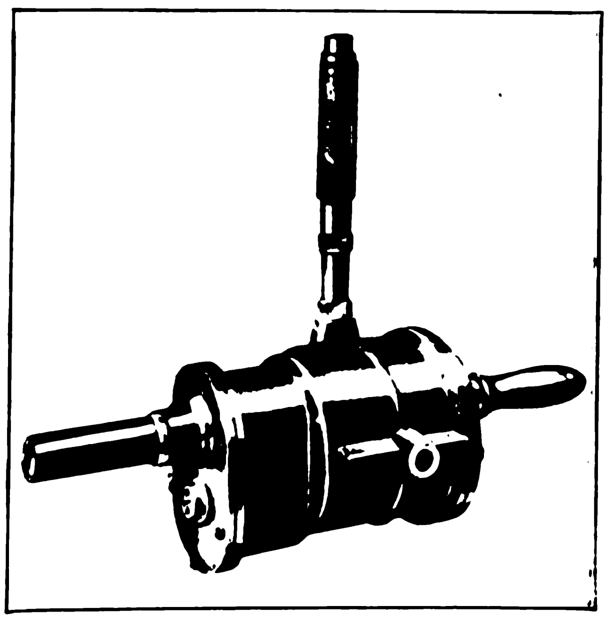
Using just the right amount of metal instead of a surplus, as is customary to insure full heads, relieves the pressure on punch and die and increases their life. It also relieves the stresses on the machine. The operator can start and stop the feed as well on the back stroke of the feed arm, doing away with the making of shorts on bung heads. The friction is adjusted to slip with unusual strain, avoiding breakage in case the blank sticks in the dies.

There is no stop on this machine. This saves wear on the feed rolls, caused by setting the stop to feed too much wire and then letting it slip, soon wearing the rolls out of round and necessitating frequent replacements. The cutoff is so constructed that it does not operate as long as there is any pressure on the punch. This arrangement saves the wear from excessive friction, which is more than many seem to realize.

These headers are made by the Asa S. Cook Co., 605 Franklin Ave., Hartford, Conn., which makes five sizes of both solid- and open-die, single-blow, cold-heading machines.

Portable Pneumatic Tapping and Drilling Machine

The machine shown was designed for tapping holes for stay-bolts and screwing bolts into place in all kinds of firebox work. It may also be used for drilling and reaming holes in other work up to $1\frac{1}{4}$ in. in diameter.



PNEUMATIC TAPPING AND DRILLING MACHINE

With a working pressure of 100 lb. it runs at a speed of 175 r.p.m. and develops $2\frac{1}{2}$ hp. When used for rolling boiler tubes, it will roll out a complete set of

three hundred $2\frac{1}{4}$-in. boiler tubes, including both ends, in 6 hr. It is composed of but nine parts—gears, throttle handle and all. The total weight in working order is 28 lb., and it is made by the Baird Pneumatic Tool Co., Topeka, Kan.

Special Shell Equipment

The illustrations herewith represent a line of special shell-making machinery developed by Horne, Dale, Brown Co., Chicago, Ill. In addition to the machines shown there are incorporated in the complete line a cutting-off machine, a banding machine and stamp rolls, thus providing complete machining equipment for shells ranging in size from 3 to 12 in.

It will be observed that the machines are of the single-purpose type and heavily proportioned. The designs were worked out in a large munition-manufacturing plant and were adopted as marketable products only after meeting the exacting requirements of shell production.

The roughing lathe, Fig. 1, has a long hollow spindle and powerful driving mechanism. The tailstock has a double spindle, one operated by a double-pitch screw for fast travel and the other by a five-pitch screw for tightening. The machine has three traverse feeds and three crossfeeds. Provision is made for hand feeding in both directions. All gears in the apron are of steel, except the worm gear, which is of bronze.

Two roughing lathes are used. The first roughing lathe, shown, rough-turns the diameter and rough-faces. The second roughing lathe, not shown, takes the second roughing cut on the diameter, finish-turns up to the end of the band groove and finish-faces the end.

The only difference in the two lathes is that the first roughing lathe has gear reduction on the spindle and has a drive pulley and pinion running on a stationary bearing, while the second roughing lathe is driven direct by a pulley on the spindle.

The grooving machine, Fig. 2, grooves, undercuts, waves and forms the radius on the end of the shell. The machine is driven direct from the lineshaft and is started and stopped by a jaw clutch on the main-drive pulley. Two tools are used, one in front and one in back of the tool carriage. The operator can use either power or hand feed when grooving, and the front tool waves and forms the radius. Stops enable the operator to get all distances exact without the use of hand gages. A swinging stop located on the tool carriage locates the base end of the shell. A double swinging stop located on the bed of the machine locates the grooving tool and also the waving tool. When the waving tool is located, the tool carriage is automatically reciprocated. The re-

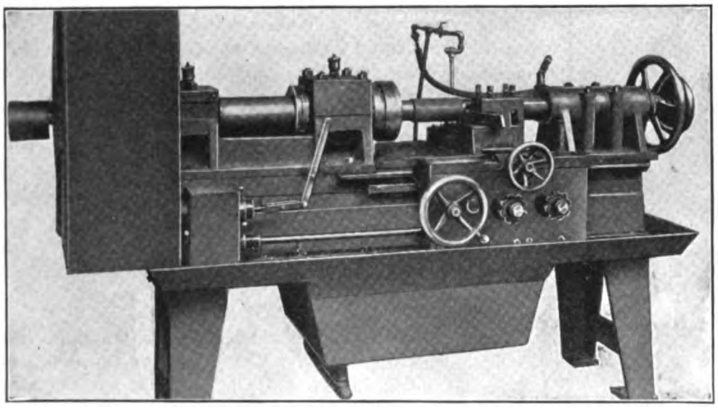


FIG. 1. SHELL-ROUGHING LATHE

Swing over bed, 16 in.; swing over tool-post slide, 7 in.; distance between centers, 24 in.; driving pulley, $19 \times 5\frac{1}{4}$ in.; floor space, 41x84 in.; weight, 3,200 lb.

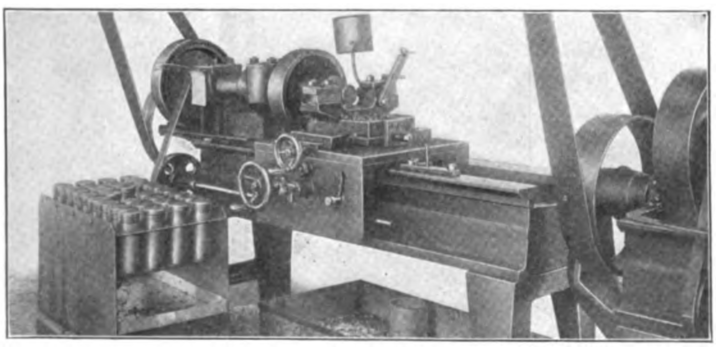


FIG. 2. GROOVING LATHE

Swing over bed, 20 in.; swing over tool-post slide, $4\frac{1}{2}$ in.; cutting tool, 10 in. over bed; distance from spindle to extreme travel of carriage, 17 in.; distance between ways, 8 in.; width of bed, 16 in.; driving pulley, $20 \times 5\frac{1}{4}$ in.; hole in spindle, $1\frac{3}{4}$ in.; floor space, 2 ft. 6 in. by 7 ft. 4 in.; weight, 3,200 lb.

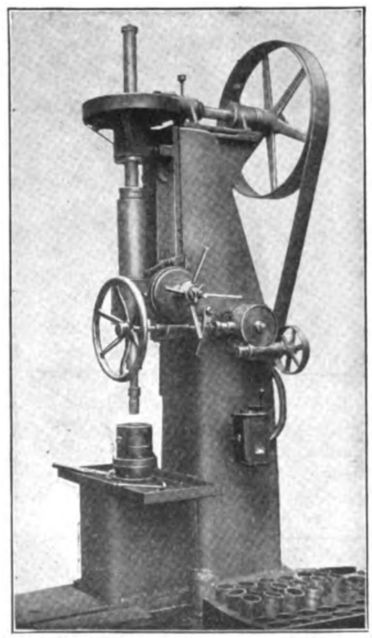


FIG. 3. SINGLE-SPINDLE DRILLING MACHINE

Distance from table to end of spindle, when up, 30 in.; travel of spindle, 20 in.; power feed per revolution of spindle, 0.012 in.; large diameter, $3\frac{11}{16}$ in.; small diameter, $3\frac{1}{4}$ in.; diameter of sleeve, 7 in.; driving pulley, $31 \times 6\frac{1}{4}$ in.; pulley speed, 170 r.p.m.; height overall with spindle up, 11 ft. 8 in.; floor space, 28x50 in.; approximate weight, 6,200 lb.

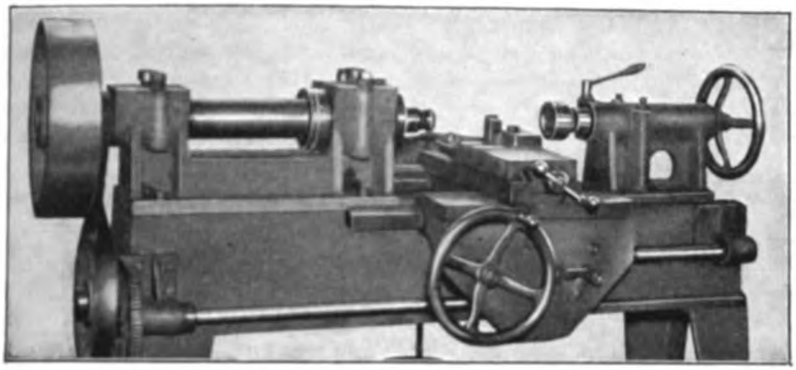


FIG. 4 SHELL-FINISHING LATHE

Swing, 18 in.; width of ways on bed, 17 in.; height from floor to center of spindle, 44 in.; driving pulley, 20x5⅝ in.; floor space, 3 ft. 4 in. by 6 ft. 8 in.; approximate weight, 3,000 lb.

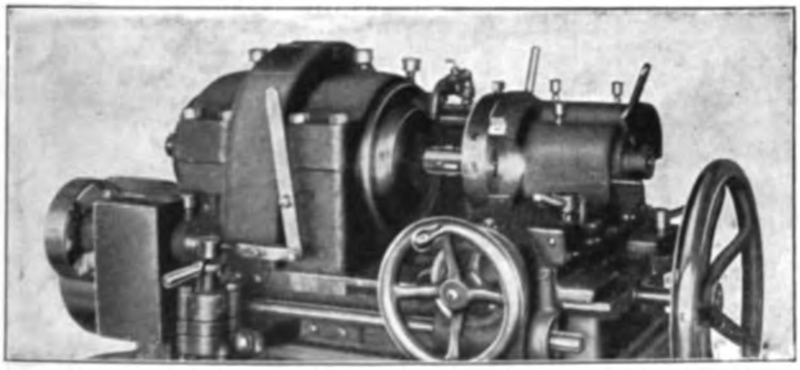


FIG. 5 SHELL-NOSING LATHE FOR 3.3-IN. SHRAPNEL

Swing, 14½ in.; width of ways, 17⅝ in.; height without legs, 2 ft. 5 in.; driving pulley, 14x3⅝ in.; spindle, 5½ in. in diameter by 19⅝ in. long; floor space, 2 ft. 9 in. by 5 ft.

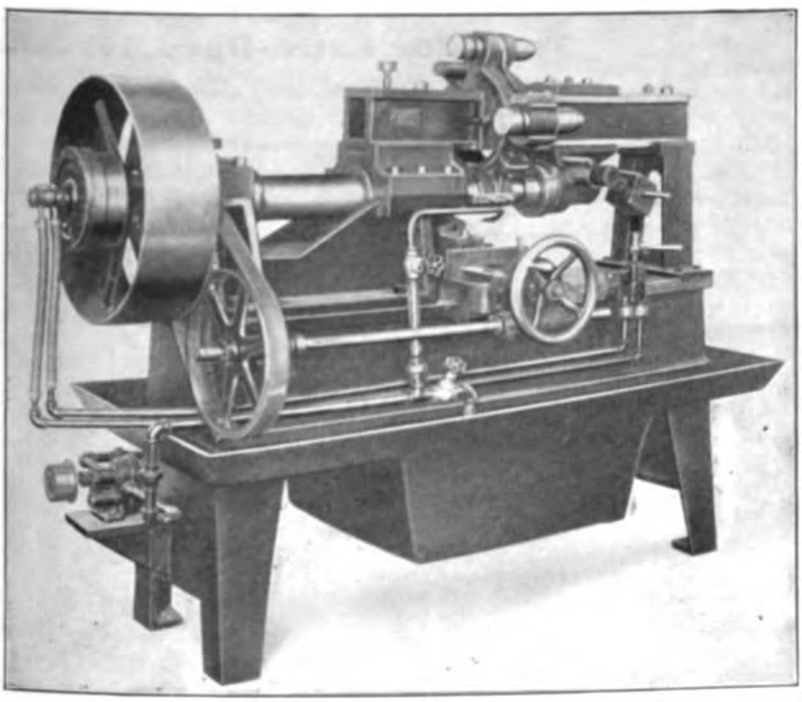


FIG. 6 COPPER-BAND TURNING LATHE

Distance between ways, 16 in.; driving pulley, 24x7⅛ in.; height from floor to center line of spindle, 44 in.; large diameter of spindle, [illegible] in.; small diameter of spindle, 4 in.; diameter of front spindle bearing, [illegible]; diameter of rear spindle bearing, 4 in.; height overall, 61 in.; floor space, 2 ft. 5 in. by 7 ft. 6 in.; weight, 3,[illegible]50 lb.

ciprocating motion for waving is accomplished by a hardened tool-steel roller contacting by spring pressure on a chilled cast-iron wave ring. The machine may be equipped with either air-operated or mechanically operated chucks.

The single-spindle drilling machine, Fig. 3, is designed to be sufficiently rigid to maintain alignment. The column is of one-piece construction. The machine is equipped for hand and power feed. The power feed is of the friction type and quickly engaged and released. An automatic feed trip is also used for releasing the feed. For hand feeding, a large handwheel is provided.

The lathe shown in Fig. 4 is intended for finish-turning the nose and diameter. A heavy pulley on the end of the spindle acts as a flywheel and aids in eliminating tool chatter. The nose end of the shell is screwed to a hardened tool-steel threaded plug located in the end of the spindle. The base end of the shell is centered and held in a self-centering center of special design. Micrometer-screw adjustment facilitates setting the tool for diameter. The machine is equipped for hand and power feed.

A turret forms part of the cross-slide on the nosing lathe, Fig. 5. The turret indexes in three positions. When indexed in the first position the nose end of the shell is bored and faced; in the second position the inside radius is formed; in the third position the shell is tapped. The machine is equipped for hand and power feed. Large, heavy handwheels are furnished for hand feeding. Three feeds are provided for power feeding. The feed screw for longitudinal feed is located in the center of the carriage.

In the copper-band turning machine, Fig. 6, the shell is held on the base end in a double-acting air chuck provided with hardened tool-steel jaws. The chuck fits into a large high-carbon steel spindle running in babbitted bearings. The nose end of the shell is held in a centering device which is made of hardened and ground tool steel running in a large bronze-bushed bearing, tapered so as to take up for wear. The turning tool bottoms solidly in the tool holder, which has three adjustments—one for the approximate height of the tool, one micrometer adjustment for the exact height and a side adjuster.

The machine is equipped with an automatic indexing magazine holding four shells. The feed is thrown out automatically by an adjusting feed tr[illegible]

Crank-Driven Slotter and New Speed Gear Box

The special feature of the crank slotter shown in Fig. 1 is the swiveling cutter bar guide, which adjusts 5 deg. each side of the perpendicular. This swivel adjustment is designed to make the machine especially adapted to die shaping. When furnished for toolroom work or duplication of parts, positive turret duplicating stops are added to the cross and lateral table motions.

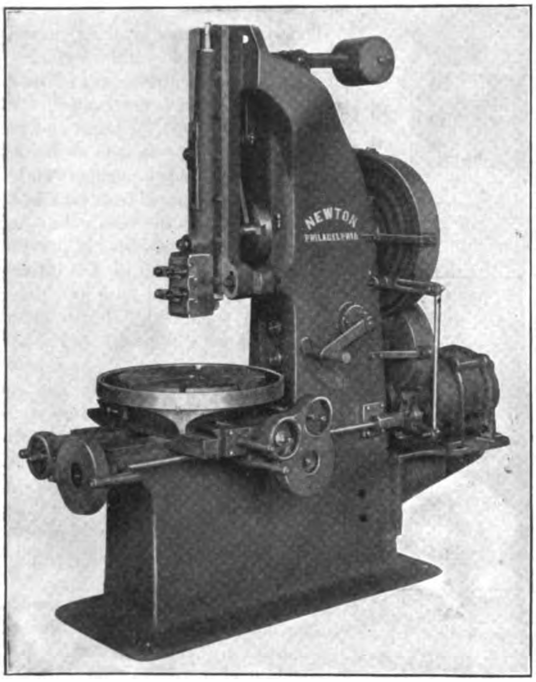


FIG. 1. CRANK-DRIVEN SLOTTER

The machine is driven by a 5-hp. 750-r.p.m. 50-cycle 3-phase 190-volt motor. To permit the use of a constant-speed motor on this machine and a number of its other types of machine tools the builders, Newton Machine-Tool Works, Philadelphia, Penn., have developed the oil-tight speed-change gear box shown in Fig. 2. This box is fitted with all steel or bronze gears, mounted on a sliding sleeve and controlled by latch levers fitted through the covers. The speed box is mounted within the upright.

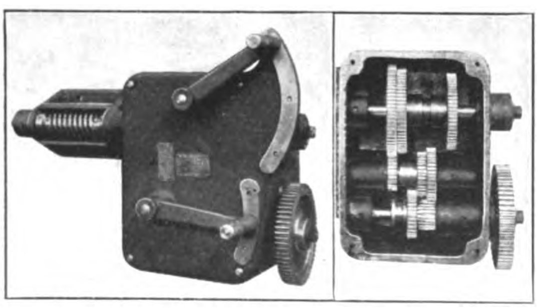


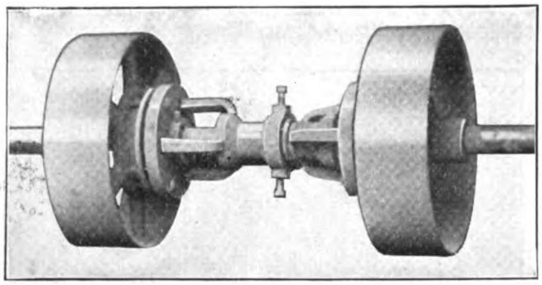
FIG. 2. OIL-TIGHT SPEED GEAR BOX

In order to dispense with belt shifting on belt-driven machines the speed box has been arranged to permit, when desired, the mounting of a single-step driving pulley on the opposite end of the shaft to that occupied by the driving gear as used on motor drives.

Pulley-Type Clutch

In the disk pulley-type clutch shown the wear is taken up by suitable lining which may be readily and economically renewed.

The clutch is so arranged that when released the clearance is sufficient to afford a clean release without drag. A large frictional surface is also provided. The engagement is gradual and the release instantaneous.

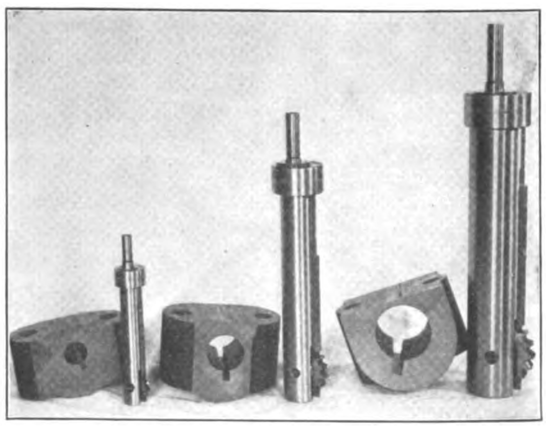


PULLEY-TYPE CLUTCH

The clutch pulley is supplied singly when the reverse is not used and is designed to be particularly adapted for machine-tool application. It is a recent product of the Porter Machine Co., Wooster, Ohio.

Tools for Extra-Deep Keyseats

While the tools shown closely resemble those previously made by the National Machine Tool Co., Cincinnati, Ohio, some changes were necessary in order to make them cut the extraordinary depth of keyseats required. As the figures will show, these keyseats are $1\frac{1}{2}$ times their width



TOOLS FOR EXTRA-DEEP KEYSEATS

Smallest size shown, $\frac{13}{16}$ in. in diameter, to cut keyseat $\frac{3}{16}$ in. wide by $\frac{9}{32}$ in. deep. Next size, $1\frac{5}{16}$ in. in diameter to cut $\frac{1}{4}$ in. wide by $\frac{3}{8}$ in. deep. Largest size, 2 in. in diameter, to cut $\frac{3}{8}$ in. wide by $\frac{9}{16}$ in. deep.

and would be difficult to cut in any other way and still obtain a slot true with the bore. These tools are intended for use in a drilling machine. The milling cutters are of high-speed steel, and the keyseats are finished at one cut.

Slip-Ring Induction Motors

A line of slip-ring induction motors, designed especially for heavy work, has been recently developed by the Westinghouse Electric and Manufacturing Co., Pittsburgh, Penn. The motors are furnished in sizes from 1½ to 200 hp. The frames of the smaller sizes are made up of steel laminations riveted between forged-steel end shields; in the larger sizes the frames are made of rolled steel.

TRADE CATALOGS

E. E. Bartlett, 326 A Street, Boston, Mass. Catalog. Greenerd arbor press. Illustrated, 28 pp., 4x[illegible] in.

Buffalo Foundry & Machine Co., Buffalo, N. Y. Catalog No. 16-4. Bell steam hammers. Illustrated, 34 pp., 8½x11 in.

G. A. Almorth, 466 Grand Ave., New Haven, Conn. Circular. Almorth practical drawing table. Illustrated.

The Hartford Machine Screw Co., Hartford, Conn. Catalog. Machine screws, nuts, set screws, cap screws, etc. Illustrated, 66 pp., 6x9 in.

The Asa S. Cook Co., 605 Franklin Ave., Hartford, Conn. Catalog No. 25. Wood screw machinery, rivet machines, open and solid die headers. Illustrated, 32 pp., 6x9 in.

The Wallace Barnes Co., Bristol, Conn. Booklet No. 7. Springs, screw-machine products, wire, steel. Illustrated, 28 pp., 6½x9½ in.

Armstrong Cork and Insulation Co., Pittsburgh, Penn. Pamphlet. "Nonpareil High Pressure Covering for Heated Surfaces." Illustrated, 64 pp., 6x9 in.

Boston Gear Works, Norfolk Downs, Quincy, Mass. Pamphlet. Worm gears, worms and spirals. Illustrated, 10 pp., 6x9 in.

Chicago Pneumatic Tool Co., Fisher Building, Chicago, Ill. Bulletin E 39. Duntley electric grinders. Illustrated, 8 pp., 6x9 in.

The Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Penn. Bulletin No. 8[illegible]. The Potentiometer System of Pyrometry. Illustrated, 28 pp., 8x10½ in.

C & C Electric and Manufacturing Co., Garwood, N. J. Bulletin No. 101. Type 81, motors. Illustrated, 20 pp., 8x10½ in.

The Richardson-Phenix Co., Milwaukee, Wis. Bulletin No. 5. Oil filters. Illustrated, 24 pp., 8½x11 in.

The Graton & Knight Manufacturing Co., Worcester, Mass. Catalog No. 3. Leather belting, leather, packings, straps, belt cement, belt dressing, etc. Illustrated, 120 pp., 6x9 in.

Brown & Sharpe Manufacturing Co., Providence, R. I. Catalog No. 1[illegible]6. Milling, grinding, gear-cutting and screw machines, machinists' tools, etc. Illustrated, 616 pp., [illegible]x6 in.

Waterhouse Welding Co., Pelham St., Boston, Mass. Catalog. Oxyacetylene welding and cutting outfits. Illustrated, 6x9 in.

Alston Saw and Steel Co., Foxcroft, Penn. Catalog. Hacksaw blades. Illustrated, 12 pp., 3½x[illegible] in.

Charles H. Besly & Co., 118-124 N. Clinton St., Chicago, Ill. Catalog No. [illegible]. Machinists' tools and [illegible] supplies, brass, copper, bronze and german silver sheets, rods, wire and tubes, brass [illegible], Besly disk grinders, etc. Illustrated, 77[illegible] pp., 7x[illegible] in.

PERSONALS

H. T. White, for a number of years tool superintendent of the Modern Tool Company, Erie, Penn., now represents the company in the Detroit territory.

D. M. Crossman has been appointed publicity manager of the Niles-Bement-Pond Co., succeeding H. M. Cleaver, who was recently transferred to the Plainfield works. Mr. Crossman was formerly assistant manager of publicity.

OBITUARY

Oliver B. Niedringhaus, superintendent of the National Enameling and Stamping Co., Granite City, Ill., died at his home in St. Louis, Mo., on May 2[illegible], after a long illness.

Fred Arnold Welles, inventor of the friction adjustment for calipers, died in Milwaukee, Wis., May 14. Mr. Welles was born in Milwaukee, June 9, 1863. After attending the public schools he entered the employ of the Edward P. Allis Reliance Works, where he learned the machinist's trade. From early youth he had shown great aptitude for things mechanical, and many steam engines, boilers and other machines were built in his father's gun shop. In this work as a boy and later as an apprentice, considerable experience was gained and he invented a cut-off and governor which bid fair to become a disturbing element in steam engineering. He also invented an adjustment for calipers and a type of surface gage having features not found on any others then made. In all he developed about one hundred different patentable tools, but never patented them owing to the continual barrier of ill health. After serving his apprenticeship he vacillated between the cut-off scheme and his tools and chose the latter, as the former seemed to him too gigantic a scheme to launch for his poor health, although it had proved very satisfactory experimentally. So he placed the Welles caliper on the market in 1889. In 1894 he became greatly interested in the gas engine and a number of different types of engines were built. He was among the first to enter the automobile field, and built a car having numerous original features, such as the planetary gear and cantilever spring as now used, the car in general being modeled after that of Leon Bollee, France. In 1905 he moved to Waukesha, Wis., where he also moved his tool business. Continual ill health forced him to dispose of this business to one of his friends and former employees.

BUSINESS ITEMS

Van Dorn & Dutton Co., Cleveland, Ohio, has removed its Denver, Colo., offices from the Ideal Building to 1633 Tremont St. C. H. Davidson, district sales manager.

To more adequately take care of its growing business in New England the Hoskins Manufacturing Company has opened a branch office in the Equity Bldg., Boston, Mass., of which J. E. Hines will be in charge.

The Modern Tool Company, Erie, Penn., have decided to devote their manufacturing facilities exclusively to their line of self-contained internal, plain and universal grinders, in pursuance of which policy they have disposed of their overhead countershaft line of grinders to Albert J. Ott, Chicago, Ill.

FORTHCOMING MEETINGS

Master Car Builders' Association. Annual meeting, June 14-17, Atlantic City, N. J. Joseph W. Taylor, secretary, Karpen Building, Chicago, Ill.

American Railway Master Mechanics' Association. Annual meeting, June 17-21, Atlantic City, N. J. Joseph W. Taylor, secretary, Karpen Building, Chicago, Ill.

American Society for Testing Materials. Annual meeting June 27 to July 1, 1916, Hotel Traymore, Atlantic City, N. J. Edgar Marburg, secretary, University of Pennsylvania, Philadelphia, Penn.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Wednesday each month. J. A. Brooks, secretary, Brown University, Providence, R. I.

New England Foundrymen's Association. Regular meeting second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, first Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. J. H. Warder, secretary, 1735 Monadnock Block, Chicago, Ill.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Technical League of America. Regular meeting second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York, N. Y.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	June 1, 1916	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$15.00	$15.00	$9.50
No. 2 X Northern Foundry, New York	20.75	20.75	14.25
No. 2 Northern Foundry, Chicago	19.00	19.00	13.00
Bessemer, Pittsburgh	21.95	21.95	14.80
Basic, Pittsburgh	18.95	18.95	13.45
No. 2 X, Philadelphia	20.50	20.50	14.25
No. 2, Valley	18.50	18.50	12.75
No. 2, Southern Cincinnati	17.90	17.90	12.40
Basic, Eastern Pennsylvania	20.50	20.50	13.25
Gray forge, Pittsburgh	18.70	18.70	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger and plates ¼ in. and heavier from jobbers' warehouse at the places named:

	New York June 1, 1916	New York One Month Ago	New York One Year Ago	Cleveland	Chicago
Steel angles, base	3.50	3.25	1.85	3.25	3.10
Steel T's, base	3.55	3.30	1.90	3.25	3.10
Machinery steel (bessemer)	3.50	3.25	1.80	3.25	3.10
Steel plates	4.10	...	...	3.65	3.50

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse at the places named:

	New York June 1, 1916	New York One Month Ago	New York One Year Ago	Cleveland	Chicago
No. 28 black	3.65	3.65	2.60	3.20	3.20
No. 26 black	3.55	3.55	2.50	3.10	3.10
Nos. 22 and 24 black	3.50	3.50	2.45	3.05	3.05
Nos. 18 and 20 black	3.45	3.45	2.40	3.00	3.00
No. 16 blue annealed	4.70	4.45	2.35	3.70	3.60
No. 14 blue annealed	4.60	4.40	2.25	3.60	3.50
No. 12 blue annealed	4.50	4.30	2.20	3.50	3.45
No. 10 blue annealed	4.55	...	...	3.55	3.40
No. 28 galvanized	5.65	5.65	4.25	5.50	5.50
No. 26 galvanized	5.35	5.35	3.95	5.20	5.20
No. 24 galvanized	5.20	5.20	3.80	50.5	5.05

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot for carload lots f.o.b. mill:

	Black June 1, 1916	Black One Yr. Ago	Galvanized June 1, 1916	Galvanized One Yr. Ago
¾ to 2 in. steel butt welded	70%	81%	50½%	72½%
2½ to 6 in. steel lap welded	68%	80%	48½%	72½%
Diameter, In.				
¾	3.45	2.19	5.69	3.16
1	5.10	3.23	8.42	4.68
1¼	6.90	4.37	11.39	6.33
1½	8.25	5.23	13.61	10.18
2	11.10	7.03	18.32	10.18
2½	18.72	11.70	30.13	16.09
3	24.48	15.30	39.40	21.04
4	34.88	21.80	56.14	29.98
5	47.36	29.60	76.22	40.70
6	61.44	38.40	98.88	52.80

From New York stock the following discounts hold:

	Black	Galvanized
3½ to 6 in. steel lap welded	61%	36%
¾ to 3 in. steel butt welded	64%	42%

Malleable fittings, Class B and C, from New York stock sell at 30 and 5% from list price. Cast iron, standard sizes, 55%.

Bar Iron—Prices are as follows in cents per pound at the places named:

	June 1, 1916	One Month Ago
Pittsburgh, mill	2.65	2.50
Warehouse, New York	3.25	3.25
Warehouse, Cleveland	3.25	3.25
Warehouse, Chicago	3.10	3.10

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-size lots, the following quotations hold:

	June 1, 1916	One Month Ago
New York	List price plus 20%	List price plus 20%
Cleveland	List price plus 20%	List price plus 20%
Chicago	List price plus 10%	List price plus 10%

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York Today	New York One Year Ago		
$6.00	$3.75@4.00	Cleveland... $6.30	Chicago... $5.25

In coils an advance of 50c. is usually charged.

High Speed Tool Steel containing from 10 to 18% tungsten sells as follows per pound in New York:

Billets ....$2.40   Bars $3.25

Drill Rod—Discounts from list price in New York are as follows: Standard, 65%; extra, 60%; special, 55%.

METALS

Miscellaneous Metals—The present quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	New York June 1, 1916	New York One Month Ago	New York One Year Ago
Copper, electrolytic (carload lots)	30.00	30.50	19.00
Tin	48.00	50.00	37.25
Lead	7.50	7.50	4.40
Spelter	15.00	18.12½	21.00
ST. LOUIS			
Lead	7.37½	7.37½	...
Spelter	14.75	18.00	...

At the places named, the following prices in cents per pound prevail:

	New York June 1, 1916	New York One Month Ago	New York One Year Ago	Cleveland	Chicago
Copper sheets, base	37.50	36.50	24.00	37.50	37.00
Copper wire (carload lots)	37.50	36.50	23.00*	32.50	37.50
Brass rods, base	44.50	44.00	23.00*	38.00	38.50
Brass pipe, base	46.50	44.50	23.00*	44.00	46.00
Brass sheets	44.50	43.00	23.00*	38.00	38.50
Solder ½ and ½ (case lots)	30.00	30.75	27.00	35.50	34.00

*At this time a year ago quotations on these supplies were withdrawn and as given above were merely nominal.

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York June 1, 1916	New York One Month Ago	Cleveland June 1, 1916	Cleveland One Month Ago
Copper, heavy and crucible	24.50	25.00	25.00	25.00
Copper, heavy and wire	24.00	24.50	24.00	24.00
Copper, light and bottoms	21.00	22.00	20.00	24.00
Lead, heavy	6.00	6.00	6.00	7.00
Lead, tea	5.50	5.50	5.00	6.00
Brass, heavy	14.25	14.50	19.00	20.00
Brass, light	11.50	12.50	12.50	13.00
No. 1 yellow rod brass turnings	15.25	15.25	14.50	14.50
Zinc	11.00	13.00	12.00	16.00

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over*	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	35.50	36.00	36.50	37.00	38.00
1/4 to 5/16	35.25	35.75	36.25	36.75	37.75
3/8 to 1 7/8	35.00	35.50	36.00	36.50	37.50
1 15/16 to 2 7/8	35.75	36.25	36.75	37.25	38.25
Rounds					
3 to 3 7/16	36.50	37.00	37.50	38.00	39.00
Squares					
3	36.50	37.00	37.50	38.00	39.00
Rounds					
3½ to 3 15/16	36.25	36.75	37.25	37.75	38.75
Squares					
3 1/16 to 3 15/16	36.25	36.75	37.25	37.75	38.75
Rounds—Squares					
4 to 4 15/16	37.00	37.50	38.00	38.50	39.50
5 to 6 15/16	38.00	38.50	39.00	39.50	40.50
7	38.50	39.00	39.50	40.00	41.00
Flats	36.50	37.00	37.50	38.00	39.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.
Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Antimony—Chinese and Japanese brands are quoted in cents per pound for spot delivery, duty paid:

	June 1, 1916	One Month Ago
New York	28.00	39.00
Cleveland	50.00@55.00	50.00
Chicago	46.00	45.00

Zinc Sheets—The following prices in cents per pound prevail:

Carload lots, f.o.b. mill................................ 24.50

	In Casks June 1, 1916	In Casks One Month Ago	Broken Lots June 1, 1916	Broken Lots One Month Ago
New York	26.00	26.00	26.50	26.50
Cleveland	26.50	26.00	27.00	26.50
Chicago	26.50	26.50	27.00	27.00

Copper Bars from warehouse sell as follows in cents per pound:

	June 1, 1916	One Month Ago
New York	43.00	42.00
Cleveland	37.50	31.50
Chicago	39.00	....

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places named:

	New York	Cleveland	Chicago
Best grade	60.00@[illegible].00	58.75	60.00
Commercial	30.00@[illegible].00	21.00	25.00@28.00

SHOP SUPPLIES

Nuts—From warehouses at the places named, on fair sized orders the following amount is deducted from list:

	New York June 1, 1916	New York One Month Ago	Cleveland June 1, 1916	Cleveland One Month Ago	Chicago June 1, 1916	Chicago One Month Ago
Hot pressed square	$2.50	$2.50	$3.00	$3.25	$3.25	$3.25
Hot pressed hexagon	2.50	2.50	3.00	3.50	3.25	3.25
Cold punched square	2.00	2.00	2.65	3.00	3.00	3.00
Cold punched hexagon	2.50	2.50	3.25	3.50	3.50	3.50

Semifinished nuts sell at the following discounts from list price:

	June 1, 1916	One Month Ago
New York	[illegible]	[illegible]
Cleveland	[illegible]	6[illegible]-10%
Chicago	6[illegible]	70%

Carriage Bolts—From warehouses at the places named the following discounts from list price are in effect:

	New York	Cleveland	Chicago
⅜ by 6 in.	[illegible]	[illegible]	60[illegible]
Larger and longer	3[illegible]	40-15%	50%

At this rate the net prices are as follows:

Length, In.	New York ¼	New York ½	New York ⅝	Cleveland ¼	Cleveland ½	Cleveland ⅝	Chicago ¼	Chicago ½	Chicago ⅝
1½	$0.[illegible]3	...	...	$0.41	...	...	$0.38	...	...
2	.58	...	...	.48	...	...	.42	...	...
2½	.63	$2.12	$[illegible]	.51	$1.39	$1.63	.46	$1.63	$4.25
3	.68	2.30	[illegible]	[illegible]	1.[illegible]1	1.[illegible]	.50	1.77	4.[illegible]0
3½	.73	2.48	6.18	.60	1.64	4.06	.54	1.91	4.75

Machine Bolts—From warehouses at the places named the following discounts hold:

	New York	Cleveland	Chicago
⅜ by 4 in. and smaller	50%	60 and 10%	60 and 10%
Larger and longer up to 1 in. by 30 in.	40%	50 and 15%	50 and 10%

At this rate the net prices per 100 follow:

Length In.	New York ¼	New York ½	New York 1	Cleveland ¼	Cleveland ½	Cleveland 1	Chicago ¼	Chicago ⅝	Chicago 1
2	$0.89	$2.32	$9.60	$0.67	$1.48	$6.08	$0.64	$1.74	$7.20
2½	.93	2.48	10.14	.70	1.57	6.22	.67	1.85	7.60
3	.97	2.63	10.68	.73	1.66	6.86	.70	1.97	8.00
3½	1.01	2.79	11.22	.77	1.77	7.48	.73	2.08	8.40

Wrought Washers—From warehouses at the places named the following amount is deducted from list price:

New York.... $4.00 Cleveland.... $6.00 Chicago.... $6.00

At this rate, the net prices follows:

Diameter, In.	New York	Cleveland	Chicago
[illegible]	$10.00	$8.00	$8.00
[illegible]	8.20	6.20	6.20
[illegible]	7.40	5.40	5.40
[illegible]	6.[illegible]0	4.50	4.70
[illegible]	5.80	3.80	3.80
[illegible]	5.40	3.40	3.40
[illegible]	5.30	3.30	3.30
[illegible]	5.20	3.20	3.20
¾, 1, 1⅛	5.10	3.10	3.10
1¼, 1⅜, 1½	5.00	3.00	3.00
1⅝, 1¾, 1⅞, 2	5.20	3.[illegible]0	3.20
[illegible]	5.[illegible]0	3.[illegible]0	3.50
2¼, 2½	6.50	4.50	4.50

For cast-iron washers the base price per 100 lb. is as follows:

New York.... $2.50 Cleveland.... $2.00 Chicago.... $2.10

Rivets—The following quotations are allowed for fair sized orders from warehouse:

	New York	Cleveland	Chicago
Steel 7/16 and smaller	45%	45-10%	52½%
Tinned	45%	45-10%	52½%

Button heads ⅝, ¾, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.:

New York.... $5.25 Cleveland.... $3.85 Chicago.... $3.50

Cone heads, same sizes:

New York.... $5.35 Cleveland.... $3.95 Chicago.... $3.60

For the following sizes the extras over the above prices in cents per 100 lb. are as follows:

1¼ to 1¾ in. long, all diameters	$0.25
⅝ in. diameter	0.35
½ in. diameter	0.50
1 in. long and shorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

Copper Rivets and Burs sell at the following rate from warehouse:

	Rivets June 1, 1916	Rivets One Month Ago	Burs June 1, 1916	Burs One Month Ago
Cleveland	List price	List price	List price	List price
Chicago	List price	List price	List price	List price
New York	10-2½% from list	20% from list	10-2[illegible]% from list	List price

Nails—Wire nails f.o.b. Pittsburgh sell at \$2.50@2.60; galvanized 1 in. and longer, \$3.50@3.60, and shorter, \$5@5.10. These prices are to regular customers and delivery is made at the mill's convenience. From warehouse wire and cut nails sell as follows:

	Wire June 1, 1916	Wire One Month Ago	Cut June 1, 1916	Cut One Month Ago
New York	$3.15	$2.90	$3.15	$2.90
Cleveland	3.05	2.95	2.95	2.8[illegible]
Chicago	2.85	2.70	2.85	2.70

MISCELLANEOUS

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York.

Welding Wire

⅜, [illegible]	10.00
No. 8, [illegible] and No. 10	11.00
⅛	12.50
No. 12	13.50
[illegible] No. 14 and [illegible]	15.00
No. 18	16.50
No. 20	17.50

Special Welding Steel

⅜	33.00
[illegible]	30.00
[illegible]	28.00

Cast-Iron Welding Rods

⅛ by 19 in. long	22.00
[illegible] by 12 in. long	26.00
⅜ by 19 in. long	20.00
½ by 21 in. long	20.00

Vanadium Wire in Coils or Sticks

[illegible]	15.50
[illegible]	15.00
¼	14.00
[illegible]	12.00
[illegible] and larger	11.00

Tin Plates—The following prices are in effect from warehouses at the places named.

			New York June 1, 1916	New York One Month Ago	Cleveland June 1, 1916	Cleveland One Month Ago	Chicago June 1, 1916	Chicago One Month Ago
Coke tin plate, 14x20:								
100 lb.			$6.25	$6.00	$6.00	$5.40	$5.65	$5.60
I. C. 107 lb.			6.40	6.15	6.15	5.55	5.65	5.75
Terne plate, 20x28:								
Base Wgt.	Net Wgt.	Coating						
100 lb.	200	8	$10.50	$10.00	$9.10	$9.10	$8.90	$8.90
I. C.	214	8	10.80	10.30	9.60	9.35	9.25	9.25
I. X.	270	8	12.80	12.30	11.85	11.60	11.50	11.40
I. C.	218	12	12.00	12.00	10.75	10.50	10.75	10.75
I. C.	221	15	13.00	13.00	10.75	10.50	11.60	11.60
I. C.	226	20	13.50	13.50	12.75	12.50	12.50	12.50
I. C.	231	25	14.25	14.25	13.75	13.50	13.75	13.75
I. C.	236	30	15.50	15.50	14.75	14.50	14.75	14.75
I. C.	241	35	17.00	17.00	16.00	15.75	15.85	15.85
I. C.	246	40	19.00	19.00	17.00	16.75	17.10	17.10

Seamless Drawn Tubing (Iron Pipe Sizes)—The base price per pound from warehouse is as follows:

	New York	Cleveland	Chicago
Brass	43.50	46.00	43.50
Copper	48.00	48.00	44.50

For immediate stock shipment the following quotations hold.

Diameter, In.	Copper New York June 1, 1916	Copper New York One Year Ago	Copper Cleveland	Copper Chicago	Brass New York June 1, 1916	Brass New York One Year Ago	Brass Cleveland	Brass Chicago
⅜ to 2½	51.00	22.50	48.00	44.50	46.60	19.50	46.00	43.50
3	51.00	22.50	48.00	44.50	46.60	19.50	46.00	43.50
3½	52.00	23.50	48.00	45.50	47.50	20.50	46.00	44.50
4	53.00	24.50	49.00	46.50	48.50	21.50	47.00	45.50
4½	55.00	26.50	51.00	48.50	50.50	23.50	49.00	47.50
5	57.00	28.50	53.00	50.50	52.50	25.50	51.00	49.50
6	58.00	29.50	55.00	51.50	53.50	26.50	53.00	50.50
7	60.00	31.50	55.00	23.50	55.50	28.50	53.00	52.50
8	62.00	33.50	59.00	55.50	57.50	30.50	57.00	54.50

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	May 6	May 13	May 20	May 27
Prompt furnace	$2.25@2.40	$2.00@2.25	$2.25@2.40	$2.25@2.40
Prompt foundry	3.75	3.50@3.75	3.50@3.75	3.50@3.75

Cotton Waste—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	11.00@13.00	11.00@14.00	11.00@13.50
Colored mixed	8.00@10.00	7.50@11.00	8.00@10.50

Sal Soda sells as follows per 100 lb.:

New York	$2.05	Cleveland	$2.25
Philadelphia	1.80	Chicago	1.90

Roll Sulphur in 360-lb. bbl. sells as follows per 100 lb.:

New York.... $2.75 Cleveland.... $2.75 Chicago.... $2.75

Wiping Cloths—In Cleveland jobbers quote as follows per 1,000 13¼x13¾, \$29.50; 13¼x20½, \$25.00.

Linseed Oil—These prices are per gallon:

	New York	Cleveland	Chicago
Raw in barrels	$0.73	$0.75	$0.78
5-gal. cans	.83	.85	.88

Boiled, it is 1c. per gal. higher.

White and Red Lead, in cents per pound, sell as follows:

	Red Dry	Red In Oil	White Dry and In Oil
100-lb. keg	10.50	11.00	10.50
25- and 50-lb. kegs	10.75	11.25	10.75
12½-lb. keg	11.00	11.50	11.00
1- to 5-lb. cans	12.50	12.50	12.50

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

Bids are being received by E. R. B. Chapman, Arch., 44 Bromfield St., Boston, Mass., for the construction of a 3-story, 100x100-ft. garage at Boston for George H. Hennessey. Estimated cost, $50,000.

The city of Fitchburg, Mass., plans to construct a concrete garage. Estimated cost, $20,000. Walter A. Davis, City Clk.

The contract has been awarded for the construction of an addition to the plant of the Norton Co., manufacturer of grinding wheels, at Greendale, Mass. (Worcester post office.)

The contract has been awarded for the construction of a 3-story, 100x150-ft. plant for the Holyoke Valve and Hydrant Co., Holyoke, Mass., to be used for the manufacture of plumbers supplies. Estimated cost, $100,000.

The contract has been awarded for the construction of a 6-story, 58x110-ft. factory at Lynn, Mass., for the Campbell Electric Co. Estimated cost, $40,000. Noted Feb. 24 and Apr. 20.

The contract has been awarded for the construction of a garage at Paradise Rd. and Elm St., Northampton, Mass., for Russell C. Parsons, Springfield, Mass. Estimated cost, $30,000. Noted May 11.

The Gillette Safety Razor Co. has awarded the contract for the construction of a 7-story addition to its plant in South Boston, Mass. Estimated cost, $100,000. Noted Apr. 27.

The contract has been awarded for the construction of a 60x165-ft. addition to the plant of the Milton Bradley Car Co. at Springfield, Mass.

An addition is being built to the foundry of the Magee Furnace Co., Taunton, Mass.

Plans are being prepared for the construction of a 1-story garage for David Shapiro, 122 Green St., Worcester, Mass. Estimated cost, $20,000.

The United Wire and Supply Co. will construct a factory on Elmwood Ave., Auburn, R. I. (Providence post office).

The Spring Ring Manufacturing Co. will construct a 2-story, 20x50-ft. concrete addition to its plant at Edgewood, Providence, R. I.

Bids are being received for the construction of a 108x110-ftñ addition to the plant of the American-British Manufacturing Co., manufacturer of metals, on Charles St., Providence, R. I. Noted Apr. 27.

The Bristol Brass Co., Bristol, Conn., is building an addition to its plant. Estimated cost, $35,000. Noted May 18.

The contract has been awarded for the construction of a factory at Hartford, Conn., for the Packard Motor Co. Estimated cost, $80,000.

The contract has been awarded for the construction of a garage at Hartford, Conn., for W. W. Walker, 749 Main St., and Russell P. Taber, 334 Pearl St., Hartford. Estimated cost, $10,000. Noted Feb. 24.

The contract has been awarded for the construction of a plant on Watertown Ave., Waterbury, Conn., for the A. H. Wells & Co., manufacturer of brass and copper tubes. Estimated cost, $75,000. Noted Apr. 20.

MIDDLE ATLANTIC STATES

Bids are being received by J. Keller, Secy., Strong Steel Foundry, 33 Morris St., Buffalo, N. Y., for a 2-story addition to the pattern shop.

The Trigger Lock Reversible Controller Finger Co., Niagara Falls, N. Y., will build a 2-story factory on Bath Ave. Estimated cost, $16,000. Robert Russell is Pres.

The Myrick Machine Co., Olean, N. Y., is enlarging its plant.

We have been informed that the Schatz Manufacturing Co., Poughkeepsie, N. Y., manufacturer of ball bearings, steel balls, etc., has started work on the new 2-story factory and is in the market for equipment for same, including tool-room equipment, milling machines, lathes, punch presses, etc. H. A. Schatz, Treas. Noted May 4.

The American Locomotive Co., Schenectady, N. Y., plans to build 3 new additions to its plant.

Rossell Bros., Warren, N. Y., plans to construct a new 3-story garage. Estimated cost, $20,000.

Plans have been prepared for the construction of a new plate and angle shop for the Samuel L. Moore & Sons Corporation, a subsidiary of the Bethlehem Steel Co., Elizabethport, N. J. (Elizabeth post office).

The Crucible Steel Co., Harrison, N. J., is building a large addition to its plant for the manufacture of torpedoes. Company also plans to construct additions for the manufacture of tool steel and automobile parts.

The American Manicuring Scissors Co., Newark, N. J., has acquired property on Beecher St. and will establish a plant for the manufacture of its specialty. Joseph Axelrod is Pres.

Galinken Bros., Newark, N. J., will construct a commercial garage and repair shop on Somerset St.

The Interstate Milk and Cream Co., Newark, N. J., will construct a new garage on Elizabeth Ave.

The North American Copper Co., New York, N. Y., has acquired a site on the Newark Meadows, Newark, N. J., and will construct a large plant for the manufacture of metal products. Harold Roberts is Vice-Pres.

Samuel Shapiro, Newark, N. J., will construct a new machine shop on Prince St.

The Chevrolet Automobile Co. plans to construct a factory along the Central Railroad of New Jersey, Plainfield, N. J.

The contract has been awarded for the construction of a 1-story addition to the machine shop of the Spicer Manufacturing Co., Plainfield, N. J., manufacturer of auto parts. Estimated cost, $20,000.

Bids will soon be received by J. O. Hunt, Arch., 114 North Montgomery St., Trenton, N. J., for the construction of a 1-story, 101x150-ft. garage for Steel & Skirm. Estimated cost, $14,000.

The contract has been awarded for an addition to the car shops of the Pennsylvania R.R. at Trenton, N. J. A. C. Shand, Philadelphia, Penn., Ch. Engr.

The Traytor Engineering Co., manufacturer of machinery, Allentown, Penn., is improving and enlarging its plant. Estimated cost, $1,000,000.

The Abrasive Materials Co., Bridesburg, Philadelphia, Penn., manufacturer of corborundum and emery wheels, has awarded the contract for the construction of a 2-story factory.

The contract has been awarded for the construction of a 4-story addition to the plant of the Ajax Metal Co., Frankford Ave. and Richmond St., Philadelphia, Penn. Noted Apr. 20 and 27.

The E. P. Alexander Co., manufacturer of machinery, Philadelphia, Penn., has awarded the contract for several additions to its plant. Estimated cost, $54,000.

John W. De Long, Delmar Apts., Philadelphia, Penn., has awarded the contract for the construction of a 2-story garage at Chelton and Paulaski Ave. Estimated cost, $20,000.

The Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Penn., is having plans prepared by Morris & Erskine, Arch., 1420 Chestnut St., Philadelphia, for a 4-story, 50x100-ft. factory for the manufacture of electrical instruments.

The Midvale Steel and Ordnance Co., Philadelphia, Penn., is in the market for a large number of cranes.

The Pennsylvania R.R., Philadelphia, Penn., is in the market for several cranes. A. C. Shand, Philadelphia, Ch. Engr.

Bids are being received by F. A. Rianhard, Arch., Masonic Bldg., Williamsport, Penn., for a 1-story assembling plant for the Lyvoming Foundry and Machine Co., Williamsport. Estimated cost, $20,000.

The Standard Car Manufacturing Co., Youngstown, Ohio, has awarded the contract for the construction of a steel-car plant near Sharon, Penn. Estimated cost, $300,000. C. H. Modd, 1512 Florencedale Ave., Youngstown, Ohio, Mgr.

The Baltimore Car and Foundry Co., Baltimore, Md., a branch of the Standard Steel Car Co., Pittsburgh Penn., is constructing a 40x90x780-ft. machine shop.

According to press reports the Baltimore & Ohio Railroad Co., Baltimore, Md., contemplates enlarging its shops at Cumberland, Md. F. L. Stuart, Baltimore, Ch. Engr.

SOUTHERN STATES

The International Steel and Plate Co., Munsey Trust Bldg., Washington, D. C., plans to construct a shipbuilding plant at Quantico, Va. About $30,000 worth of equipment will be required. H. M. Isaac, Secy.

The Wheeling Steel and Iron Co., Wheeling, W. Va., plans to construct additional mills at its plant at Yorkville, W. Va. (Glenhayes post office).

The Sloss-Sheffield Steel and Iron Co., Birmingham, Ala., plans to construct a byproduct plant at North Birmingham.

J. H. Talent, Dayton, Tenn., is in the market for machinery for the manufacture of plow handles.

The Ashland Iron and Mining Co., Ashland, Ky., plans to construct a new finishing mill.

MIDDLE WEST

The contract has been awarded for the construction of a factory at Canal Dover, Ohio, for the Penn Iron and Steel Co. Estimated cost, $25,000.

Bids will soon be received for the construction of a 1-story, 80x440-ft. factory for the J. G. Brill Car Co. at Cleveland, Ohio. S. M. Curven, Pres.

Bids are being received by F. Baird, Arch., 505 Bangor Bldg., Cleveland, Ohio, for the construction of a 1-story, 47x100-ft. garage for the County Club at Cleveland. Estimated cost, $12,000.

The contract has been awarded for the construction of a 1-story addition to the plant of the A. R. Davis Motor Co., at 2020 Euclid Ave., Cleveland, Ohio. Estimated cost, $20,000. Noted May 25.

We have been advised that the Northern Blower Co., 4515 Storer Ave., Cleveland, Ohio, is in the market for heavy power sheet metal working machinery. Noted May 11 and 25.

The contract has been awarded for the construction of a factory at Cleveland, Ohio, for Wilson S. Yerger, metal manufacturer, 1226 Howard St., Philadelphia, Penn. Estimated cost, $4,000.

The American Locomotive Co. plans to construct a plant at Elyria, Ohio. Estimated cost, $65,000. Harry Weil, Gen. Mgr.

Bids have been received for the construction of a foundry at Lorain, Ohio, for the American Shipbuilding Co. Estimated cost, $50,000. A. G. Smith is Gen. Mgr. Noted Apr. 6 and 20.

The Blackwood Steel Castings Co. is constructing a steel foundry at Springfield, Ohio. Noted May 18.

Bids are being received for the construction of a 1-story, 50x160-ft. garage at Toledo, Ohio, for W. T. Hubbard, 384 South Erie St., Toledo.

The contract has been awarded for the construction of a factory at Youngstown, Ohio, for the General Fireproofing Co., manufacturer of steel products. W. H. Foster, Pres. and Gen. Mgr.

The contract has been awarded for the construction of an addition to the factory of the Columbus Handle and Tool Co., at Columbus, Ind.

The contract has been awarded for the construction of an addition to the plant of the Maxwell Newcastle Manufacturing Co., manufacturer of automobile parts, at Newcastle, Ind. Noted May 4.

The Hoover Steel Ball Co. plans to construct a 40x400-ft. addition to its plant at Ann Arbor, Mich., by its engineering forces. L. J. Hoover, Vice-Pres. and Gen. Mgr.

The H. B. Sherman Manufacturing Co., manufacturer of brass goods, is constructing an addition to its plant at Barney and Kalamazoo St., Battle Creek, Mich.

The Roeller Foundry Co. plans to construct a plant at North Water and Trumbull St., Bay City, Mich.

The Celfor Tool Co. plans to construct an addition to its plant at Buchanan, Mich.

The Gold Valve Engine Co., Charlotte, Mich., recently incorporated with $40,000 capital stock, will construct a plant at Charlotte for the manufacture of gasoline engines. George M. Fenn is Pres.

Bids are being received by Harry S. Angell, Arch., 722 Free Press Bldg., Detroit, Mich., for the construction of a 2-story factory at Detroit for the Detroit Brass Works. Gordon C. Hall, 1322 Brooklyn Ave., Secy.

Plans are being prepared for a plant on West Fort St., Detroit, Mich., for the Detroit Seamless Steel Tube Co. Noted May 11.

Siewek Bros., manufacturer of tools, jigs and dies, has awarded the contract for the construction of an addition to its plant at 75 Baltimore Ave., Detroit, Mich.

Plans have been prepared for the construction of a 2-story, 95x150-ft. factory at Detroit, Mich., for the Wadsworth Manufacturing Co., manufacturer of automobile bodies. W. C. Rowling, 1256 East Jefferson Ave., Secy. Estimated cost, $40,000.

The contract has been awarded for the construction of a garage at Flint, Mich., for B. J. McDonald. Estimated cost, $30,000.

The contract has been awarded for the construction of a factory at Hamtramck, Mich., for the Hygeia Filter Co. Noted May 25.

The contract has been awarded for the construction of an addition to the plant of the Spenser-Smith Machine Co. at Howell, Mich.

Bids have been received for the construction of an addition to the factory of Werner & Pfleiderer Co., manufacturer of special machinery, at Saginaw, Mich.

The Michigan Crowned Fender Co. is constructing a factory at Ypsilanti, Mich.

The U. S. Pressed Steel Co. is constructing a plant at Ypsilanti, Mich.

Bids are being received for the construction of a 1-story, 100x160-ft. factory at Aurora, Ill., for the Lyon Metallic Manufacturing Co., manufacturer of metal lockers. Estimated cost, $15,000.

We have been advised that the Apex Appliance Co., manufacturer of washing machines, 3.21 West 5th St., Chicago, Ill., is in the market for lathes, drill presses and electric elevator. Noted May 18.

The Appleton Electric Co., manufacturer of electrical specialties, 224 North Jefferson St., Chicago, Ill., has purchased a site at Paulina and Wellington St. on the Chicago River, Chicago, on which it plans to construct a new plant.

N. Dinghey, 30 North Dearborn St., Chicago, Ill., will construct a garage at 7025 South Halsted St., Chicago.

The Jones Foundry and Machine Co., North Ave. and Noble St., Chicago, Ill., will construct a foundry and machine shop at 1200 South Kostner Ave., Chicago. Estimated cost, $[illegible],000.

The Ogren Motor Works is constructing a 3-story, mill construction building on Sacramento Blvd. between Chicago and Grand Ave., Chicago, Ill. Estimated cost, $85,000.

The contract has been awarded for the construction of a 2-story garage at 3720 Southport Ave., Chicago, Ill., for Matthew Schmidt. Estimated cost, $10,000. Noted May 18.

An addition is being built to the foundry of the Vermillion Malleable Iron Co., Hoopeston, Ill.

The contract has been awarded for the construction of a plant at Peoria, Ill., for the Keystone Steel and Wire Co. Estimated cost, $1,750,000. Noted May 4 and 25.

The contract has been awarded for the construction of a 1- and 2-story, 50x200-ft. foundry for the Malleable Iron Range Co., Beaver Dam, Wis. A. G. Hill is Pres.

The main building of the Hess Iron Works, Green Bay, Wis., has been purchased by the Green Bay Drive Calk Co., Green Bay, who will equip it for a drop forge plant for the manufacture of horse shoes and calks for horse shoes.

The Thomas B. Jeffery Co., manufacturer of automobiles, has awarded the contract for the construction of a foundry and manufacturing building at Kenosha, Wis.

The Aluminum Goods Manufacturing Co. is constructing a 50x300-ft. addition to its plant at Manitowoc, Wis.

The contract has been awarded for the construction of a 1-story garage at Milwaukee, Wis., for the Milwaukee Building Construction Co. Estimated cost, $10,000.

Bids have been received for the construction of a 1-story, 50x120-ft. garage at Osceola, Wis., for E. A. Zorn.

The contract has been awarded for the construction of a factory for the Continental Truck Manufacturing Co. at Superior, Wis. Estimated cost, $50,000.

WEST OF THE MISSISSIPPI

Fire recently destroyed the factory of Woods Bros. Silo and Manufacturing Co., 36th and Orchard St., Lincoln, Neb. Loss, $100,000.

Plans are being prepared by W. V. Kernan, Bee Bldg., Omaha, Neb., for the construction of a 100x132-ft. garage for the Blackstone Holding Co., Bee Bldg. Estimated cost, $25,000.

Plans are being prepared by C. A. Randall, Arch., Sheridan, Wyo., for the construction of a garage at Buffalo, Wyo., for I. E. Gilbert, Sheridan.

The Barks & Barstow Manufacturing Co., Valley Park, Mo., manufacturer of steel roofing and specialties, will build a factory adjacent to the plant of the Wrought Iron Range Co., St. Louis, Mo.

The Maxwell Motor Co. plans to construct an assembling plant at Dallas, Tex.

Plans are being prepared and bids will soon be received by L. H. Ruggles, Arch., 330 Robinson Bldg., Tulsa, Okla., for the construction of a 100x140-ft. garage for H. C. Stahl and M. A. Younkman, 1217 South Baltimore St. Estimated cost, $15,000.

WESTERN STATES

The Wilcox Auto Co. plans to rebuild its garage and machine shop at Burley, Idaho, which was recently destroyed by fire.

Higgs Bros. plans to construct a 50x140-ft. garage and machine shop at 2nd and Main St., Mansfield, Wash.

Plans are being prepared by W. W. DeVeaux, Arch., for the construction of a 50x140-ft. garage and machine shop at 3rd and Yakima St., North Yakima, Wash. Estimated cost, $10,000.

D. A. Connolly will construct a garage at 34 Broadway, Portland, Ore.

CANADA

The Canada Cycle and Motor Co. will construct a plant at Weston, Que. Estimated cost, $100,000.

The Board of Control of Ottawa, Ont., plans to construct a civic garage and repair shop. Norman H. Lett, City Clk.

Press reports state that the Rumely Tractor Co. plans to construct a garage at Calgary, Alta. Estimated cost, $30,000.

GENERAL MANUFACTURING

NEW ENGLAND STATES

The Cushman-Hollis Co., Auburn, Maine, manufacturer of shoes, will construct a 4-story, 143x164-ft. addition to its plant at Union and Court St.

Press reports state that the Savage Paper Co., Skowhegan, Maine, plans to reconstruct its paper mill.

The Costikyan Carpet Co., recently incorporated, plans to construct a plant at Lowell, Mass. M. W. Costikyan, Pres.

The West End Thread Co. has awarded the contract for the construction of a 3-story addition to its plant at Millbury, Mass.

The United Lace and Braid Co. will build an addition to its plant on Wellington Ave., Auburn, R. I. (Providence post office). Estimated cost, $50,000.

The Simons Braid Co., Dexter St., Providence, R. I., plans to construct a 2-story, 70x120-ft. addition to its plant at Providence.

Plans are being prepared for the construction of an 83x163-ft. mill building at Thomesville, Conn., for the Winchester Woolen Co. Estimated cost, $50,00. Noted Apr. 20.

MIDDLE ATLANTIC STATES

The contract has been awarded for the construction of a factory at Albany, N. Y., for B. & W. Bernstein, 96 South Pearl St., manufacturer of carpets. Estimated cost, $10,000.

Bids are being received by Benjamin Driesler, Arch., 153 Remsen St., New York, N. Y. (Borough of Brooklyn), for 3-story building on Ditmas Ave. for William Beckers Aniline and Chemical Works, Brooklyn. Estimated cost, $20,000. Noted Mar. 30.

Plans have been prepared for a 2-story factory in Elizabeth St. between Lake Ave. and Genesee River, Rochester, N. Y., for Rochester Folding Box Co. Estimated cost, $175,000.

Plans have been prepared by J. G. Elendt, Engr., Cutler Bldg., Rochester, N. Y., for a 2-story chemical cold-storage building at Ransomville, N. Y., for G. E. Hubble. Estimated cost, $75,000.

The Coats Manufacturing Co., Wellsville, N. Y., manufacturer of furniture, is building 2 additions to its plant.

The New Jersey Leather Co., Camden, N. J., has awarded the contract for the construction of a 2-story brick factory. Estimated cost, $55,000.

The Hopewell Valley Canning Co., Hopewell, N. J., will improve its plant and install new machinery.

The American Mono Service Co., Newark, N. J., manufacturer of paper containers, will enlarge and improve its plant on Verona Ave.

The Strong Rubber and Asbestos Co., Newark, N. J., will improve and enlarge its plant on Bigelow St.

H. Entin, Trenton, N. J., will build a factory on Commercial Ave. for the manufacture of burlap bags.

The Verona Chemical Co., Verona, N. J., will build a 2-story addition to its plant at Verona and Riverside Ave.

The Scott & Bowne Co., manufacturer of chemicals, has awarded the contract for the construction of a factory at Watsessing, N. J. (Bloomfield post office).

The Union Powder Co., 42 Broadway, New York, N. Y., plans to construct an addition to its plant at Emporium, Penn., to be used for the manufacture of nitric and sulphuric acid.

The Harbred Silk Co., Galeton, Penn., is constructing a silk mill.

J. S. Ward & Co., manufacturer of chemicals, care of Ward C. Haffner, Railroad St., Hanover, Penn., has awarded the contract for the construction of a 2-story addition to its plant. Estimated cost, $10,000.

The contract has been awarded for the construction of a 2-story addition to the plant of Charles P. Cochrane, Butler and N St., Philadelphia, Penn., manufacturer of carpet. Estimated cost, $16,500. Noted May 25.

The Belmont Packing and Rubber Co., Philadelphia, Penn., is having plans prepared by Carl P. Berger, South Penn Sq. Bldg., Philadelphia, for a 2-story factory at Seviva and Butler St. Noted May 18.

Plans have been prepared by J. Martsolf, Arch., House Bldg., Pittsburgh, Penn., for the reconstruction of the plant of the Beaver Refrigerator Co., New Brighton, Penn., recently destroyed by fire. Estimated cost between $18,000 and $35,000. H. S. Hawthorne, New Brighton, Mgr. Noted May 11.

The contract has been awarded for the construction of a 3-story optical factory on South 8th St., Reading, Penn., for the Pennsylvania Optical Co., Reading. Noted Dec. 16 and Apr. 20.

Bids are being received by I. C. Eberly, Oakbrook, Reading, Penn., for a 1-story factory to be leased by the Oakbrook Hosiery Co., Oakbrook.

SOUTHERN STATES

The E. I. du Pont de Nemours Powder Co., Wilmington, Del., plans to construct a dynamite plant at Williamsburg, Va.

The Paden City Glass Co., Paden City, W. Va., recently organized, plans to construct a factory at Paden City.

The Malines Knitting Mills, Winston Salem, N. C., will build an addition to its plant. Estimated cost, $4,000.

The Melrose Knitting Mills, Raleigh, N. C., plans to install new machinery in its plant.

The Asceptic Cotton Co. is building a new plant at Alton Park, Tenn.

The Kalbfleich Chemical Corporation, Chattanooga, Tenn., plans to construct a $75,000 plant at Chattanooga.

The Thatcher Spinning Mills, Chattanooga, Tenn., is building a 150x500-ft. plant. Noted Dec. 30.

The Kelly Handle Co., Memphis, Tenn., plans to establish a handle factory at New South Memphis. Estimated cost, $100,000. S. J. Weigel, Central Bank Bldg., Memphis, Arch.

The Memphis Furniture Manufacturing Co., Memphis, Tenn., will build a 2-story addition to its plant.

W. E. Goertz, 520 Stahlman Bldg., Nashville, Tenn., is in the market for machinery for the manufacture of pearl buttons.

The American Metallic Packing Co., Lexington, Ky., is in the market for a 10-ton locomotive crane, equipped for bucket, a 5- or 6-ton tamden steam road roller and a 10x10x10 steam air compressor, all second hand.

MIDDLE WEST

The B. F. Goodrich Co., manufacturer of rubber goods, has awarded the contract for the construction of a factory at Akron, Ohio. Estimated cost, $25,000.

The Pearce Tire and Rubber Co. is constructing a plant at Ashtabula, Ohio.

The American Puncture-Proof Tire Co. has purchased a site on Harvard Ave., Cleveland, Ohio, and will construct a factory. Estimated cost, $50,000.

The Forest City Engineering Co., Engr., 512 Hippodrome Bldg., Cleveland, Ohio, will soon award the contract for the construction of a factory at Cleveland, for the National Artificial Silk Co., 735 Central Ave. Estimated cost, $300,000. Noted May 18 and 25.

The McCoy-Nelson Sanitary and Stoneware Co. will construct a 2-story, 10x100-ft. addition to its plant at Roseville, Ohio.

Plans are being prepared by H. L. Bass & Co., 801 Hume Mansur Bldg., Indianapolis, Ind., for 1-story, 280x300-ft. factory for Western Cabinet Co., Indianapolis, Ind. Estimated cost, $40,000. O. K. Mahorney, Claypool Hotel, Indianapolis, is interested.

The contract has been awarded for the construction of an addition to the packing plant of the Sullivan Packing Co. at Beecher Ave. and Michigan Central R.R., Detroit, Mich. Estimated cost, $75,000.

The Welch Furniture Co. will construct a factory at Grand Rapids, Mich.

The August Carlson's Glove Manufacturing Co. contemplates enlarging its factory at Marquette, Mich. Estimated cost, $5,500.

The Kompass & Stoll Co., manufacturer of kitchen cabinets, is constructing a 2-story, 75x75-ft. addition to its factory at Niles, Mich.

The Monroe Body Co., manufacturer of carriages, etc., is constructing an addition to its factory at Pontiac, Mich. Noted May 11.

The Chicago Rawhide Co. has awarded the contract for the construction of a 1-story tannery at 1301 Elston Ave., Chicago, Ill. Estimated cost, $6,000.

WEST OF THE MISSISSIPPI

Fire recently destroyed the plant of the Montana Sash and Door Co., Billings, Mont. Loss, $150,000.

The Farmers Union, Swifton, Ark., plans to construct a cotton gin at Newport, Ark. Estimated cost, $12,000.

The Deport Oil Mill, Deport, Tex., will construct a cotton seed oil mill. Estimated cost, $35,000.

The Mexico Guayule Co. will construct a factory at El Paso, Tex., for extracting rubber from the wild guayule shrub. Estimated cost, $50,000.

The Loudon Hosiery Mills, Loudon, Tex., will construct a 3-story addition to its plant.

WESTERN STATES

The Crown-Willamette Paper Co. will enlarge its plant at Oregon City, Ore. Louis Bloch, Vice-Pres.

The Fall Brook Citrus Association plans to construct a packing plant at Fall Brook, Calif.

The contract has been awarded for the construction of a plant on Santa Fé Ave., Los Angeles, Calif., for the manufacture of boxes for the Southern California Box Co., 1335 East 6th St. Noted Feb. 17.

A. B. Shoemaker plans to construct a fruit packing plant at Modesto, Calif. Estimated cost, $6,000.

The John Horstmann Chemical Co. plans to construct a factory at Redwood City, Calif. Estimated cost, $25,000.

CANADA

S. W. Halliday, 20 Arlington Ave., Montreal, Que., will construct a factory on Catharine St., Montreal, for the manufacture of carriages. Estimated cost, $6,000.

Winstainer & Son, 58 St. Lawrence Blvd., Montreal, Que., manufacturer of picture frames, will rebuild its factory at Montreal which was recently destroyed by fire and will install new machinery.

The Ardiel Shoe Co. contemplates constructing an addition to its plant at Elmira, Ont. Estimated cost, $6,000.

The Solid Leather Co. has awarded the contract for the construction of an addition to its plant at Preston, Ont. Estimated cost, $50,000. Noted May 25.

The Canadian Consolidated Rubber Co. is constructing an addition to its plant at St. Catherines, Ont. Estimated cost, $25,000.

Classified Advertising

The Classified Advertising section appears on pages 255, 256, 257, of this issue and will in future appear in the same relative position in the paper.

American Machinist

Volume 44 No. [illegible]
[illegible] Thursday
[illegible] Company

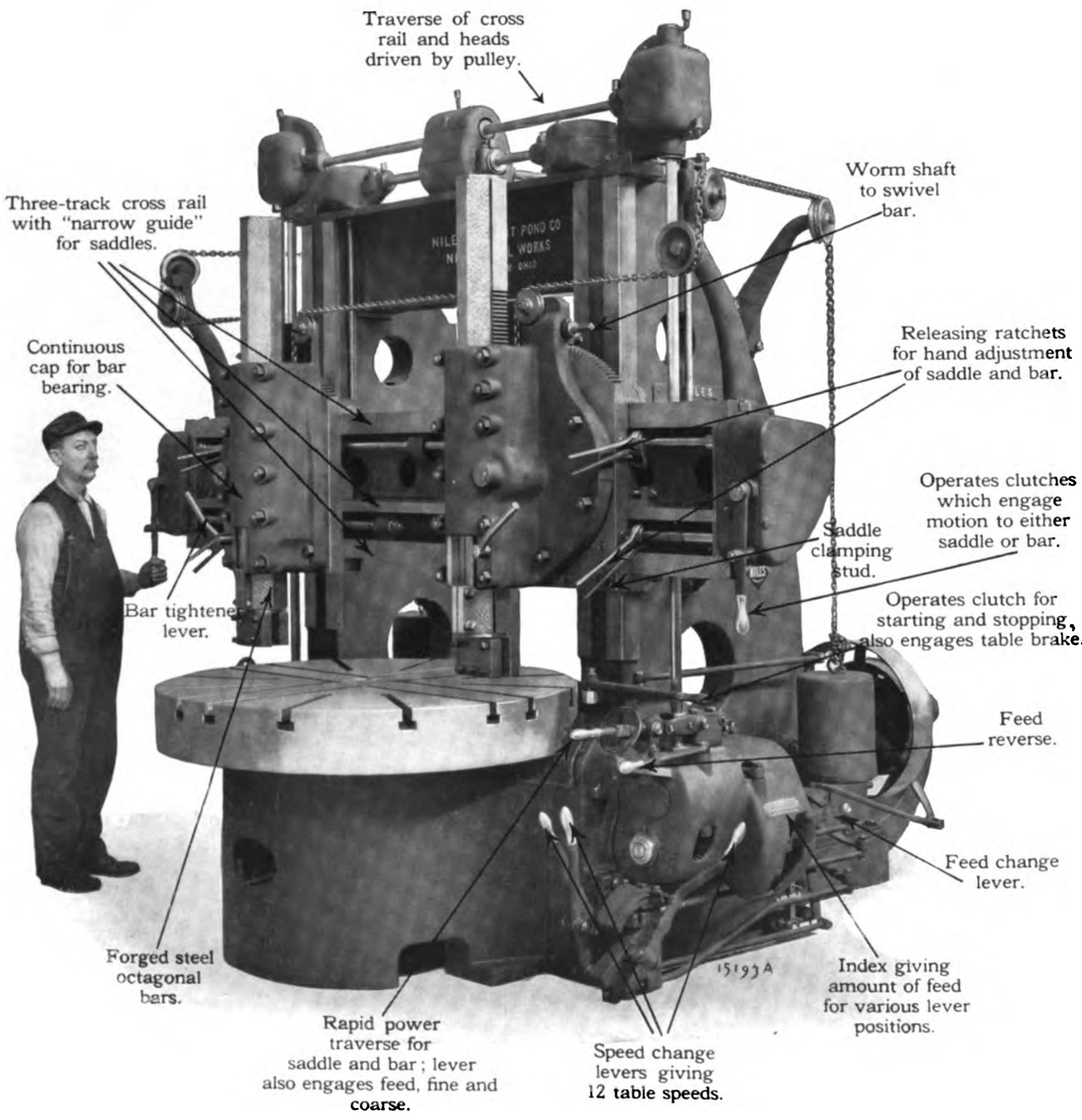
NEW YORK, JUNE 8, 1916

Price, 15 Cents
Contents, First Page
Advertising Index, Last Page

FOLLOW THE ARROWS

To the Superior Points of our

All-Improved-Feature Boring Mills



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Niles-Bement-Pond Co.,

111 Broadway, New York City
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American Machinist

L. P. ALFORD, Editor

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CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormsy processes, protected by United States patents issued June 22, 1915, and Apr. 18, 1916.

NUMBER OF COPIES PRINTED THIS ISSUE, 23,600

This includes the English Edition. None sent free regularly, no returns from news companies, no back numbers.

Talks With Our Readers

By the Publisher

I PICKED up a copy of the June 1st issue and as I read the advertisements the thought occurred to me that you are certainly being benefitted greatly by modern advertising—

The kind of advertising that only good products can stand.

It was surprising to me to see how many concerns put their business propositions in terms that made it absolutely impossible for you to secure other than completely satisfactory results.

One concern put it in black and white that if the article is not satisfactory it "can be returned at our expense." Another has confidence enough in its product to sell it to you "on any terms of guarantee that you may desire." Still another says: "If it doesn't live up to every claim you don't have to pay for it."

With advertisers standing back of their product in this way—is it any wonder that I call the Buying Section the "Buyers Friend?"

Is it any wonder that the progressive machine shop man uses this section as a real "Buying Guide?"

Are you making it count BIG for you?

Flue-Reclaiming System of the Santa Fe Shops

By Ethan Viall

SYNOPSIS—Heretofore a large number of flues have been scrapped because there has been no practical way to repair flaws or thin spots more than 1 or 2 ft. from the ends. By the method described, thin places may be cut out anywhere in the length of the flue and successfully repaired. All repairs are of course rigidly tested to insure results.

One of the great and continual expenses of any railroad is the constant repair or replacing of locomotive-boiler flues. Safe-ending is almost a continuous

FIG. 1. RATTLER HOUSE, SHOWING PISTON CYLINDER

FIG. 2. VIEW OF OPPOSITE END

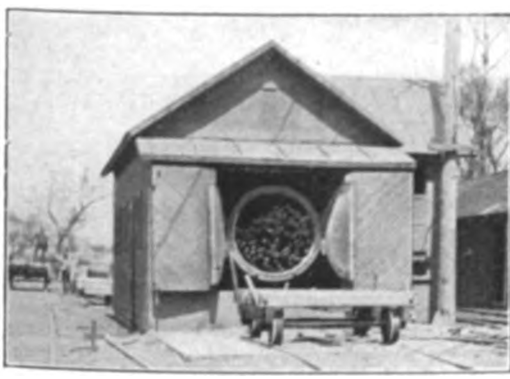


FIG. 3. RATTLER READY TO DISCHARGE LOAD

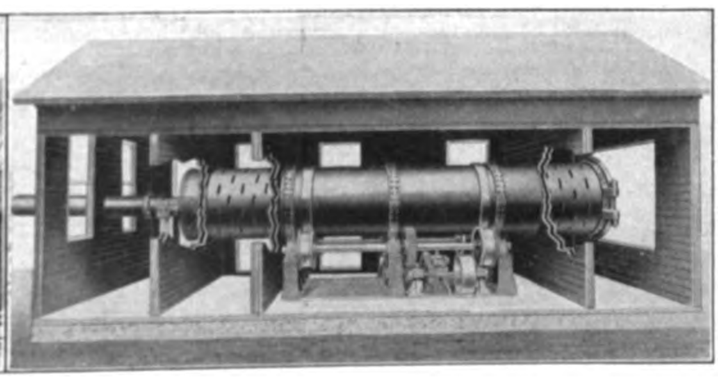


FIG. 4. VIEW SHOWING SOME OF THE DETAILS

performance, but the ordinary safe-end welder will not weld on pieces over 35 or 40 in. long, and 18-in. lengths are about the practical limit. In consequence a 20 ft. flue might have a thin spot of only an inch or so in the middle, and yet two pieces nearly 10 ft. long would have to be scrapped because there has been no good way of eliminating the thin spot. If the defect is merely a pit or small place, sometimes oxyacetylene is successfully employed, but for larger places this method is impractical for numerous reasons. After long and careful study of the problem the mechanical department of the Santa Fe Ry. finally evolved a way to reclaim a large proportion of the otherwise scrap flues. An outfit was installed in the Topeka shops of the system, and after a period of more or less expensive experimenting it has been in successful operation for about eight months. Although some of the steps described in this article are familiar to every railroad-shop man, the process of handling the flues will be shown from start to finish, with the exception of the removal and replacement in the boilers.

As in all railroad shops, the first operation after removal from the boilers is to rattle the flues to remove scale of all kinds and thoroughly clean them, both inside and out. Two methods of rattling are in general use—the wet and dry process. In the Topeka shops the dry process only is employed; and as the rattler itself has some unique features, it will be described in detail. It was made by the Baird Pneumatic Tool Co., Topeka, Kan., and several are in use along the system. The rattler at the Topeka shops is in a separate building, as shown in Fig. 1. Projecting out from this building is a long tube, which is the piston cylinder. The piston is used to shove out the rattled flues or to alter the length of the rattling chamber. A view from the opposite end, with the building doors thrown open, is given in Fig. 2. In Fig. 3 the end of the rattler is shown open ready for the flues to be pushed out onto the waiting truck. A wash drawing of the device is shown in Fig. 4. The

machine is capable of handling a full set of boiler tubes at once, or from 250 to 300 tubes. It will thoroughly clean them inside and out in from 2 to 6 hr., according to the kind of scale deposited on the flue. The average in this shop is about 900 per day of 10 hr. Some scales can be rattled in an hour, while some with the hardest of lime require 6 hr. A movable head operated by means of the air piston referred to makes flues as it goes. The result is beautifully clean and bright flues that look like new.

The main part of the rattler is contained in a central room, which is practically dust proof. Here the motor and driving mechanism are placed. This prevents all unnecessary wear on the parts and is managed by having the body of the rattler ride in rings set in wooden partition walls, which effectually keep the dust out of

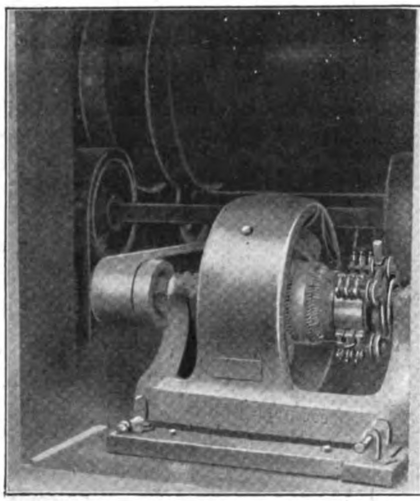


FIG. 5. METHOD OF DRIVING THE RATTLER

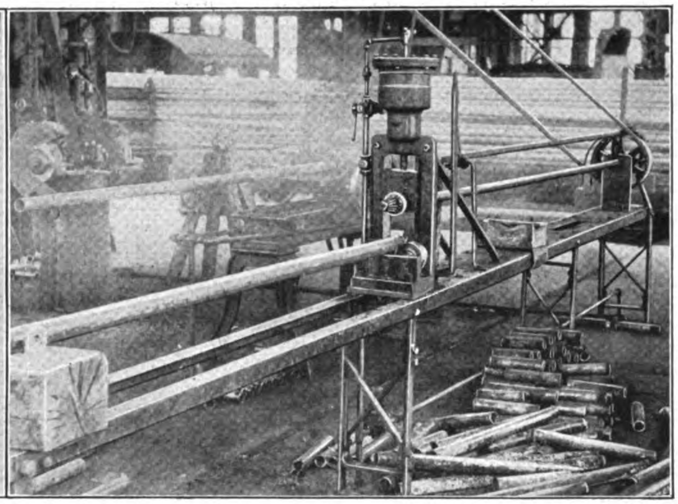


FIG. 6. THE EXTRA-LONG CUTOFF MACHINE

it possible to rattle flues 24 ft. in length or shorter and hold them so that they will not have sufficient lateral movement to tangle and be destroyed, as is often the case with a rattler in which no such provision is made. When 20-ft. flues are rattled, the head is adjusted to 20 ft. 6 in., which gives them only 6 in. of lateral movement while being cleaned. After the flues have the central part. The rattling chamber itself rides on flanged rollers operated through gearing at the back, which is belted to a drive motor in front, where it is easily accessible, as shown in Fig. 5.

After the flues have been rattled, they are carefully gone over by experienced men, who test them with hammers for flaws or thin spots. As soon as a weak

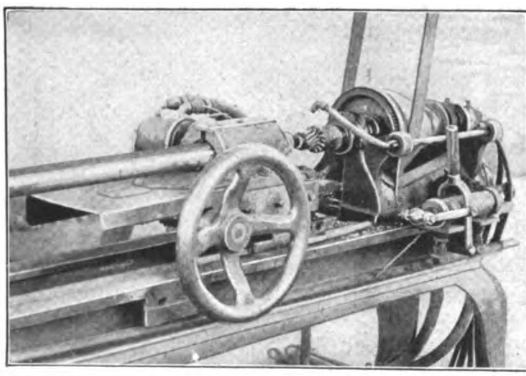


FIG. 7. THE END-REAMING AND SQUARING MACHINE

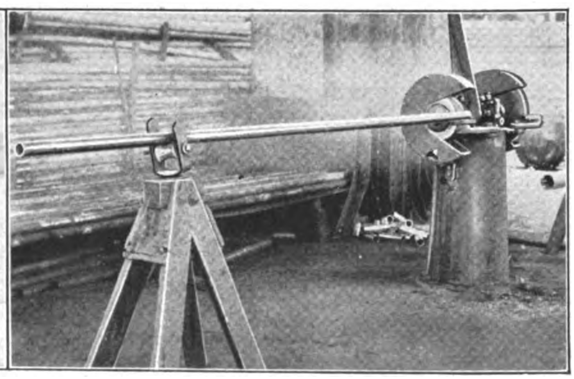


FIG. 8. METHOD OF BRIGHTENING THE ENDS

been rattled, the end doors are opened, air is let into the piston cylinder, and the whole lot is pushed out into the basket car, as previously mentioned. By referring to the drawing, it will be seen that the main body of the rattler has no opening in it for the escape of the lime, openings at the ends only being provided. This method holds the lime in for scouring purposes until it gradually works to the end dust chambers, scouring and grinding both inside and outside of the spot is detected, it is marked with chalk as far as it extends. As the tester finishes a flue, he places it in a cradle. When this is full, it is run to the cutoff machine, Fig. 6, which is air operated and differs but little from those in common use, except that it will cut to the middle of a 24-ft. flue if needed. The operator of this machine cuts out the weak places that the inspector has marked. Sometimes these are only a few inches in length; at other times they are several

feet long, as shown by the pieces on the floor under the machine. To pass as "good," a piece of any length must not only be free from thin places, but must weigh a certain amount per foot. As a rule, it is not necessary to weigh pieces, as an operator soon gets the "heft" of a piece as unerringly as a cashier detects counterfeits.

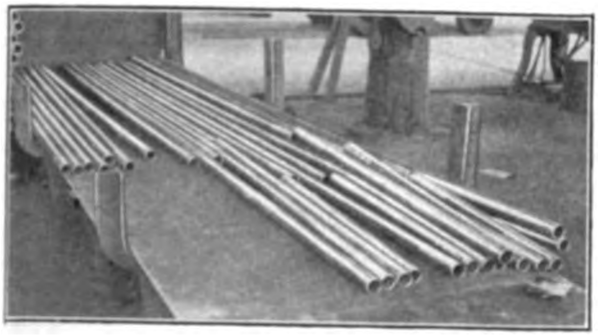


FIG. 9. METHOD OF SORTING OUT THE LENGTHS

As the various good pieces are to be butt-welded into full flue lengths, a clean, straight end is desirable. This is obtained by milling, as shown in Fig. 7. The flue to be milled is held in an air-operated set of jaws and fed to the revolving mill, which mills off the end square and also reams out the inside so as to remove the burr left by the cutoff.

In order to give the gripping jaws of the welder good, clean contact the ends of the pieces are ground on the outside for about 6 or 7 in. back from the ends, as in Fig. 8, the operator simply revolving the tube end against the grinding wheel. The ground pieces are sorted out into suitable lengths to form full-length flues when two pieces are butted together, keeping in mind that only two welds are allowed to a flue. A number of pieces sorted into suitable lengths for welding are illustrated in Fig. 9. These, when butt-welded and a safe-end welded on, will give a full-length flue with only two welds.

The welding is done on the butt-welder, shown in back and front views in Figs. 10 and 11. The machine itself is practically as received, but the inside mandrel and outside rolls, together with the driving mechanism, were added in the shop after considerable experimenting. Without these the method would be a failure.

A close-up view from the operating side is given in Fig. 12. The switch is carried on top of the post A,

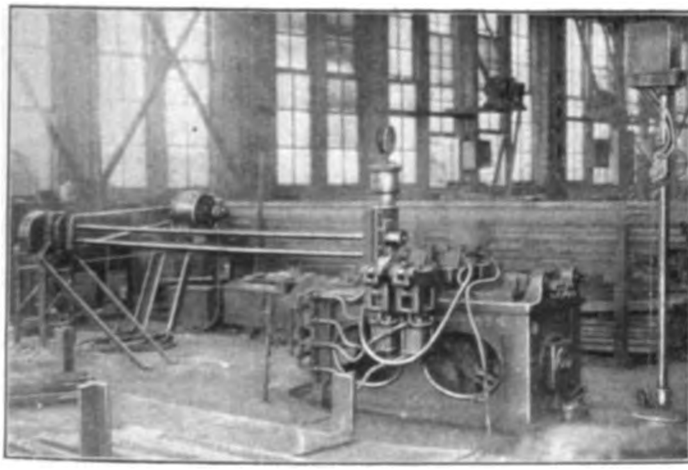


FIG. 10. BACK VIEW OF ELECTRIC WELDER

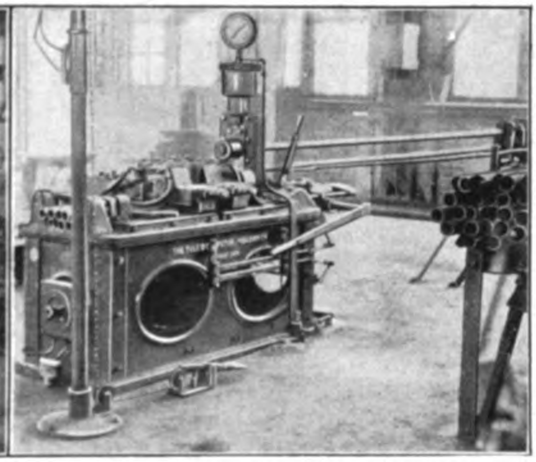


FIG. 11. FRONT VIEW OF WELDING MACHINE

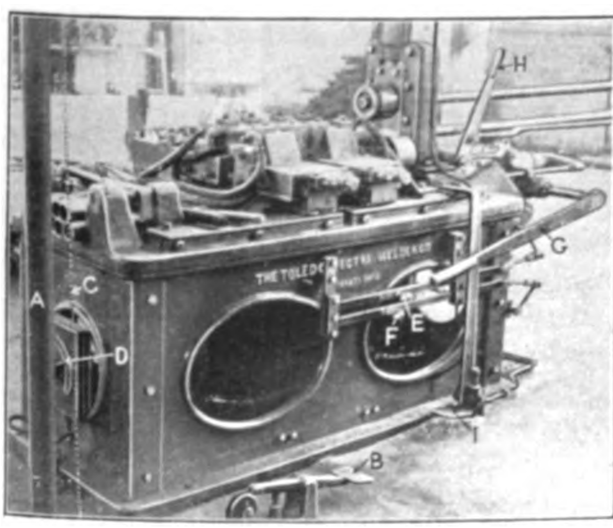


FIG. 12. THE OPERATING LEVERS AND FOOT TREADLES

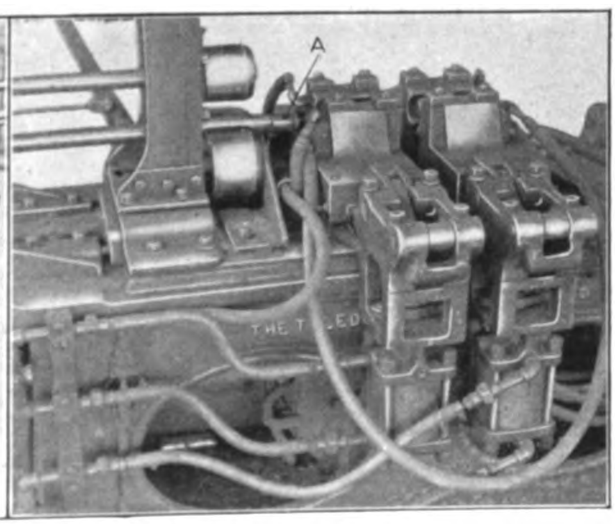


FIG. 13. MACHINE EMPTY, SHOWING THE INSIDE

and the welding current is turned on by means of the foot treadle B, which works the chain C. When a stronger or weaker current is desired, the amount is regulated by turning the pointer D. The gripping jaws, or electrodes, are air operated, the valves being worked by the handled slides E and F. The lever G operates the hydraulic apparatus used to bring the jaws closer together when butting the weld. The lever H works the clutch controlling the roll and the mandrel. There are three rolls, but only the upper one is power driven. The flue rests on the two lower ones, and the upper one is brought down by pressing on the foot treadle I, which works the air valve to the cylinder above the roll.

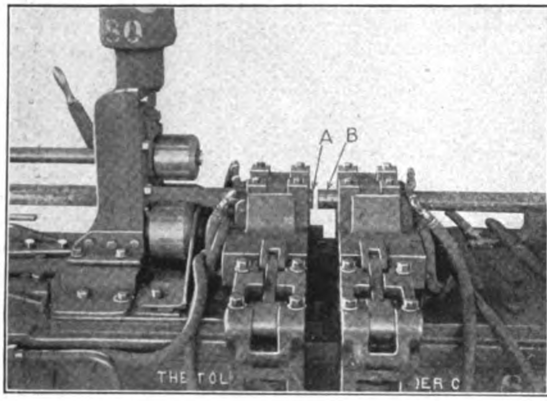


FIG. 14. FLUE PARTS READY FOR WELDING

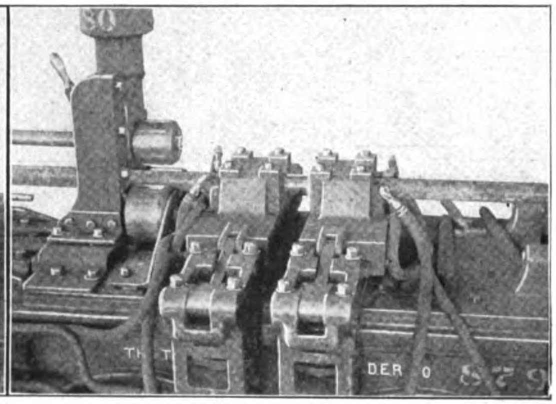


FIG. 15. FLUE ENDS JUST BEGINNING TO HEAT

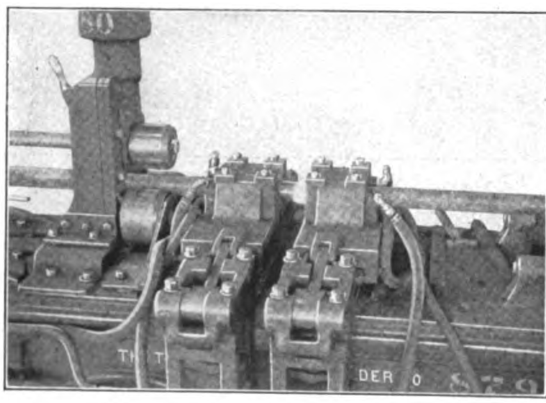


FIG. 16. ALMOST HOT ENOUGH FOR WELDING

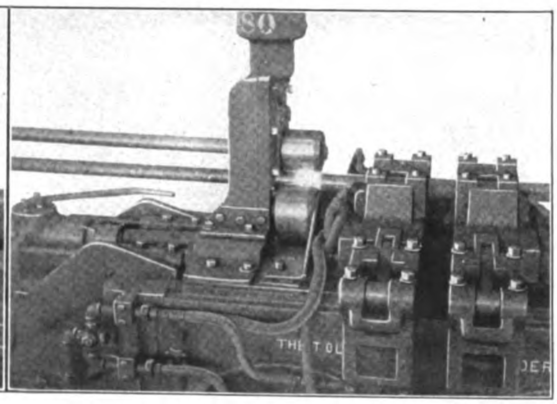


FIG. 17. ROLLING OUT THE UPSET METAL

Another view of the machine, from the back, is given in Fig. 13. This shows the mandrel A that works inside the flue as the outside is rolled between the three rolls after the parts have been heated and butted together. The action of the mandrel and rolls is to take out the upset and give a weld that is smooth on the outside and with very little extra metal inside. The gripping jaws are water-cooled, and the operating air cylinders are plainly shown.

Fig. 14 shows two parts of a flue in place in the jaws and illustrates how it is slipped over the mandrel. It will be observed that the mandrel does not extend far enough beyond the rolls to interfere with the welding or become heated from the current passing between the jaws. As it is impossible always to have the two parts to be welded of the same thickness, the setting of the pieces in the jaws must be done with judgment. If one piece is thinner than the other and they were both set in the jaws the same distance out, the thin one would burn before the thick one was hot enough to weld properly. To avoid this, a thick and a thin piece are placed about as shown in Fig. 14, A and B. In this case the thick one is at A and the thin one at B. As the thick one is in closer to the jaw, it will heat faster. The thin one, being set out farther, gives practically the same amount of metal for the current to heat. The result is an even heating and a perfect weld.

Fig. 15 shows two pieces the reverse of the ones just shown. As the work gradually heats, it looks as in Fig. 16. At the proper heat, the operator butts the work together to form the weld, which leaves a considerable amount of upset. He then shoves the tube along over the mandrel until the weld is between the rolls, when he throws in the clutch and brings down the upper roll. The work spins between the rolls, Fig. 17.

On flues made up in this machine the two parts comprising the main part of the flue are not only welded,

but the safe end is also welded on in the same manner. Fig. 18 illustrates some of the completed flues, and Fig. 19 some of the safe ends close up.

To give an idea of the perfect welds thus obtained, some of the welds were sawed apart purposely and are shown in Fig. 20. The weld on the outside can hardly be detected, and only a slight ridge shows on the inside. Welded in this way, there is absolutely no lump to cause trouble in passing through the flue sheet.

After being welded, the flues are tested under 100 lb. cold-water pressure in the apparatus seen in Fig. 21. This device holds two flues at a time. An air cylinder at *A* draws up a yoke carrying two cups that cover the ends of the flues. Water is then forced in; and while the pressure is on, the operator taps the welds with a hammer and carefully examines them for defects of any kind.

The flues welded are of the 19- and 20 ft. lengths and are 2 or $2\frac{1}{4}$ in. in diameter. About 250 welds per day can be made, on an average. With two welds to a flue, this makes about 125 flues reclaimed per day. Regular safe-ending is done on Hartz machines in the usual way, as the electric welder cannot handle all the work at present. The efficiency of the electric-welding method will be understood when it is known that out of three lots, selected at random, the failures were as follows: (1) 100, five bad; (2) 99, six bad; (3) 102, three bad. The general average will run about as indicated by these figures. After being tested, the welds are annealed to take any possible metal strains. They are then ready to go to the boilers.

FIG. 18. A PILE OF FLUES WELDED IN TWO PLACES

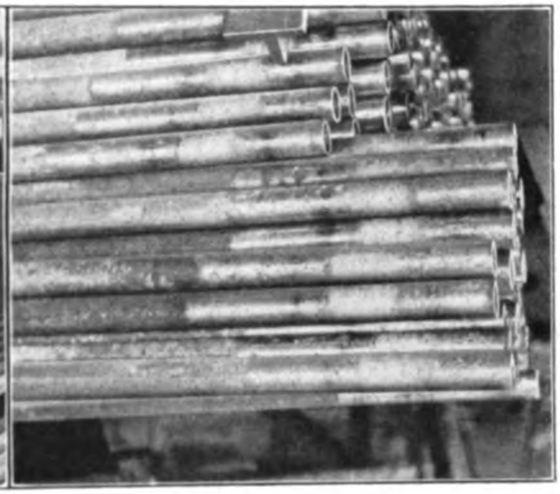


FIG. 19. CROSS-VIEW OF ELECTRIC-WELDED SAFE ENDS

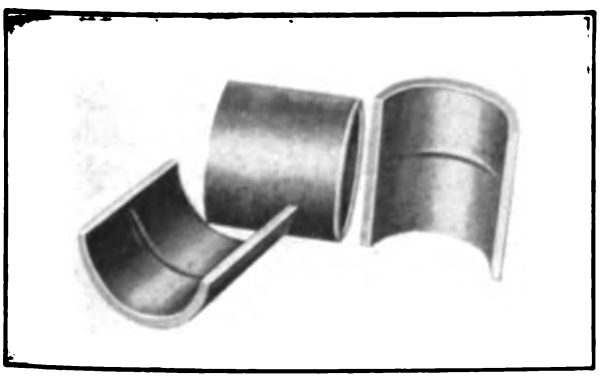


FIG. 20. SAMPLES OF ELECTRIC FLUE WELDS

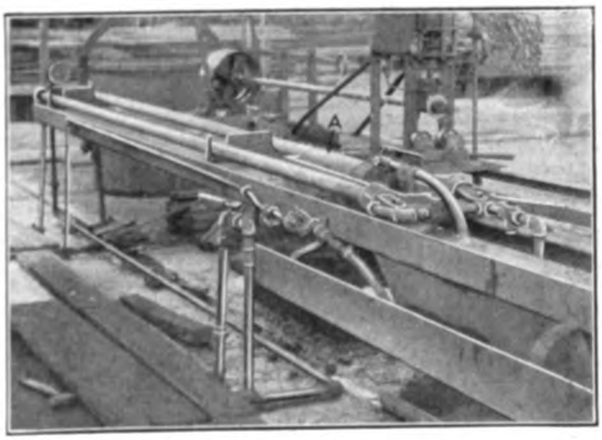


FIG. 21. THE DUPLEX TESTING DEVICE

Efficiency of Tool Steels

In a paper recently read before the Iron and Steel Institute, Prof. J. O. Arnold proceeded to show that not only is there no relation between Brinell hardness and lathe efficiency, but also that a plain carbon turning tool with very high Brinell hardness may, on comparison with another tool of considerably lower Brinell hardness, register an efficiency of practically zero, while the tool of about 15 per cent. lower Brinell hardness may run perfectly for 18 min. and during the last 5 min. of the test cut cleanly at a blood-red heat before breaking down.

The Brinell hardness of a properly hardened tool is an almost negligible factor of efficiency. The efficiency depends almost entirely on the thermal stability of the simple or compound hardenites in the hardened steel. The simple hardenite of plain carbon steel has a thermal stability of which the limit is certainly less than 300 deg. C., while the compound hardenite of a carbon-tungsten-chromium-vanadium high-speed steel may be rendered stable up to a temperature of about 700 deg. C.

The Rolling Stone Gathers the Shekels

By John R. Godfrey

Of all the various kinds of pure and unadulterated bunk handed out to the young engineer or mechanic the particular brand that urges him to stick everlastingly at the job and so gather the reward of diligence is unfortunately about the worst specimen that can be found. While it is probably true that the rolling stone rubs some of the bark off the corners and spends a few extra dollars in carfares and moving-picture shows, in most cases he seems to have more money to spend and is at least as well off at the end of the year. At least, that is the experience of a number of men whom I know of various ages and occupations.

Two particular instances come to mind; and while these by no means prove a rule, I can personally recall many others.

Bill Brown, for want of a better name, is a young technical graduate who has been knocking around the cold world for only two years. He took the first job available—puttering around in a machine shop, building printing presses and doing similar work at $8 per. According to tradition, he should have stuck to the job and mastered every detail, so that at the end of ten or fifteen years he might have been a general foreman, drawing perhaps $25 a week, if he was lucky. It so happened, however, that in about three months a gasoline-motor job happened along; and as he had previously "titrivated" balky automobile motors, etc., he was offered $15 a week.

Age and Earning Power

This developed into $18 and finally $20, and he was given charge of motor testing, with considerable designing and drawing-room work on the side. He was soon carrying quite a load of responsibility, working long hours and doing exceptionally good work. It did not particularly help his state of mind to know that he was holding down a job at $20 per which had previously been paying considerably more, nor was it altogether gratifying to be told that a boy of 22 couldn't possibly be worth more than that, no matter what he was doing. He, poor chap, in his ignorance, and despite his college education, seemed to feel that the firm was paying for work done and not for the number of years he had inhabited this vale of tears.

So when another man came along with an offer of $25 a week to assist him in working out the design of a new and experimental machine, coupled with easier hours, better working conditions and the promise of advancement despite his youth, Bill Brown was just foolish enough to take the job. Of course, the very fact that the shorter working hours and better conditions appealed to him in the least proved very plainly that he was of the mollycoddle type and not made of the sterner stock which we read about in books telling us how to succeed. In order to run exactly true to form he should have rejected the offer with scorn and stuck to the old concern, regardless of the hours and the pay envelope and grimly determined to stick it out on that line if it took ten years of his life, and so make them see his intrinsic worth.

But somehow the usual formula for success slipped another cog, and inside of two months the gas-engine firm was wiring him and sending special-delivery letters offering him $30 per week and all kinds of promises for advances if he would return to the fold. They even went so far as to suggest that the only reason for not offering him more to begin with was that they believed it was always well to have something to look forward to. They further assured him that the future remuneration could be very safely left in their hands, as they always rewarded faithful service without the necessity of even asking for a raise.

Upon being gently reminded that this was not the previous experience, they blandly assured him that the reason for not paying him any more previously was that he was not then worth any more to them. They quite forgot, however, to explain why two months' absence, in which his mind was fully occupied on entirely different work, should have increased his value 50 per cent.

Another case that comes to mind is a most successful works manager who a comparatively few years ago was a machinist running a lathe at the usual rate. He was a close observer and a hard worker and is today one of the best-paid works managers in this country. But he did not arrive at this very satisfactory position by sticking to one job and waiting for his ability to be recognized by his employer. He has probably not been in any one shop over four years, and in many of them he has stayed a much less time than this. But as an indication that bluff plays no part in his success, it may be interesting to know that he has been employed by one of the largest firms in his line at three different times, each time going back at a decidedly larger salary than the company was willing to pay him previously. In some ways it seems to be a case of "never missing the water until the wells run dry."

Even in the good old days some of the shops used to have the habit of discharging the apprentice as soon as he was out of his time and telling him to go elsewhere for a couple of years. This was not done especially for the benefit of the boy's pocket-book, but to add to his fund of shop experience, so that he would be of more value when he came back. But it was never advocated for men after they grew up; the rolling-stone formula began to apply about that time.

The Line of Least Resistance

There is something about the old adage that appeals to most of us, probably because it's so much easier to stick to one kind of a job than to float around from place to place. This is especially true if we have a flock of youngsters in school and the Missus has a whist club that she just can't bear to leave.

But the sad part of it is that in too many cases a man simply has to quit the old firm to get anywhere near what he earns. The "success" men (who generally have to pawn their shirts between checks they get for the articles they write about the matter) dope out a lot of hot air about growing up with the job, or ahead of it, but with too many managers it works in reverse gear. They never seem to wake up to the possibility of your being worth more until the other fellow offers you a job.

The companion exasperation to this is the game of "getting new blood" into the business by letting the old super resign and taking in a new man to improve things. The interesting thing is that he usually does. But when you boil it down, you find that many of his improvements are made possible by new machines that the old super asked for in vain. The new man gets many opportunities that were denied the old, and he makes a good showing.

Finding the Turning Point in the Small Shop

By John H. Van Deventer

SYNOPSIS—In the majority of successful shops there is one definite turning point at which a start is made toward bigger and better business. Many times this change is made unconsciously, and the turning point cannot be definitely located. In this case the installation of one machine changed the shop product from an average to an exceptional one.

A small shop that is 68 years old is something of a rarity and is therefore of interest in a country where plants mushroom over night as if under the spell of Aladdin's lamp. That a small shop can stand the buffetings and trials of 68 years of competition is also an interesting fact, establishing as it does that the small shop is after all of a hardy and robust nature. In an instance of this kind, one is apt to look for work a little out of the ordinary in order to account for such a long existence.

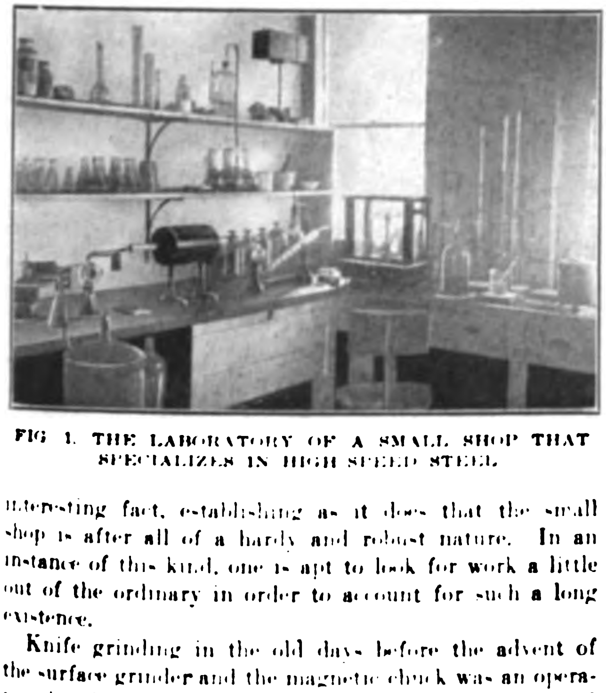


FIG. 1. THE LABORATORY OF A SMALL SHOP THAT SPECIALIZES IN HIGH-SPEED STEEL

Knife grinding in the old days before the advent of the surface grinder and the magnetic chuck was an operation in which the old fashioned grindstone and side wheel labored in partnership with a patient grinder hand who was unable with all his skill to grind anything really straight. Fifteen thousandths of an inch was considered a close job in those days. Most of the work was held and fed by hand, some of it in crude fixtures that were as likely to spring the knife out of shape as to hold it flat. Only those who have surface-ground thin stock by such means in the past can appreciate the real value of the magnetic chuck.

Prior to 1906 this was the way that A. Hankey & Co., Rochdale, Mass., were grinding knives. A rather ordinary line of work, one might say, and one that was not at all uncommon throughout New England, where knife grinding in America was indigenous.

A shop, in order to keep up with the times, must not only study its own progress and that of its competitors, but—and more important—it must keep in close touch with the progress and tendencies of its customers. Shops exist that are so bound up in themselves that self-interest is a far bigger factor than service, and other shops depending on these for a part of their products oftentimes find their own advancement hindered through a lack of someone's else initiative. At the time of which I have been speaking, when knife grinding was so crudely handled, a class of knife users of considerable importance consisted of the woodworking-machinery manufacturers. Compared with the present-day product, wood planers at this time were crude and slow machines. A feed of 25 ft. per min. was considered high and in fact was about the maximum that could be used for smooth work. Anything faster than this would show revolution marks on the finished board, the old four-square planer head with its thick, clumsy, hand-ground knives being almost impossible to balance perfectly.

One could not, without clairvoyant power, foresee that the 25 ft. per min. feed would some day be multiplied twelve times and that lumber would be shot through these machines at the rate of 300 ft. per min. But it was possible to arrive at the conclusion that an improvement in planer knives would mean an increase in planer feeds. Here was an opportunity for some knife-making shop to analyze conditions, find the weak point and help to push aside the obstacles holding back the progress of the wood planer.

The installation choice of a new machine is taken more seriously in the small shop than in the large one. No doubt this is because one machine among many does not affect the whole as much as when one is added to a few, just as a single vote in a small town is of much more relative importance in local elections than one vote in a large city. The installation of the wrong machine in a big shop means annoyance and a small loss; the installation of the wrong machine in the small shop may put it out of business. On the other hand, not buying a machine that is needed, while it will not result in a sudden calamity, is likely to terminate in a case of gradual dry rot.

The "Rogers Boys," as J. R. and Francis P. Rogers, Jr., are known in Worcester and vicinity, believed that a suitable surface grinder would solve a problem of the wood-planer knife. Not only had they the conception of what was needed, but not finding a suitable machine for this purpose on the market, they designed and had built the special machine illustrated in Fig. 2—an act that involved playing a $10,000 stake against their belief. That this was an investment and not a gamble is evidenced by the fact that from this machine came the first high-speed steel wood-planer knife made, and others have been coming from it ever since.

This machine is of interest, not only as an example of good judgment displayed at an opportune time, but also for what it will do. The grinding wheel is 24 in. in diameter with an 8½-in. face. Running at 5,000 ft. per min. it is so free from vibration that one cannot tell whether or not it is in motion, even when holding to

his ear a screwdriver with its end applied to the wheel bearing.

The table of this machine is 10 ft. long, its entire length being equipped with Walker magnetic chucks having a width of 8½ in. There are two table speeds—40 and 60 ft.—one for roughing and the other for finishing. On the class of work produced on this machine, limits and finish are held exceptionally close, some knife specifications calling for tolerances no greater than 0.00025. In view of this requirement the accomplishment of this machine in removing $\frac{1}{32}$ in. per hr. from a surface 120 in. long and 8½ in. wide is rather remarkable. The table is reversed by a pneumatic clutch.

The rear view of this machine, seen at *B*, displays 2½-in. flexible steel hose through which cooling water is applied to the wheel. When the machine was first tested out, this hose was not fastened as securely as is shown, but was held by a husky negro who directed it upon the back of the wheel. The gentleman, becoming absent-minded during the course of events, allowed the nozzle to deviate from its proper path; as a result the 2½-in. stream projected between the housings and knocked a couple of interested spectators from a bench alongside the table. What happened to the spectators is known, but what happened to the darkey is not related.

One does not see anything unusual in the practice of saving the sweepings from the floor of a mint in which gold coins are being made, but it is rather strange to find a similar practice in a knife shop. However, when you consider where the price of high-speed steel is today and where it is quite likely to go, there may not be much to be wondered at after all. The accumulation of dirt shown in the tank at *A* in Fig. 1 is in reality high-speed steel grinding dust floating on top of water. This material is carefully saved, packed and shipped to the steel mills, where every bit of tungsten is eagerly welcomed.

One can get an idea of the proportions of a high-speed steel wood-planer knife from the illustration at *A* in Fig. 3. They are from ⅛ to $\frac{3}{16}$ in. thick, from 1½ to 2 in. wide and from 4 to 50 in. long. The heat-treatment and straightening of a high-speed steel blade of such proportions require a high degree of skill. All these blades are hardened in Kenworthy furnaces using fuel oil vaporized by steam under a pressure of 125 lb. and are quenched in Houghton's soluble quenching compound. After quenching, they are tempered, or "let down," to approximately 600 deg. F. Before this, however, they must be straightened, a peculiar thing about high-speed steel being that it is impossible to straighten it after this second heating.

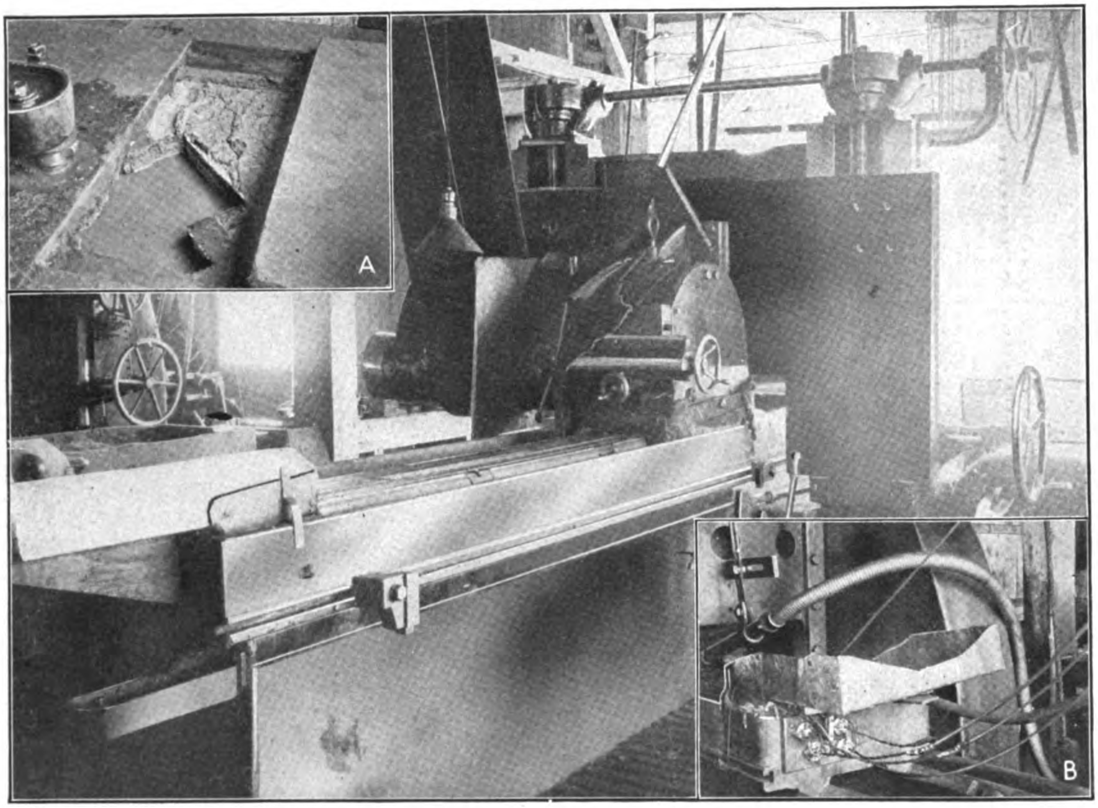


FIG. 2. THE SURFACE GRINDER THAT PROVED TO BE THE TURNING POINT

Planing Iron at 230 Ft. per Min.

The machine-shop man who has been unpleasantly surprised by the ease with which some high-speed drills and reamers break under slight provocation would expect a thin high-speed steel knife of this kind, hardened to a scleroscope hardness of 85, to be a rather delicate and fragile tool. He would change his mind if he could see

the piece of 1½-in. angle iron shown at *B* in Fig. 3, which was accidentally fed into a double surfacer and planed both top and bottom for 18 in. of its length at a speed of 230 ft. per min., some ⅜ in. in depth being removed from one of the ribs and a full $\frac{1}{32}$ in. from the entire surface of the other rib. The high-speed steel knives which did this fast iron planing were somewhat dulled, to be sure, but a grinding put them in condition for further cutting of lumber.

Before the installation of this "turning-point machine" the Hankey company was doing what a number of other firms were also doing and in about the same way. The use of this machine upon high-speed steel knives, however, necessitated careful study of the heat-treatment of this material and led to a specialization in accurately ground high-speed steel knives and tools, which has been

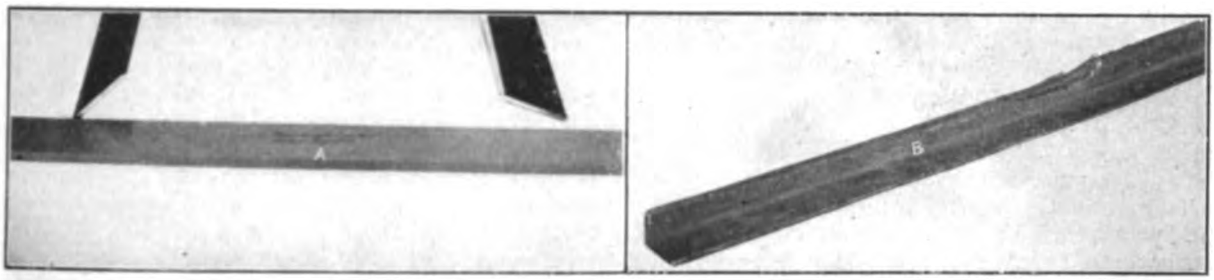


FIG. 3 HIGH-SPEED STEEL WOOD PLANER KNIVES AND WHAT THEY DID TO ANGLE IRON

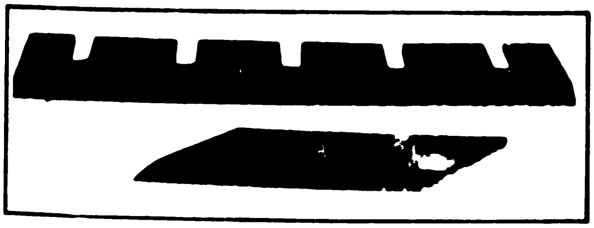


FIG. 4. COMPOSITE-STEEL WOODWORKING KNIVES

a profitable line of business. But the turning point was the installation of the grinder.

High-carbon and composite-steel tools and knives are also heat-treated and ground at this plant. Two of these are shown in Fig. 4, the one at *A* being a wood planer knife for a square-cutter head and the one at *B* being a miter knife. They have soft steel backing on tool-steel edges. The furnace weld is rolled, and the grinding of a piece of this kind, one part of which is soft and one part hard, without leaving a mark at the junction of the two pieces may be considered a noteworthy job. In fact, the face of these blades must be ground to a radius, that is, held to very close limits. One and one-half thousandths is allowed for location of this radius centrally with the blade, and 0.001 in. is allowed on the length of the radius.

It is not often that a small shop is able to change the grade of its product as markedly as this, owing to the installation of a new machine. Every small shop, however, can keep in mind the fact that each machine installed should be a turning point toward better work and more profits.

This thought, coming at the time when new equipment is to be purchased, will influence the buyer to select the machine best suited to his needs regardless of what its cost might be.

Financial Literary Rewards

By R. D. Gatewood

Many readers have no doubt had occasion to comment on the apparent lack of financial reward to literary labor, particularly that involved in writing technical articles. Not one writer in 50 can live on the earnings from his literary efforts, yet it is an undisputed fact that other professional men—physicians, lawyers, consulting engineers—can sit in their offices and take in as a single fee for a service that costs them an hour's time a sum equal to that which an editor works a month to win. Surely, it takes almost as much time, money and labor to fit a man thoroughly for one profession as for another; and I may add that it requires just as much talent and genius to be a successful technical writer as to be a doctor, a lawyer or an engineer. In the character of work done and in the amount and kind of preparation required there is little reason why one of these professional men should be better paid than another, yet there is no field of human effort where the contrariety of pecuniary reward is more pronounced than that presented by professional and literary labor.

After all, the monetary compensation for this kind of work is fixed by the great law of supply and demand, and technical men with literary tendencies must find their true reward in some such thoughts as the following: Every technical man who can do good, marketable literary work along the line of his specialty owes a certain duty to his profession and his generation to record the results of his own experience.

A certain professional respect is usually accorded him by his fellow workers, especially if his articles contain anything of an original nature. The effort to present his subject in a clear, concise way nearly always results in giving the author himself a clearer view and better grasp both of his particular subject and of the engineering profession as a whole.

These are some of the compensations of doing literary work for technical magazines; and if more consideration were given them, fewer writers would permit their literary tendencies to die out, and more men would enrich their profession with an expression of their views.

The Growth of the Aëroplane Industry is indicated by the exports of 398 aëroplanes for 1915 against 40 in 1914 and 19 in 1913. The value of the 1915 exports was $2,960,814, or an average of $7,439 per machine, against $6,337 in 1914 and $3,227 in 1913. The exports of aeroplane parts were also very large, amounting to $2,457,782 as compared with only $145,997 in 1914 and $25,606 in 1913. Imports of aeroplanes into the United States decreased from 16 and 13 in the fiscal years of 1912 and 1913 respectively to only one each in the fiscal years of 1914 and 1915.

Punches and Dies for Making a Gate Wearing Shoe

By Robert Mawson

SYNOPSIS—These tools are made of cast iron and are put into service without any finish whatever. The scale provides a hard wearing surface for the bending or forming operations. The stock is heated in a furnace before being bent.

On page 894 are shown some cast-iron punches and dies designed and used by the Narragansett Machine Co., Providence, R. I. Other similar tools are illustrated and described in this article. It will be observed that the tools are of somewhat simple construction; and as the stock is of a rough character, adjustable locating surfaces are employed. The tools, as well as those previously discussed, are giving satisfaction, producing parts quickly and accurately.

Cast-iron punches and dies have not been used very extensively in the forming of machine elements. For most punches and dies either machine steel or tool steel is employed. When the former is used, it is necessary that much accurate machining be done. Often when the shapes are rather intricate, the punch and die must be made in various parts which are then fastened together with setscrews and dowels or similar mediums. In manufacturing some punches and dies many companies employ cast iron as the base of the die, on which is fastened a tool-steel die plate. When this method is followed, the die bed must be accurately machined, and after the tool-steel elements have been made, it must be hardened and ground to the required contour.

The hardening process is to many firms somewhat of a task, and unless care is taken it tends to warp the tool-steel element. This change in shape must be remedied by the subsequent grinding operation. In the making of the punch a somewhat similar procedure is followed. The shank and body of the tool are usually made from machine steel, which must be machined. The tool-steel punch must also be machined, hardened and ground. The change of shape in this element must be remedied in the same way as in making the die.

After the tool-steel element has been accurately ground to the correct contour, it must be attached to the shank base by means of screws and dowels. It will be observed that tools made in the manner described call for a high grade of tool making. It takes a long time to complete the tools, and the punches and dies produced are therefore costly. It is true, however, that tools made in this manner usually give extended service.

On the other hand, many of them break, and their upkeep is quite an item in the shop equipment. In the bending and forming of many of the simpler elements on machines cast-iron punches and dies may be employed to advantage. For such tools the design made in the drawing office must give a tool strong enough to resist any strain brought upon it by shop practice. No allowance is made for finish, unless it be on the shank.

This part, however, may be molded smooth enough to fit the press without machining and thus reduce the cost of the tool to the lowest figure. The castings are made from the pattern and, as mentioned, are not machined. This is an advantage, as the skin on the cast iron provides a hard surface to resist any wear during the use of the tools.

It will be noticed on the first two tools shown that adjustable stop screws are employed to locate the steel strip, which has been previously cut to length. In operation the stock is slid against the inner edge of the screw, and the punch, being fed down, produces the contour desired. The last tool performs two operations. The first of these is to produce a bend on the flat side. The heated plate is then placed in the slot, and by feeding the punch down a second time the bend is made.

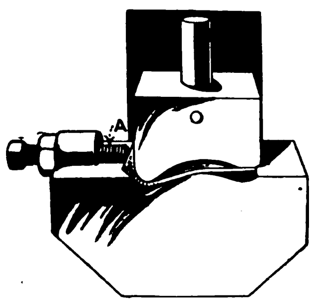


FIG. 2

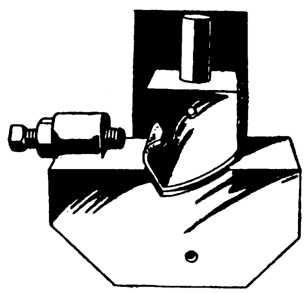


FIG. 4

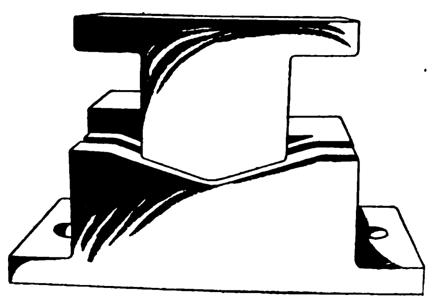


FIG. 6

PRESS TOOLS FOR MAKING A GATE WEARING SHOE AND SIDE HANGER

FIGS. 2 AND 2-A

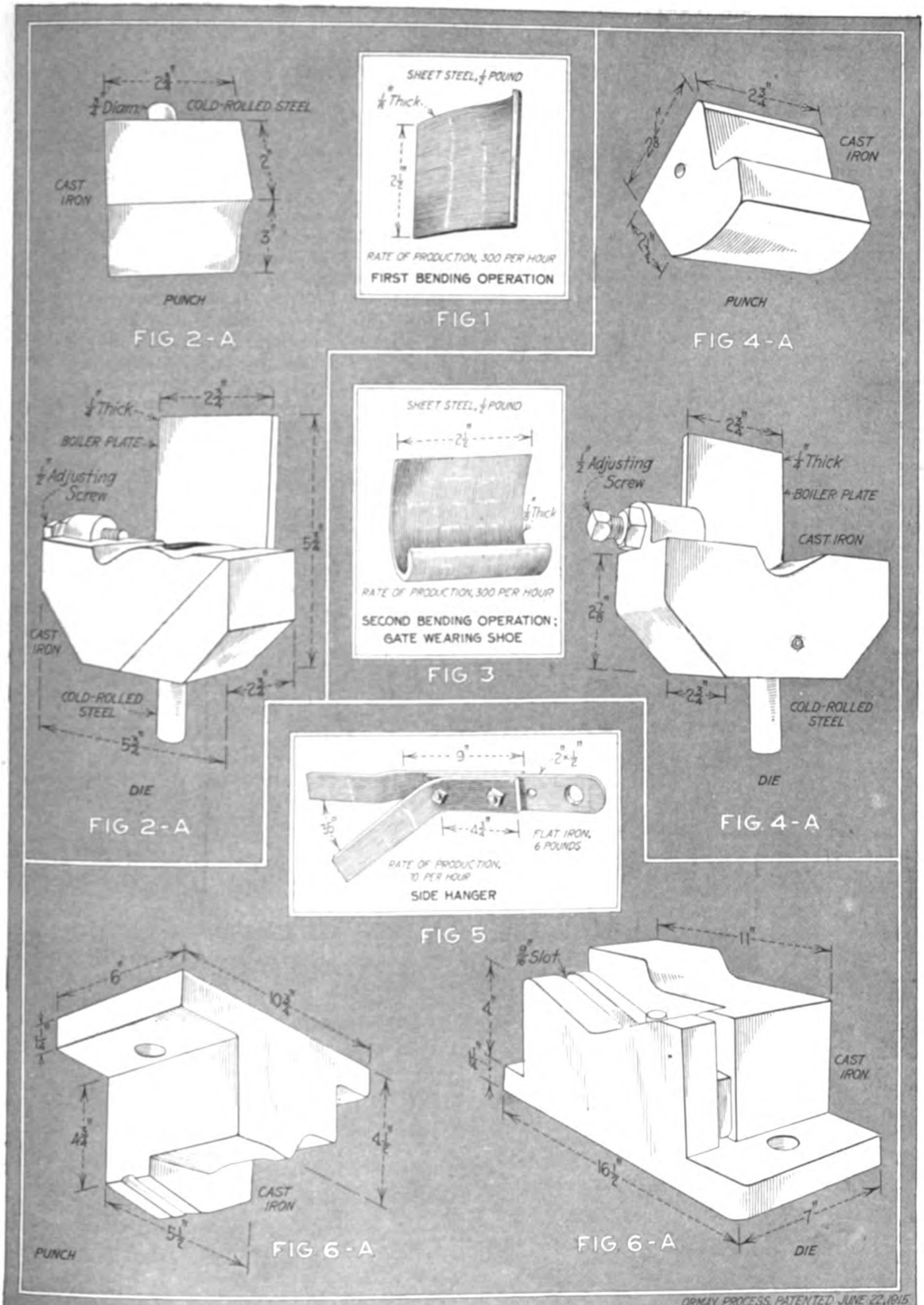
Operation—First bending operation on gate wearing shoe, Fig. 1. The stock, which has been cut to length, is placed on the die against the adjustable screw A. It is formed to the required contour by the punch, which is fed down.

FIGS. 4 AND 4-A

Operation—Second bending of gate wearing shoe to the form in Fig. 3. The part is placed on the die, being again located by the adjustable screw, shown. The punch is fed down by the press, giving the element the desired shape, as illustrated.

FIGS. 6 AND 6-A

Operation—Bending both elements to make a side hanger. One plate is placed on the die and the bend on the flat side of the first element is made. The other part is placed in the slot of the die, and by feeding down the punch a second time the edge bend is made. Thus the tools are used for bending both bars complete in two operations.



DETAILS OF PUNCHES AND DIES FOR MAKING A GATE WEARING SHOE

Russia and America--Economic Doubles

By Edwin Francis Gay*

In an economic sense, Russia and the United States are more alike than any other two great countries of the world. Underneath their wide differences of language, government and religion these two countries show fundamental similarities. Russia includes the eastern portion of the great-plains area of the northern hemisphere; America the western portion. Both have had a history of agricultural pioneering. Both have great natural resources of fertile land, forests, and mines, which have been drawn upon with the pioneer's inevitable prodigality.

Russia and America are the two wings, so to speak, of the great movement in economic development which originated in western Europe a little over a century ago, and thence has spread eastward and westward. They both borrowed from this center the new technical equipment of machinery and power for production and transportation, and adapted it to their similar needs.

In this borrowing and adaptation the United States has preceded and has in turn influenced Russia. It is no accident, for example, that the river steamers of the Volga are like those of the Mississippi, nor that railroad construction and equipment are similar in the two countries. In both, railroads had to be built as cheaply as possible, through long stretches of sparsely populated territory; and Russia has consciously adopted the solution of the problem that was found by American engineers.

The factory system and machine production were transplanted in both cases, though earlier across the Atlantic; and the infant industries of each country have called for protection from the competition of the more mature and proficient central nations. It is again no accident that these two countries, the eastern and western outposts of the industrial revolution, are alike in raising the highest protective tariffs.

Since from an economic point of view these regions are new areas of development, demanding capital greater than they could themselves supply, they have borrowed abundantly from the older centers of accumulation. The United States and Russia, therefore, are the two great debtor countries, and as such must export commodities to pay for the interest charges and for other services rendered. It is in consequence of this debt relationship that they each have an excess of exports over imports; they each show what is misleadingly called a "favorable" balance of trade.

*Dean of the Harvard Graduate School of Business Administration.

Both countries have been somewhat similarly affected by the western European current of economic and social thought. The high tide of Liberalism at the middle of the nineteenth century led them, among other changes, to temporary tariff reductions and to agrarian reform. The liberation of the serfs in Russia and the freeing of the slaves in the United States were contemporaneous.

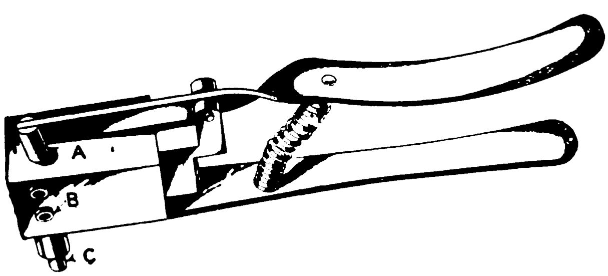
The fundamental parallelism of economic development shown in these and many other aspects of national life is especially marked in the agricultural basis of foreign trade relations. During the last half-century both countries have been absorbed in the economic subjugation of great continental areas; of necessity they have been hitherto land powers rather than sea powers. Their exports have consisted chiefly of agricultural products, and despite high tariffs they have offered large and profitable markets for the importation of manufactures and luxuries from western Europe.

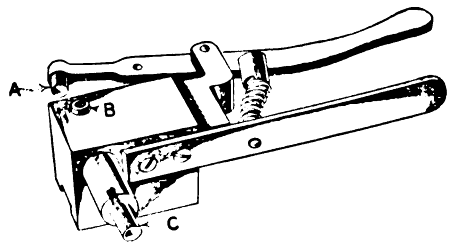
This similarity of commercial position does not, however, indicate any necessary antagonism of trade interests between the two countries. The development has throughout proceeded somewhat more rapidly in the United States, which in consequence of this development is nearer than Russia to the end of the great period of foodstuff exports and capital indebtedness. The United States will hereafter be increasingly able to supply Russia with manufactured goods, especially with agricultural machines and tools, tractors and machine equipment for its industrial plants.

It is important for American manufacturers to study the Russian market and to encourage reciprocal trade relations. The United States is entering upon a new era in its economic life. As a manufacturing nation, it cannot longer be a merely passive trader, but must actively seek foreign outlets for its wares. As a nation, we are as yet far from realizing our need of thorough training for this new work, and we must perhaps be disciplined by hard experience. Economic necessity will force upon us closer international contacts, both commercial and political. In Russia we find a power which in our national history has been consistently friendly to us and which now offers an inviting field for American business enterprise.—*Russia.*

Small Pin-Drilling Jigs

Two drilling jigs, used in the shop of the Henderson Motorcycle Co., Detroit, Mich., for drilling crossholes in small pins, are here shown. The pins to be drilled are thrust into bushed holes in the body of the jigs and are held in by the spring levers *A*. The drill guide bushings are shown at *B* in both jigs. The pins are removed by squeezing the handles and hitting the knockout pins *C*.





TWO SMALL PIN-DRILLING JIGS FOR MACHINING CROSSHOLES IN CYLINDRICAL MOTORCYCLE AND OTHER PARTS

Afterthoughts on the Panama-Pacific Exposition

By Frank A. Stanley

SYNOPSIS—A review by a writer who has visited many large expositions, pointing out salient features which might be overlooked by the casual visitor. The large attendance, the success in designing unusual buildings and keeping them clean and attractive, and the direct sales and future business secured by builders of the few machine tools exhibited are all of a special interest. The growth of machinery for preparing and packing food products is also shown and is far greater than we are apt to realize.

Since the close of the Panama-Pacific International Exposition at San Francisco, Calif., I have asked a good many of my acquaintances, engineers, manufacturers, business men and others who had the privilege of visiting the fair, what they considered the most important, the most interesting or the most striking feature of the exposition.

Quite naturally, there have been almost as many different answers to the question as there were persons to whom the query was put; and quite as naturally also, the replies have depended somewhat upon whether this exposition was the first one attended or whether visits had been made to earlier great international shows, so that the observers had had an opportunity for making comparisons between the San Francisco exposition and those at St. Louis, Buffalo, Paris, Brussels, Chicago and other cities.

It is rather difficult, even for a sophisticated newspaper man accustomed to visiting all the world's great shows as they come along, to determine what most impressed the majority of visitors at the Panama-Pacific Exposition. This having been a contemporary exposition, necessarily some of the most striking exhibits at earlier fairs were eliminated; yet without doubt historical exhibits showing the evolution of certain industries have in the past constituted almost, if not quite, the most attractive and instructive displays at international expositions. Among such as may be recalled have been the historical railroad exhibits showing the development of modern locomotives and cars from the primitive rolling-stock of over a century ago; the progress in steamship construction; the growth of design and manufacture of various lines of machinery; the evolution of heavy ordnance, firearms and the like; and the change and improvement, revolutionary in most instances, that have occurred in numerous other lines of activity.

Eliminating from the San Francisco exposition such interesting displays of former days, historical in their character and far reaching in their educational influence upon visitors of all ages, what then were the dominating features at the fair which closed last December?

Considering the exposition as a whole, its compact arrangement, its artistic design in grouping of buildings, its novel and more than pleasing color scheme, its unique system of illumination throughout the grounds, its general atmosphere of neatness and cleanliness—for there were no scrap heaps, dumps, garbage piles or other disagreeable and unsanitary and unsightly features to be found at the rear of the buildings or along unimportant passageways—were all factors in causing this exposition to be considered by trained observers the most attractive one yet produced in any city of the world.

From an engineering point of view the show had its shortcomings in many respects, as might have been expected, due to certain conditions which from their nature seemed insurmountable. In the first place, San Francisco itself, lying at the extreme western point of the continent and situated in a state numbering less than two million and a half population and over two thousand miles away from the center of population of the United States, seemed to many, prior to the opening of the fair, to be too far away to attract any special attention from a considerable number of people who would have decided unhesitatingly to visit an exposition held nearer the geographical center of the country. The great European War, manufacturers busier than ever, the expectation that a comparatively small percentage of people in this country would attend the exposition, that an almost negligible number would come from abroad and that consequently a big expense account would very likely have to be borne by exhibitors, particularly from the East, with little likelihood of any commensurate return either in immediate or future business, decided the majority of machinery builders not to exhibit at the exposition.

Experience of Exhibitors

Whether this policy, viewed from a broad standpoint, was a wise one need not be considered here. The fact remains, however, that to the astonishment of everybody the attendance at the exposition was not only far greater than ever anticipated by the most optimistic Californian, but even exceeded the total attendance at any of the former expositions held in this country, with the exception of the Chicago fair of 1893. Such machine-tool builders and dealers as did have displays, as well as numerous exhibitors of other lines of machinery who were interviewed during the closing days of the exposition, all expressed themselves as more than satisfied with the outcome of their endeavor toward making the fair as representative as possible of our national industries.

Not only did they have in each instance a far greater number of interested visitors than anticipated, but more to the point, their exhibits were productive of much real business. In several cases I was told by machine exhibitors that they had developed a large amount of entirely new business in what to them was practically a new territory. In certain instances the entire exhibits were actually sold on the spot, together with additional similar equipment to be shipped from the home factories, as a direct result of having gone to this Coast exposition with a fairly full line of their products. In the cases referred to, the exhibitors found themselves immediately reimbursed financially for the expense to which they had

been put in shipping to the Coast and maintaining their exhibits throughout the ten months of the exposition and made a fair profit in addition.

Beyond this remains the fact that a considerable and growing amount of new business was opened up with certain machines heretofore little used or known in the Far West, so that the sales made at the exhibit constitute but a part of the business resulting as a direct outcome of manufacturers' exhibiting their tools.

In this connection it is of interest to mention the experience of one tool builder from the Middle West, who had a liberal display under his own exhibit. He stated that, never before having visited the Pacific Coast and having had in his years of manufacture a relatively small amount of business in that section, he was somewhat disinclined to go to the expense of filling space in Machinery Palace. Upon second thought he decided that as an American citizen he would make the venture and do his little part toward making the exposition truly national and not sectional in its character, so far as relates to the United States. In his case at least the fulfillment of what he felt to be an obligation and a duty brought a financial return which could hardly have been expected by most optimistic exhibitors at the outset. Tools of the very kind he was showing were wanted immediately in the near vicinity, were purchased during the exposition period, and he was relieved of the burden of shipping back home. The transaction ran into such an amount that he was at once able to show a good profit over and above the expense to which he had been put as an exhibitor.

Attitude of Machinery Builders

In visting the San Francisco exposition I followed the policy adopted at former international expositions of arriving not far from the closing date, when exhibitors have had ample time to review thoroughly the outcome, financial and other, to themselves and business friends; when the earlier enthusiasm, so far as any enthusiasm had existed, has diminished or worn away; and when a fairly accurate consensus of opinion from all sides and angles bearing upon the show may be obtained. On all past occasions I have been assured by various manufacturing friends that they had had enough of big shows, that such exhibitions were not worth while from a business point of view, that they were through for all time with such expositions except as casual visitors. In most cases, to be sure, there was a change of heart in the course of time, and usually the next exposition fortunately found these same manufacturers present with their displays of newer and better lines of machines. At San Francisco, probably in part for the reason just given and in part for the peculiar conditions obtaining at home and abroad, previously referred to, the great majority of our machinery manufacturers were not represented. But from those who were there as exhibitors I heard no complaint that the venture had not paid from any point of view as in the past, or that this was the final appearance for them as participants in a big exposition.

It is my firm opinion, based upon observation and upon the results of numerous interviews with exhibitors, that those who showed at San Francisco will, with possibly a few exceptions, be optimistic participants in our next great international exposition, no matter in what part of the country it may be held.

Professor Larkin, of Mt. Lowe Observatory, has pointed out that at this exposition the highest achievements in the history of man were exhibited. He refers in this connection to five of the greatest inventions emanating from the brain of man, these being the diffraction grating, the telegraphone, the Audion amplifier, the wireless telephone and Thordarson's transformer for one million volts.

These devices, wonderful developments in the scientific field and each of wide importance, were in spite of their value probably examined by a comparatively small number of visitors. It is doubtful if even a small percentage of people outside of the engineering and scientific fraternities knew of them or heard that they were exhibited. For most people at an exposition of this kind wander about through building after building in an aimless, undirected fashion, glancing at everything along the main aisles, seeing nothing particular in detail. They eventually leave the grounds in a semidazed condition, knowing that they have seen many new objects, but unable usually to describe any special feature. They have seen the show as a whole and seem well content with their experience.

On the other hand, visitors who go with some fairly definite object in view find that, with a somewhat limited amount of time, while they see much of interest in their respective fields they are never able to make a complete round-up of all the exhibits which they have in mind as worth examining. It yet remains for some progressive individual to develop some form of itinerary, some fairly simple routing process by means of which people going to an exposition to study certain lines of advancement in the respective arts and sciences in which they are interested may with a minimum of time and effort see every exhibit likely to be worth while to them.

Undoubtedly the most interesting engineering exhibit from a popular viewpoint was the great working model of the Panama Canal, this model covering an area of nearly four acres and being produced on the scale of 1:600 horizontal and 1:150 vertical. The amphitheater in which the model was installed was so built that the water level was about 20 ft. below the spectators, so that a clear birdseye view was obtained of the surrounding country as well as of the canal itself.

The operation of this model included the passing of vessels of various kinds through the canal and locks and the running of trains over the Panama R.R. All details were worked out so thoroughly as to include lights and channel buoys, range towers, etc., the whole affair being electrically operated.

Coming as it did to commemorate the opening of the canal across the Isthmus of Panama, the San Francisco exposition had in this one feature of the canal model an exhibit unsurpassed at any previous world's fair. It is doubtful if as much money has ever been spent on any engineering undertaking in the history of the world as on the carrying out of the work of the construction of the great canal. And the opportunity to witness the operation of the large-scale model at San Francisco was appreciated by hundreds of thousands of visitors, the greater portion of whom are naturally so situated as to make it impossible for them to visit the canal itself.

While machine tools, textile machinery, engines and so on were shown in relatively small numbers, there were numerous examples of striking development in machine

construction since the last international exposition—among these, Diesel oil engines, certain types of motors, electric apparatus, farm implements and automatic and semiautomatic machines of various kinds.

One of the most important developments in the machinery field during the past few years is the equipment for manufacturing, handling and packing food products of all kinds. Can-making machinery has long been on the market, and it is fairly familiar apparatus to designers and mechanics in general. But of later lines of equipment for preparing foods and containers less is commonly known. At the time of the World's Fair in Chicago in 1893 few of our modern patented breakfast foods were on the market, and not until about the time of the Louisiana Purchase Exposition in St. Louis in 1904 was any appreciable amount of machinery developed for the preparation in packing of these articles of diet now so common in every household. The ten or twelve years past have seen an amazing extension of new food preparations and a still more wonderful development of mechanical apparatus for their manufacture. Then, too, in the period referred to, methods of preparing and packing old standard lines of food like fish, meats, fruits, vegetables, cereals and the like, coffee, tea, cocoa, milk and so on have been revolutionized. At San Francisco, for the first time was a really complete line of machinery for this important work on exhibition.

Food Machinery Most Ingenious

The history of the origin and evolution of such apparatus is a most interesting one, involving the design and arrangement of new combinations of mechanism for handling materials which, before, it had always seemed impracticable to deal with except with simple crushing, rolling and steaming apparatus and in many cases with hand labor alone or with the simplest forms of hand appliances. Labor in this field had always been of the cheapest, the work often carried on at home or in small factories by children or by older people oftentimes not otherwise employable. With the development of new forms of food products there sprang up a corresponding development of ingeniously designed machinery for their preparation, and coincidentally mechanical apparatus began to be devised for application to the handling of older foods and tending toward the elimination of the cheap unskilled labor in that particular activity.

This machinery embodies as a class not only some most intricate and interesting mechanism, but also a degree of workmanship not excelled in many of our finest machine tools and other equipment of precision. It is rapid in its operation and it is kept scrupulously clean mechanically, so that its product emerges in incomparably better condition for consumption than would otherwise be possible, even granting that it might be practicable to produce certain of these preparations at all except by this mechanical process.

It is a far cry from Providence, R. I., in the year 1894 to San Francisco, 1915. Nearly a quarter of a century has passed since in the former city were built what were probably about the first of the automatic machines for manufacturing breakfast foods, and these may be considered the pioneers in the now long line of highly developed apparatus for such operations, most of this equipment having seen its evolution during the past ten or twelve years at the outside.

In 1893 the shredded-wheat preparations now made at Niagara Falls were first patented, and a number of special machines were built for manufacturing these foods in large quantities. The following year I, a young journeyman machinist in the Brown & Sharpe shops, with three other young mechanics on a battery of four Reed engine lathes, was put to work on the job of turning out a considerable number of grooved tool-steel rolls for a lot of wheat-shredding machines which the firm had taken to build on contract. And these machines had to be built with a high degree of accuracy throughout.

The rolls for these machines were of Jessop steel, and as nearly as I can remember they were approximately 5 in. in diameter, 5 in. long and weighed about 25 lb. each; they were bored for a $1\frac{1}{4}$-in. shaft, or spindle, and were relieved in the bore to leave a bearing surface at each end about 1 in. in length.

The steel blanks, well annealed, were first rough-bored on a vertical chucking machine, rough-turned to within, say, $\frac{1}{16}$-in. diameter and then brought to me at the head of the lathe crew—head, not in authority, but in the position of my lathe, which stood nearest the chucking department. It was my part of the work to bore the hole to size, turn the diameter accurately, face the ends down to an exact overall length and pass the blank along to the other men, who divided among the three lathes the roughing down of the series of fine grooves around the circumference of the roll—these grooves being spaced about $\frac{1}{16}$ in. apart and having a V-form about like a U.S.S. thread—and the finishing of the roll surface and grooves with a flat-form cutter extending the full length of the roll face.

Handling a Chuck Job

Although there were a good many rolls to be made for the shredding machines, it was hardly necessary to make any lathe tools for the purpose, except the flat grooving cutter referred to. The roughed blank as it came to the first lathe was placed in an independent four-jawed chuck, trued up fairly closely, a light cut turned at the outer end for about an inch to receive a steadyrest and a similar light cut turned at the inner end as near the chuck jaws as possible. With the steadyrest supporting the end of the blank, a tool was applied to face the end of the roll square, and the outer end of the hole was bored a dead fit to a plug gage, the bearing thus formed as far as the recessed portion of the work having, as already mentioned, a length of about 1 in.

Next, the roll was reversed end for end in the chuck, the other end supported in the back rest and the chuck end trued accurately with a test indicator. The exposed end was then faced off true and the outer end of the hole bored to the plug-gage fit just as the other end of the hole was previously bored. The test of the alignment of the two bearing surfaces thus bored from opposite ends of the roll was that a hardened and ground arbor with the very slightest degree of taper must pass straight into the work with perfect fit, just as if the roll had been bored straight through from end to end at one setting.

While this process requires quite a bit of explanation, it was easy enough to follow out in practice; and the bore was much more quickly and easily finished to exact size than would have been the case had the attempt been made to run a slender boring tool clear through from

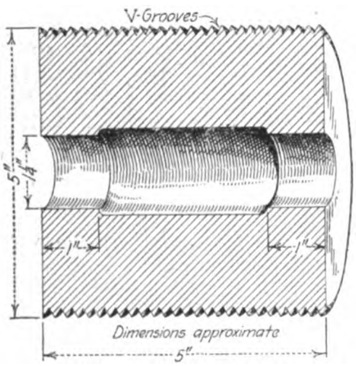
front to back. With a chuck in first-class condition, it is always a fairly simple matter to indicate with accuracy a piece of work of almost any reasonable size and form. The experience derived at this time was useful for many years afterward, and I have never since worried over a job of chucking.

Following the facing and boring of these rolls, they were placed on an arbor, turned to size to a vernier caliper, faced exactly to length to another vernier—for large-size micrometers were not available in those days—and the rolls were then passed along to the grooving lathes.

In preparing the finished rolls for assembling in the shredding machines they were forced onto spindles which were hardened and ground, the journals being fitted in bearings finished with the same degree of precision as the rolls themselves.

Shop Happenings

Two peculiar incidents occurred during the carrying out of this contract which oftentimes bring these details to mind at the breakfast table: The long serrated forming tool for finishing the V-grooves in the rolls was originally made in one piece about ½ in. thick. It was clamped fast to the top of a flat holding block on the



ROLL DETAIL FOR WHEAT-SHREDDING MACHINE

cross-slide of the lathe. It was thus left clamped in place one Saturday afternoon; and the following Monday morning, after a marked reduction in temperature over Sunday—this was in midwinter—the tool was discovered fractured clear across from cutting edge to back, due undoubtedly to a combination of stresses imposed by the action of the clamping bolts and by the change in temperature. It is my recollection that provision was made to obviate this trouble with later tools of the same character by modifying the clamping method.

The other occurrence was not so easily explained, although quite understandable: We had two valuable 12-in. verniers on the job in constant use and never out of sight except when returned to the toolroom at night. One morning we discovered that the vernier plate from one of these tools was missing, and without doubt it was borrowed by somebody to complete a vernier he had under construction for his private equipment of measuring appliances. Never having had time nor inclination to make one of these precision calipers myself, I felt cleared of any suspicion which might otherwise have fallen in my direction, and I always believed the other members of the crew to be as innocent as myself. I remember that the department-foreman was somewhat annoyed by the transaction, and I am still wondering if he ever located the missing vernier plate.

One of these shredding machines, as now made, was exhibited in operation at the exposition, motor driven and up to date in every respect. A detail of one of the rolls described is shown herewith, dimensions being approximate only.

It will probably occur to many inquiring minds to ask why such precision is required in machine parts used merely in the process of stripping up a soft, plastic material where accuracy of product would seem to be of little importance and if of any importance would seem to be equally unattainable because of the nature of the material itself and of subsequent processes through which it may be passed. We, as machine designers, are prone to believe that as soon as we depart from the working of hard materials like metals, hard rubber and possibly a few similar substances including perhaps certain articles made of wood, any special degree of accuracy is practically impossible as a commercial attainment and if really feasible would be of no special advantage. As a matter of fact there are many materials like paper, leather, fabrics of one kind or another, articles produced from paper pulp and other plastic substances where accuracy of product is not only required, thus making accurate manufacturing equipment essential, but where, without this accuracy in the process, the present great speed of output would be entirely impossible even though the product itself might in cases pass inspection so far as character of fabrication is concerned.

There are instances in considerable number where without accurate contacting surfaces materials will not feed properly through the machine; where the quantity passing under the operating mechanism during a given cycle will be either insufficient or too liberal in amount; where the contact surfaces themselves will not be kept properly cleaned to continue their work as they should. These are some of the factors having an important bearing upon the design and construction of a large class of machinery including among other groups food-preparing apparatus.

The manufacturer of food products has to consider a number of things which do not enter into the experience of the producers of a vast number of other articles. His goods must be absolutely clean if he is to hold his market indefinitely; they must be produced in enormous quantities if he is to interest big distributors of such products; each package turned out must be fully up to weight or he will run foul of the food laws; and yet he must not regularly exceed the specified weight in any appreciable degree, for if he does so, his profits will disappear.

Anyone who has had the opportunity to inspect some of our great establishments engaged in this and kindred industries cannot fail to have been impressed by the extent to which automatic weighing apparatus has been installed in such places to provide a positive safeguard against the possibility of a single food container being shipped from the factory either under or over weight by even a minute fraction of an ounce. For this reason alone, if for no other, accuracy in food-manufacturing machines thoroughly justifies itself.

Readers of these columns have already had the opportunity of examining illustrations of the "Iron Chink" made by the Smith Canneries Machine Co., of Seattle,

Wash., for dressing salmon at a previously unheard-of-rate of speed, displacing in the case of each machine dozens of hand laborers formerly employed exclusively in this process. Articles have also appeared showing the accuracy of the methods utilized by that firm in building this automatic machine. It has to be made properly in order to run at all; and it has to be built very accurately in order to operate at the requisite rate of speed for making it an economic factor in canning establishments as compared with the cheap, unskilled, but nevertheless rapid, hand labor universally employed in the past for dressing and packing fish.

One of these machines which has now been built for several years was exhibited at San Francisco, where probably for the first time a few million people learned that it is no longer necessary to dress and pack by old-fashioned hand methods the several hundred millions of pounds of salmon annually prepared for market in the great Coast fisheries.

This company builds other machinery for canneries and similar establishments, one of these an automatic weighing machine in which filled cans as they pass are switched to one side or other of the main line of movement if they are either overloaded or underweight in the slightest degree. The deviation from standard weight may then be rectified and the cans passed along with the bulk of containers which have already gone through the machine and stood the test of accuracy in weight.

Still another important line of apparatus of allied character produced by this firm and exhibited at the Panama-Pacific Exposition was candy making machines of various types; one such is for the manufacture of sugar peppermints. In operation, several hundred, possibly a thousand or more, peppermints feed slowly along the apron on the top of the machine, the sugar mixture of the right degree of consistency being ejected automatically from the receptacles at the head of the machine. The candy mixture once made, charged with the desired flavoring ingredients and placed in the receiving tanks is automatically maintained at proper consistency, is forced at the right intervals and with the proper amount of weight and of the desired size upon the traveling work table. During its passage along the machine to the point of discharge into packages it attains the requisite degree of hardness, and all this without the intervention of the attendant or the touch of his hands.

Restaurant Machinery

Another interesting and useful machine for automatically preparing good things to eat was a roasting device used by a restaurant on the Zone. I do not know who installed it. I do know that its work of helping to prepare properly cooked food for thousands of hungry visitors was eminently satisfactory. As there operated, it constituted a modernized extension of the old roasting spit which our early ancestors slowly revolved with its burden of flesh, fish or fowl before the great open fires of long ago.

In the new form the apparatus embodies something of the principle underlying some of our modern hardening furnaces in that the material to be subjected to the action of the heat is passed slowly along the zone of high temperature and at the same time rotated so that every portion of the object is acted upon uniformly. Several roasts, whether chicken, beef, mutton or other, are cooked simultaneously, and the output of this installation as required by restaurant patrons on the Zone was something astonishing to persons not accustomed to seeing rations provided for an army. The attendant told me during the closing days of the exposition that during the ten months of the show he had roasted on the machine over fifty thousand chickens, and as for beef and other roasts, as he expressed it, "the Lord only knew how many of these had been cooked on the apparatus."

This article has done little more than touch upon a few of the many mechanical devices which, as operated at the exposition, seem of unusual interest to the designer as indicating a marked tendency toward covering in the near future the entire field of food products with the machine process. While, as pointed out, the earlier developments in this direction are well known, there are in the field large numbers of new machines with which comparatively few people have had the chance to familiarize themselves. And it would appear that the opening here for the trained designer is a broad one, with almost unlimited opportunity for original work in developing ways and means of handling and preparing foodstuffs for shipment and consumption.

There are at present on the market, and examples were exhibited at San Francisco, full outfits of mechanical apparatus for sorting and grading oranges and other fruits; for cleaning and packing raisins; for sorting olives, crushing them, refining the oil and so on. A great deal of this equipment has been developed in California and is to be seen in no other section of the country.

Evolution of Repeating Small Arms and Ammunition

By Robert F. Mitchell

Away back in the fifties, or earlier, came what was called the "pepper box" pistol put on the market by Col. Samuel Colt, of Hartford, Conn. It was loaded from the muzzle with powder, wad and a round bullet. A good many '49-ers used it in their rush to California for gold. It was not a very reliable weapon, as there was almost no barrel, the charge coming out of the cylinder. There was not much force to the charge when it was fired.

The story was current when I was in Springfield that Colonel Colt got his idea of the weapon from one he saw in the Tower of London. He improved it and started making it, and from that was evolved the modern Colt revolver. In 1860 came along the first revolver that used fixed ammunition, made by Smith & Wesson, of Springfield, Mass. They first produced them at the Market St. shop and then had some ten thousand made at Rock Falls, Conn.

In 1861 they built a new factory on Stockbridge St. I went to work for them in June, 1861, in their new shop. I remember that they used the upper floor for making their 0.22 cartridges, and as it was a new thing to have the powder, bullet and fulminate all in one small copper shell, they were not perfect, and a great many misfires resulted.

Some progressive people in Bridgeport saw the possibilities of a business and started making the cartridges. In a short time Smith & Wesson sold out that part of

their business, but continued making their revolvers. While I was there they were making 2,000 of the 0.22 size per month, and 1,000 to 1,200 of the 0.32 caliber.

From the hinge barrel came the spider which ejected all the cartridge shells at once. It was invented by a man named Rodier, a French Canadian. After this appeared the automatic, which is not a revolver at all, as it ejects the empty shell by means of the gas which comes from the firing of the cartridge.

Evolution of the Small Arm

The evolution of the gun was as follows: First came the match lock; second, the flint lock; third, the skin cartridge fired by a hat cap on a nipple of the gun; fourth, the thin metal rim fire; fifth, the folded head with a rim reinforced by an inside and outside cup. Then came the center fire, with a small primer in the center of the head.

Along in the years between 1850 and 1860 a man by the name of Rollin White invented the Smith & Wesson revolver. The story I heard during the two years I worked in their factory was this: "Rollin White was on the river bank one Sunday trying his invention when along came Dan Wesson. He stopped, looked the gun over, tried it, and was so taken with it that the two came to terms."

Wesson was to give White $1,000 cash and 25c. a pistol during the life of the patent. White was to defend his patent, which he had to do in a number of cases. One suit lasted almost three years, but he finally won out in all of them. There were three shops making his pistol, and all a direct infringement on his patent.

Wesson hunted up Smith and they formed a partnership, Smith furnishing $20,000. Rollin White was a lame man. I remember him well, as he was experimenting on his pistol in the next vise to mine. One of the cartridges went off and the ball passed very near me and hit the wall beyond. After that he went into the cellar to do his experimenting. That little incident fully impressed Rollin White and his invention on my mind.

Previous to 1861 White invented what was known as the "volcanic pistol," which was the nucleus of the Winchester gun. It was about a foot long, the barrel and magazine being one piece of steel. The ammunition consisted of a pointed bullet about one-half inch long. It was hollow for about two thirds of its length and filled with powder. A wad containing the fulminate was crimped into the bullet, and when fired the bullets would go possibly 500 ft., while others would go perhaps 10 or 20 ft.

The pistol was a failure on account of the poor ammunition; but the principle was there and was finally improved into what was known as the Henry rifle, worked out by Tyler Henry. Gov. Oliver F. Winchester then bought out Henry's patents and formed the Winchester Repeating Arms Co., which has prospered so that its guns and ammunition are known the world over.

I have been connected in one way and another with the gun and ammunition business ever since I was 16 years old, so have had a chance to know and observe a great deal about both. I went to work for the Winchester Repeating Arms Co. in the year 1871 and shortly afterward went into the cartridge room, where I made the dies and punches for the manufacture of what is called the 0.44 flat-rim fire cartridge. We made 20,000,000 for the Turks, who previously had purchased some 30,000 or more rifles for the use of their troops and police in Constantinople.

George Stetson was the cartridge man in charge at that time. There were only two other places where they made rim fire cartridges—the Union Metallic Cartridge Co., of Bridgeport, and one in Springfield, Mass., owned by a man named Leete.

Small Copper-Pipe Bending Forms

By E. V. Allen

Bending forms for the purpose of giving copper pipe the right shape for use as oil or gasoline feed pipes on Henderson motorcycles are shown in Figs. 1 and 2. The pipes are ¼ in. outside diameter, and soft enough to be bent by hand. In the forms shown in Fig. 1 the pipe ends are placed in the sockets indicated at *A* and *B*. and then the pipe, which has previously been cut to correct length, is simply pressed against the forms with the fingers.

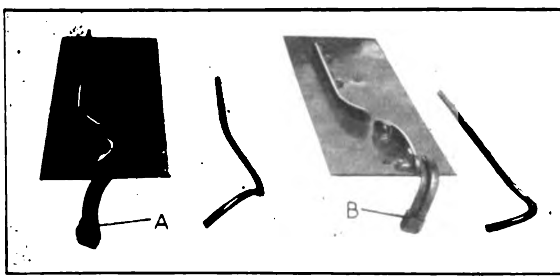


FIG. 1. FORMS FOR BENDING OIL AND GASOLINE PIPES

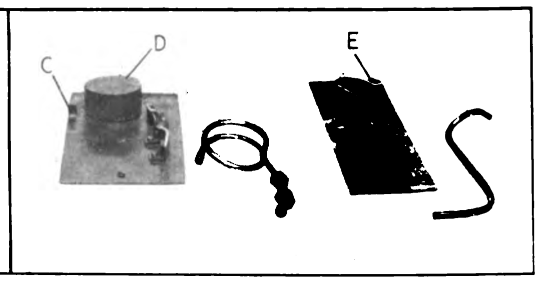


FIG. 2. TWO OTHER PIPE-BENDING FORMS

In Fig. 2 the pipe is first started with the end just between the block *C* and the center plug *D*. It is then coiled around the plug once and on the second turn is made to follow the form at the right. After the pipe is removed from the form the coil is pulled apart slightly, as shown. The pipe at the right is started at *E* and then shaped as are the others.

While these pipes are soft and easily bent, forms like those shown are necessary to prevent kinks, careless bending or other trouble. Made in this way, the assemblers have little trouble in making a good-looking job without the necessity of tinkering on the work after the bend is made.

Making 1-Lb. Cartridge Cases--I*

By Robert Mawson

SYNOPSIS In this article are described in detail the tools and methods used in manufacturing the 1-lb. cartridge case. Owing to the close limits called for on the shell, some difficulties in tooling were met with. The tools described are producing a shell to the desired requirements. The various types of machines and the rate of production are also included.

The manufacture of the 1-lb. cartridge case demands many interesting punch press operations. This will be apparent when the close limits allowed on the shell are noticed. The New York & Hagerstown Metal Stamping

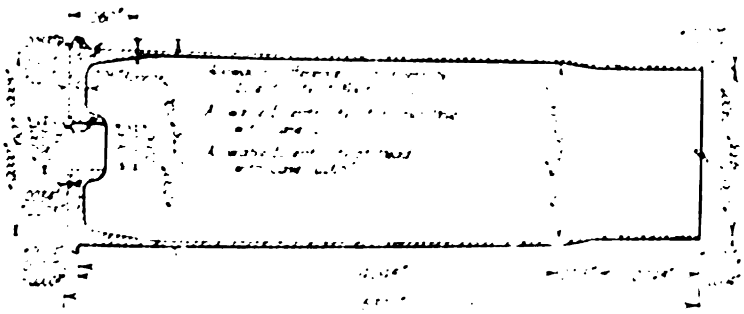


FIG. 1. DETAILS OF 1-LB. CARTRIDGE CASE

Co., Hagerstown, Md., is producing a high-grade case, and the tools and methods employed are here described.

In Fig. 1 is shown a detailed illustration of the cartridge case. The various stages through which the element progresses from the punched blank to the com-

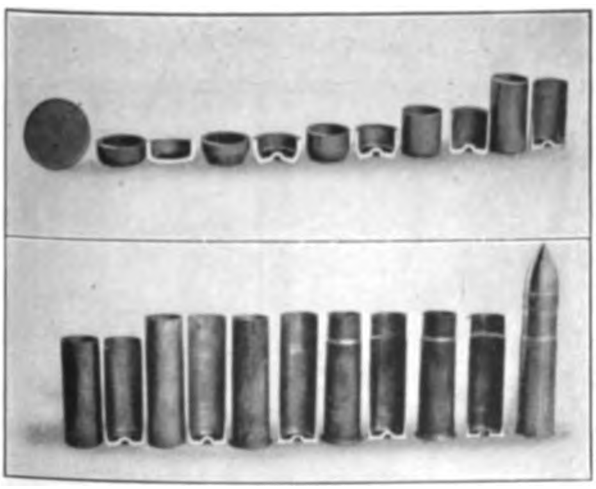


FIG. 2. VARIOUS STAGES OF 1-LB. CASE FROM BLANK TO FINISHED PART

pleted cartridge case are illustrated in Fig. 2. For each of these stages a sample has been cut, so that the work performed may be observed. The chemical analysis of the brass used for making the cases is: Copper, 70 per cent.; zinc, 30 per cent., with a variation of 1 per cent. either way and an allowance of ½ per cent. for impurities. The physical qualities are 48,000 to 54,000 lb. tensile at the mouth, 58 per cent. minimum local elongation. At the head the tensile strength should be 60,000 lb. minimum, and no local elongation is specified at this point. Under the head the tensile strength should be 58,000 lb. minimum, and no local elongation is specified. The specifications called for in manufacturing the cartridge cases are as follows:

TABLE OF SEQUENCE OF OPERATIONS

1. Blank	13. Trim to length	21. Machine to length
2. Cup	14. Anneal and pickle	22. Burr inside of primer hole
3. Anneal and pickle	15. Fifth draw	23. Finish-machine primer hole and form recess
4. Indent	16. Trim to length	24. Wash
5. Anneal and pickle	17. Head	25. Final inspection
6. First draw	18. Anneal open end and wash	26. Stamp
7. Anneal and pickle	19. Form taper	27. Pack ready for shipping
8. Second draw	20. Face and finish-machine flange and rough out primer hole	
9. Anneal and pickle		
10. Third draw		
11. Anneal and pickle		
12. Fourth draw		

1. The cases must be cold drawn from brass of the proper quality.

2. The curvature at the neck shall conform to that of the standard gun chambers shown on the drawings, within manufacturing limits.

3. Ten from each lot of 5,000 shall be selected by the inspector to be proved.

4. The proof shall be the firing of each of the selected cartridge cases once with service charge and shell. Two of the fired cases shall then be selected by the inspector; and from each of them three additional service rounds shall be fired without re-forming, but the forward end of the cylindrical part of the neck may be contracted sufficiently to grip the shell at each reloading.

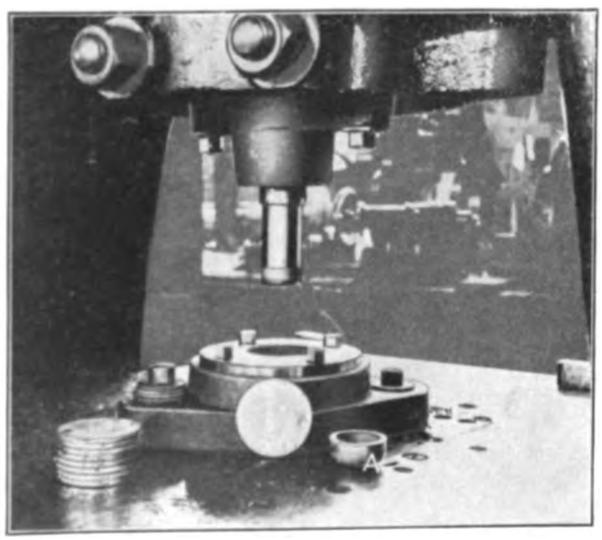


FIG. 3. CUPPING PUNCH AND DIE FOR FIRST BLANKING OPERATION

5. The proof cases of accepted lots may be incorporated in the regular lots, provided they are re-formed and again pass inspection.

6. No cases must show signs of weakness or excessive hardness.

The blanks from which the cases are made are purchased and measure 2⅞ in. in diameter and 0.20 in. thick.

The blanks are cupped with the punch and die shown in Fig. 3. For this operation the blank is placed in the die; and when the punch is fed down with the machine, the part is formed to the contour *A*. A diagrammatical view of the operation is given in Fig. 4.

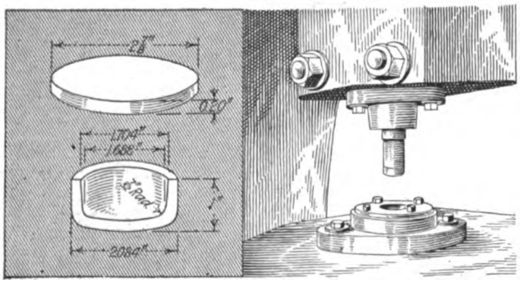


FIG. 4. OPERATION 2: CUPPING
Machine Used—Ferracute 6-in. stroke press.
Production—625 per hr.
References—Figs. 3, 5, 6, 7 and 8.

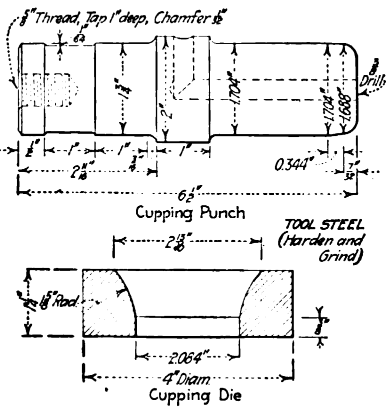


FIG. 5. DETAIL OF PUNCH AND DIE

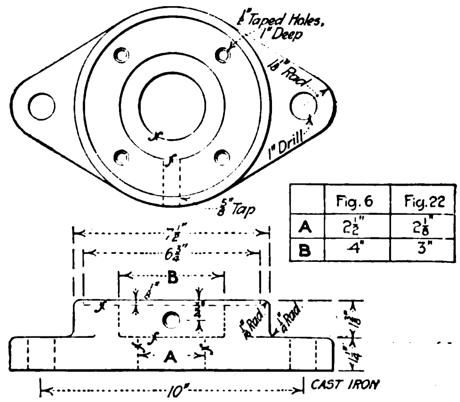


	Fig. 6	Fig. 22
A	2½"	2⅛"
B	4"	3"

FIGS. 6 AND 22. DETAIL OF BOLSTER

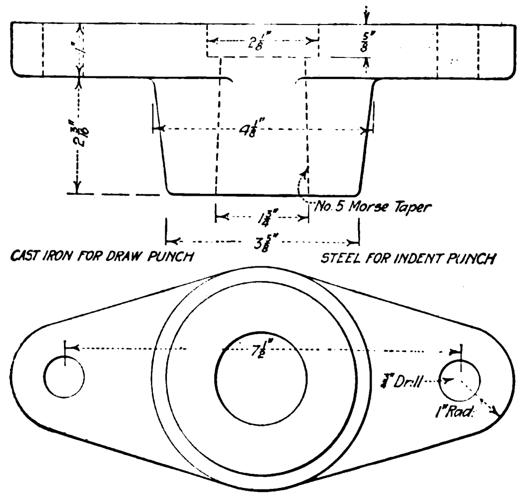


FIG. 8. DETAIL OF PUNCH HOLDER

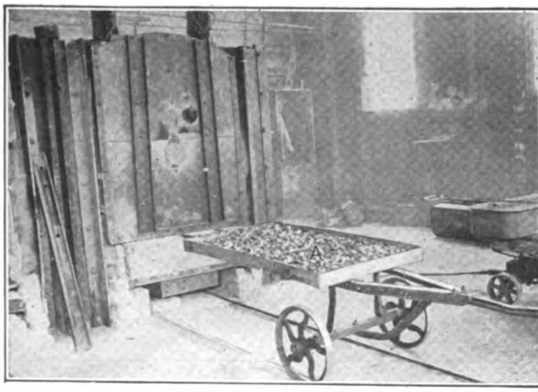


FIG. 9. GAS-HEATED ANNEALING OVENS

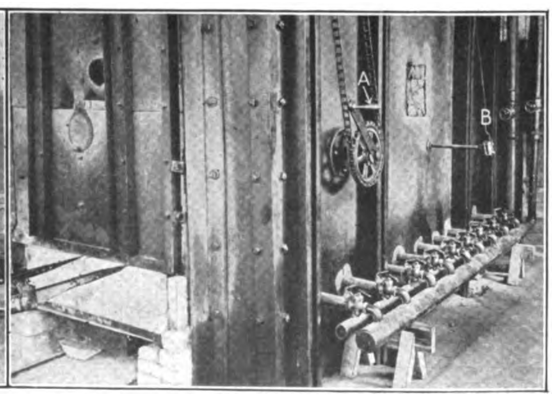


FIG. 10. SIDE VIEW OF ANNEALING OVEN

A detail of the punch and die is seen in Fig. 5, the bolster in Fig. 6, the retainer plate in Fig. 7 and the punch holder, which is used for the cupping operation, in Fig. 8.

The shells are annealed in the gas-heated oven illustrated in Fig. 9. The parts are placed on the tray *A* and conveyed by the truck shown. The tray is then slid into the oven, the average temperature of which is approximately 1,380 deg. F. The parts are allowed to remain in the oven 30 min.

In Fig. 10 is shown a side view of the oven, and the manner in which the gas is fed may be seen. It will be observed that the arrangement is fitted with nine branches, which are fastened into the main supply pipe. These branch pipes convey the gas and distribute it so that a sheet of flame may be obtained under the tray

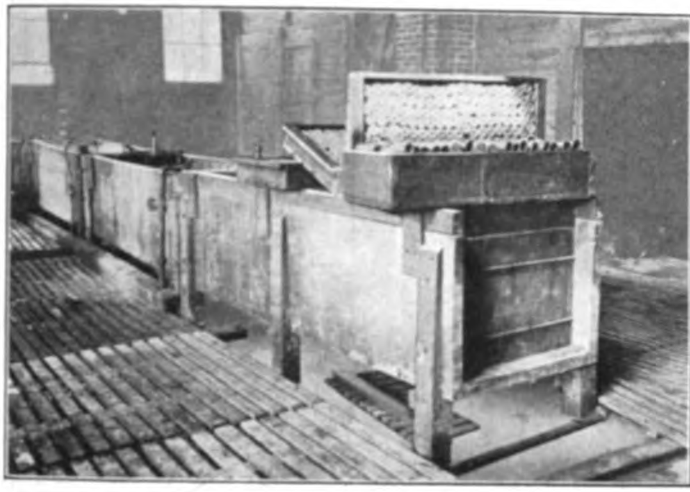


FIG. 11. PICKLING TABLES

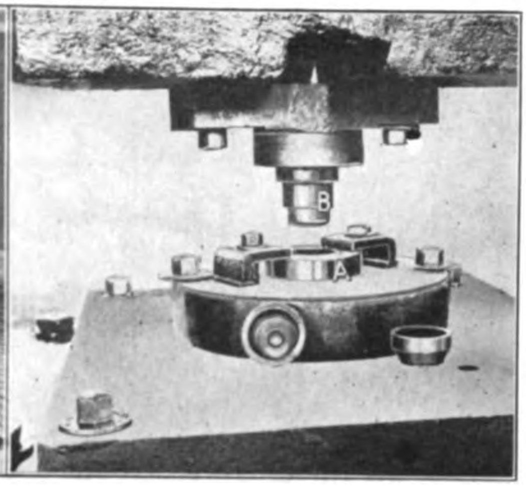


FIG. 12. INDENTING DIE

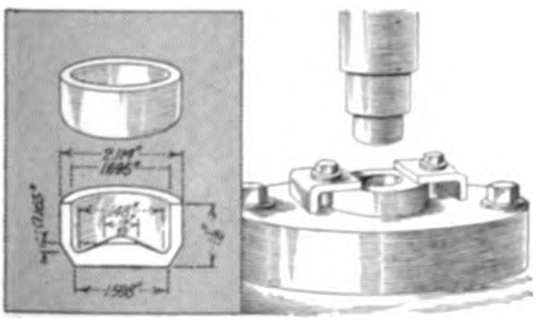
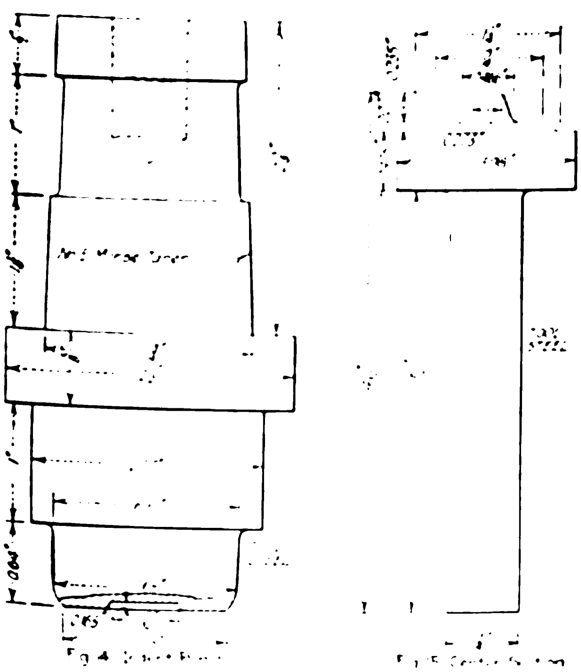
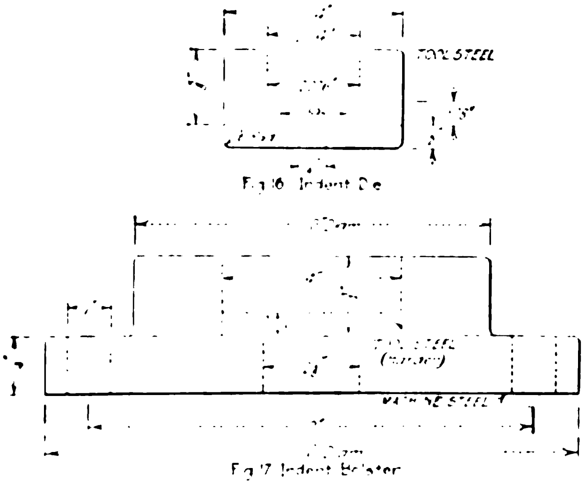


FIG. 13. OPERATION 4. INDENTING
Machine Used: Special 2$\frac{3}{8}$-in. stroke press
Production: [illegible] per hr.
References—Figs. 7, 8, 12, 14, 15, 16 and 17



FIGS. 14 AND 15. DETAILS OF INDENTING TOOLS



FIGS. 16 AND 17. DETAILS OF INDENT DIE AND BOLSTER

holding the parts to be annealed. The handle *A*, operating through the sprocket and chain shown, is used for opening the furnace door. The temperature of the furnace is taken by a pyrometer through the lead wire *B*.

After annealing, the parts are conveyed to the pickling tanks, Fig. 11, and washed in "Edis" compound, to remove the scale. The parts are then transferred to the punch and die, Fig. 12, to be indented. The cupped shell is placed in the die *A*. The punch *B*, fed down with the machine, forms the indentation. The operation is shown in diagrammatical form in Fig. 13.

The retainer plate, Fig. 7, the punch holder, Fig. 8, the punch, Fig. 14, the center section, Fig. 15, the die, Fig. 16, and the bolster, Fig. 17, are used for the indenting operation.

The parts are then annealed and pickled in a similar manner to that described for the previous operation. After the pickling they are returned to the machine illustrated in Fig. 18, and the first drawing operation occurs. The part is placed in the die *A*, and the punch *B* is fed down, performing the first drawing operation. One

of the parts before drawing is shown at *C*; and after being drawn, at *D*. The operation may be seen in diagrammatical form in Fig. 19.

The punch holder, Fig. 8, the punch, Fig. 20, the die, Fig. 21, the bolster, Fig. 22, and the retainer plate, Fig.

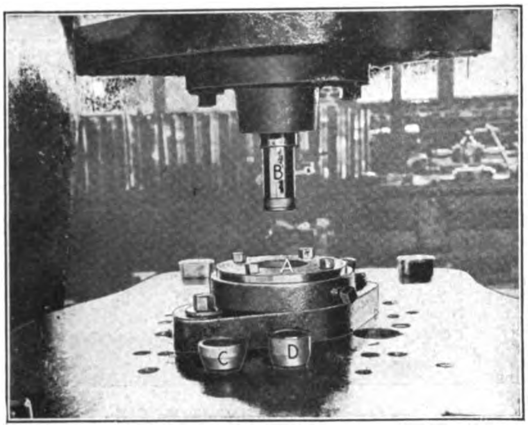


FIG. 18. FIRST DRAWING OPERATION

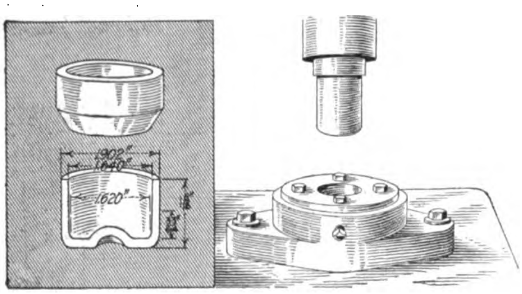


FIG. 19. OPERATION 6: FIRST DRAWING
Machine Used—Ferracute 6-in. stroke press.
Production—550 per hr.
References—Figs. 8, 18, 20, 21, 22 and 23.

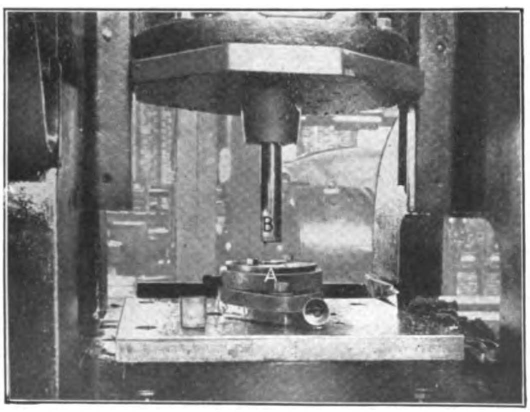


FIG. 24. SECOND DRAWING OPERATION

23, are used for this first drawing operation. The parts are then annealed and pickled in a similar manner to that previously described.

The next operation is the second drawing. The machine and tools for this work are shown in Fig. 24. The part is placed in the die *A*; and when the punch *B* is fed down, the desired draw is made on the case. This operation is shown in diagrammatical form in Fig. 25. The punch holder, Fig. 8, the bolster, Fig. 22, the punch,

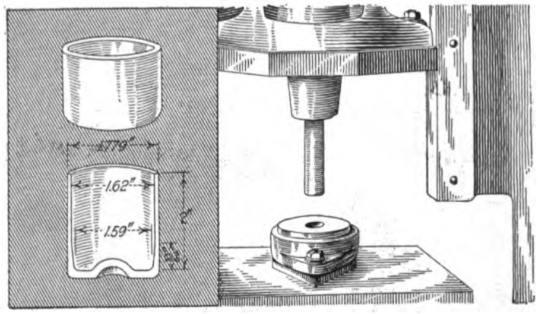


FIG. 25. OPERATION 8: SECOND DRAWING
Machine Used—Bliss 8-in. stroke press.
Production—550 per hr.
References—Figs. 8, 22, 24, 26, 27, 28 and 29.

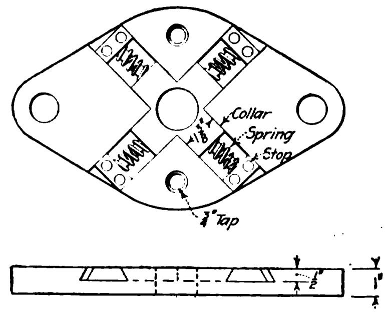


FIG. 29. DETAIL OF STRIPPER

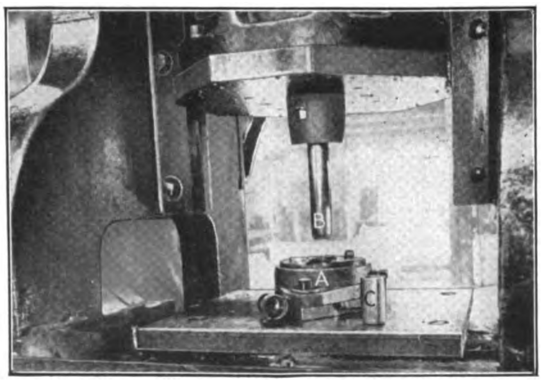
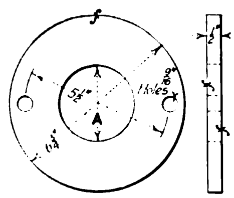


FIG. 30. THIRD DRAWING OPERATION



DIAM. A	DATA	FIG. NO.
$2\frac{7}{8}$"	For Cupping and Indent Die	7
$2\frac{5}{32}$"	For 1st Draw Die	23
$1\frac{15}{16}$"	" 2nd " "	28
$1\frac{53}{64}$"	" 3rd " "	34
$1\frac{47}{64}$"	" 4th " "	39
$1\frac{43}{64}$"	" 5th " "	44

FIGS. 7, 23, 28, 34, 39 AND 44. DETAIL OF RETAINER PLATE

Fig. 26, the die, Fig. 27, the retainer plate, Fig. 28, and the stripper, Fig. 29, are used in performing the second drawing operation.

The cases are again annealed and pickled in a similar manner to that described. Then the next operation on the shell is the third drawing, which is done with the machine and tools shown in Fig. 30.

The part is placed in the die *A*. The punch *B* is fed down into the shell and draws it to the shape seen at *C*. This operation is also given in diagrammatical form in Fig. 31.

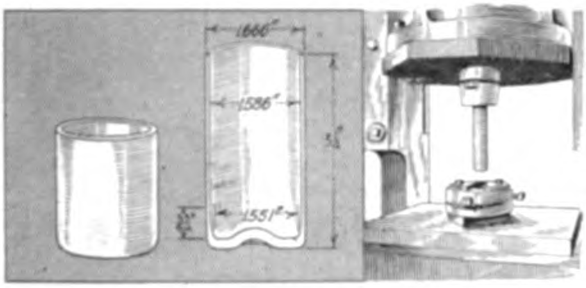


FIG. 31. OPERATION 10. THIRD DRAWING
Machine Used—Bliss 8-in. stroke press.
Production—[illegible] per hr.
References—Figs. 8, 22, 29, 30, 32, 33 and 34.

FIG. 35. FOURTH AND FIFTH DRAWING OPERATIONS

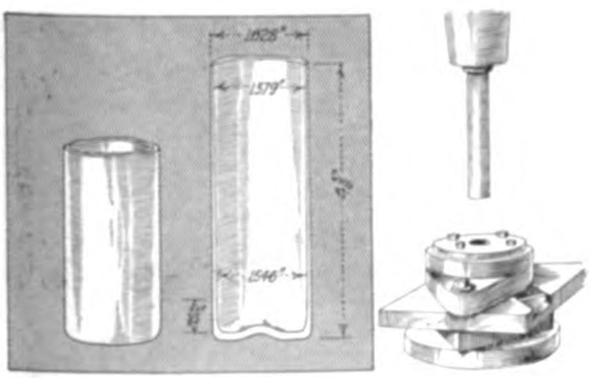


FIG. 36. OPERATION 12. FOURTH DRAWING
Machine Used—Bliss 15-in. stroke press.
Production—[illegible] per hr.
References—Figs. 8, 22, 29, 35, 37, 38 and 39.

The punch holder, Fig. 8, the bolster, Fig. 22, the stripper, Fig. 29, the punch, Fig. 32, the die, Fig. 33, and the retainer plate, Fig. 34, are used for the third drawing operation.

The parts are again annealed and pickled in the manner described and are then conveyed to the machine shown in Fig. 35 for the fourth and fifth drawing operations. The punch *A* and the die *B* are used for the fourth drawing operation, which gives the form shown at *C*. This operation is also shown in a diagrammatical view in Fig. 36. The punch holder, Fig. 8, the bolster Fig. 22, the stripper, Fig. 29, the punch, Fig. 37, the die, Fig. 38, and the retainer plate, Fig. 39, aid in this drawing operation.

The case is next taken to the special lathe, Fig. 40, and the open end trimmed so that the overall length is 4½ in. The case is gripped with the wooden tongs *A* and slipped into the chuck *B* against a stop surface.

The handle *C* is drawn forward, actuating the jaws of the chuck so that they grip the case securely. The parting tool *D* is fed against the revolving case, and the end is trimmed to the correct length.

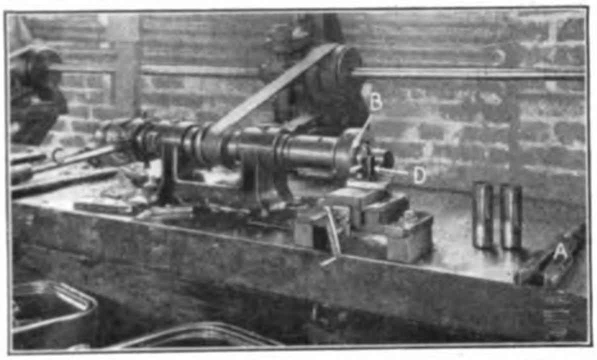


FIG. 40. TRIMMING END OF SHELL

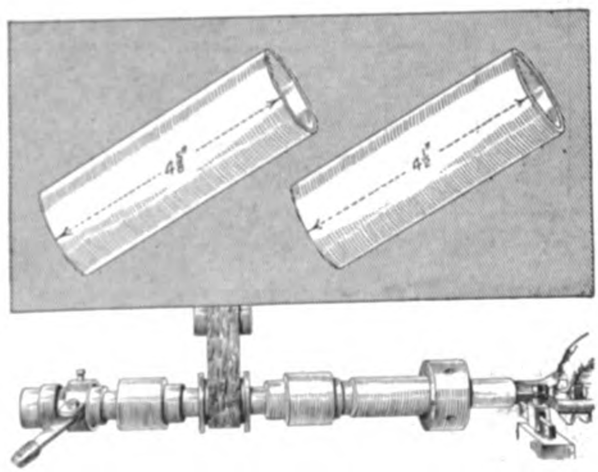


FIG. 41. OPERATION 13: TRIMMING TO LENGTH
Machine Used—Special lathe.
Special Tools—Lathe, chuck, wooden tongs and parting tool.
Production—200 per hr.
Reference—Fig. 40.

The handle is pushed back, thus releasing the chuck, and with the aid of the tongs the case is removed from the machine. This operation is shown in diagrammatical form in Fig. 41. The case is transferred to the oven, annealed and afterward pickled in a manner similar to that previously described.

The case is now ready for the fifth and last drawing operation, which is performed on the machine that was used for the fourth draw, Fig. 35. The punch *E*, being forced down, draws out the shell, which has been placed in the die *D*, to the contour *F*. This drawing operation is shown in diagrammatical form in Fig. 41-A. The punch holder, Fig. 8, the bolster, Fig. 22, the stripper, Fig. 29,

the punch, Fig. 42, the die, Fig. 43, and the retainer plate, Fig. 44, are used for this last drawing operation.

The shell is then taken to the lathe, Fig. 40, which has the stop in the chuck set so that the distance from

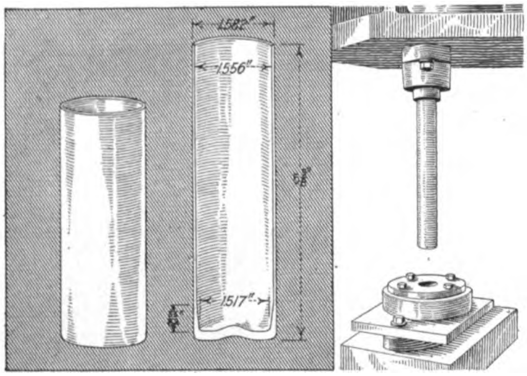


FIG. 41-A. OPERATION 15: FIFTH DRAWING
Machine Used—Bliss 15-in. stroke press.
Production—400 per hr.
References—Figs. 8, 22, 29, 35, 42, 43 and 44.

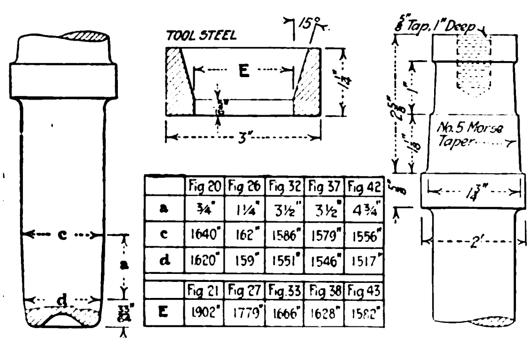


	Fig 20	Fig 26	Fig 32	Fig 37	Fig 42
a	¾"	1¼"	3½"	3½"	4¾"
c	1640"	162"	1586"	1579"	1556"
d	1620"	159"	1551"	1546"	1517"
	Fig 21	Fig 27	Fig.33	Fig 38	Fig 43
E	1902"	1779"	1666"	1628"	1582"

FIGS. 20, 21, 26, 27, 32, 33, 37, 38, 42 AND 43. DETAILS OF DRAWING PUNCHES AND DIES

the end of the shell to the tool is 5½ in. The shell is placed in the chuck and is trimmed in a manner similar to that previously described.

(To be continued)

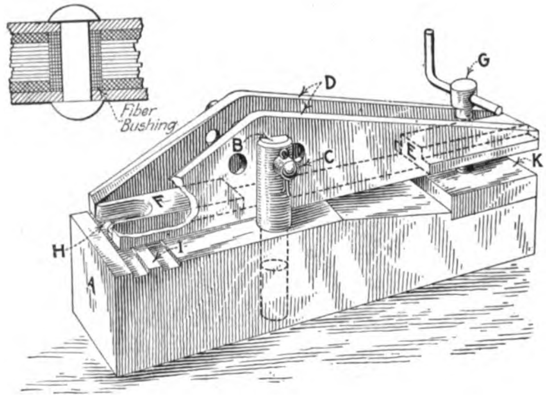
Riveting Insulated Laminations

By Jan Spaander

Insulating materials play an important part in many industries, but fibers, bakelites and condensites are often difficult to handle, especially when riveting several layers of thin punchings between a layer of fiber and iron on each side, as illustrated. The rivet passes through a fiber bushing, and when riveted it is apt to bend slightly and burst the bushing. The defective work can only be discovered by testing the finished product.

A successful riveting jig is shown in the sketch. The cast-iron base plate *A* carries the two steel bearing pins *B*. Through these bearings a pin *C* forms the fulcrum of a yoke *D*, consisting of two vertical steel plates that are clamped together by the plates *E* and *F*. The plate *F* is cut out at the nose of the jig to allow passage to the rivet.

The plate *E* is the nut for the screw *G*, with which the nose can be made to press the piece to be riveted between the surfaces *H* and *I*. The yoke has different fulcrum holes to suit different jobs. The sides of the slot in the plate *F* and the nose of the yoke *D* are scooped



RIVETING INSULATED LAMINATED PARTS

out to give easy access to the hammer. To allow a quicker opening of the jaw, a loose plate *K* is put under the screw.

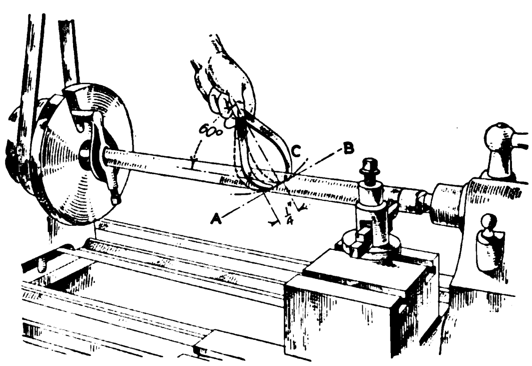
The bushing is made slightly long; and when the pressure of the jig forces the soft fiber of the bushing against the rivet, this has to stand straight and take the hammering.

Calipering Running Work

By M. Jacker

Calipering can be readily done while the lathe is running by the method herewith described for filing and polishing to within 0.0005 in. (or one-half a thousandth) of size.

Make a spot at the end of the work to suit the micrometer measurement, then start the lathe on a filing speed. While the lathe is running, set the calipers by this spot, just so that you can hardly feel



CALIPERING RUNNING WORK

them making contact when held at about 60 deg. and swung ⅛ in. on each side of the center line, as shown. Care must be taken that the caliper leg *C*, or the one farther from you, does not get to the left of the other leg, or it will get caught on the work. Both points of the caliper must be on a line, as *AB*, square with the shaft.

Lubricating Oils and Cutting Compounds for Shop Use*

By W. Rockwood Conover†

SYNOPSIS--*Wastage of oils and cutting compounds through inexpert buying and careless use is common in machine shops. The principles that should govern selections, tests that should control quality and methods that should give satisfactory use are all outlined. The cheapest oil or compound is often the most expensive.*

One of the subjects that enlist the attention of the manufacturer is that of lubricating oils and cutting compounds. The manufacturing plant that does not include among its departments a chemical testing laboratory where proper tests of lubricants can be made and values accurately determined often depends upon the judgment of its superintendent or department heads, with the too frequent result that either a too high price is paid for oils or else quality is sacrificed in a mistaken idea that, by employing cheap oils, money is being saved. There is scarcely any other subject connected with machine-tool operation on which there is such diversified and contradictory opinion and judgment as that of the lubrication of machine-bearing surfaces and the lubricating of cutting tools.

Often the superintendent or foreman of a department in selecting oils depends upon the judgment of the operator, which is apt to be based by years of following some previously established rule or practice taught in the early days of learning his trade. Many of the old theories and practices have become obsolete and have been shown under the light of modern shop experience to be not only expensive, but not of equal value to the practices established in recent years.

Lubricating Oils for Machinery

The preserving and maintaining of bearing surfaces of machinery and minimizing of friction are of prime importance and should have preference over all other considerations in the purchase of lubricating oils. In addition to chemical tests practical tests should be employed to determine satisfactorily the wearing quality and value of lubricants. To accept the opinion of individuals or dealers may as often prove expensive as otherwise. A reduced oil account is not economy if the ledger shows greatly multiplied upkeep and repair charges on machine tools at the end of the year and the factor of depreciation much increased. There is a wide latitude in the degree of viscosity of lubricating fluids between lubricants having a low specific gravity and lubricants having too much body; between pure mineral oils and those containing a high percentage of animal fats that tend to acidity and produce a corrosive effect, however modified, on bearing surfaces.

The small manufacturer not in a position to employ chemical analysis should at least determine by practical tests the lubricating value of given oils on the specific work on which he desires to use them in his own factory. The importance and advantage of such tests in large establishments are equally obvious and not to be questioned, but there the conditions are essentially better and the facilities multiplied. The necessity for accurate data is also proportionately greater.

An oil purchased at a comparatively low cost may be good; it may answer the purpose, but it may be neither economical nor wise to use it in the long run. On the other hand, the axiom "The best is the cheapest" is not always a true one. Certain oils are adapted to the lubrication of shaft bearings, the bearings of shop motors and high-speed power-transmission machinery, but they are not adapted to the lubrication of the bearing surfaces of large boring mills and lathes, of millers and planers having heavy friction load. An oil of lighter body or less viscosity can be selected for the former than is practicable for the latter class of machinery. Conditions must be carefully studied—speeds, pressure, temperatures, friction load, etc.—and careful tests made, if the manufacturer would wisely and economically choose the grade or kind of lubricants adapted to his work. An error in judgment in the grade of oils for costly machine tools may necessitate repairs that neutralize the saving in purchase price for many months. With the indifferent manufacturer oil is oil, and through lack of proper attention to this important feature of factory expense the careless operative is as likely as not to use cylinder oil on all the smaller working engine parts or high-grade machine oil on line shaft bearings; and the practice is likely to be continued unobserved until serious trouble or loss results.

For the bearing surfaces of large machine tools an oil free from animal fats, of increased specific gravity and of much greater viscosity than oils designed for light high-speed machinery should be selected. This sort of lubricant will give increased wearing quality where speeds are comparatively slow and the friction loads more or less heavy. Such machine oils can be purchased at prices ranging from 14 to 20c. per gallon. With these oils there will be no increase in temperatures, and the bearing surfaces will keep in excellent condition. For babbitted surfaces on light machinery cheaper oils will serve.

Some manufacturers select an inexpensive mineral oil, costing 12c. or less per gallon, for general lubrication of machine tools, shafting, shop motors, etc. The economy of this practice is doubtful under conditions of heavy friction load or high speed, when the proper maintenance of shop machinery and of machine tools is considered and the expense of such upkeep for the year computed. An oil costing at least 30 or 40 per cent. more than the just mentioned figure will give far more satisfactory results and be found more economical in the long run, both from the standpoint of consumption and that of keeping the tools in good condition.

For lubricating the bearings of cranes of high-tonnage capacity and on some other classes of heavy machinery operated at low speed, where the friction load is not too

*Prepared for the author's forthcoming book on "Industrial Economics."

†Factory economist, General Electric Co.

great to permit their use, one of the cylinder-oil stocks at a cost not exceeding 15 or 16c. per gallon can be chosen to advantage. These oils are also suitable for lubricating rubber mills, heavy rolls, cylinders, etc.

In running experimental tests and commercial tests on electrical or other machinery preparatory to shipment a good quality of mineral oil costing from 10 to 12c. per gallon should be employed as a substitute for the higher-priced oils preferred in the permanent operation of the machines. One of the reasons for this substitution is the fact that in these preliminary tests the facilities for handling the oil and preventing leakage are not, as a rule, as complete as when the machines are installed in their permanent location, and there is consequently an increased percentage of consumption and waste. It has been found by experiment that temperatures, even where machines are operated under high speed during the process of testing, are not perceptibly increased by the use of the cheaper oil. In all such cases, however, it is advisable to make careful tests on the specific work for which the lubricant is required, to determine any difference in temperature or friction load, before a permanent change is made.

Cutting Oils and Compounds

Regarding the subject of cutting oils and cutting compounds there is wide diversity of opinion. Not a few manufacturers of the old school still hold the belief that pure lard oil is the cheapest and most satisfactory cutting lubricant for most classes of work in the long run. In the majority of cases this opinion is the result of clinging to old theories and of aversion to inaugurating new practices; or if based on actual tests and experiments, the tests have not been conducted on a practical basis. Were we to grant the correctness of judgment of these manufacturers in so far as the wearing quality of oil is concerned, we have still the factors of cutter grinding and the keeping of tools cool to consider. It has been demonstrated by practice that on certain classes of work and under certain conditions a compound into which water enters largely as a component part is not only cheaper in cost, but superior to pure oil in cooling properties.

On account of the number and variety of cutting lubricants on the market careful chemical analyses and practical tests should always be made by the manufacturer before purchasing. Nearly all compounds contain a certain percentage of free fatty acid and consequently are acid in their reaction, and nearly all have a more or less detergent action on metal surfaces covered with oils. Choice should be made of those compounds which are least acid and which exert the least corrosive influence on metal surfaces. This is especially important in the case of multiple-spindle machines and all machines where the work is in close proximity to the bearing heads, as under these conditions the oil is likely to become washed from the bearings and the expense of machine-tool repairs, in consequence, to be materially increased.

The initial cost of any cutting lubricant is relatively unimportant. What the consumer needs to know primarily is the action of the lubricant on the point of cutting tools in reference to absorbing and neutralizing heat generated in cutting, its lubricating properties, its wearing quality, its specific gravity, flash point, percentage of free fatty acid and in the case of water compounds its ability to form a perfect emulsion and remain in a proper state of solution. The factor of retaining metal dust in suspension must also not be overlooked. Some compounds run dirty continually until entirely consumed, holding minute particles of metal dust in suspension until the compound becomes thoroughly charged with this foreign matter. This condition tends to increase friction at the point of the cutting tool and to raise temperatures abnormally, thereby reducing in some degree the cutting power. Lastly, the intial cost is important, but only relatively so. An oil of high market price may wear sufficiently longer than the cheaper grades to show a lower running cost per hour, and this is frequently true. It is one of the strongest arguments in favor of the use of pure lard oil or a high-grade mixture of lard and mineral oil.

When the manufacturer is about to purchase any of the cheaper oils or water compounds, he should insist upon being furnished by the refiner or dealer with running cost per hour, or consumption, on various classes of work, for comparison with the cost of lubricants he has previously been using. If these data cannot be obtained from the dealer, the manufacturer should conduct accurate and careful tests in his own shop in order to determine the relative economy of lubricants offered him. Without these precautions he can form no intelligent judgment in the matter and is as likely to be deceived as otherwise.

These comparative tests must include the cost of repairs to machine tools and many other items of information, as indicated in the paragraph on testing, in order to obtain data of sufficient value to render a decision as to purchase safe and correct. Even under such exhaustive analysis any fluctuation in the cost of maintenance of machine tools may be due to the character of the work performed and the strength of the tool itself rather than to the use of a different lubricant. For this reason it will readily be acknowledged that the manufacturer must, to some extent at least, base his decisions on broad judgment and experience, his habit of observation and his insight into the conduct of processes in his shop. It is not exceeding the limit of truth, however, to state that a very large percentage of the consumers of cutting oils and lubricants do not know with definite certainty the actual conditions with reference to economical consumption of these materials within their shops, and often too much dependence is placed on the statements of dealers or on the judgment and opinion of the tool operator.

Testing Cutting Lubricants

In making practical tests of cutting lubricants it is desirable to select a piece of work on which the machine can be run for at least one week, and a much longer period is preferable. The oil cups should have attention to see that there is a free flow of oil to the bearings. The tank should be thoroughly cleaned of the previous lubricant, and all bearing surfaces, turret heads and slides should be cleaned before the machine is loaded for test. It is not sufficient to allow the lubricant to flow onto the top or side of the tool. The feed pipe should be so arranged that a full, strong stream will be carried directly to the point of the tool and to the surface being cut, in order that the tools and work may be properly cooled. Of equal importance is the manner in which the tools are ground. A good compound has often been condemned through ignorance of these two essentials—the

adjusting of feed pipes for proper flow and the grinding of tools at the proper angle for greatest efficiency on the surfaces to be cut. Grinding the cutting tool at a wrong angle not only results in increased heating and loss of cutting power, but is frequently the cause of bad work as well. To this must be added the increased cost of frequent regrinding and the loss through delay and stoppage of productive work.

When the machine is loaded with compound and the test started, it is necessary that the proportion of stock or stock solution and water be maintained uniform throughout. Otherwise, the running cost per hour or cost for a given quantity of work cannot be satisfactorily ascertained, as the quality of the work will not be uniformly good. With all cutting lubricants into which water enters as one of the component parts the factor of evaporation is a serious one, and it is necessary, after the first day's run, to add more water, in greater or lesser amount, each succeeding day to hold the proportions constant. The degree of dilution called for in the manufacturer's or dealer's specifications should be maintained throughout the test. Without this care the operator will after a few days be running a mixture fully as expensive per hour's run or per piece as lard or other oils. It may be even more expensive.

In conducting comparative tests the following data should be carefully kept: Total running time, time spent grinding tools, time spent on repairs or other delays, actual operating time, condition of tools at commencement, depreciation of tools, speed and feed, number of pieces finished, quality or character of work done, number of gallons of compound in reservoir at start, number of gallons of compound in reservoir at finish.

With preliminary tests of this kind the cost per running hour and ratio of economy and advantage between different kinds of cutting compounds sold on the market, or between a cutting compound and a cutting oil, may be safely and satisfactorily determined. In the case of lard oil or mineral oil or a mixture of both the oil should be reclaimed from the chips and this amount deducted from the quantity with which the machine was originally loaded, the cost of reclaiming being considered in the final estimate.

After the choice of a cutting compound has been determined upon, the bearings of the machines should be opened at reasonable intervals and conditions noted; and careful inspection should be made of slides and all other wearing surfaces with which the lubricant has come in contact. Machines operated with any of the various water cutting compounds should be inspected and cleaned with greater frequency than those loaded with oil for reasons previously indicated in the paragraph relating to fatty acids and their tendency to corrode or wash oil from bearing surfaces. The cost of machine repairs should also receive attention and a comparison be made, after a reasonable length of time, with previous periods, taking into consideration the number of hours the tools are operated and the character of the work or burden placed upon the machine.

In addition to the reduced cost per running hour effected by the use of proper cutting compounds the factor of speed is worthy of consideration. It has been demonstrated that, with the right kind of lubricant, the cutting speed can in many instances be increased from 10 to 15 per cent. As productive output per machine is of prime importance, particularly in the factory where tool equipment and space are limited, the securing of this advantage is desirable.

There are certain classes of work in the shop, such as milling large-sized keyseats, turning, tapping, threading and milling operations on steel containing a high percentage of carbon, where the work involved is unusually hard, in which the use of pure lard oil is wise. In this case it is well to use either a grade known as "prime lard oil" or one known as "off-prime lard oil." The amount of fatty acid in the former does not usually exceed 2 per cent., and in the latter the percentage is only slightly greater. The advantage of employing these grades, where pure lard oil is indicated, will be apparent, as they exert little or no detergent effect on machine tools, greater speeds are possible than can be secured with cheaper grades of oil, and they give most excellent service from any standpoint. The lower grades, known as "extra No. 1 lard oil" and "No. 1 lard oil," are not recommended. The former may contain as high as 10 per cent. of fatty acid, and in the latter this element may reach 20 per cent., which makes it undesirable as a cutting fluid.

Lard Oil and Lard-Oil Mixtures

A large percentage of the heavy-duty work in most shops can be done to advantage with mixtures of lard oil and mineral oil or a good quality of mineral oil.

For automatics and for general screw-machine work on copper and steel where tapping or threading constitutes a part of the operations performed a lubricant consisting of equal parts of lard oil and mineral oil undoubtedly gives the best service. The mineral oil should be of fair quality, and the cost of the mixture should not exceed 35 to 40c. per gallon, according to market prices on lard oil. This makes a good lubricant of excellent body and sufficiently viscous to form a continuous and comparatively thick film on the point of the cutting tool. The tools stand up well and require less grinding than is the case when lighter-bodied oils are employed.

This formula for cutting oil, designed to do the most difficult operations of tapping and threading copper and steel in automatics and turret machines and other heavy-duty work on steel, is more satisfactory and more economical in consumption than the so-called mineral lard oils and screw-cutting oils generally offered to the manufacturer. The mineral lard oils and screw-cutting oils at prices ranging from 24 to 35c. per gallon must necessarily contain an increased amount of mineral oils or low-grade petroleum distillates, in order to yield the oil manufacturer or dealer a profit. If the consumer mixes his own lubricant, he is enabled to obtain a full-strength, equal-part solution of the two oils at a figure as low as, or lower than, he is compelled to pay for the so-called special cutting oils on the market. And this equal-part mixture has greater wearing durability and keeps the tools in better condition.

Any statements made to the effect that the mineralized lard oils or screw-cutting oils can be employed as a lubricant base and thinned down in the same manner in which prime lard oil or off-prime lard oil is capable of being reduced should receive careful and serious consideration before purchases are made.

From an economical standpoint the consumer will find it wise to make his own mixtures. By doing this he has accurate knowledge of the quality of the lubricants em-

ployed on his machine tools, the ingredients composing each formula are fully within his control, the machine-tool equipment is better conserved, and a saving of at least 25 per cent. in initial cost should be the result.

In general, for the purposes of drilling, turning, shaping and cutting off of steel and copper and also for all operations on brass in automatics, semiautomatics and multiple-spindle turret machines a good quality of mineral oil not exceeding 12 to 15c. per gallon in cost gives excellent service. If this oil has a proper degree of viscosity, it will spread a continuous film on the point or face of the cutting tool, reducing friction and preventing abnormal heating and wear. The oil should flow freely through the pump and supply tubes. It is not necessary to employ the higher-priced mineral oils, screw-cutting oils or mixed lard oils for this class of work. This grade of oil is also suited to many operations on the lathe, miller, keyseater, etc., where an oil lubricant of comparatively light body is indicated. It not only keeps the tools cool, but wears well on the usual classes of work performed on the latter type of machines.

For steel sheet punching and for some classes of drawing work where the materials are not too heavy this grade of oil makes a satisfactory lubricant. It will be found, in competition with water lubricants, on steel sheet to show a lower cost per running hour or per machine. It also keeps the dies in better condition, reducing the amount of grinding. For the heavier work of drawing cups or shells from heavy steel sheets an oil of greater body is necessary. This may be prepared by mixing lard oil and mineral oil in proper proportions.

Detergent Effect of Water Compounds

The advocates of water compounds will dispute the wisdom of employing oil for drawing work, but it is always better to use oil, except on lighter drawing processes, unless a reduced cost per operating hour or a reduction in total consumption cost can be shown to be accomplished by the former. The claims of great savings effected by the water compounds are frequently not borne out in actual practice. They also exert a detergent effect on machine tools in many cases, while oil maintains the dies and presses in good condition. The factor of evaporation in compounds into which water enters largely as an ingredient is also so great as often to render their adoption uneconomical and often prohibitive.

A large number of manufacturers still cling to the practice of using screw-cutting oils or mineralized lard oils on the greater percentage of their work. This practice in many cases is neither warranted nor indicated by the conditions. A very large percentage of the work in most factories, with the exception of tapping and threading operations on steel and copper, can be done with a good quality of mineral oil with far greater economy. This oil can be purchased at prices not exceeding 12 to 15c. per gallon.

Some manufacturers prefer a mixture of lard oil and fuel oil or of lard oil and kerosene in various proportions for cutting lubricants. These mixtures are used in bolt-threading and nut-tapping machines and also in automatic and hand screw machines. While the initial cost per gallon is below that of lard oil and mineral oil in equal proportions, fuel oil or kerosene is not recommended because of the low flash point of these oils. It is doubtful, also, if these formulas give the same degree of durability as the equal-part mixture of lard oil and mineral oil.

The subject of cutting lubricants into which water enters largely as a component part of the formula deserves careful consideration. The number of these compounds offered on the market in recent years has greatly increased. The manufacturer is pressed to make a trial of each new brand, with the assurance that it is far superior to anything previously put forth, both in the quality of the mixture itself and in the reduction of consumption cost made possible by its use. The arguments of the salesman are frequently clinched with the statement that the new compound is the result of years of study on the part of some scientist whose discovery the dealer has been fortunate enough to secure and is now ready to sell the manufacturer at prices that will revolutionize the expense of tool lubrication.

Confusion in Lubricant Practice

The progressive manufacturer desires to adopt all reasonable measures to keep in the front ranks of those aiming toward efficient management in business, with the result that he tries out many of these so-called new compounds, hoping thereby to save large sums of money, as he has been definitely assured he can do. All this experimenting tends to confusion in the lubricant practice in his shops and may in the end work injury to his machine-tool equipment, unless these tests are confined to a very limited number of machines in one department and are conducted for a long period of time before the use of the material is extended.

A large percentage of the cutting lubricants prepared with water have a detergent effect on metal surfaces, tend to wash the oil from the bearings and slides and to gum the working parts of machine tools. Many dealers claim that their compounds do not have a corrosive effect on metal surfaces and that the soluble oils, of which the better grades of these compounds are composed, lubricate and preserve the bearings and slides of the machines. That the oil portion of these compounds counteracts to a considerable extent the chemical action of the water is conceded.

In general, lubricants having water as a component part are not recommended for automatics, hand screw machines or any class of machines of the turret type where there are numerous working parts—exposed or otherwise—with which it will come in contact. The factor of evaporation is so great in the case of water solutions and the wearing quality or durability of these solutions so much below that of good oils as to render the economy effected a somewhat negligible quantity, when the maintenance of machine-tool equipment in prime condition is considered. And this is a most important item of expense in the large factory, bearing a direct relation to the investment in new tools. It is also true that in many instances carefully conducted tests will indicate the running cost per hour, or for a definite period, of a water compound to be in excess of that of a mixed lard oil, properly proportioned, or of a good grade of mineral oil, while the arguments in favor of the employment of oils on the previously mentioned types of machines are enhanced by the fact that with the use of oils the danger of corrosion is entirely eliminated.

Water compounds may be employed to advantage on certain classes of work and on certain kinds of machine

tools where the working parts are few and the danger from the action of water is reduced to a minimum. On plain horizontal lathes and on lathes of the Gisholt type, machining steel, etc., and on millers and drilling machines operating on both iron and steel the use of these compounds is indicated. They give excellent service, also, on coldsaw work.

In using water compounds on gear-cutting machines special care should be exercised in selecting a mixture that will not in any degree, however slight, gum or clog, as otherwise the index feed may be thrown out of true.

For the lighter machine operations, including plain drilling and milling processes, a simple standard soap compound of good quality may be employed to advantage. For vertical drilling machines of the automatic-feed type these soap compounds are adapted to quite a wide range of work on steel and iron. They are sufficiently viscous to afford a fair amount of lubrication to the point of the tool, and at the same time the tendency to heating is largely overcome by the large percentage of water.

On account of the composition of soap bases and rapid evaporation of water these compounds require more or less frequent addition of water or of the stock solution, in order to maintain a proper degree of specific gravity throughout the run. The initial cost is attractive to the consumer, and this should not exceed from ½ to 1c. per gallon for the solution when prepared ready to load into the machine.

A Good Compound for Many Operations

A good compound for the heavier classes of work, such as milling steel, cutting off steel on coldsaws and turning, boring and facing of steel castings on lathes and boring mills, may be prepared by the manufacturer within his own plant by combining a good-quality soap base with pure lard oil, soda and water in proper proportions. The proportion of lard oil entering into the formula should be graded from 1 to 5 gal. per barrel of solution, according to the class of work to be done. These mixtures will range in cost from 2 to 8c. per gallon.

This formula gives good service on a variety of operations on metals where the employment of a water compound of heavy body is indicated. It forms a strong, viscous solution that flows freely, supplying abundant lubrication to the point of the cutting tool and at the same time reducing the temperature to a minimum. The life or wearing qualities are excellent, due to the percentage of pure lard oil entering into its composition. It will be found to meet the severest conditions under which a water compound may be expected to work to advantage, while the initial cost of the several proportions or degrees of strength of the formula is lower in most instances than the various dilutions of the so-called soluble oils on the market. In general, the weakest form of the solution, costing approximately but 2c. per gallon, will do the work of mixtures costing from 30 to 50 per cent. more.

A good compound for grinding cams and cones and finishing shafts may be made by combining lard oil and mineral oil with a soap base, soda ash and water in proper proportions. The cost of this mixture should not exceed ½c. per gallon ready to load into the machine. Notwithstanding this low initial cost, it proves a most satisfactory lubricant for this class of work. The tendency to hold metal dust in suspension is minimized to a degree that renders it specially adaptable to automatic grinders for various classes of finishing operations. The quality of work obtained is equal to that secured by any of the more costly preparations.

Applying Soluble Lubricants to Tools

It is of the utmost importance in operating machines with soluble cutting lubricants that a strong, full stream of the fluid be supplied to the tool. The success or failure of a lubricant often depends upon this factor as much as on any other. It is sometimes desirable to supply the lubricant to the tool from different angles with more than one feed pipe, in order to flush the cutting point or edge to the fullest degree possible and also to lubricate the work.

The method of application has more to do with results than most overseers or tool operators appreciate. In shops where a number of machine tools are grouped or arranged in series a system of overhead tank and piping, conducting the lubricant to each individual tool of the group, affords an efficient method of lubrication. Sufficient compound to operate all the machines for a given length of time can be prepared and loaded into the supply tank, thus simplifying the labor of handling. By the introduction of proper methods of supplying the lubricant, speeds can often be increased and additional cutting tools employed.

As previously stated, the factor of evaporation in all cutting lubricants containing water is important. As it is necessary to add a small percentage of water daily to the tank, after the machine has been started, a careful inspection should be made at intervals to keep the dilution in proper proportion. Unless this is done, the cost of operating may equal or exceed that of clear oil, and no economy result. Since the degree of evaporation varies according to atmospheric conditions, it is not sufficient to add an equal quantity of water on each succeeding day.

Metal dust and other foreign matter with which compounds come in contact in the pan or tank of the machine also affect the specific gravity to a considerable extent. It is desirable, therefore, to use those compounds in which the tendency to hold metal dust in suspension is modified to as great a degree as possible. Where stock solutions of compounds are prepared and stored for future use, the barrels should be tightly headed to prevent evaporation and the solution drawn off through faucets in preference to opening the barrel.

The number of lubricating oils and cutting compounds required in any plant, however large, is generally comparatively limited, and the more simplified the practice the more economical and satisfactory are the results obtained.

Care and Distribution of Oils and Compounds

All stocks of oils and cutting compounds should be kept in a central storehouse under the supervision of a competent person to whom orders can be sent by the various foremen for such supplies as are needed for their current use. All solutions or compounds should be prepared at the oil house and delivered to the departments on signed orders only. It is not good practice to allow the foreman or boss of a department to make up mixtures according to his own judgment of what may be required for his work. This procedure tends to confusion and

prevents establishing and maintaining a uniform practice throughout the factory on similar processes. There is a common tendency among shop foremen to make up mixtures of their own for special jobs or to use a different oil from their neighbors on similar classes of operations and metals. There is not only no economy effected under this method, but on the contrary there is certain to be conspicuous loss. The manufacturer will be constantly called upon to purchase, either for trial or permanent use, some oil or compound not already in stock, to suit the whim or fancy of the individual overseer or workman.

A printed schedule of practice should be placed in the hands of the section superintendents or head foremen of each department, showing the various kinds of lubricants to be used for all classes of work throughout the factory. The oilhouse keeper should be provided with a record giving the formulas he is to prepare and keep in stock. He should also be provided with schedules showing the kinds of oils or compounds to be used in the several departments, together with the names of foremen eligible to draw these materials. An additional list including the names of foremen eligible to draw pure lard oil should also be in his possession.

STANDARDIZING LUBRICANT PRACTICE

With these data he is enabled carefully to scrutinize all orders received and question the filling of any orders calling for lubricants which the foreman is not scheduled to use. By following this system the manufacturer will find that he is enabled to secure absolute uniformity of practice in his shops, and in addition to this he is enabled to control consumption within the limits of production requirements and prevent undue waste.

A good supply of small cans and spouts should always be kept in stock, so that no leaky cans may remain in the hands of the workmen.

Analyses and tests should be made at intervals on all oils purchased, in order to insure against adulterations and also to keep the standard of quality up to the specification as provided for in the original contract made with the oil refiners or dealers.

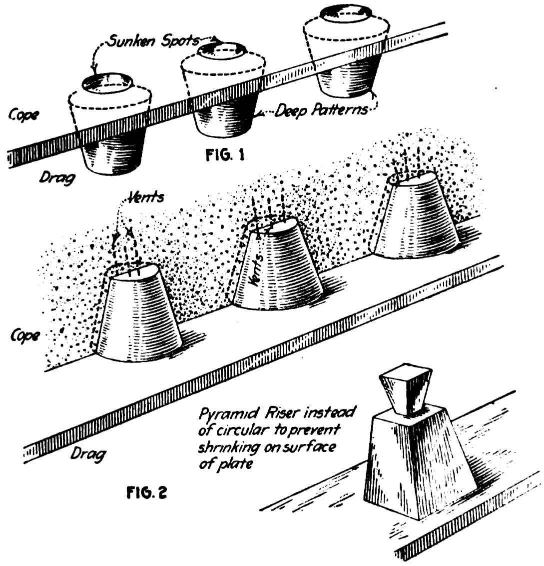
A record should be made of all oils and compounds delivered to the various departments. Regular monthly reports should be issued to the superintendents of sections and also to the head foremen of departments, in order to keep them advised of the rate of consumption and enable them to control the supplies of lubricants used within the portions of the factory under their jurisdiction. These reports are also criticized by the general superintendent or factory economist and the attention of the department heads called to any excess.

Preventing Local Shrinkage in Aluminum Castings

By F. Webster

In making aluminum pattern plates difficulty was experienced from surface cavities opposite each deep part, as shown in Fig. 1. It had been customary to mold these plates with the deep parts in the drag, using a riser over each thick place.

A method of molding them in the cope is now practiced with great satisfaction. The same pattern serves as before, but reversed; and wire vents are made in the sand over each piece. Also, there is used on the plate a riser having a form of a pyramid instead of a cylinder, so as



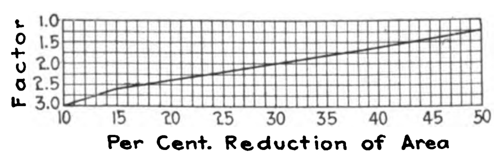
PREVENTING SURFACE SHRINKAGE ON HEAVY PARTS OF ALUMINUM CASTINGS

to prevent a sunken ring around the riser. Fig. 2 shows the arrangement.

[Surface shrinkage on heavy parts is caused by their cooling more slowly than the light parts. It can be cured in many cases by the insertion of metal chills in the mold surfaces of the heavy parts. These equalize the cooling and prevent surface shrinkage.—Editor.]

Power Needed for Wire Drawing

Kenneth B. Lewis, in the *Blast Furnace and Steel Plant* for December, 1915, gives a formula for the horsepower required to draw wire. It is the result of some 60 motor readings made under known conditions and



RELATION OF REDUCTION OF AREA IN PERCENTAGE AND THE FACTOR F

covering a wide range of size and quality of material. The formula is

$$Hp. = T\,(A - a)\,S\,\frac{F}{33{,}000}$$

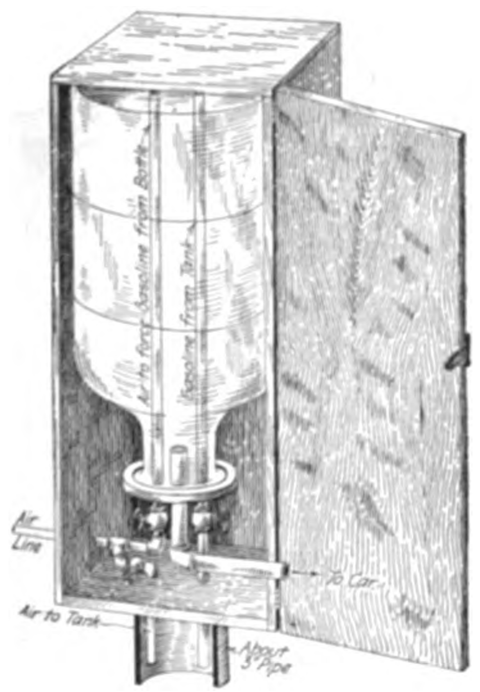
where

T = Tensile strength of stock before the draw, expressed in pounds per square inch;
S = Speed of draw in feet per minute;
A = Area of wire before the draw, in square inches;
a = Area of wire after the draw, in square inches;
F = Factor selected from the accompanying chart.

Letters from Practical Men

Simple Measuring Reservoir for Gasoline

The illustration shows an efficient and inexpensive reservoir for measuring gasoline. It consists of a large glass bottle, bottom up, marked with a couple of bands across the body to denote gallons. The gasoline is forced by air pressure into the bottle from an underground tank.



MEASURING RESERVOIR FOR GASOLINE

When the bottle is quite full, the air is shut off. The gasoline runs by gravity into the tank of the motor car. The customer can see exactly what he is getting, and there is no room for argument about quantity.

Du Bois, Penn. J. M. Ericson.

More Meddling with Weights and Measures

As many readers have learned, there has been introduced in Congress a bill for the abolition of the Fahrenheit thermometer scale. The first section of the bill reads, in part, as follows:

> Be it enacted, etc., that the Centigrade scale of temperature measurement shall be the standard in United States Government publications, the use of the Fahrenheit scale being discontinued, etc.

This bill was introduced by Representative Johnson of Washington and was advocated by him before the House of Representatives in a speech containing all the usual flamboyant gush of a confirmed metricite, a single sentence being sufficient to show its spirit:

> Let us not shift our burden needlessly, sluggishly, cravenly, onto the shoulders of our successors; they will have plenty of burdens of their own. Let us profit by the opportunity to earn high credit for energy and progressive spirit ourselves and to stimulate our successors by our example to earn similar credit in the many lines that will still be open to them.

We are also told that:

> The abolition of the Fahrenheit scale would be welcomed by scientists the world over. The Centigrade scale is used in all countries except in the United States and the British Empire.

The least that may be said of this is that, like most metric statements, it is not true. The thermometer scale of Réaumur is, as is well known, still largely used in Germany, while thermodynamics and steam engineering as studied and practiced in the United States are based exclusively on the Fahrenheit scale; and we suppose that thermodynamics may fairly be called a science.

Dr. Stratton is at least a scientist, and he ought to know that all tables of the properties of saturated and superheated steam and all entropy charts published in the United States are based on the Fahrenheit degree, the pound and the cubic foot, that this bill, which contemplates a change in the unit of temperature, but not in that of weight or volume, involves the use of new steam tables and charts based on the Centigrade scale and the pound and that we have no such tables or charts. It is only recently that satisfactory tables of the properties of superheated steam have been prepared and published at large expense and labor.

Of course, the destruction of these tables is of no importance to the metric mind. Those who have undertaken the infinite labor of this calculation for the public good should, in the opinion of the metric partisans, be glad to see the tables laid on the scrap heap in the interest of the metric hobby.

As in all these cases, the advocates of the measure see nothing in the way but the making of new instruments and the acquiring of new habits of thought, which latter, as usual, they tell us would be acquired "almost instantly and without effort." They see nothing of the confusion due to the break in records. They know nothing of the science of thermodynamics. They care nothing for the wishes of the public. The views of a handful of scientists are paramount.

It is easy to ridicule the Fahrenheit scale; but no one has shown, because no one can show, the slightest advantage in the use of the Centigrade scale. As a matter of fact, for records of the weather the smaller degree of the Fahrenheit scale avoids fractions, and the lower zero point reduces the use of negative temperatures. So far from there being any advantage in raising the zero point, it would increase the use of negative temperatures and the liability of error when calculating average temperatures, as every meteorological observer knows.

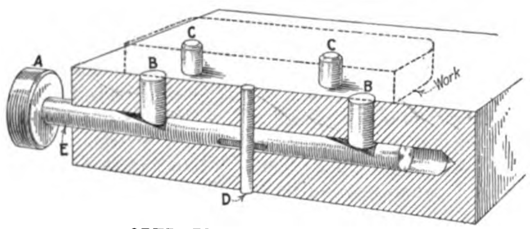
As usual, Dr. Stratton is at the front in this attempt to introduce confusion by upsetting standards of measurement. He is chairman of a committee of the American Association for the Advancement of Science, which has charge of the bill; and he has issued a circular letter from the Bureau of Standards soliciting "expressions of

opinion." Recalling that the Centigrade is the metric scale of temperature, we see again how much faith is to be put in his recent professions that he has little interest in, and is devoting less activity to, the effort to bring about the adoption of the metric system.

New York City. F. A. HALSEY.

Ejector for Jigs and Fixtures

An efficient ejector, shown in the illustration, is of value on jigs and fixtures where the locating is done over two pins. In most cases where an ejector is not provided the operator uses a nail, scratch awl or almost



OPERATION OF THE EJECTOR

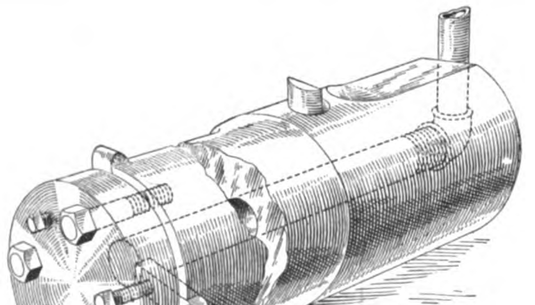
anything to take the work off. This practice not only spoils the tool, but it also loses a lot of time.

All that is necessary to manipulate the ejector here shown is to press against the knob *A*, which causes the pins *B* to push the work off the locating pins *C*. The pin *D* keeps the plunger *E* in place. Any number of ejector pins can be placed on one fixture.

Dayton, Ohio. D. WATSON.

Boring Bar for Shells

The illustration shows a cheap but efficient boring tool for rough-boring the 4.5-in. British high-explosive shell. It is made to fit a hole in the turret and to carry three cutting tools made of ½-in. square high-speed tool steel or stellite. The coolant is piped to the central hole in the bar and squirts out all around the circumference,



BORING BAR FOR SHELLS

directly on the cutting points. The cutters themselves are practically surrounded by the stream of coolant.

The tool was designed after trying out some of the most likely looking adjustable boring tools on the market, but none of them would stand up to the heavy and continuous work of a munitions factory.

Probably the reason why this tool is superior is because it has three cutting points. The absence of small screws and other parts likely to give out is a great advantage where the tools are to be used by operators who are not machinists. JOHN S. WATTS.

New Glasgow, N. S.

Tool Chest for Garages

The illustration shows a tool box used in Waterman Bros. garage, Fresno, Calif. A portable crane hoists the cars up, and the front wheels are placed upon two

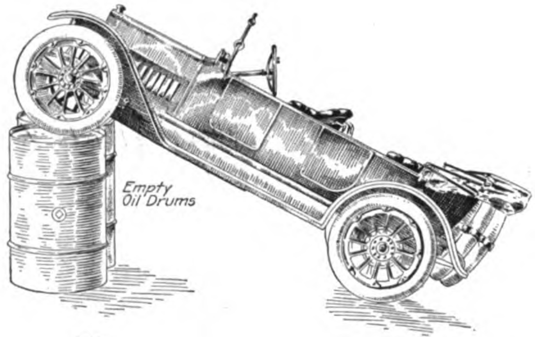


FIG. 1. AUTO ON DRUMS FOR REPAIRS

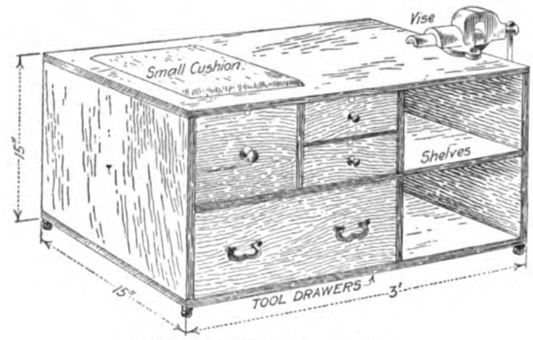


FIG. 2. THE TOOL CHEST

empty oil drums. As no pits are used, this method gives easy access to the bearings and other parts underneath. The car on the drums is shown in Fig. 1.

The tool box, on casters, as in Fig. 2, is pushed under the car. The workman sits on the box to tighten bearings and to fit up new ones. He has all his tools and his vise handy. W. R. SCOTT.

Fresno, Calif.

Drill for Machining Bone

Some green-bone tubes 2 in. long and of $\frac{3}{16}$-in. outside diameter, with walls 0.020 in. thick, were required. The drill illustrated did the work without splitting the bone. A section of bone was first sawed to length, allowing about ⅜ in. for holding in the chuck to finish before cutting off to the required length.

The blank was filed by hand on one end to fit into a $\frac{3}{16}$-in. draw-in collet. By taking very light cuts and feeds the blank was machined its full length to fit the collet, into which it was slipped, leaving about one-half the length exposed. The hole was drilled with an ordinary carbon-steel twist drill.

The drill point, however, was ground, as shown at *A*, by holding it to the corner of the emery wheel as indicated by the dotted curve at *B*, allowing the face of the lip to come flat against the side of the wheel and grinding away each side of the drill center so as to leave it about one-half the original thickness, as shown by the dotted lines *C*. The drill was also ground, one lip slightly longer than the other, which prevented a tendency of the drill to wedge and split the bone. After the hole was drilled to size through the $1\frac{3}{4}$-in. round blank, a round nose tool of self-hardening high-speed steel was used to reduce the outside diameter until the walls were about 0.030 in. thick. Then emery cloth served to bring the diameter to finished size. The tool was ground to shape in the same way as for turning metal but was kept sharp to avoid crowding the thin tube and breaking it.

DRILL FOR MACHINING BONE

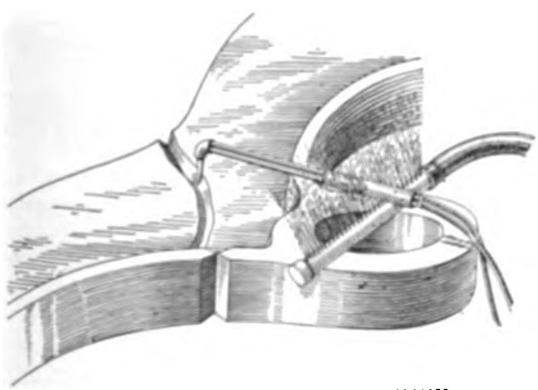
In turning so long a tube of this diameter a short section should be brought to size first, then another short section and so on till the length required is brought to size. Care must be taken not to crowd the drill too fast, and the chips should be removed frequently.

Rochester, Minn. GEORGE G. LITTLE.

Oxyacetylene Welding Kink

The failure of a heavy welding job can often be traced to the discomfort of the operator. To stand up to a large preheated casting is often quite a task.

Where air pressure is available, the device shown in the illustration will be found useful. A row of small



OXYACETYLENE WELDING KINK

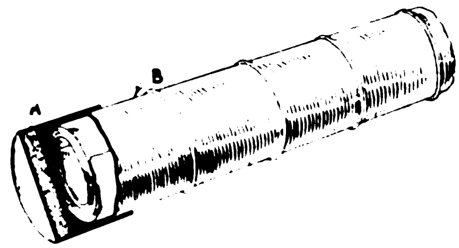
holes is drilled in a pipe of convenient size to attach to the air hose. The other end of the pipe is closed.

This contrivance is placed across under the torch and held by a clamp or a weight in such a position that a curtain of swiftly moving air passes between the hot casting and the operator. The device affords protection from the heat and does not interfere with the manipulation of the torch or obstruct the view of the operator.

Watertown, Mass. H. HOWARD.

Blueprint Tube

The cover of the tube containing the blueprint paper was of the type that pulls off and was not a good fit, thus allowing the paper to spoil. I turned down a felt wheel *A*, about $\frac{3}{4}$ in. thick, to the right size and



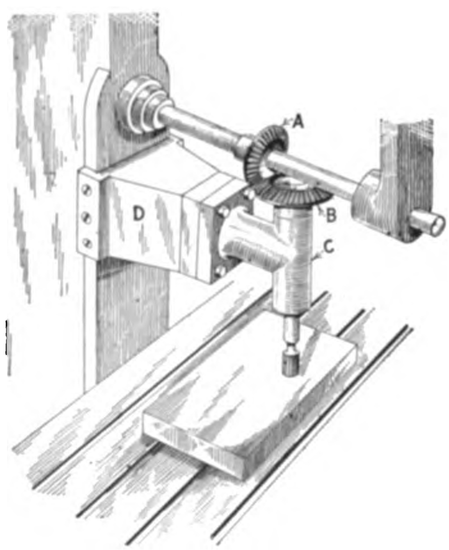
BLUEPRINT TUBE

then shellacked it to the inside of the cover. The tube *B* now hits the felt, making a good joint, and I have no trouble in keeping the paper.

South Sudbury, Mass. HERBERT A. PRATT.

Profiling Attachment for the Horizontal Miller

A simple efficient profiling attachment connected to a plain horizontal miller is shown in the accompanying illustration. Fastened to an arbor of the machine is the bevel gear *A*, which drives the bevel gear *B* and thus transmits the vertical motion. The casting *C* is made



PROFILING ATTACHMENT FOR THE MILLER

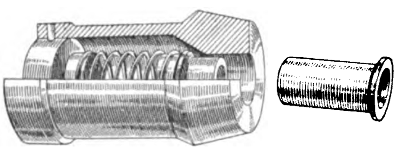
in such a manner as to allow the longest bearing possible for the vertical spindle. It has a bronze bush in which the vertical spindle runs, provision being made for adjustment when wear occurs. The casting *D* is

merely a filler block and should be rugged, to add stability to the attachment generally. This casting is fastened to the ways of the miller by means of gib and screws. J. H. MOORE.

Hamilton, Canada.

Work-Ejecting Collet

The illustration shows a spring collet with a coil spring and plunger fastened in the back end. I use a cupped bumper in the turret head to force the work against the spring plunger when chucking it. By releasing the



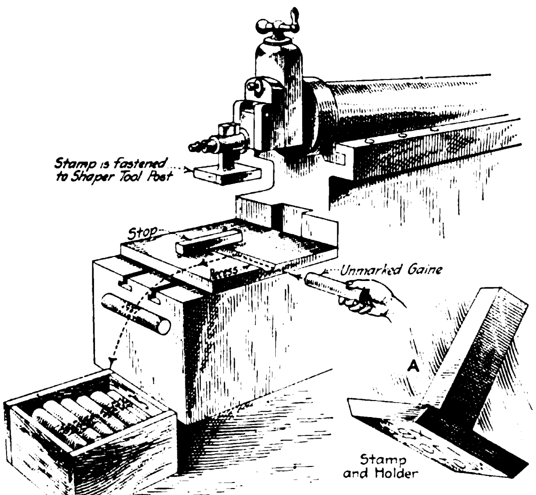
WORK-EJECTING COLLET

collet the spring forces the work out and so prevents the operator from getting his hands caught in the tools while extracting work. I have known this method to increase production 25 to 30 per cent. in some places.

Detroit, Mich. J. E. BRACKETT.

Marking Gaine Bodies in Shaper

The illustration shows a practical and rapid method of marking gaines. A holder *A* is made to fit into the tool post of a shaper. In this holder stamps are inserted, as shown, and the holder fastened into the shaper. A special platen with a stop and a recess, as indicated,



MARKING GAINE BODIES IN A SHAPER

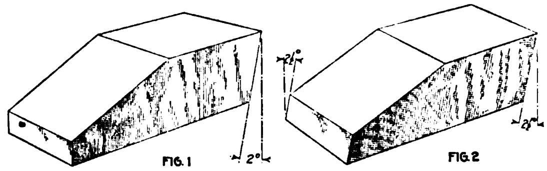
is made to go in the table. The forward stroke of the shaper rolls the markings in nicely, and incidentally no time is lost in withdrawing the gaine.

A steady, heavy shaper should be used to insure satisfaction, as there is considerable upward thrust when the markings are rolled in. The capacity of this machine equals the stroke of the shaper, which should be 1 per second. JAMES DOWNS.

Lynn, Mass.

Design of Holding Jaws

The illustration shows two end views of ordinary "hold-downs." It is contended that the vise jaw in Fig. 1, coming in contact with the angular side of the hold-down, will cause that side to rise, giving to the upper corner of the small side a slight rotary downward



DESIGN OF HOLDING JAWS

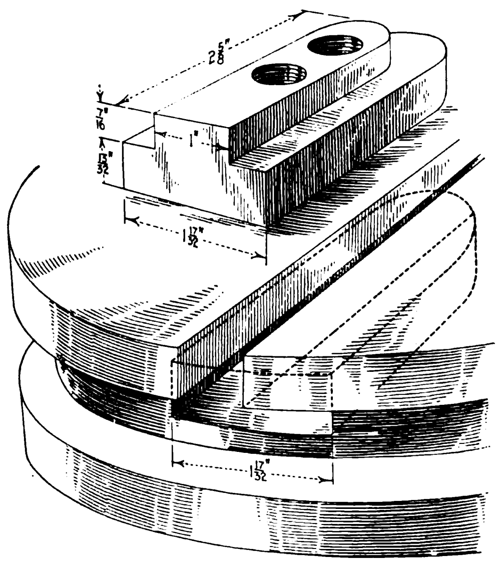
motion on the work that is being held. In Fig. 2 the angle is the same on both sides.

Both sides being parallel, there is a full contact against the work. But it is claimed that this style has not the essential downward action on the work. Which is right? Any information will be appreciated on this subject.

Detroit, Mich. ROBERT J. BEUTER.

Repairing Tool-Holder Slots in a Turret-Lathe Tool Head

The illustration shows how the tool-holder grooves or slots on a 2x24-in. Jones & Lamson turret-lathe head were repaired. The repairs were necessitated by the



REPAIRING TOOL-HOLDER SLOTS

stripping of the threads in the 5/8-in. tapped holes used in clamping the tool holders to the turret table.

The head was milled out with an end mill and T-slot cutter to the dimensions shown. Pieces of cold-rolled steel were then milled to have a driving fit in these slots. FREDERICK W. SNYDER.

Williamson School, Penn.

Discussion of Previous Question

First Wheel Lathe in Brazil

The wheel-turning lathe illustrated on page 596 is of interest, as it shows a simple method of adding electric drive to an old machine tool, but your correspondent is mistaken in thinking that this lathe, installed in 1902, was the first wheel lathe in Brazil.

Wheel-turning lathes were in service in Brazil over 20 years previous to that date, and I understand that the English firm of machine-tool makers, Craven Bros., Ltd., of Manchester and Reddish, which specializes in railway machinery, has been supplying wheel lathes to Brazil since 1878. In 1893 this company shipped direct to the San Paulo Railway Co. a lathe having 6-ft. diameter faceplates for turning locomotive driving wheels up to 5 ft. 3 in. in diameter on tread. With several others, this lathe was altered to electric drive in 1906. Up to quite recent times, interrupted only by their large manufacture of war material, Craven Bros. have been supplying wheel lathes, belt and electric drive, to railway companies in Brazil and Argentina. C. PARSONS.

Alderley Edge, Cheshire, England.

Attitude of Employers Toward Military Training

Percy E. Barbour, on page 867, Vol. 43, and page 33, Vol. 44, brings out a number of good points in connection with military training and desires to interest employers in the matter of arranging for the militia members having leave for local and camp training.

A few particulars of what has been done in this country may be of interest. What in Great Britain are called "Territorial" soldiers are members mostly of units existing until a few years ago as "volunteers." The volunteer movement, which was revived about 1860 from a system in vogue 70 or 80 years earlier, developed into an institution and brought into being corps which in the first instance paid all their own headquarters, provisions, uniforms, and incidental expenses. The government merely provided arms, adjutants and drill instructors from the regular army.

Though enrolled for home defense, legally it was, I believe, somewhat doubtful if they could be forced to serve on mobilization except voluntarily, as the units from the legal point of view were in the nature of private social clubs with members banded together for military instruction. Later, the government allowed a grant of about \$8.50 a year for each efficient volunteer—that is, to everyone who attended, say, 60 drills and a week's camp in two years. This grant assisted in providing uniforms, headquarters, etc.

During the last few years the Territorial army was formed, composed of practically the same volunteer units, but the men were all legally "attested" and bound to mobilize in case of invasion or great national emergency. They also received army pay and maintenance during their yearly fortnight's camp, the government paying all expenses of equipment. A great distinction between the Territorials—colloquially, "terriers"—and the old volunteer is that in the old comparatively haphazard formations one part of the country might have too large a proportion of artillery, another too many cavalry, etc., but in the Territorials the army units are formed of the proper proportion of each branch of miilitary service.

The term Territorial is used because the units are raised in counties or districts from which regular or irregular British regiments take their names. This local connection is real, as local bodies named "Territorial Associations," which include military, municipal, academic and other civilian representatives, administer the government funds and supply headquarters, clothing and equipment, with the exception of arms. The military authorities are responsible for training only. The university, college and senior "public" or "grammar" schools have senior or junior officers' training corps, which have proved useful in providing keen, receptive junior officers. It may be added that a new volunteer movement on the lines of the original one of 1860 has sprung up since the war, composed of men over strictly military age or otherwise unable to serve in the active army. After the usual period of government neglect the volunteer units now are recognized for home-defense purposes, and certain duties compatible with their civilian vocations are allotted them, pay at army rates being granted during their spells of duty.

The Territorial system has proved a great success. Mobilized on the declaration of war, although only attested for home defense, nearly the whole number volunteered for foreign service and after a few months' final training have since served at the various fronts. It has been proved that what many previously considered simply amateur troops are capable of speedy utilization. Probably a matter of 300,000 men mobilized at first, and supplementary units acting as feeders and additions to the first lines will have doubled or trebled the numbers. A great mistake was that thousands of skilled mechanics were allowed to leave the country in the first rush as part of these units, when they would have been of much greater national value as munition workers. However, many men have been brought back, and the mistake will not be repeated. Of course, the enormous amount of ammunition and high-explosive shells needed in present-day warfare has been a revelation to even those who thought themselves really prepared.

The main object of this letter is to confirm Lieutenant Barbour's testimony as to the beneficial effects of such military training on most workmen, especially town dwellers. I can speak both from past personal experience and from that of men working under me who have been induced to join by their comrades.

To begin with, the evening drills take the participants entirely out of the shop atmosphere and give them bodily and mental exercise of an interesting character. Those

who go in for qualifying for noncommissioned-officer rank are compelled to study in order to obtain the proficiency certificates that make them eligible for their rank. Once obtaining them does not guarantee the permanence of the rank; the examination now has to be passed each year. This necessary effort, to my own knowledge, has enabled a number of men to improve their positions both in workshop and civilian life generally. One laborer, for instance, rose to rank as a valued quartermaster sergeant. The greater mental alertness thus encouraged has assisted many men eventually to obtain wage increases of 50 to 75 per cent. Then the fortnight's camp in country, mountain or seaside air, with the regular exercise, plain food and entire change of daily occupation, makes new men of nearly all the members, and the beneficial effect is felt throughout the year.

Many large engineering works have for years had battalions, companies, batteries, etc., specially connected with them, and such units as the Electrical Royal Engineer Volunteers—now Territorials—have been recruited from well-known works, Lord Kelvin being their honorary commandant. The Crewe Railway Works of the London & North-Western Railway Co. used to supply a complete battalion of railway engineers able to cope with any class of field railway work. Both they and the Electrical Royal Engineers furnished volunteer units during the South African War. The Woolwich Arsenal and other armament-producing concerns in other parts of the country have furnished artillery contingents.

Under the circumstances which have arisen the United States will, in my opinion, have only reason for satisfaction if the machine-shop element—all ranks—undergoes some military training on British Territorial lines. Although their services in the first instance might be of greatest value as munition producers, they would then understand and appreciate better the duties of the fighting-line personnel, and after a sufficient reserve of war material had been built up would eventually constitute a valuable reserve for defensive or offensive action.

Manchester, England. JAMES VOSE.

The Buying of Machines--The Production Guarantee

Referring to page 830 under the heading of "The Buying of Machines," I wish to take exception, as a representative of a machine-tool company, to one statement contained in the article, namely: "If he is not willing to guarantee a minimum production after knowing the conditions, we may be justified in looking askance at the machine he builds."

As everyone knows, the conditions in shops vary so greatly in different parts of the country that it is impossible to guarantee production in the shop of the purchaser, owing to the variation in equipment, men, conditions, etc., which are so widely diversified in different sections. For instance, some time ago I installed in one of the largest manufacturing plants a machine for turning certain articles. Previous time on this piece was 6 min. Under a premium system the men were making a slight premium equal to about 5½ min. actual time. Our machine was installed. I set it up, and one of the lathe hands—not a machinist—was put to work on the first run of about 5 hr. duration. The first hour the operator turned 57 pieces, and the final 2 hr. his time averaged 37 sec. for each article. This firm has since installed a number of these machines, and only in rare cases have they equaled this time. I have found in different shops, with the same equipment, which is furnished by the firm that I represent, production differences as great as 100 per cent., owing at times to the condition of the toolroom, whether skilled or unskilled labor is employed, the lighting of the shop, the ability of the executive in charge, the difference in grade of material used, etc.

The machine-tool firm that I represent has made it a practice to give an estimate rather than a guarantee. We feel save in being able to demonstrate to a customer what can be produced in his own shop. It has been the practice among machine-tool builders within the last two years to refuse almost entirely to guarantee production except on special machines—not on standard machine tools. D. R. CLARKSON.

Rochester, N. Y.

"Metricinchia"--A Drawing-Room Disease

A certain disease confined to shop drawings I have taken the liberty of naming "metricinchia." The cause of it is a general mix-up of metric and English measurements on drawings. The reason for English measurements forcing themselves to the front is that the shop in which this disease occurs has generally adopted the metric system. But now and again a case comes up where a Whitworth standard or gas thread has to be used. Then the drawing gets the disease.

I remember being given a drawing for a spindle, a part of which was to be turned ⅞ in. in diameter. This shop would not have the disease on the drawings, so it was sized 22.22 mm. I naturally thought it had to be accurate to $^1/_{100}$ mm. But no, it was not particular! J. H. DAVIS.

Wembley, England.

Wanted--A Lighting Gage

The editorial on page 654 reminds me of the lighting system in a pattern shop where I was employed. A lighting gage would be of little value in this shop, because the room was dark all the time. One large electric lamp furnished light for the pattern makers' benches. This light burned all day. Single lights hung over each machine. Each pattern maker was instructed to turn off the light when he finished using a machine, but the men did not do it.

Here is where the boss got busy. His idea might be a suggestion in shop-lighting economy. The bandsaw and ribsaw lights were operated by means of a spring-released push button located and fastened at the end of each belt shifter. Shifting the belt and starting the saw brought the end of the shifter rod against the push button and thus turned on the light. Reversing the shifter shut off the light.

It is quite possible that similar automatic light-controlling applications will suggest themselves, and in addition to the economy thus effected a higher quality of product results from the enforced use of light when needed.

Kenosha, Wis. J. McCABE.

Editorials

Dr. Stratton's Engine

During the week beginning May 22 there convened in Washington the eleventh annual Conference on Weights and Measures—a body composed of state, municipal and county officials charged with the execution of laws relative to weights and measures. Of it Dr. Stratton is president, and through it more than any other channel, silently and unseen by the public, he is spreading his metric propaganda to the remotest parts of the country.

The proceedings of the session just past show that his preliminary work has been thoroughly done, the body having been converted to the system. Its Metric System Committee brought in a report of the customary kind, extoiling the system to the skies, handing out the regular list of glittering generalities, making the usual charges of ignorance and urging the importance of the adoption of the system. In due course the Committee on Resolutions brought in a corresponding report in the form of resolutions, which were adopted *without a dissenting vote.*

We have in recent editorials pointed out the manner in which, to the facilities of the Bureau of Standards, Dr. Stratton has annexed those of the Government Printing Office and, through the franking privilege, those of the Post Office Department in spreading his metric propaganda. We have now to point out that he has also added the influence of state, municipal and county weights and measures officers directed through an organization of which he is the head and which reaches out from the Bureau of Standards to the Atlantic, the Pacific, the Canadian border and the Gulf. No such engine for the promulgation of the metric system was ever before seen in this or any other country.

These weights and measures officials have to deal with the inspection and regulation of weighing and measuring apparatus and standards used in commerce—that is, in the transfer of ownership of commodities from one party to another with a view, especially, to the detection of false weights and measures. The factory use of weights and measures is beyond their ken and without their knowledge. They know nothing of the meaning of a change in factory units, a shortcoming which, under the circumstances, is not their fault, but their and the country's misfortune. Being under the dominating influence of Dr. Stratton, their attitude is not suprising. We are convinced that an organized effort to educate these officials in the things of which they know nothing is the most pressing need of the hour.

What Is a Gate, and What Is a Sprue?

Surprising as it may seem, there is a friendly controversy in at least one large die-sinking shop in this country as to what part of a set of drop-forging dies is the gate and what is the sprue. Some contend that the small narrow opening, leading from the impression of the die to the larger grooves in the ends of the blocks, where the bar from which the forging is made enters, is the gate and that the enlarged opening which takes the end of the bar of stock is the sprue. Others reverse the meanings of these terms, saying that the smaller opening is the sprue and the larger the gate.

Of course, everyone is benefited if all use the same name for the same thing. While it does not matter whether one part is called a sprue and the other a gate, it is necessary that we should all use the same term for the same thing. In attempting to understand anything of this kind it is always a good plan to hunt for a similar case. Fortunately, one is easily found. The words sprue and gate are well known in founding and were unquestionably used there for many years before drop forging became an art.

Webster's dictionary gives this foundry definition for the word sprue: "The hole through which metal is poured into the gate and thence into the mold." The definition for gate from the same authority is: "A channel or opening through which metal is poured into the mold."

Thus, in founding, the small opening leading outward from the impression in the mold is the gate, and the larger opening beyond the gate is the sprue.

Another way to look at this matter would be to ask what is a gate in our ordinary everyday speech. To every one of us it is a small opening through some inclosing fence or wall. It leads from one large space to another large space. When we seek to apply this meaning of the word gate to the opening in a set of drop-forging dies, we must at once call the small opening leading from the die impression to the larger groove outside the gate and call the larger groove itself the sprue.

Thus both from the parallel use in foundry practice and from our knowledge of the everyday meaning of the word gate it seems wise in drop-forging practice to call the small opening the gate and the larger the sprue.

If there are any readers of the *American Machinist* who differ with this conclusion, they will confer a favor upon everyone by sending in their views.

Prevalence of Resignations

In these days of "war order jobs" not a little disquiet has been caused among employees in the munition sections of the country by the sight of fellow-workmen elevated—sometimes over night—to a supervisory position. Foremanships and superintendencies have been so plentiful that it has become the common practice for men who are dissatisfied to resign calmly enough and obtain coveted advantages in another shop. Their rise is not amid the knocks and bumps of the sidewalk; they go with a rush, as in a high-powered motor car. They do not climb into a desired position, but reach it as in an aeroplane.

There is an old saying to the effect that whatever goes up must come down. Such spectacular advancement

is due to the present delicate, unusual and unstable economic situation. Everyone knows that things cannot continue indefinitely as they now are. When the change comes and things are turned back to normal business conditions, there will be a letting down of many men from positions of foremen and superintendents to the lathe, the bench and the planer. This fact should be clearly foreseen by everyone who is now taking advantage of things as they are.

There is of course no objection to a man's bettering himself—on the other hand, it is his clear duty to do so. But the permanence of that betterment should be carefully studied and provisions made against the day of change, so that when a letting down does come, it will not bring a feeling of unrest.

In the normal order of things few men now in a position of great responsibility have reached that place through an aëroplane ascent. They slowly climbed the slopes and steeps and after mastering each new grade scaled other rocks and overcame other difficulties to reach the next higher elevation. There is really no "royal road" to anything that is good—not even to power. The man who has been carried up a mountain in a motor car is usually very much surprised when he finds himself at the top. On the other hand, there are no surprises to the man who reaches his place of eminence by sturdy climbing. When he has reached the top, it seems natural that he should be there. The preceding difficulties have been overcome, and he is quite as much at home at the top as when he was patiently working his way upward from the bottom.

From a slightly different angle it is altogether wrong to begrudge a man a quick turn of good fortune that puts him above his fellows. It is unwise to covet any position of responsibility unless one is willing to submit to the iron discipline and patient work that seem to be inseparable from all positions of eminence. Too many of us "put aspiration for perspiration, yearning for earning, and longing for labor."

Russian Business and Need of a Commercial Treaty

Exact figures of United States exports to Russia prior to the war are difficult to obtain, because part of our products sent to that great empire was first shipped to Germany. The known exports are $45,000,000 in 1912, and the total was probably at least $80,000,000 yearly for the past few years. All this business should be handled direct, thereby saving the added charges of European middlemen. That these charges are high seems very probable and no doubt did much toward earning for America the reputation of manufacturing only high-priced products.

Another obstacle to our trade with Russia lies in the fact that since the former administration we have not renewed our commercial treaty with that country. It seems to be the general opinion that the victorious European powers will endeavor to obtain great concessions from their allies after the war; and as the *American Machinist* has pointed out before, it is very important that we should have a new commercial treaty signed with Russia at the earliest possible date. The old one was canceled for political effect. This nation has no more right to dictate Russia's internal policies than Japan has to dictate ours. Some of our European competitors seized upon this cancellation of our former treaty to advertise our action all through Russia for the purpose of hurting our trade.

Prior to the war, Germany was Russia's best customer, taking a large proportion of Russia's agricultural exports in return for her own manufactured products. Germany built this trade up from $12,000,000 to $270,000,000 per annum in eight years. It is often the case that warring nations become the best of friends after peace has been declared.

Groups of noncompeting American manufacturers must coöperate and pool their export expenses. They must send a high-class American who speaks Russian to study the market, to educate Russian buyers to American standards (in cases where our standards are more serviceable than those now used) and send home the valuable kind of information that only the highly trained man knows is needed.

The representative will find that Russia's agricultural expansion needs credit for reasons similar to those underlying the development of our Central States 30 years ago, at which time the density of our population and general economic conditions closely resembled the conditions in the Russia of today. We financed the development of our Western States by mortgages. Russia has been financing her development by a system of long credits. Interest rates are high; payment is slow, but sure.

The German demand for accurate credit ratings caused the formation of an agency in Germany that was said to know more about Russian credits than the Russians knew themselves. In every part of Russia, German travelers were found. With characteristic thoroughness they overlooked nothing. We must do likewise! Whenever a complicated machine was sold, the Germans always sent a man to demonstrate it, so that those of our manufacturers who prefer to depend on their catalogs must see that these contain simple, clear instructions for erection and operation. Such catalogs must be printed in Russian, with both American and metric dimensions clearly stated. The Russians have their own system of weights and measures, but it is not necessary to convert the dimensions of our products into those units.

Those American manufacturers who do not wish to send representatives may make arrangements with reliable Russian firms to act for them, furnishing these agents with suitable literature and catalogs printed in Russian or arranging for the printing of such matter in Russia. Catalogs sent out from Germany always gave detailed information showing how to figure the delivered cost at any part of Russia, including the Russian customs dues. As in South America, there are two grades of machinery required—our standard grade and a cheaper but serviceable one for the average buyer.

The laws concerning travelers' movements in Russia are complicated, and a new arrival should take care to ascertain the requirements without delay.

The *Review of Reviews* in advertising its school of character analysis prints this amazing statement: Dr. Blackford has analyzed the characters of 15,000 people. Failures, 0; successes, 15,000. Even the best of us make mistakes, but it begins to look as if there is *one* person on earth today who is infallible.

Shop Equipment News

Automatic Shell-Roughing and Finishing Lathe

Fig. 1 shows a Reed-Prentice 14-in. automatic roughing and finishing lathe for shells, automobile pistons, piston sleeves, plunger and similar work. This lathe is built by the Worthington Pump and Machinery Corporation at the Blake & Knowles Steam Pump Works, East Cambridge, Mass.

The geared head is of the two-speed type. The high speed is through 4-pitch $3\frac{1}{2}$-in. face herringbone gears made in two halves doweled and bolted together; the second speed is through 4-pitch gears having $2\frac{5}{8}$-in. and 3-in. faces. The shaft and spindle are made from a high-carbon steel, running in renewable-type bronze bushings.

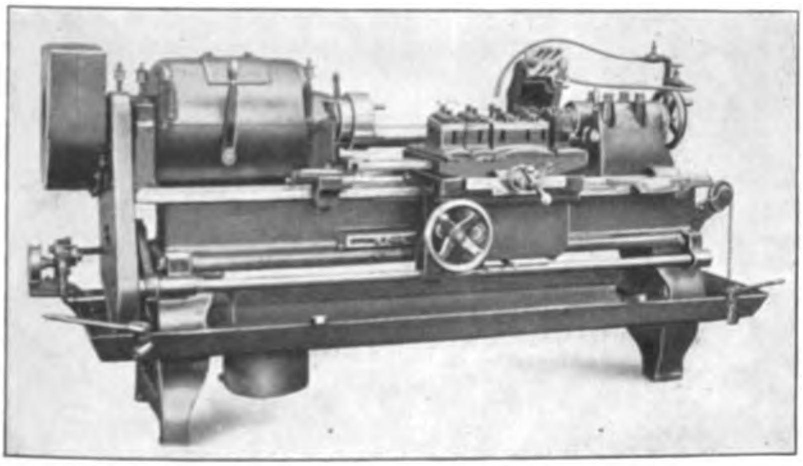


FIG. 1 AUTOMATIC SHELL-FINISHING LATHE
Swing, 14 in.; driving belt, 6 in.; floor space, 11 ft. by 30 in.; weight, 5,500 lb.

The faceplate is equipped with two steel pins for driving the shell, which fits into centers both in the faceplate and the tailstock. The carriage holds three tool posts. One of these carries five tools, which are fed in and out by a cam. The two tool posts, having one tool each for forming the nose, are controlled by a path cam. After the shell has been machined to the required dimensions, the weight shown at the end of the machine draws back the tools and also returns them ready for machining the next shell. A trip arrangement throws the pulley on the crankshaft on the loose pulley. The tool posts are of very rigid design and built to hold the tools without the possibility of chatter. The cam control bar is plainly shown over the ways.

The upper tool post is for facing the butt end of the shell and also for machining the copper-band groove. The desired motion is obtained for these tools by an angular slot in which a roll travels.

Careful attention has been paid to the design of the tail-stock. This is not only exceptionally heavy, but has a somewhat unusual spindle-clamping mechanism. The clamping handle is below the spindle. This leaves the upper surface solid to better resist upward stresses from the cutting tools.

The headstock gears are thoroughly guarded and are provided with a cover that is easily removable for inspection. The gears at the end of the lathe are also well protected, making for increased safety of the operator. The various tools are lubricated by oil, which is forced by a belt-driven pump through the piping shown.

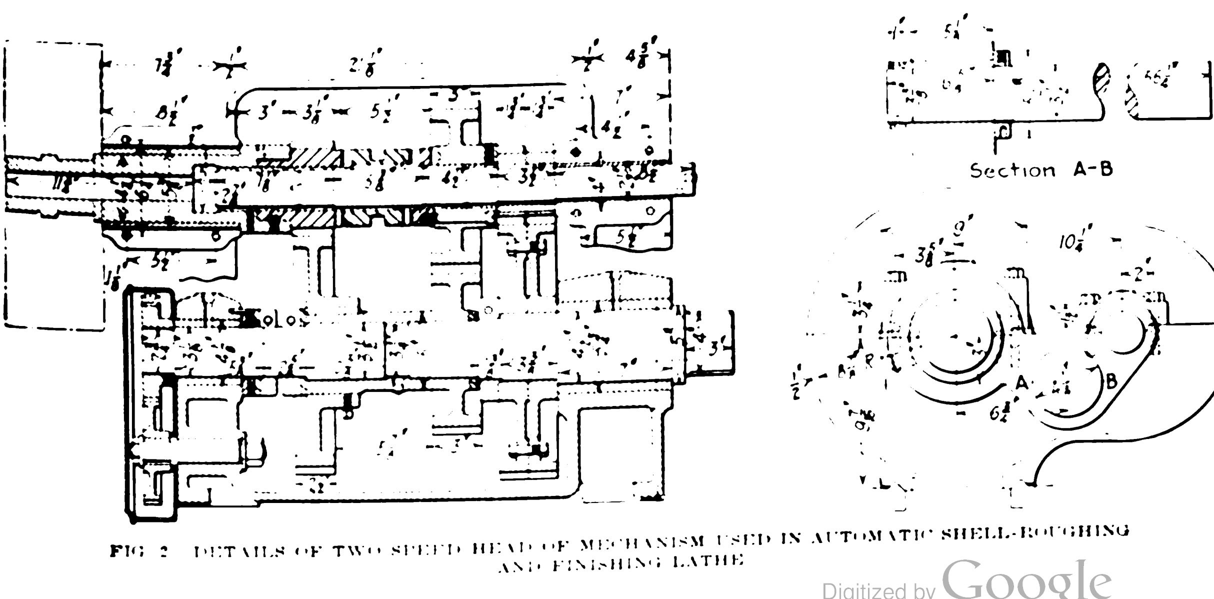


FIG. 2 DETAILS OF TWO-SPEED HEAD OF MECHANISM USED IN AUTOMATIC SHELL-ROUGHING AND FINISHING LATHE

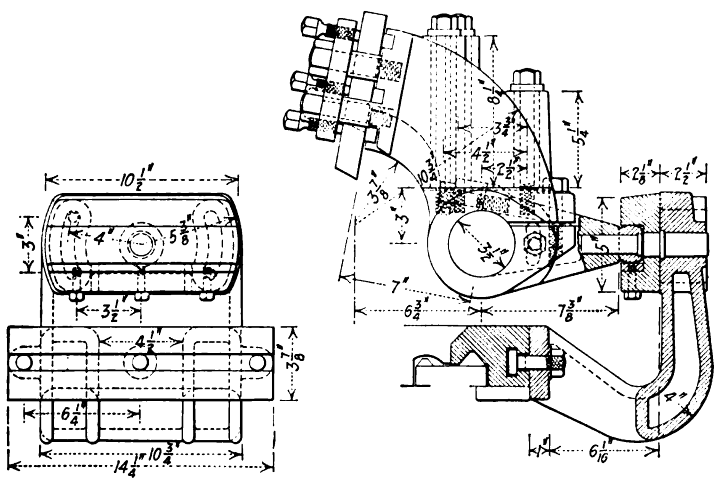


FIG. 3. DETAILS OF BACK ARM ATTACHMENT

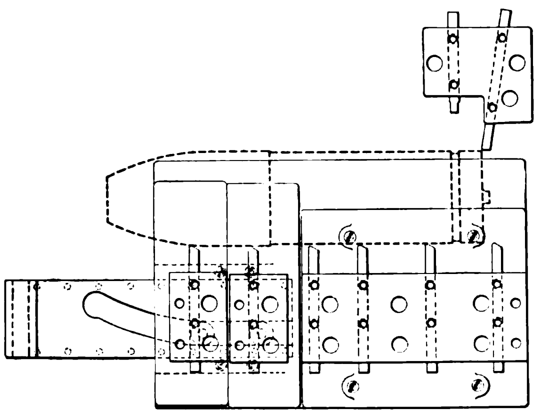


FIG. 4. TOOL LAYOUT FOR TURNING SHELLS

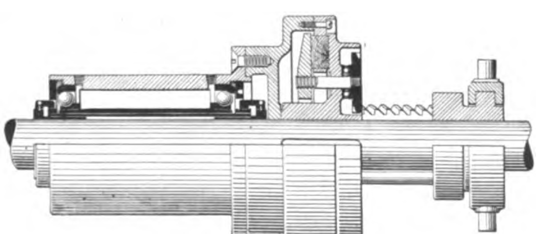
The details of the head construction, carriage and tool layout are shown in Figs. 2, 3 and 4.

This machine, as will be noticed, is of the multiple type, thus reducing the time in machining.

Ball-Bearing Friction Clutch

The friction clutch shown incorporates the standard design perfected by the Hilliard Clutch and Machinery Co., Elmira, N. Y., and described on page 875.

The standard clutch mechanism made by this firm operates satisfactorily up to a rim speed of 5,000 ft. per min., which means that the small-size clutches will operate satisfactorily from 2,000 to 2,500 ft. per min. The great difficulty at such speeds is the lubrication in the clutch sleeve. In the form of clutch shown, this difficulty is overcome through the application of a ball-bearing sleeve, which, as will be observed, provides a large reservoir for the lubricant.



BALL-BEARING SLEEVE FRICTION CLUTCH

It will be noticed that the mechanism for compounding the frictional pressure is of the Hilliard standard rack and gear worm-threaded stud combination. The compounding pressure ranges from 96 to 1 in the small-size clutches up to 168 to 1 in the largest size.

The illustration shows the single-plate type of clutch, in which maple blocks are clamped between the two friction surfaces by means of the rack gear and screw mechanism shown. The ball-bearing sleeve design is clearly indicated.

Special-Purpose and Assembly Arbor Presses

A special feature of the line of arbor presses illustrated is the application of handwheels for exerting the pressure by the use of which there is provided a continuous motion.

The press shown in Fig. 1 is fitted up for molding material which when hot is plastic.

This press is used for forcing a plunger into a mold through the hot material. The mold is then turned upon its side and a second plunger is forced through the hot material. When the material is cool, the mold is placed under projections A and A^1, and one plunger is withdrawn; the mold is then placed upon its end under the points B and B^1, and the second plunger is withdrawn.

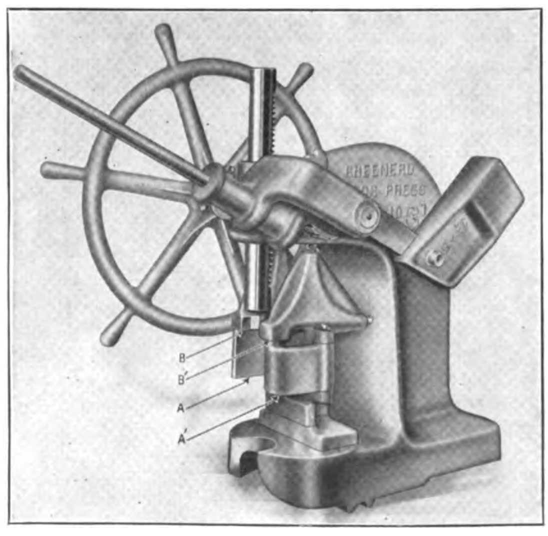


FIG. 1. ARBOR PRESS WITH MOLDING ATTACHMENT

That part of the fixture marked A^1 is swung out of the way when the mold is used lengthwise. The fixture is bolted to the base and held firmly in place by means of

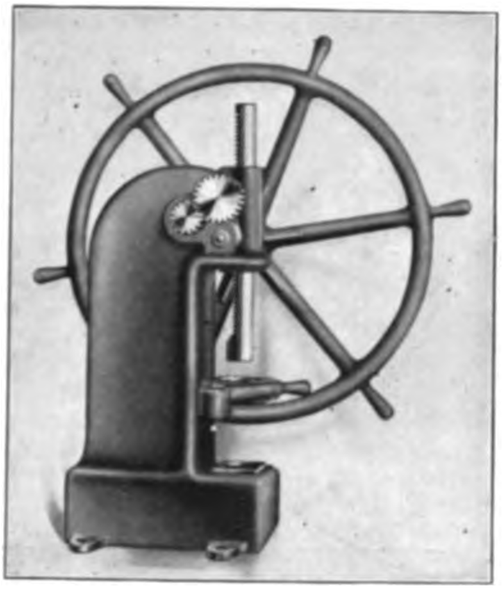


FIG. 2. ASSEMBLING BENCH ARBOR PRESS

four screws tapped into the fixture and screwed out against the press frame.

The 24-in. pilot handwheel is used for withdrawing the plunger. The lever is used for forcing in the plungers. front portion may be swung out on the pivot shown, allowing the work to be placed in position.

The gearing is compounded, two pinions engaging the ram. The wheel may be easily "thrown," so that 2,000 to 3,000 lb. pressure may be exerted on the ram.

The special heavy-base press, Fig. 3, was fitted up for the assembly of parts requiring 600 to 1,000 lb. The guide on the lower part of the rack insures alignment of the parts.

The presses shown are recent additions to the line made by Edwin E. Bartlett, Boston, Mass.

Heavy-Duty Engine Lathe

In the design and construction of the lathe shown the purpose was to provide a machine capable of absorbing the heaviest cuts with high-speed steel cutting tools.

The double-trussed and webbed headstock, with bowl section coming up almost halfway around the cone in front and rear, is designed not only to insure rigidity, by tying together the front- and rear-spindle bearings, but also to safeguard the operator against the revolving pulleys.

The bed is braced internally by crossgirths. At the rear end the bed is cut away to allow the overhang or quick removal of the tailstock or turret. The horizontal and vertical surfaces of the inner side of the front shear are scraped bearings to provide a supplementary bearing for the carriage. The two horizontal bosses cast on the back of the bed are planed to receive taper attachments, radius-arm brackets, and various other lathe attachments.

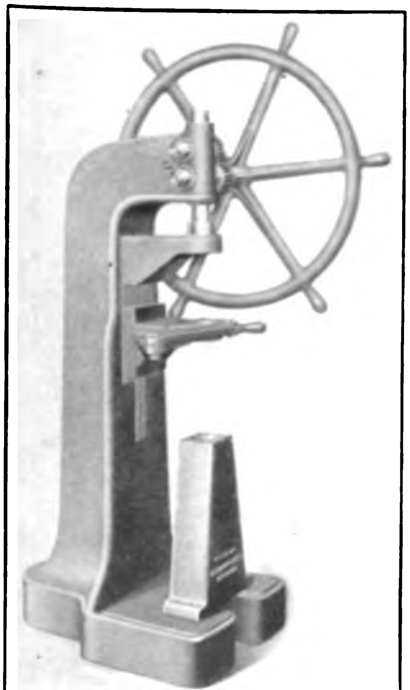
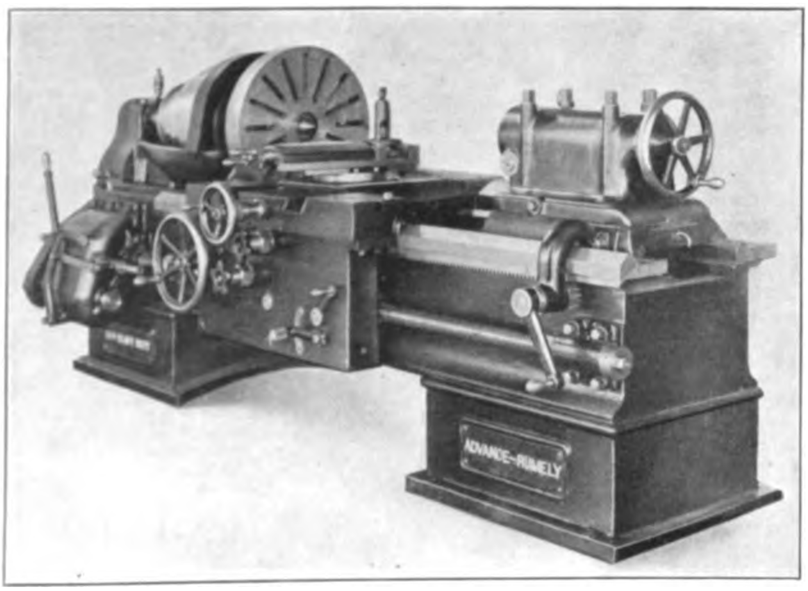


FIG. 3. HEAVY BASE ARBOR PRESS



HEAVY-DUTY ENGINE LATHE

Swing over shear, 26 in.; swing over carriage, 17 in.; takes between centers, 10-ft. bed, 6 ft.; hole through spindle, 2 in.; cone-pulley diameters, 20, 16 and 12 in.; back-gear ratio, 10.2 : 1; width of face of cone, 6¼ in.; weight, 10-ft. bed, 10,000 lb.

The press shown in Fig. 2 was originally built for use in assembling. The fixture shown secured to the frame has a hole accurately in line with the ram and the recess in the base. The fixture is divided, the front portion being quickly and securely locked. When unlocked, the

The carriage is 11 in. long on the ways and is provided with T-slots for mounting auxiliary tools, etc. The dovetail on the crossfeed is 12 in. wide on top, and wear is taken up by taper gibs. The carriage takes a right-angled bearing on the inner horizontal and vertical sur-

faces of the bed directly in line with the tool thrust. This supplementary bearing shortens the span of the carriage from the front to the rear V's.

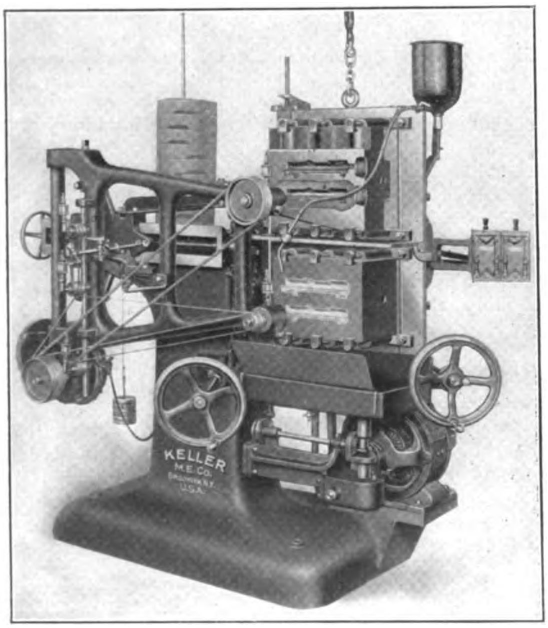
In the apron a back plate that forms a double-walled apron supports the studs front and rear. The apron is tongued and grooved to the carriage in addition to being bolted and pinned. The reverse lever, which shifts the double bevel gear either to right or to left, as the feed is desired, is located in front of the apron. When this bevel gear is engaged, a fixed safety pin prevents the half-nuts from engaging the lead screw.

The quick-change gears are of machine steel, permitting changes while the lathe is under cut. The lead screw passes through the double bevel-gear sleeve and engages it by a key and spline.

The machine is a recently manufactured product of the Advance-Rumely Co., La Porte, Ind., and its sales distribution is in the hands of R. W. Baily, 122 South Michigan Ave., Chicago, Ill.

Automatic Profiling or Die-Sinking Machine

The illustration shows a new size of automatic profiling machine which has been recently produced by the Keller Mechanical Engraving Co., of Brooklyn, N. Y.,



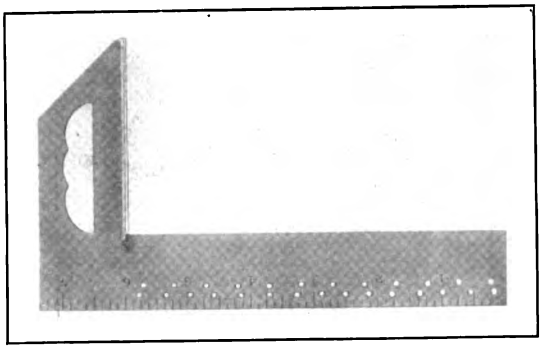
SPECIFICATIONS FOR TYPE E-3 PROFILING MACHINE

Maximum size of pattern, 22x12 in.; maximum size of die block, 22x15x9 in.; feed range, 0.0005 to 0.040; height over all, 6 ft. 6 in.; floor space, 6 ft. 9 in. by 4 ft. 7 in.; weight, including counterweights, 5,000 lb.; drive motor, 1½ hp.; cutter motor, ¾ hp.

and which is known as the Type E-3. The principle of operation of this machine is similar to that of the two smaller sizes, which were described in the *American Machinist* in Vol. 43, p. 653, and in Vol. 32, p. 535, respectively.

Belt-Lace Hole Templet

The templet square shown was designed for correctly spacing holes for belt lacing where the twisted round or wire belt lacing is used in making the joints.



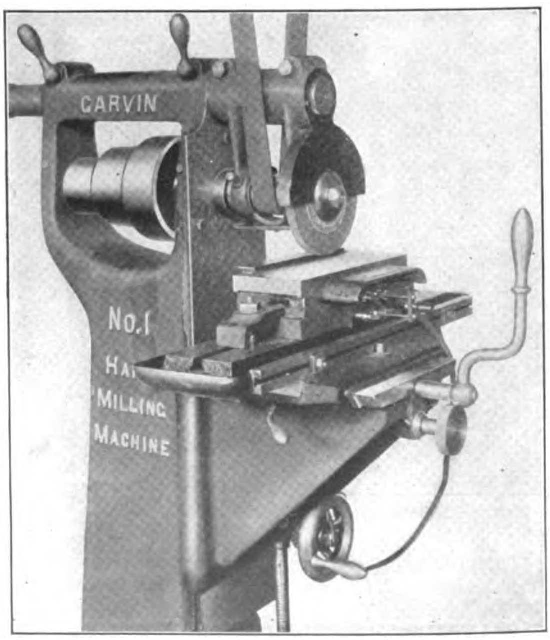
TEMPLET FOR LAYING OUT LACE HOLES

The application is apparent. In addition to its insurance of proper spacing for maximum strength, time is saved. The templet is a recent product of the George W. Southwick Co., Stamford, Conn.

Surface Grinding Attachment for the Miller

In the illustration is shown a compact, rigidly constructed attachment for the miller by the use of which such a machine is readily converted into a surface grinder.

The attachment consists of a double-arm fixture which is clamped rigidly to an overarm. The driving pulley of



SURFACE GRINDING ATTACHMENT FOR MILLER

the attachment is held between two substantial bearings which eliminates the possibility of spring in the grinding-wheel spindle. It will be seen that the attachment incorporates an adequate wheel guard.

This attachment is a recent product of the Presto Machine Works, 119 Lafayette St., New York City.

NEW PUBLICATIONS

STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS—By Frank F. Fowle, editor-in-chief. Fourth edition, 1916 pages, 4x6½ in., illustrated, indexed, flexibly bound. Price, $5. McGraw-Hill Book Co., New York.

The work of preparing this edition was begun early in 1913. It embodies so many changes and so much new matter that it is virtually a new book. The general scheme and features of arrangement which received indorsement in prior editions have been retained. Much of the work of revision has been done by experts selected because of their particular knowledge of the subjects to be discussed. The names of these men appear in connection with the sections for which they are responsible.

As heretofore, this handbook is intended primarily as a reference book of practical information and data for practicing electrical engineers, and as a supplement to textbooks used in engineering schools.

However, there is much matter of value to mechanical engineers and to those who have charge of the installation, operation and maintenance of electrical apparatus in machine shops. One of the new sections, No. 15, "Industrial Motor Applications," must be especially pointed out in this connection. It covers 468 pages and takes up the application of motors to many kinds of machines, with extended references to machine tools and wood-working machinery.

PERSONALS

L. C. Curl, formerly purchasing agent for the Buda Co., Harvey, Ill., is now purchasing agent for the Continental Motor Mfg. Co., Muskegon, Mich.

Henry M. Shaw, formerly Eastern representative of the Gardner Machine Co., Beloit, Wis., has joined the sales organization of the Sherritt & Stoer Company, Philadelphia, Penn.

D. W. Patten, who was associated with the Windsor Machine Co. for several years, has joined the sales force of the New Britain Machine Co. and will look after their interests in the Ohio territory.

Sterling H. Bunnell, for the past nine years connected with the Griscom-Russel Company in sales and engineering capacities, has resigned to become chief engineer of the recently organized American branch of R. Martens & Co.

Lloyd E. Shirley, for a number of years superintendent of the foundry of the C. S. Bell Co., Hillsboro, Ohio, has severed that connection to become associated with the Garland Mfg. Co., Des Plaines, Ill., as vice-president and general manager.

Richard Martens, vice-president and managing director of the shipping and engineering firm of R. Martens & Co., New York City, sailed for Petrograd on May 16, after a six months' stay in the United States during which period Mr. Martens perfected the organization of his American Company.

OBITUARY

Selden G. North, vice-president of the North Bros. Manufacturing Co., Philadelphia, Penn., died at his home in that city on April 24, aged 73 years.

Chester B. Albree, founder and for many years president of the Chester B. Albree Iron Works, Pittsburgh, Penn., died on May 27. Mr. Albree was born in Pittsburgh in 1862. After his start in the mechanical field he became well-known through a number of inventions.

BUSINESS ITEMS

Charles R. Parmele, machine-tool dealer, has moved from 81 Northern Ave. to 50 Church St., New York City.

The Dexter Metal Mfg. Co., Camden, N. J., announce the absorption of the interests, plant and good will of Merritt & Co., steel locker manufacturers.

The Chicago office of James Clark, Jr., Electric Co., Louisville, Ky., has been moved from 201 Machinery Hall Building to its new store and office at 31 North Jefferson St. Oscar P. Wodack, manager.

The Quigley Furnace Specialties Co., with headquarters at 26 Cortlandt St., New York City, has been incorporated and organized to specialize in fuel and furnace engineering. M. S. Quigley, so long connected with this class of work, is president of the new organization.

TRADE CATALOGS

Shaft Making Machinery. Medart Patent Pulley Co., St. Louis, Mo. 32 pp., 6x9 in.

Texaco Crater Compound. The Texas Co., 17 Battery Place, New York. Pp. 32, 6x9 in.

Besly Grinders. Charles H. Besly & Co., 118-20 N. Clinton St., Chicago, Ill. 54 pp., 7x9 in. This catalog gives complete specifications, dimensions and weights for all Besly disk grinders and accessories regularly manufactured.

One Century in Business. Peter A. Frasse & Co., Inc., 417-421 Canal St., New York. 6x9 in. This is an Anniversary Booklet commemorating the one hundred years the company has been in business. It contains very fine pictures of the founder and also of the past and present officers and an illustration of the new electric steel works in Hartford.

FORTHCOMING MEETINGS

Society of Automobile Engineers. Midsummer cruise, steamship "Noronic," Detroit, Mich., June 12-16. Coker F. Clarkson, secretary, 29 West 39th St., New York City.

Master Car Builders' Association. Annual meeting, June 14-17, Atlantic City, N. J. Joseph W. Taylor, secretary, Karpen Building, Chicago, Ill.

American Railway Master Mechanics' Association. Annual meeting, June 17-21, Atlantic City, N. J. Joseph W. Taylor, secretary, Karpen Building, Chicago, Ill.

American Society for Testing Materials. Annual meeting June 27 to July 1, 1916, Hotel Traymore, Atlantic City, N. J. Edgar Marburg, secretary, University of Pennsylvania, Philadelphia, Penn.

American Foundrymen's Association and American Institute of Metals. Annual meeting, September 11-16, Cleveland, Ohio. A. O. Backert, secretary, American Foundrymen's Association, Cleveland, Ohio.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Wednesday each month. J. A. Brooks, secretary, Brown University, Providence, R. I.

New England Foundrymen's Association. Regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting third Tuesday, section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. J. H. Warder, secretary, 1735 Monadnock Block, Chicago, Ill.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Technical League of America. Regular meeting second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York, N. Y.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	June 2, 1916	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$15.00	$15.00	$9.50
No. 2 X Northern Foundry, New York	20.75	20.75	14.00
No. 2 Northern Foundry, Chicago	19.00	19.00	13.00
Bessemer, Pittsburgh	21.95	21.95	14.70
Basic, Pittsburgh	18.95	18.95	13.60
No. 2 X, Philadelphia	20.50	20.50	14.25
No. 2, Valley	18.00	18.50	12.75
No. 2, Southern Cincinnati	17.90	17.90	12.40
Basic, Eastern Pennsylvania	20.50	20.50	13.25
Gray forge, Pittsburgh	18.70	18.70	13.45

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger and plates ¼ in. and heavier from jobbers' warehouse at the places named:

	New York June 2, 1916	New York One Month Ago	New York One Year Ago	Cleveland	Chicago
Steel angles, base	3.50	3.25	1.85	3.25	3.10
Steel T's, base	3.55	3.30	1.90	3.25	3.10
Machinery steel (bessemer)	3.50	3.25	1.80	3.25	3.10
Steel plates	4.25	4.25	...	3.65	3.50

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse at the places named:

	New York June 2, 1916	New York One Month Ago	New York One Year Ago	Cleveland	Chicago
No. 28 black	3.65	3.65	2.60	3.20	3.20
No. 26 black	3.55	3.55	2.50	3.10	3.10
Nos. 22 and 24 black	3.50	3.50	2.45	3.05	3.05
Nos. 18 and 20 black	3.45	3.45	2.40	3.00	3.00
No. 16 blue annealed	4.70	4.45	2.35	3.70	3.60
No. 14 blue annealed	4.60	4.40	2.25	3.60	3.50
No. 12 blue annealed	4.50	4.30	2.20	3.50	3.45
No. 10 blue annealed	4.55	4.25	...	3.55	3.50
No. 28 galvanized	5.65	5.65	6.00	5.50	5.50
No. 26 galvanized	5.35	5.35	5.70	5.20	5.20
No. 24 galvanized	5.20	5.20	5.55	5.05	5.05

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot for carload lots f.o.b. mill:

	Black June 2, 1916	Black One Yr. Ago	Galvanized June 2, 1916	Galvanized One Yr. Ago
¾ to 2 in. steel butt welded	70%	81%	50½%	72½%
2½ to 6 in. steel lap welded	68%	80%	48½%	72½%
Diameter, In.				
¾	3.45	2.19	5.69	3.16
1	5.10	3.23	8.42	4.68
1¼	6.90	4.37	11.39	6.33
1½	8.25	5.23	13.61	10.18
2	11.10	7.03	18.32	10.18
2½	18.72	11.70	30.13	16.09
3	24.48	15.30	39.40	21.04
4	34.88	21.80	56.14	29.98
5	47.36	29.60	76.22	40.70
6	61.44	38.40	98.88	52.80

From New York stock the following discounts hold:

	Black	Galvanized
3½ to 6 in. steel lap welded	61%	36%
¾ to 3 in. steel butt welded	64%	42%

Malleable fittings, Class B and C, from New York stock sell at 30 and 5% from list price. Cast iron, standard sizes, 55%.

Bar Iron—Prices are as follows in cents per pound at the places named:

	June 2, 1916	One Month Ago
Pittsburgh, mill	2.60	2.50
Warehouse, New York	3.25	3.25
Warehouse, Cleveland	3.25	3.25
Warehouse, Chicago	3.10	3.10

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-size lots, the following quotations hold:

	June 2, 1916	One Month Ago
New York	List price plus 20%	List price plus 20%
Cleveland	List price plus 20%	List price plus 20%
Chicago	List price plus 10%	List price

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York Today	New York One Year Ago	Cleveland	Chicago
$6.00	$3.75@4.00	$6.30	$5.25

In coils an advance of 50c. is usually charged.

High Speed Tool Steel containing from 10 to 18% tungsten sells as follows per pound in New York:

Billets .... $2.40 Bars $3.25

Drill Rod—Discounts from list price in New York are as follows: Standard, 65%; extra, 60%; special, 55%.

METALS

Miscellaneous Metals—The present quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	New York June 2, 1916	New York One Month Ago	New York One Year Ago
Copper, electrolytic (carload lots)	29.50	30.50	20.00
Tin	45.00	51.50	40.00
Lead	7.50	7.50	6.50
Spelter	13.50	18.00	28.50
ST. LOUIS			
Lead	7.37½	7.37½	...
Spelter	13.37½	17.87½	...

At the places named, the following prices in cents per pound prevail:

	New York June 2, 1916	New York One Month Ago	New York One Year Ago	Cleveland	Chicago
Copper sheets, base	37.50	36.50	25.00	38.50	37.50
Copper wire (carload lots)	37.50	36.50	26.75	33.00	37.50
Brass rods, base	44.50	44.00	26.62½	42.00	38.00
Brass pipe, base	46.50	44.00	33.50	45.00	46.00
Brass sheets	44.50	43.00	26.75	42.00	38.50
lots)	28.75	31.62½	29.50	32.50	34.00

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York June 2, 1916	New York One Month Ago	Cleveland June 2, 1916	Cleveland One Month Ago
Copper, heavy and crucible	24.00	25.00	23.50	25.00
Copper, heavy and wire	23.50	24.50	23.00	24.00
Copper, light and bottoms	19.50	22.00	20.00	24.00
Lead, heavy	6.00	6.00	6.00	7.00
Lead, tea	5.50	5.50	5.00	6.00
Brass, heavy	14.00	14.50	13.50	20.00
Brass, light	11.00	12.50	11.50	13.00
No. 1 yellow rod brass turnings	14.50	15.25	14.00	14.50
Zinc	9.50	12.00	8.00	16.00

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
$\frac{3}{16}$ to $\frac{7}{32}$	35.50	36.00	36.50	37.00	38.00
¼ to $\frac{5}{16}$	35.25	35.75	36.25	36.75	37.75
⅜ to 1⅞	35.00	35.50	36.00	36.50	37.50
1$\frac{15}{16}$ to 2⅞	35.75	36.25	36.75	37.25	38.25
Rounds					
3 to 3$\frac{7}{16}$	36.50	37.00	37.50	38.00	39.00
Squares					
3	36.50	37.00	37.50	38.00	39.00
Rounds					
3½ to 3$\frac{15}{16}$	36.25	36.75	37.25	37.75	38.75
Squares					
3$\frac{1}{16}$ to 3$\frac{15}{16}$	36.25	36.75	37.25	37.75	38.75
Rounds—Squares					
4 to 4$\frac{15}{16}$	37.00	37.50	38.00	38.50	39.50
5 to 6$\frac{15}{16}$	38.00	38.50	39.00	39.50	40.50
7	38.50	39.00	39.50	40.00	41.00
Flats	36.50	37.00	37.50	38.00	39.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Antimony—Chinese and Japanese brands are quoted in cents per pound for spot delivery, duty paid:

	June 2, 1916	One Month Ago
New York	23.00	38.00

Zinc Sheets—The following prices in cents per pound prevail:

Carload lots, f.o.b. mill 22.50

	In Casks June 2, 1916	In Casks One Month Ago	Broken Lots June 2, 1916	Broken Lots One Month Ago
New York	24.00	26.00	24.50	26.50
Cleveland	26.50	26.00	27.00	26.50
Chicago	26.00	27.00	26.50	27.50

Copper Bars from warehouse sell as follows in cents per pound:

	June 2, 1916	One Month Ago
New York	43.00	42.00
Cleveland	37.50	38.50
Chicago	39.50	38.25

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places named:

	New York	Cleveland	Chicago
Best grade	60.00@65.00	56.75	60.00
Commercial	30.00@35.00	19.00	24.00@28.00

SHOP SUPPLIES

Nuts—From warehouses at the places named on fair sized orders the following amount is deducted from list

	New York June 2, 1916	New York One Month Ago	Cleveland June 2, 1916	Cleveland One Month Ago	Chicago June 2, 1916	Chicago One Month Ago
Hot pressed square	$2.50	$2.50	$3.25	$3.25	$3.25	$3.25
Hot pressed hexagon	2.50	2.50	2.75	3.25	3.25	3.25
Cold punched square	2.00	2.00	3.00	3.00	3.00	3.00
Cold punched hexagon	2.50	2.50	3.00	3.25	3.50	3.50

Semi-finished nuts sell at the following discounts from list price

New York .. 50-10% Cleveland .. 65% Chicago 65%

Carriage Bolts—From warehouses at the places named the following discounts from list price are in effect

	New York	Cleveland	Chicago
[illegible] by 6 in	[illegible]	50-10-[illegible]	60-[illegible]
Larger and longer	3[illegible]	40-15%	50%

At this rate the net prices are as follows

Length, In	New York [illegible]	New York $\frac{1}{2}$	New York [illegible]	Cleveland [illegible]	Cleveland $\frac{1}{2}$	Cleveland [illegible]	Chicago [illegible]	Chicago $\frac{1}{2}$	Chicago [illegible]
$1\frac{1}{2}$	$0.[illegible]			$0.43			$0.[illegible]		
2	.[illegible]			.48			.42		
$2\frac{1}{2}$	.63	$2.12	$[illegible]	.[illegible]	$1.[illegible]	$3.[illegible]	.46	$1.63	$4.25
3	.6[illegible]	2.[illegible]	[illegible]	.[illegible]	1.[illegible]	3.[illegible]	.[illegible]	1.77	4.[illegible]
$3\frac{1}{2}$	.73	2.48	6.18	.60	1.64	4.[illegible]	.[illegible]	1.[illegible]	4.75

Machine Bolts—From warehouses at the places named the following discounts hold:

	New York	Cleveland	Chicago
[illegible] by 4 in and smaller	50%	60 and 10%	60 and 10%
Larger and longer up to 1 in by 30 in	40%	50 and 5%	50 and 10%

At this rate the net prices per 100 follow

Length, In	New York [illegible]	New York $\frac{1}{2}$	New York 1	Cleveland [illegible]	Cleveland $\frac{1}{2}$	Cleveland 1	Chicago [illegible]	Chicago [illegible]	Chicago 1
2	$0.[illegible]	$2.[illegible]	$[illegible]	$0.67	$1.46	$6.[illegible]	$0.64	$1.74	$7.20
$2\frac{1}{2}$	.[illegible]	2.[illegible]	[illegible]	.70	1.[illegible]	6.[illegible]	.67	1.[illegible]	7.60
3	.[illegible]	2.[illegible]	1[illegible]	.73	1.66	6.[illegible]	.70	1.[illegible]	8.[illegible]
$3\frac{1}{2}$	1.01	2.[illegible]	11.[illegible]	.77	1.77	7.48	.73	2.08	8.40

Wrought Washers—From warehouses at the places named the following amount is deducted from list price

New York .. $4.00 Cleveland .. $6.00 Chicago .. $6.00

At this rate, the net prices follow:

Diameter, In	New York	Cleveland	Chicago
[illegible]	$10.00	$8.00	$8.00
[illegible]	[illegible]	6.20	6.[illegible]
[illegible]	7.40	5.40	5.40
[illegible]	6.[illegible]	4.[illegible]	4.[illegible]
[illegible]	5.[illegible]	3.80	3.80
$\frac{1}{2}$	5.40	3.40	3.40
[illegible]	5.[illegible]	3.30	3.[illegible]
[illegible]	5.[illegible]	3.20	3.[illegible]
[illegible]	5.[illegible]	3.[illegible]	3.[illegible]
[illegible], 1, $1\frac{1}{8}$	5.[illegible]	3.[illegible]	3.[illegible]
$1\frac{1}{4}$, $1\frac{3}{8}$, $1\frac{1}{2}$	5.20	3.20	3.[illegible]
$1\frac{5}{8}$, $1\frac{3}{4}$, $1\frac{7}{8}$, 2	5.[illegible]	3.[illegible]	3.[illegible]
$2\frac{1}{4}$, $2\frac{1}{2}$	6.[illegible]	4.[illegible]	4.[illegible]

For cast-iron washers the base price per 100 lb is as follows

New York .. $2.50 Cleveland .. $2.00 Chicago .. $2.10

Rivets—The following quotations are allowed for fair sized orders from warehouse

	New York	Cleveland	Chicago
Steel [illegible] and smaller	4[illegible]	45-10%	50%
Tinned	4[illegible]	4[illegible]-10%	50%

Button heads [illegible], [illegible], 1 in diameter by 2 in to 5 in sell as follows per 100 lb

New York .... $5.25 Cleveland .. $3.85 Chicago .. $3.50

Cone heads, same sizes

New York .... $5.35 Cleveland .. $3.95 Chicago .. $3.60

For the following sizes the extras over the above prices in cents per 100 lb are as follows

[illegible] to [illegible] in long, all diameters	$0.25
[illegible] in diameter	0.15
$\frac{1}{2}$ in diameter	0.50
1 in long and shorter	0.50
Longer than 5 in	0.25
Less than kegs	0.50
Countersunk heads	0.30

Nails—Wire nails f.o.b. Pittsburgh sell at $2.50@2.60, galvanized 1 in and longer, $4.[illegible]@4.60, and shorter, $[illegible]@[illegible].10. These prices are to regular customers and delivery is made at the mill's convenience. From warehouse wire and cut nails sell as follows:

	Wire June 2, 1916	Wire One Month Ago	Cut June 2, 1916	Cut One Month Ago
New York	$[illegible].15	$3.15	$3.15	$3.15
Cleveland	[illegible]	3.[illegible]	2.[illegible]	2.[illegible]
Chicago	2.[illegible]	2.75	2.85	2.75

Copper Rivets and Burs sell at the following rate from warehouse:

	Rivets June 2, 1916	Rivets One Month Ago	Burs June 2, 1916	Burs One Month Ago
Cleveland	List price	List price	List price	List price
Chicago	List price	List price	List price	List price
New York	10-2½% from list	20% from list	10-2½% from list	List price

MISCELLANEOUS

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire

[illegible]	10.00
No. 8, [illegible] and No. 10	11.00
[illegible]	12.50
No. 12	13.50
[illegible] No. 14 and [illegible]	15.00
No. 18	16.50
No. 20	17.50

Special Welding Steel

[illegible]	33.00
[illegible]	30.00
[illegible]	28.00

Cast-Iron Welding Rods

$\frac{1}{4}$ by 19 in. long	22.00
[illegible] by 12 in long	26.00
[illegible] by 19 in. long	20.00
$\frac{1}{2}$ by 21 in. long	20.00

Vanadium Wire in Coils or Sticks

[illegible]	15.50
[illegible]	15.00
[illegible]	14.00
[illegible]	12.00
[illegible] and larger	11.00

Tin Plates—The following prices are in effect from warehouses at the places named.

	New York June 2, 1916	New York One Month Ago	Cleveland June 2, 1916	Cleveland One Month Ago	Chicago June 2, 1916	Chicago One Month Ago
Coke tin plate, 14x20						
100 lb	$6.25	$6.50	$5.40	$5.40	$5.60	$5.60
I. C. 107 lb	6.40	6.15	5.55	5.55	5.75	5.75

Terne plate, 20x28:

Base Wgt	Net Wgt	Coating	New York June 2, 1916	New York One Month Ago	Cleveland June 2, 1916	Cleveland One Month Ago	Chicago June 2, 1916	Chicago One Month Ago
100 lb	200	8	$10.50	$10.00	$9.10	$9.10	$8.90	$8.70
I C	214	8	10.80	10.30	9.35	9.35	9.25	9.25
I X	270	8	12.80	12.30	11.60	11.60	11.50	11.40
I C	218	12	12.00	12.00	10.50	10.50	10.75	10.75
I C	221	15	13.00	13.00	10.50	10.50	11.60	11.60
I C	226	20	13.50	13.50	12.50	12.50	12.50	12.50
I C	231	25	14.25	14.25	13.50	13.50	13.75	13.75
I C	236	30	15.50	15.50	14.50	14.50	14.75	14.75
I C	241	35	17.00	17.00	15.75	15.75	15.85	15.85
I C	246	40	19.00	19.00	16.75	16.75	17.10	17.10

Seamless Drawn Tubing—The base price per pound from warehouse is as follows:

	New York	Cleveland	Chicago
Brass	43.50	46.00	46.50
Copper	48.00	48.00	44.50

For immediate stock shipment 3c. is usually added, which makes the following quotations

Diameter, In	Copper New York June 2, 1916	Copper New York One Year Ago	Copper Cleveland	Copper Chicago	Brass New York June 2, 1916	Brass New York One Year Ago	Brass Cleveland	Brass Chicago
[illegible] to $2\frac{1}{2}$	51.50	34.50	48.00	46.50	46.60	31.50	46.00	44.50
3	51.50	34.50	48.00	46.50	46.60	31.50	46.00	44.50
$3\frac{1}{2}$	52.50	35.50	48.00	47.50	47.50	32.50	46.00	45.50
4	53.50	36.50	49.00	48.50	48.50	33.50	47.00	46.50
$4\frac{1}{2}$	55.50	38.50	51.00	50.50	50.50	35.50	49.00	48.50
5	57.50	40.50	53.00	52.50	52.50	37.50	51.00	50.50
6	58.50	41.50	55.00	53.50	53.50	38.50	53.00	51.50
7	60.50	43.50	55.00	55.50	55.50	40.50	53.00	53.50
8	62.50	45.50	59.00	57.50	57.50	42.60	57.00	55.50

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	May 13	May 20	May 27	June 3
Prompt furnace	$2.00@2.25	$2.25@2.40	$2.25@2.40	$2.50@2.75
Prompt foundry	3.50@3.75	3.50@3.75	3.50@3.75	3.25@3.50

Cotton Waste—The following prices are in cents per pound.

	New York	Cleveland	Chicago
White	11.00@13.00	11.00@14.00	11.00@13.50
Colored mixed	8.00@10.00	7.50@11.00	8.00@10.50

Sal Soda sells as follows per 100 lb.:

New York .... $2.05 Cleveland $2.25
Philadelphia .... 1.80 Chicago 1.90

Roll Sulphur in 360-lb bbl sells as follows per 100 lb.:

New York .... $2.75 Cleveland .... $2.75 Chicago $2.75

Foundry Supplies—In New York, the following quotations prevail:

Foundry blacking	1½c. per lb.
Foundry flour (best grade)	$1.75 per bbl.
Foundry rosin	12c. per lb.
Core oil	40c. per gal.
Core wash	1½c. per lb.

Sponge Cloths (Wiping Towels) in New York have advanced 5c per dozen and sell as follows: 16x18 in., 35c.; 18x20 in., 40c.; 18x22 in., 43c. In Chicago prices are $24 to $28 per 1,000. In Cleveland, per 1,000, 13¼x13¼ sell at $29.50 and 13¼x20½ at $35.

Fire Clay in Chicago sells at 50c. per bag of 100 lb.

Linseed Oil—These prices are per gallon:

	New York	Cleveland	Chicago
Raw in barrels	$0.72	$0.73	$0.75
5-gal cans	.82	.83	.85

Boiled, it is 1c. per gal. higher.

White and Red Lead, in cents per pound, sell as follows:

	Red Dry	Red In Oil	White Dry and In Oil
100-lb keg	10.50	11.00	10.50
25- and 50-lb. kegs	10.75	11.25	10.75
12½-lb keg	11.00	11.50	11.00
1- to 5-lb cans	12.50	12.50	12.50

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

Plans have been prepared by L. E. Destremps, Arch., 251 Union St., New Bedford, Mass., for the construction of a 1-story, 81x106-ft. garage.

Plans have been prepared for the construction of a 1-story addition to the plant of the Duckworth Chain and Manufacturing Co., 41 Mill St., Springfield, Mass.

Bids have been received for the construction of a 1-story, 50x110-ft. garage for Abraham Berkowitz, 5 Chapin St., Worcester, Mass. Estimated cost, $14,000. Noted Apr. 13.

Plans are being prepared by Ellis & Hanck, Arch., Room 515, 171 Westminster St., Providence, R. I., for the construction of a garage for the Mexican Petroleum Corporation, 164 Allen Ave., Providence.

A 2-story, 64x110-ft. addition is being built to the plant of the Maxim Silencer Co., Hartford, Conn., manufacturer of guns.

The International Silver Co. is constructing a factory at Meriden, Conn.

We have been informed that the New London Marine Iron Works Co. is reconstructing its foundry at New London, Conn. Noted May 25.

The Meekers Union Foundry Co. plans to construct an addition to its foundry at Norwalk, Conn.

The Connecticut Alloyed Metals Co., Bridgeport, Conn., is building a 1-story factory on Stratford Ave., Stratford, Conn.

Plans are being prepared for the construction of a factory on Canal St., Waterbury, Conn., for the American Brass Co.

The Chase Metal Works is constructing a 3-story, 75x159-ft. factory on Crane St., Waterbury, Conn.

Plans are being prepared for the construction of a factory at Browns Farms, Waterbury, Conn., for the Metal Specialty Manufacturing Co.

MIDDLE ATLANTIC STATES

An addition is being built to the plant of the Ferguson Steel and Iron Co., Bailey Ave. and New York Central R.R., Buffalo, N. Y.

An addition is being constructed to the plant of the North Buffalo Hardware Foundry Co., Erie R.R. and Bridgemen St., Buffalo, N. Y.

The business of the Lefever Arms Co., Syracuse, N. Y., has been taken over by the Lefever Gun Co., Ithaca, N. Y. The new owners are now building a new factory and plan to construct several more additions at Ithaca.

A. I. Namm & Son, 494 Fulton St., New York, N. Y. (Borough of Brooklyn), has awarded the contract for the construction of a 1-story, 94x100-ft. garage. Estimated cost, $13,000.

The contract has been awarded for improving and enlarging the garage of Morris & Smith, New York, N. Y. (Borough of Brooklyn). Estimated cost, 19,000.

The contract has been awarded for the construction of a 2-story garage for William B. Storrer, 430 Atlantic Ave., New York, N. Y. (Borough of Brooklyn). Estimated cost, $20,000. Noted Jan. 27.

Peter Reiley, Bergen St. near Vanderbilt Ave., New York, N. Y. (Borough of Brooklyn), is having plans prepared by Charles Olsen, 1762 69th St., for a 2-story brick machine shop. Estimated costl, $6,000.

Bids are being received by the Commissioner of the Department of Street Cleaning, Municipal Bldg., New York, N. Y., for 1 Putnam 18x36-in. motor-driven engine lathe complete, 1 Robertson motor-driven hack saw, 1 No. 2 Garvin universal motor-driven milling machine, 1 Monarch 14-in. by 6-ft. motor-driven engine lathe complete, 1 Barnes motor-driven 22-in. sliding-head drill press, 1 Barnes motor-driven water emery grinding machine, 1 Barnes 30x36-in. 60-ton screw press and 1 motor-driven air compressor running 225 r.p.m., 7½ to 10 cu.ft. per min.

The Packard Motor Car Co., Broadway and 61st St., New York, N. Y. (Borough of Manhattan), is having plans prepared by Albert Kahn & Ernest Wilby, Assoc. Arch., 58 Lafayette Blvd., Detroit, Mich., for the construction of an 8-story brick and reinforced-concrete addition to its service station at Long Island City (Borough of Queens).

The Joseph Dixon Crucible Co., Monmouth St., Jersey City, N. J., has awarded the contract for the construction of a 4-story addition to its plant at Wayne and Monmouth St. Estimated cost, $18,000.

Plans are being prepared by W. H. Conover, Arch., 114 Liberty St., New York, N. Y., for the construction of a 3-story, 40x104-ft. brick and reinforced-concrete garage at Albany St. and Spring Allep, New Brunswick, N. J., for E. Mount, Englishtown, N. J. Estimated cost, 15,000.

Walter Scott & Co., Plainfield, N. J., manufacturer of printing presses, contemplates the construction of an addition to its plant on South Ave. Walter C. Scott, 418 East Front St., Plainfield, is Pres.

J. E. Dunn, care of Sargent Bros., Somerville, N. J., plans to construct a 1-story, 60x400-ft. manufacturing plant and 2 smaller buildings at Plainfield, N. J., to be occupied by the American Motor Co., 140 Broadway, New York, N. Y. Estimated cost, $40,000.

The Keystone Steel Ordnance, Philadelphia, Penn., plans to establish a steel and munition plant at Swedesboro, N. J. H. S. Lembert, 709 North 63d St., Philadelphia, Penn., interested.

Fire recently damaged the foundry of the McVay-Walker Co., Braddock, Penn. Loss, $50,000.

The contract has been awarded for the construction of a 3-story addition to the plant of the Pringle Electric Manufacturing Co., 1906 North 6th St., Philadelphia, Penn. Noted May 18.

The Adder Machine Co., Kingston, Penn., has awarded the contract for the construction of a 2-story addition to its machine shop. Estimated cost, $35,000. Noted May 11.

Plans are being prepared and bids will soon be received by the Pittsburgh Steel Co., Pittsburgh, Penn., for a 1-story car shop. W. A. Scott, 512 Ferguson Bldg., Pittsburgh, interested.

A 1-story addition will be built to the plant of the New Era Elevator and Machine Co., 111-113 Grant St., Baltimore, Md.

Bids will be received by Bureau of Supplies and Accounts, Navy Dept., Washington, D. C., for furnishing and delivering at Guantanamo Bay under Schedule 9709 miscellaneous quantity of saws, scrools, blades, turning chisels, gouges, parting tools and 1 combination wet and dry grinder.

SOUTHERN STATES

The Tilley-Reimann Iron Works will construct a new plant in Sistersville, W. Va.

The Louisville & Nashville R.R., Louisville, Ky., contemplates the enlargement of its shops at Mobile, Ala. Estimated cost, 400,000. W. H. Courtenay, Louisville, Ch. Engr.

MIDDLE WEST

The A. J. Miller Vehicle Body Co. is constructing a 2-story factory at Bellefontaine, Ohio. Noted May 4.

The American Clay Machinery Co. plans to construct an addition to its factory at Bucyrus, Ohio.

Plans are being prepared for the construction of an addition to the plant of the Berger Manufacturing Co., manufacturer of steel roofing, ceilings and metal filing devices, at Canton, Ohio. Estimated cost, $300,000. Noted Apr. 20.

Hinderer Bros., manufacturer of steam and hot water heaters, plans to construct a factory on 22d St., N. W., Canton, Ohio.

The Timken Roller Bearing Co. has awarded the contract for the construction of a factory at Canton, Ohio.

The Cincinnati Iron and Steel Co. plans to construct additions to its plant on Freeman Ave., Cincinnati, Ohio.

Plans are being prepared for the construction of additions to the plant of the Cisco Machine Tool Co. at Cincinnati, Ohio.

The F. H. Lawson Co. plans to construct a plant at Cincinnati, Ohio, for the manufacture of automobile accessories, fenders and mufflers.

The Atlas Car and Manufacturing Co. plans to construct a plant at Cleveland, Ohio.

The Dayton Engineering Laboratories Co. plans to construct an addition to its plant on East 1st St., Dayton, Ohio. a plant at Cleveland, Ohio.

The Davies-Mitchell Engineering Co. 220 Union Bldg., Cleveland, Ohio, plans to construct a plant at Cleveland for the manufacture of automobile motors.

The contract has been awarded for the construction of an adidtion to the plant of Joseph Dyson & Son Co., manufacturer of machine forgings, 5125 St. Clair Ave., Cleveland, Ohio.

The Packard Cleveland Motor Co., 5206 Prospect Ave., Cleveland, Ohio, has awarded the contract for the construction of an addition to its plant at Cleveland. Estimated cost, $100,000. Noted Apr. 6.

The contract has been awarded for the construction of an addition to the plant of the White Co., manufacturer of automobiles, at St. Clair and 79th St., Cleveland, Ohio. Estimated cost, 45,000.

The Columbus Malleable Iron Co. plans to construct a 1-story addition to its plant at Columbus, Ohio. Estimated cost, $60,000.

The Shaw Wire Fence Co. plans to construct a factory on Reynolds St., Columbus, Ohio. A. Kelly is Mgr.

The Malm Machine Co. is equipping a plant at Dayton, Ohio. A. Malm is Pres.

The Ohio Steel Foundry has taken over the plant of the Bucyrus Steel Castings Co. at Lima, Ohio, and plans to enlarge same. Noted Feb. 3.

The National Tube Co. plans to construct an addition to its plant at Lorain, Ohio.

The Ohio Seamless Tube Co. plans to enlarge its plant at Shelby, Ohio.

The Haughton Elevator and Machine Co. plans to construct a factory on Spencer St., Toledo, Ohio.

W. W. Wainwright & Son, manufacturer of auto parts, plans to construct additions to its plant at Connersville, Ind.

The Newton Kelsay Hame and Harness Co. plans to construct a foundry as an addition to its plant at Evansville, Ind.

The Haynes Stellite Co. contemplates constructing a plant at Kokomo, Ind.

Plans are being prepared for the construction of a factory at Lafayette, Ind., for the Ross Machine Co.

The Inter-State Motor Co. plans to construct an addition to its plant at Muncie, Ind.

H. S. Grey and J. N. Klock plan to construct a steel casting [illegible] near Graham Ave., Benton Harbor, Mich.

The American Express Co. has been granted a permit for the construction of a 1-story garage on 24th St., Detroit, Mich. Estimated cost, $4[illegible].

The Maxwell Motor Co. plans to improve its plant at Detroit, Mich. Estimated cost, $2[illegible].

The Michigan Copper and Brass Co. has been granted a permit for the construction of a 1-story factory on Jefferson St., Detroit, Mich. Estimated cost, $10[illegible].

The Schoentorn Cowles Manufacturing Co., manufacturer of [illegible] specialties, is constructing a 2-story factory at Detroit, Mich.

The Turner-Moore Manufacturing Co., manufacturer of machine [illegible], has awarded the contract for the construction of a 2-story factory at McKinstry Ave. and the Michigan Central R.R., Detroit, Mich.

The S[illegible] Motor Truck Co. has been granted a permit for the construction of a factory near Jefferson and Connor Ave., Detroit, Mich. Estimated cost, 10,990. Noted May 11.

The Joseph N. Smith & Co., manufacturer of automobile [illegible], plans to construct a 2-story factory at Dubois St. and East Grand Blvd., Detroit, Mich. E. L. Ackerman, Pres.

The Zenith Carburetor Co. has awarded the contract for the construction of a factory on [illegible] Ave., Detroit, Mich.

Work will soon be started on the construction of a factory in M[illegible], Mich., for the L. [illegible] Manufacturing Co., manufacturer of cam shafts and other motor specialties. Noted May 25.

Plans are being prepared for the construction of a factory at S[illegible], Mich., for the [illegible] & [illegible] Action and Supply Co. Estimated cost, $[illegible]. L. Kurtz is Mgr.

The Springfield Metal Body Co., Springfield, Mich. Noted Dec. 9.

F. A. [illegible], Quincy, Ill., plans to construct a factory at [illegible], Ill., for the manufacture of automobile accessories.

The contract has been awarded for the construction of a 2-story factory at 2[illegible] Marshall Blvd., Chicago, Ill., for the A[illegible] Co. Estimated cost, $10,000. Noted Apr. 2[illegible].

V. A. Hackel plans to construct a 1-story garage at 7227 South Shore Ave., Chicago, Ill. Estimated cost, $15,000.

H. P. Jensen has been granted a permit for the construction of a 1-story garage at 2[illegible]-23 Milwaukee Ave., Chicago, Ill. Estimated cost, $25,000.

The Jones Foundry and Machine Co., North Ave. and Noble St., Chicago, Ill., has awarded the contract for the construction of a foundry and machine shop at 12[illegible] South Kostner Ave., Chicago. Estimated cost, $[illegible]. Noted June 1.

C. Nielsen plans to construct a 1-story garage at 4329 Kedzie Ave., Chicago, Ill. Estimated cost, $10,000.

Work will soon be started on the construction of an automobile service station at Chicago, Ill., for L. E. Russell, 25 North Dearborn St., Chicago. Estimated cost, $10,000.

The Durand Steel Locker Co. plans to construct an addition to its plant at Chicago Heights, Ill. Estimated cost, $[illegible].

The Geneva Foundry is constructing an addition to its foundry at Geneva, Ill.

Plans are being prepared for the construction of a 2-story foundry at Rockford, Ill., for the Union Foundry and Machine Co.

The contract has been awarded for the construction of additions to the plant of the Fairbanks Morse Manufacturing Co., manufacturer of windmills and engines, at Beloit, Wis. Noted May 11 and 25.

The Automatic File and Index Co. will construct an addition to its factory at Green Bay, Wis. F. L. Straubel is Pres. and Mgr.

The Kissel Motor Car Co. plans to construct a 3-story, 72x316-ft. addition to its plant at Hartford, Wis.

The American Brass Co. plans to extend and enlarge its plant at Kenosha, Wis. Estimated cost, $2,000,000. J. Robert Coe is Ch. Engr.

The Arrow Fuse and Manufacturing Co. plans to construct a factory at Milwaukee, Wis. H. E. Uihlein is Pres.

The contract has been awarded for the construction of a factory at 6[illegible]7 Muskego Ave., Milwaukee, Wis., for the Badger Wire and Iron Works.

Frank Mulkern plans to construct an addition to its garage at Downer Ave. and Park Pl., Milwaukee, Wis. Estimated cost, $25,000.

The contract has been awarded for the construction of a 1- and 2-story, 50x100-ft. garage and repair shop at Osceola, Wis., for E. A. Zorn. Noted June 1.

The contract has been awarded for the construction of a garage at Merritt St. and Jefferson Ave., Oshkosh, Wis., for the Thom Auto Co. Estimated cost, $45,000. Noted Mar. 23.

The Ozaukee Heater Co. has awarded the contract for the construction of a plant at Saukville, Wis., for the manufacture of oil burners and stoves. Noted May 18.

WEST OF THE MISSISSIPPI

The Howard Auto Co., St. Joseph, Mo., recently incorporated with 17,500 capital stock, by F. W. Howard and Davis D. and A. A. Rullman, plans to establish a machine shop and garage.

The Oil City Brass Works, Beaumont, Tex., will construct a brass foundry and machine shop.

The Madison Real Estate and Investment Co., 201 Colorado National Bank Bldg., Denver, Colo., has awarded the contract for the construction of a 2-story garage.

P. A. Bartz, Windsor, Colo., plans to construct an addition to his garage and machine shop.

WESTERN STATES

Joshua Green plans to construct a garage and machine shop at 505 East Pine St., Seattle, Wash. Estimated cost, $20,000.

The Columbia County Auto Co. plans to construct a garage at St. Helens, Ore. Estimated cost, $20,000.

The contract has been awarded for the construction of a plant on Santa Fé Ave., Los Angeles, Calif., for the American Can Co. Estimated cost, $100,000. Noted Sept. 30 and Feb. 24.

A machine shop is being constructed at 719 East 1st St., Los Angeles, Calif., by S. D. Sturgis.

The John W. Leavitt Co. plans to construct a 2-story reinforced-concrete garage and auto sales building at K and 13th St., Sacramento, Calif. Estimated cost, $35,000.

Bids will be received by Bureau of Supplies and Accounts, Navy Dept., Washington, D. C., for furnishing and delivering under Schedule 9,706 at San Francisco, Calif., 1 used steam road roller.

Bids will be received by Bureau of Supplies and Accounts, Navy Dept., Washington, D. C., for furnishing and delivering at San Francisco, Calif., under Schedule 9,709, 1 16-in. universal saw.

The Schnell Estate plans to construct a 1-story reinforced-concrete garage at Sausalito, Calif. Estimated cost, $18,000.

CANADA

The Canadian Tube and Iron Co., Ltd., 107 Hamilton St., Montreal, Que., plans to construct an addition to its plant at Montreal.

The Rudkins Brass and Iron Co., Peterborough, Ont., plans to install new machinery in its foundry.

The Port Hope Machine and File Works has taken over the Helm's Foundry at Port Hope, Ont., and will install machinery for recutting files.

The Renfrew Electric Manufacturing Co., Ltd., plans to construct an addition to its plant at Renfrew, Ont. Estimated cost, $5,000.

The Russell Motor Co., King and Duncan St., Toronto, Ont., plans to construct a factory at Toronto.

The Canada Forge Co. plans to construct an addition to its plant at Welland, Ont. Estimated cost, $50,000.

The Russell Motor Co., West Toronto, Ont., recently purchased 28 acres of Trethewey Farm, near Weston, Ont., on which it plans to construct a plant for the manufacture of cycles and skates. Estimated cost, $100,00. T. A. Russell is Pres.

GENERAL MANUFACTURING

NEW ENGLAND STATES

We have been informed that the Milford Manufacturing Co., Milford, N. H., is constructing an addition to its weave shed at Milford and is in the market for looms and winders. Noted May 18.

The contract has been awarded for the construction of an addition to the factory of the Valley Woolen Mills at Leicester, Mass.

The contract has been awarded for the construction of an addition to the plant of the Hood Rubber Co. at Watertown, Mass. Estimated cost, $20,000. Noted Feb. 10.

The United Lace Works plans to construct an addition to its plant on Wellington Ave., Cranston, R. I. Estimated cost, $50,000.

The Crown Manufacturing Co., manufacturer of cotton yarns, plans to construct an addition to its plant at Pawtucket, R. I.

Bids have been received for the construction of a 4-story, 70x150-ft. mill at Norwich, Conn., for the Winchester Woolen Co.

The contract has been awarded for the construction of an addition to the factory of the American Thread Co. at Willimantic, Conn.

MIDDLE ATLANTIC STATES

The contract has been awarded for the construction of a 3-story piano factory for Otto Higel, Inc., 1021 Main St., Buffalo, N. Y. Estimated cost, $80,000.

Plans prepared for altering factory at 147 Barbey St., New York, N. Y. (Borough of Brooklyn), for C. Smith, manufacturer of boots and shoes. Estimated cost, $10,000.

Plans have been prepared by William Higginson, Arch., 13 Park Row, New York, N. Y. (Borough of Manhattan), for the construction of a 1- and 6-story reinforced-concrete factory building at North 11th and Berry St. (Borough of Brooklyn), for McKesson & Robbins, 91 Fulton St., Manhattan, manufacturer of drugs. Estimated cost, 90,000.

The McDermott Dairy Co., 91 Manhattan St., New York, N. Y. (Borough of Manhattan), has awarded the contract for the construction of a 2- and 4-story brick garage at 525-31 West 38th St.

The Degnon Realty and Terminal Improvement Co., Nott Ave., New York, N. Y. (Borough of Queens), (Long Island City), and 30 East 42d St., Manhattan, has awarded the contract for the construction of a 1-story garage at Long Island City to be occupied by the New York Couch Bed Co., 418 West 25th St., Manhattan.

Plans have been prepared by William Higginson, Arch., 21 Park Row, New York, N. Y. (Borough of Manhattan), for the construction of a 4-story, 100x230-ft. factory building at Anabel Ave. and Creek St., Long Island City, N. Y. (Borough of Queens), for the Degnon Realty and Improvement Co., 30 East 42d St., Manhattan, to be leased by the Kindel Bed Co., Chicago, Ill. Estimated cost, $125,000.

Bids are being received by Charles Kiehm, Arch. and Engr., Gardner Bldg., Utica, N. Y., for 4-story, 50x137-ft. factory for Norwich Pharmacal Co., Norwich, N. Y. G. L. Marsters and E. S. Easton Norwich, in charge.

The chemical plant of Fries' Bros. Chemical Co., Bloomfield, N. J., recently destroyed by fire, will be rebuilt. Estimated cost, $25,000. Noted May 25.

The Eagle Printing Ink Co., 265 Gates Ave., Jersey City, N. J., has awarded the contract for the construction of a 4-story factory. Estimated cost, $30,000.

We have been informed that the Botany Worsted Mills, Passaic, N. J., does not plan to construct a plant at Wallington, N. J., as stated in our issue of May 25.

The West New York Silk Mills, West New York, N. J., has awarded the contract for the construction of a 1-story brick addition to its silk mill in 23d St. Estimated cost, $15,000.

The Chandler Oilcloth and Buckrum Co., 241 37th St., New York, N. Y. (Borough of Brooklyn), has awarded the contract for improving several of the buildings of its plant at Yardville, N. J.

The Crinoka Mills Co., Philadelphia, Penn., has awarded the contract for the improvement of its plant.

The contract has been awarded for the construction of a 1-story addition to the machine shop of the Quaker City Rubber Co., 629 Market St., Philadelphia, Penn.

Plans are being prepared by C. J. Young, Arch., 520 Washington St., Reading, Penn., for a 2-story shoe factory for the Richland Enterprise Manufacturing Co., Richland, Penn. Estimated cost, 20,000.

Bids will soon be received by E. Emmers & Co., Royersford, Penn., for the construction of a 3-story addition to its knitting mill. J. V. Poley, C. E., 162 2d Ave., Royersford, Arch.

According to press reports the Curtis Bay Chemical Co., Curtis Bay, Md., plans to construct several additions to its plant. Estimated cost, $1,500,000.

SOUTHERN STATES

The Lumberton Cotton Mills, Lumberton, N. C., will construct an addition to its plant and install new machinery.

Plans are being considered by the North State Veneer Co., Statesville, N. C., for the construction of a plant at Camden, S. C. C. Stimpson and P. D. Kennedy, Prop.

The plant of the Gulf Compress Co., New Decatur, Ala., recently destroyed by fire, will be rebuilt.

MIDDLE WEST

The Double Tire and Rubber Co., Akron, Ohio, plans to construct a factory at Barberton, Ohio.

Plans are being prepared for the construction of a 6-story factory at Elyria, Ohio, for the Troxel Manufacturing Co., manufacturer of bicycle saddles and tool bags.

Work has been started on the construction of a factory at Brown Ave. and Dorr St., Toledo, Ohio, for the St. Clair Manufacturing Co., manufacturer of potash, lye and other chemicals.

The Kelly Springfield Tire Co., Akron, Ohio, has awarded the contract for the construction of additions to its plant at Wooster, Ohio. Noted May 25.

The W. W. Mooney Co., tanner, has been granted a permit for the construction of a 3-story addition to its plant on 5th St., Columbus, Ind. Estimated cost, $20,000. Noted Sept. 30.

The contract has been awarded for the construction of a factory at Rural and Roosevelt St., Indianapolis, Ind., for the Linde Air Products Co., New York, N. Y. Estimated cost, $30,000.

The Cadillac Chemical Co. will rebuild its plant at Cadillac, Mich., which was recently destroyed by fire with a loss of $50,000. Noted May 25.

The Rundell Bros. Produce Co. plans to rebuild its cold-storage and packing plant at Owosso, Mich.

Bids have been received for the construction of an addition to the tannery at Saginaw, Mich., for F. W. and F. Carlisle Co. Estimated cost, $15,000.

The Independent Can Co., Kinzie and Wood St., Chicago, Ill., has awarded the contract for the construction of a 2-story, 25x115-ft. factory at 403 North Wood St., Chicago. Estimated cost, $20,000. Noted May 25.

Straus & Schram, Inc., manufacturer of furniture, is constructing an addition to its plant on 33rd St., Chicago, Ill. Estimated cost, $100,000.

A 40x400-ft. addition is being built to the plant of the Mineral Point Zinc Co., Depue, Ill., to be used for the manufacture of zinc oxide. Estimated cost, $200,000.

The International Shoe Co. plans to construct a tannery at Hartford, Ill. (East Alton post office.)

The Green Bay Packing Co., Green Bay, Wis., recently incorporated with $200,000 capital stock, plans to construct a large packing and refrigerating plant. F. C. Greiling is interested.

The Rhinelander Paper Co., Rhinelander, Wis., contemplates expenditure of $100,000 for improving and extending its plant.

Plans are being prepared for the construction of additions to the factory of the West Bend Woolen Mills at West Bend, Wis. Estimated cost, $40,000. John Geib, Mgr. Noted Mar. 23.

WEST OF THE MISSISSIPPI

The Grimes Canning and Preserving Co., Des Moines, Iowa, is enlarging its plant.

The Wolff Packing Co., Topeka, Kan., is enlarging its plant. Estimated cost, $50,000.

Duncan, Young & Co., Inc., 50 Church St., New York, N. Y., are interested in a project to construct a shipbuilding plant at Beaumont, Tex.

The Carthage Cotton Oil Co., Carthage, Tex., will construct a cotton-seed oil mill. Estimated cost, $20,000.

The Rogers-Wade Furniture Co., Paris, Tex., is building an addition to its plant.

The O'Brien Gin Co., Ardmore, Okla., recently incorporated by J. D. O'Brien, J. M. and C. C. Jones with $10,000 capital stock, plans to equip a ginning plant.

The Farmers Custom Gin Co., Vanoss, Okla., recently incorporated by C. L. Brooks, G. L. Standridge and J. E. Kinsey, with $16,000 capital stock, plans to establish a ginning plant.

The Cowgill Co., Craig, Colo., manufacturer of harnesses, will soon start work on the construction of a new factory. Estimated cost, $10,000.

WESTERN STATES

The Pacific Fruit Express Co. plans to rebuild its plant at Pocatello, Idaho, which was recently destroyed by fire with a loss of $10,000.

The Glacier Fish Co. plans to construct a 100x200-ft. cold-storage plant at Tacoma, Wash. Estimated cost, $50,00.

Fire, May 17 destroyed the plant of the Milton Ice and Cold Storage Co. at Milton, Ore. Loss, $20,000.

The Hawley Pulp and Paper Co. plans to construct an addition to its plant at Oregon City, Ore.

Fletcher Linn and W. E. Flanders, Portland, Ore., has taken over the plant of the Union Furniture Manufacturing Co., at Portland, and will remodel and install new machinery.

The Southern Reduction Co. plans to construct a packing plant at Beardsley and Crosby St., San Diego, Calif. D. C. Crouch is Mgr.

The San Joaquin Valley Sugar Co. plans to improve and enlarge its plant at Visalia, Calif.

CANADA

Plans are being prepared for the construction of an addition to the plant of the American Pad and Textile Co., Queen St., Chatham, Ont. Estimated cost, $35,000.

The Peerless Weaving and Belting Co., Ltd., has leased the factory of the Ludlam Ainslie Co., Arthur St., Hamilton, Ont., and will install new machinery.

The Hall Glove Co., 215 Suydam Ave., Jersey City, N. J., contemplates constructing a factory at Simcoe, Ont. Estimated cost, $30,000.

Classified Advertising

The Classified Advertising section appears on pages 160, 161, 162, *of this issue and will in future appear in the same relative position in the paper.*

American Machinist

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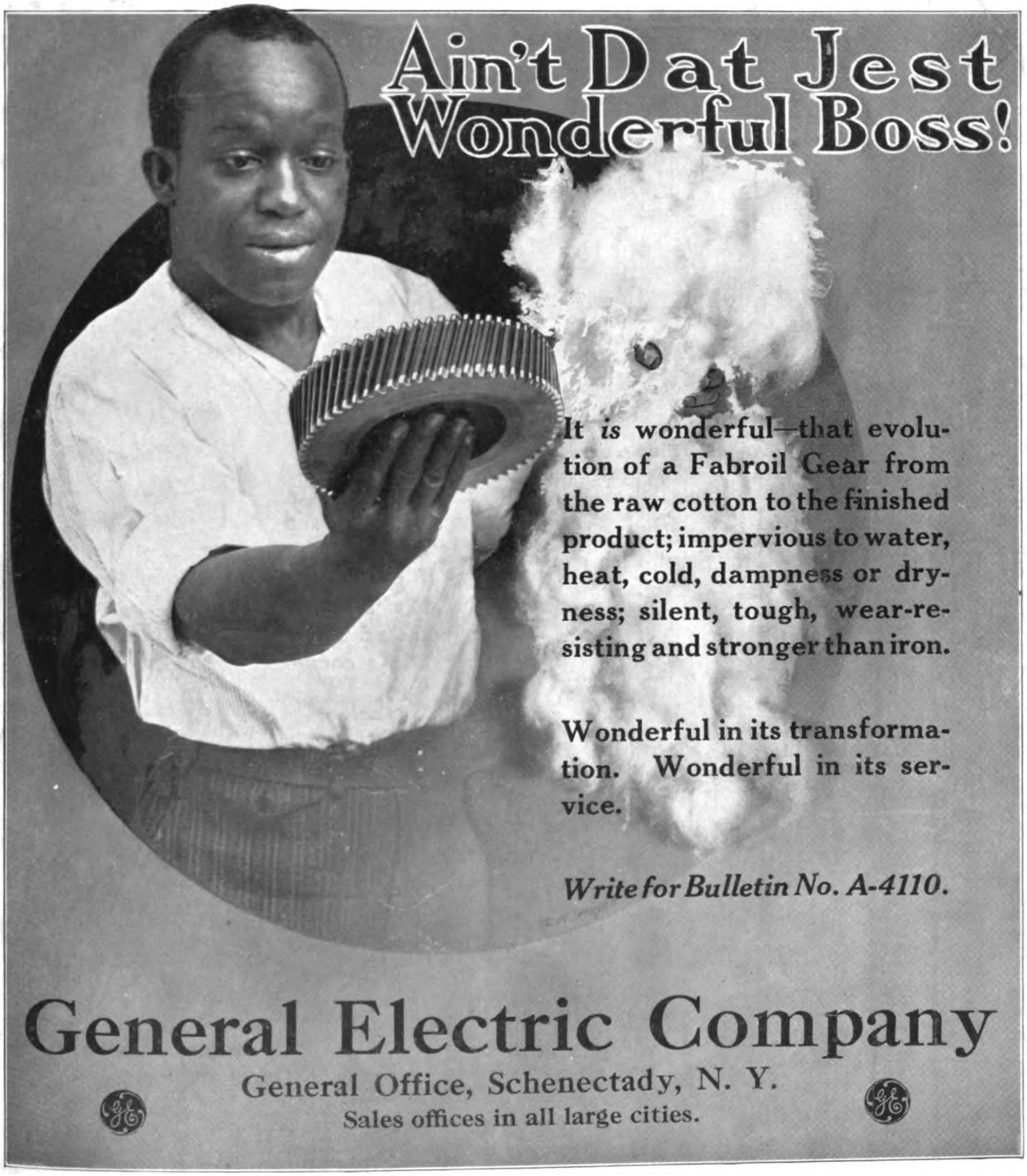

FOR SHORT DELIVERY

Lathes For Boring Heavy Shells

36-inch Heavy Lathe with boring tailstock

All Steel Gears

Lathes are equipped throughout with steel gears and are driven by 20-hp. motors. Rear end of spindle is provided with a special thrust bearing of heavy construction to take the end thrust due to boring large holes.

Boring Tailstock

The boring ram is forged steel 6 inches square, and has a very long bearing in the tailstock. The ram feed is driven from the feed shaft, at the rear of the bed, through worm and worm wheel, giving a smooth motion for boring. By means of two levers four feeds can be obtained without changing any gears. These levers are attached to the tailstock and hence are always in a convenient position.

Supports for Work and Boring Ram

A steadyrest is provided to support the shell or other work. There is also furnished a special rest to support the end of the boring ram. This rest moves along the bed with the ram as it feeds.

Specifications, Delivery, Prices, etc., Promptly furnished on Request.

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25 Victoria St., London, S. W.

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American Machinist

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CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormay processes, protected by United States patents issued June 22, 1915, and Apr. 18, 1916.

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Talks · With · Our · Readers

By the Publisher

"When interested in a particular line of equipment, I want the best information I can get; and upon the theory that the man who makes the machine knows more about it than anybody else, I apply to him."

Here is a striking reversal of the old order of things of the days of not so long ago, when the spirit of the commercial world was summed up in the injunction to "let the buyer beware."

"Let the buyer beware" implied distinctly that if the buyer did not beware he would, very likely, be neatly "trimmed."

In short, the business men of this "caveat emptor" period had as their sole object the selling of their merchandise. It mattered not how they sold—whether by hook or crook — but *sell* they must.

And now comes our American Machinist reader with a clean right-about-face. When he wants the best information, he goes to the seller.

"Let the buyer beware," was the order of things in the commercial world but a few short years ago. The reverse is fast becoming the order of today. For the seller is the man who must largely supply the facts upon which the buyer has to base his judgment.

And advertising has played no small part in the establishment of this new confidence.

There has been a change in public opinion on the attitude and general responsibility of the maker and seller of equipment.

There has also been a change in the attitude and general responsibility of the maker and seller, himself. This is the prime cause for the change in public opinion.

Note that the metamorphosis of the I'll-get-the-best-of-you-if-I-can seller into the responsible informant with his unexcelled specialized knowledge, is coincident with the development of modern advertising.

Modern advertising, in fact, is both an expression of and one of the causes behind, the responsible character of the present-day maker and seller of equipment and supplies which makes him the man to whom to turn when you want the best information on his particular specialty.

It is the expression of it because no maker and seller of equipment can successfully advertise in a field like the machine industry, without that responsibility and character.

It is a cause for the reason that when a man stands out and begins to tell what he has, he shortly discovers his weak spots and shortcomings — and then at once mends his fences.

There is nothing that makes a man toe the scratch so sharply as to know that somebody is watching him.

The New Technology

EDITORIAL CORRESPONDENCE

SYNOPSIS—The Massachusetts Institute of Technology celebrates its Golden Jubilee this week. Very fittingly this is also the occasion of the dedication of its magnificent new buildings, where the Institute and Harvard University will hereafter coöperate in the education of engineers. This article gives a general description of the grounds and buildings and of the ceremonies accompanying their occupation.

It is quite unlikely that there is devoted to educational purposes any other group of buildings that combine greater advantages of situation and construction than are found in the new grounds and buildings of the Massachusetts Institute of Technology. In the midst of Greater Boston at an imposing place on the Charles River Esplanade the Institute has secured the land and has erected the structure shown on the following page. Incidentally it is of interest to mention that the design, engineering and construction of these buildings have been in the hands of Technology graduates. The method of planning for the new buildings followed an unusual course. Customarily when one wishes to construct a building the architect is called in and all matters are put into his control. Here the beginning was at the other end, and plans already fairly well outlined were put into the architect's hands to be developed in final detail.

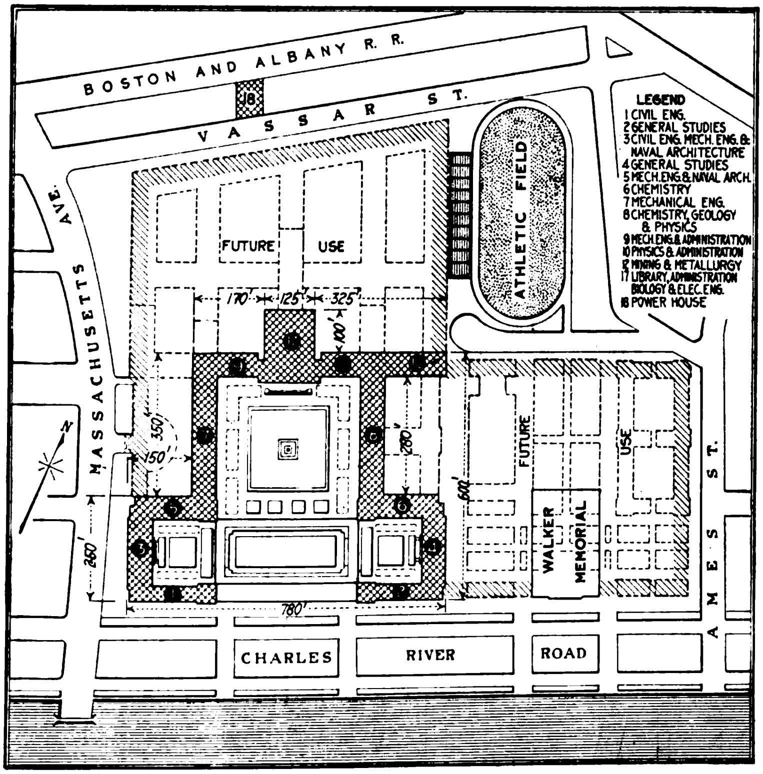


FIG. 1. PLAN OF THE NEW MASSACHUSETTS INSTITUTE OF TECHNOLOGY

When the plot in Cambridge was purchased, President MacLaurin sent first to the heads of all the departments of Technology, asking each one to make plans for his department as if there were no other department in the Institute. The same procedure was requested of the Walker Memorial and Athletic Council, so that well-developed outlines were furnished by men who were themselves experts in planning, being the heads of civil and other engineering departments. When the ideas of these principal men were developed to a degree, Dr. McLaurin called them together; then followed a coördination of the different plannings. The result is now manifest in substantial form, and the Massachusetts Institute of Technology is to move into a new home that from subfoundation to roof is especially suitable for the purpose for which it is intended.

One of the items that was not overlooked was the question of distance to travel. This has impressed itself upon the minds of the students of the present Institute, where, with the several buildings on different streets and quite widely separated, the five-minute interval between lectures proves to be scant time in which to get from one detached laboratory to an equally detached drafting room. The consideration of allied courses was therefore made by the registrar, and those courses which were likely to be taken by the same student in his standard work, or the most popular of the options, were placed in departments close together. In a group of buildings of which the axis is nearly one-half a mile in length, the importance of this arrangement will be appreciated. The educational portion of the new Technology buildings may be described as a connected group of buildings three and four stories in height, attached to, and on each side of, the library. The library is the hub and predominating feature of the construction, and its great dome looks down on the court from a height of nearly 200 ft. This central court, which is open to the river front, expands when near the Esplanade into two large minor courts. These and other courts interior to the buildings insure the necessary lighting of the rooms. These courts are flanked by the department buildings, and the latter are linked together so as to afford circulation under one roof throughout all portions of the structure. It will be unnecessary for the student to be out of doors in passing from one exercise to another, and he may thus avoid the necessity of a raincoat or an overcoat. The buildings receive light from both sides, and all of the drafting rooms are on the top floor, where there are skylights hidden by the parapets.

The fundamental principle of interior construction comprises a system of bays of uniform size, which may be compared to the sectional bookcase in the home library. The floors are hung on the walls entirely free of the partitions. Rooms can be made in any multiple of the unit by merely removing partitions; and since these do not support floors, the desired changes will be easy and inexpensive. Each department may thus have its rooms suited to its future needs instead of modifying its future needs to suit the limitations of its rooms.

In addition to providing for this expansion of room space the plans also permit growth of the various building sections or wings. There is a chance of enlarging the departments in future buildings, and the present constructions afford the opportunity of erecting extensions or wings so that any department may expand into a building suited to its needs. These will be added usually either in one or two directions, but with some departments three directions are possible.

This planning is the result of careful consideration of the needs of the Institute by the various technical men at the head of the departments, in consultation with the architect. Unknown as they are today, the common needs of any department can be met without disarranging any of the other established departments. This provision for the future will assure to the departments about twice as much space as they receive now, when Technology has taken possession.

The great court embraced by the wings opens upon the Charles River Esplanade, the boulevard established by the Metropolitan Park Commission. The frontage of the Technology lot is 1,500 ft. along this, while the length along Massachusetts Ave. is nearly the same. Half of the property is to be devoted to the educational purposes, and the other half will be for social facilities, which the Institute has heretofore lacked. It is the intention to develop the Walker Memorial, an undergraduate club house, gymnasium, commons, a dormitory system and other student features.

The view from the river shows strikingly the splendid proportions of the whole group. It is not possible to get the proper depth of the court from the illustration, but it must be remembered that the central dome of the library is about 600 ft. back from the Esplanade.

Educators from all parts of the world will come to Boston this week for the dedicatory exercises of the new buildings and the celebration of the fiftieth anniversary of the establishment of the Institute.

An interesting spectacular feature of the exercises is the water festival of Monday, held in the Charles River Basin. The Institute will demonstrate to the citizens of Boston the adaptability of that body of water to aquatic sports. In addition to the masque and pageant held in the Court of Honor of the new buildings a spectacle of interest is the formal transfer of the archives of the Institute from the old buildings to the new site. A procession of the corporation and faculty of the Institute will assemble at the Rogers Building and proceed to the basin. Here, after the fashion established long ago in the City of Venice, the officials of Technology will make their first formal entry into Cambridge over the waters of the basin in a Boston-built barge.

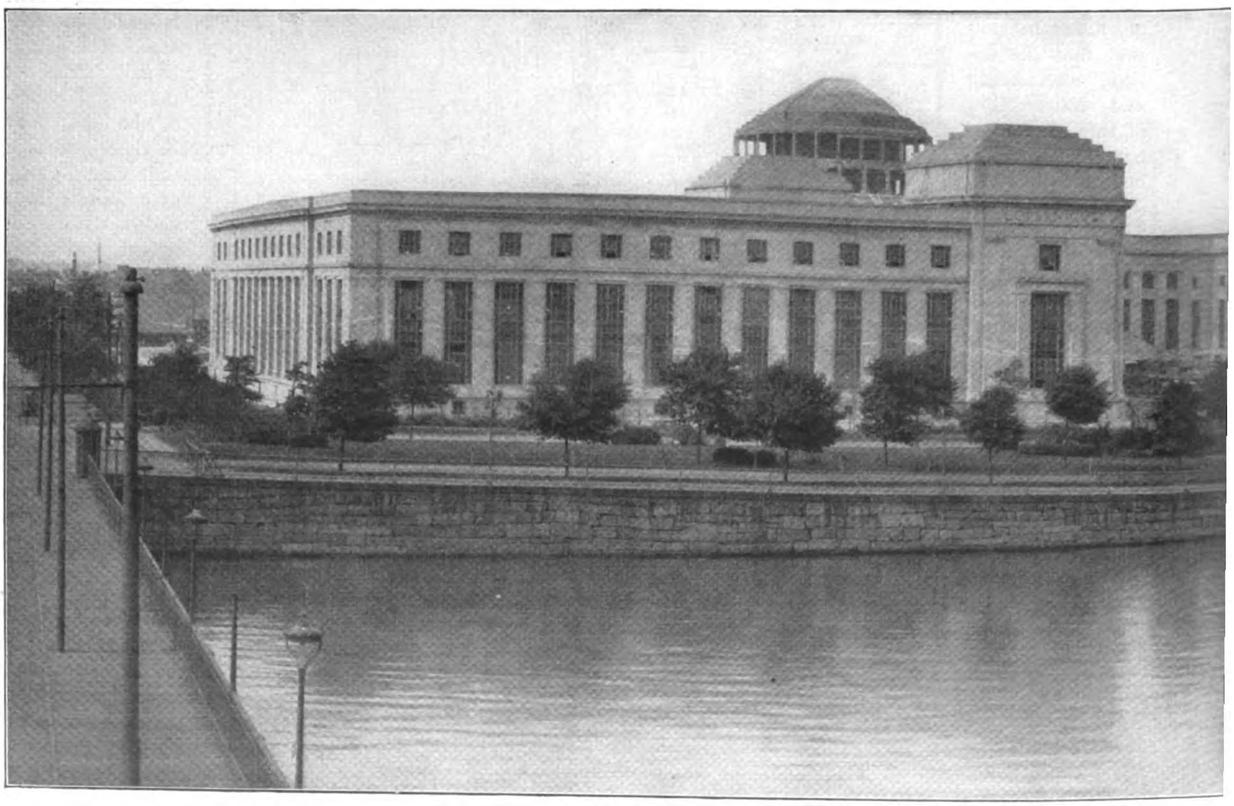


FIG. 2. THE NEW BUILDINGS OF THE MASSACHUSETTS

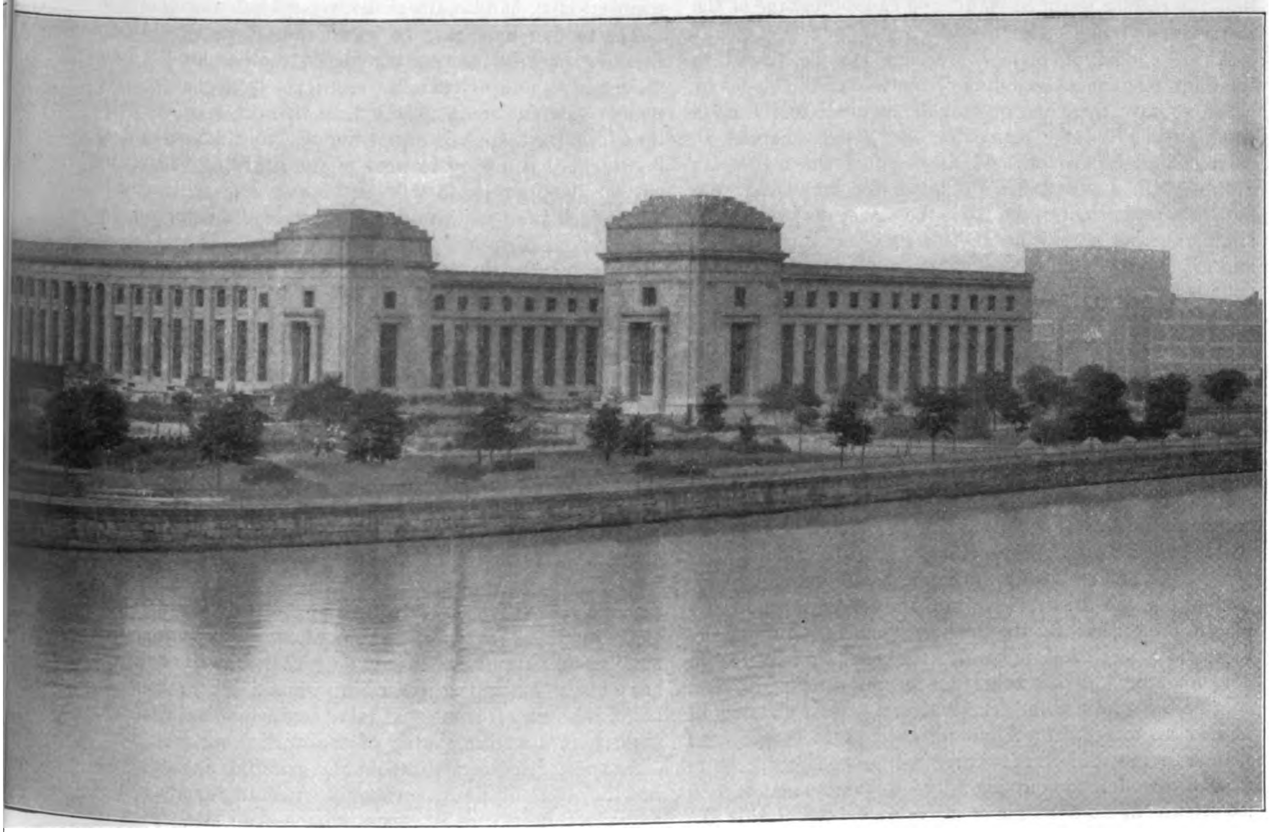
This vessel is something new in American naval architecture. The after-deck rises in tiers following the pattern of the ancient vessels, making an elevated quarter-deck for the highest officials. The rail is broken in places to form entrances to the vessel, and at these points are exquisite decorations. The hold above the lower deck is provided with openings through which the oarsmen propel the vessel on its way. Fifty Technology students have competed with their fellows for the honor of rowing this unique barge.

Boston has wonderful opportunities in the Charles River Basin for the pleasure of its people, but these have thus far been practically neglected. This week, two torpedo boats and a submarine will be in the basin, and a race in pulling crews in boats from the warships stationed in Boston will furnish excitement. The Technology class crews are to have a race, and races of single shells and war canoes will round out the exposition of speed coming from the application of muscle.

Following the exposition of muscle and what is sometimes called the "ash breeze," come examples of speed from the wind, as shown in races of yachts and sailing canoes. Yet another step forward, and speed from power—mechanical power—is to be shown by fast motor boats in action, not only by what we usually understand by "motor boats," but sea-sleds as well and a patrol squadron of five submarine chasers.

Overhead, aëroplanes will perform various evolutions, and a most unusual and interesting demonstration of a man-carrying kite will be made by Samuel F. Perkins, a Technology graduate, who has volunteered to show the results of his studies and invention along these lines. The crowning attraction in the alumni proceedings is the pageant and masque. The court of the buildings furnishes a setting such as is seldom found within the limits of a great city. The buildings will be illuminated with the same degree of skill that characterized the lighting of the San Francisco exposition, the electrical engineer who had charge of the latter being in charge of the illumination here. As the flotilla carrying the faculty and honored guests and bearing the archives of the Institute arrives at the embankment, the signal will be given for the beginning of festivities. In the middle of the court is a space fitted with all the devices of a modern stage. Spotlights will illuminate special features, while flood lighting and vertical rays will give rise to interesting color effects.

In this arena there will be delineated step by step man's progress in conquering the forces of nature. The huge circle will be filled with thousands of elements—students and other participants—in chaos and confusion, a magnificent spectacle of uncoördinated jostling forces. It will be a world without rule. Primordial man sees this world and thinks to conquer it. He is represented by a group of the huskiest of Technology students, selected with care because of their physical prowess. Again and again savage man enters the circle and again and again is flung out by the forces that do not know his bidding. Growing more and more intelligent and calling to his aid great principles working with Reason and Will and Skill—symbolical characters that come to his aid—he subdues chaos, and order and civilization are established.



INSTITUTE OF TECHNOLOGY AS SEEN FROM HARVARD BRIDGE

Grinding Reamers for Steel

By J. B. Murphy

The drawing shows a method that we have tried out during the past two years with very good results in grinding machine reamers. All angles given in the drawing are correct; and if reamers are treated as shown and described, a true, glass-smooth hole will result. Either lard oil or cutting compound may be used as a lubricant, or coolant. Some of these angles for machine reamers are a departure from general usage; but the grinding methods given have been very thoroughly tried out and found highly satisfactory.

Reamers as they leave the factory are certainly not always ground in the most satisfactory manner. To meet the high-speed heavy-production requirements of the day, certain qualities are required, as follows:

First, the reamer must be of exactly the correct shape; and by "exactly" I mean as nearly correct in fluting and dimensioning as mechanical skill can accomplish. If the blades are just a little "under" the center, several results will be very likely to occur. This, in effect, would produce a top rake, giving a thinner cutting edge, which would not "hold up" in service.

Again, the edge at the cutting corner *F*, made by the 45-deg. chamfer, will wear away very rapidly, necessitating frequent regrinding and so shortening the life of the reamer. When the corner becomes dull, the reamer will begin to pick up metal and cause a rough hole. Further than this, an undue strain is imposed upon the lands, and they are quickly worn away, spoiling the reamer, unless it is ground down for a smaller size. Besides all this, the reamer is apt to "bite" and cause breakage of the reamer or twisting off of the tang.

A great deal of reamer breakage can be traced to ignorant, or careless, grinding of the face of the blades by hand, to save the time or trouble required to set up a machine to grind the reamer on the 45-deg. chamfer *B*, as it should be ground. If the faces of the blades are ground with a "backward" rake, as for brass, etc., you have a scraping cut right from the start; and the faults from grinding a rake on the blades occur much sooner and in an aggravated degree.

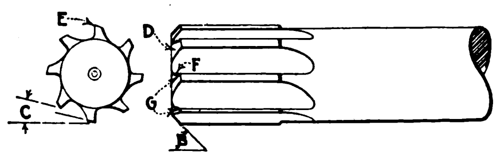
The subject of proportion needs no comment—that is the business of the manufacturer, and here we are to deal with the problem of putting the reamer in the best possible condition for use, to the exclusion of everything else.

Second in consideration, but not in importance, is the cutting edge *E*, which must be well cleared, yet well supported, so that it may produce the greatest possible number of holes before being returned to the toolroom for regrinding. Experience teaches me that this cannot be accomplished by one grinding cut. Two cuts are imperative if the cutting edge is to possess the combined qualities of strength and endurance in the highest degree.

Consider the illustration for a moment. A reamer is placed on centers in the tool grinder and indexed by means of a tooth rest or spring; the machine is set to 45 deg. and, say, $\frac{3}{16}$ in. below the center of the machine spindle for a 5-in. grinding wheel and almost any size of reamer up to $1\frac{3}{8}$ in. A cut is taken at *E*, turning the reamer by hand. This setting will give slightly more than 2 deg. for the cutting edge—an angle that a long experience has taught me to be correct. After this the grinder table is dropped $\frac{1}{4}$ in. farther, making a total for the cutting point of $\frac{7}{16}$ in. below the center of the grinder spindle. A backing-off cut is taken, as at *D*.

The backing-off angle will be approximately 5 deg., or 3 deg. more than the cutting edge. And this angle is also correct if we are to have long service and high production, although some may dispute the efficiency of both angles. A backing-off angle *C*, of 15 deg., like a cutting edge of 5 to 7 deg., is far too great for present working conditions. A 5-deg. angle for the cutting edge gives too sharp an edge to last long, and a backing-off angle of 12 to 15 deg. does not give the cutting edge sufficient support. The backing-off should come to within about $\frac{1}{32}$ in. of the cutting edge as at *G*. For convenience, however, the angles given are variable, to a reasonable extent. All angles may be up to 1 deg. greater than herein given, but never less.

The machine setting suggested will answer for reamers $\frac{3}{4}$ in. to $1\frac{3}{8}$ in. inclusive. For setting other sizes see "American Machinist Grinding Book," Table 33. This table is for milling cutters, but it also forms the best working base from which to calculate the machine settings for reamers. The angles given for the cutting edge of milling cutters form the best backing-off angle for reamers while the cutting edge may be 40 per cent. of this angle. These recommendations consider end-cutting reamers only; hand reamers deserve special consideration.



METHOD OF GRINDING MACHINE REAMERS

The reamer must also be "dead round" on the 45-deg. chamfer, or we will have trouble of another kind. This matter is something that has been grossly neglected. No reamer can cut more nearly true than it is itself. If, therefore, the reamer is hurriedly, or carelessly, ground, it is evident that, owing to wear of the grinding wheel, the cut on the first blade will be heavier and will remove more stock than in grinding the last blade, bringing the reamer "out of round" on the chamfer.

Consequently the outline on the chamfer, or cutting, end resembles an ellipse. A reamer so ground will cut large in direct proportion to the error in roundness. I find that a reamer cutting large for this reason produces a ragged, or scored, hole and that the hole cannot be round. The only remedy is the hand reamer, and even this may not bring the hole true, but merely minimize the evil.

The effect on the reamer is still more serious. The cutting corners of some of the blades are dulled to an excessive degree, causing undue wear on the lands of these blades, not only spoiling the reamer, but also helping along the work of producing ragged, elliptical holes instead of smooth and round ones.

There is one more essential—the sharp corner, as at *F*. It is produced at the junction of the sharpening and backing-off cuts—not the cutting corner, but the one just back of the cutting corner. This should be "broken" by hand, with an oil stone. It takes but a moment and will greatly improve the quality of the work.

I expect disagreement about the grinding angles given, but they have all been thoroughly tried out for upward of two years, operating at very high speed on steel forgings of varying density.

Screw Threads in Small Shops

BY JOHN H. VAN DEVENTER

SYNOPSIS—Every shop has much to do with screw threads, especially in their broadest application as means for holding machine parts together. Many shops lose money through not being "on to the curves" of the simple but sometimes aggravating machine elements. This article deals with various methods of screw cutting applicable to small shops.

When you buy a suit of clothes, you do not give a thought to the unseen thread that holds the pieces of cloth together. But let this unseen thread fail to do its duty in some important seam, and it becomes to you momentarily the most important thing in the world!

There is a close analogy between threads and threads, as applied in the textile and mechanical fields. Both of them hold things together, both have been given the same

FIG. 1. CUTTING ONE SIDE OF THE THREAD SPACE IS BETTER THAN CUTTING BOTH

name; and take either away from its field of application and you put civilization back many centuries.

History does not give us a description of the man who first cut a screw thread, so we are at a loss to know whether this thread was cut to the United States standard, the sharp V-standard, the Whitworth standard, the British Association standard, the French metric standard, the International standard, the Löwenherz standard, the acme standard, the Cadillac standard, the square standard, the Briggs pipe standard, the British pipe standard, the hose standard, the British standard fine screw, the Society of Automobile Engineers standard, the American Society of Mechanical Engineers machine-screw standard, the old standard of machine screws, the gas-fixture standard or the Cycle Engineers standard.

Being a pioneer has its advantages, one of them being that you do not have such a conglomeration of established standards to worry about and choose from. To think of the brain energy that has followed the convolutions of all of these different standard screw threads makes one as dizzy as Mark Twain's "drop of whisky running down a corkscrew." Picture to yourself the numerous conclaves of the wise men of all the nations necessary to establish such an unholy medley of standards, the fuming and fussing and evaporation of brain vapor that were required to invent, establish and sort these 57 varieties! National societies have sat in discussion upon it, universities have deliberated upon it, corporations have investigated it, and in fact, taken all-in-all, this simple mechanical element has had almost as much public discussion as any of the "big" issues of the day.

The regrettable thing about it is that with all this thought, talk and action, while we have standards giving the dimensions, angles and proportions of screw threads, with a few exceptions we have not yet had laid down what is more important for the shopman—the *limits* defining these standards. One of the notable exceptions to this is the A. S. M. E. standard for machine screws, which has been adopted by all tap and die makers.

While there are so many standards to choose from, the small-shop man need not be in a dilemma about which one to take. Outside of repair jobs, which call for special threads, nine-tenths of his work is or should be restricted to the U. S. standard, and the other one-tenth which will call for a finer pitch, should be divided between the A. S. M. E. standard for machine screws for diameters under ½ in. and the S. A. E. standard for the fine-pitch threads between ½ and 1 in. There is no excuse for making special taps in the small shop, and the policy of sticking to these established standards will save money.

Do not attempt to hog repair business by using a special thread standard of your own, for nothing makes the user of a machine more angry than to find that some screw that has been lost or broken is a special one and must be replaced at the factory. You may lose a cent or two of profit by not having the repair order come to *you,* but you are likely to lose the customer's business if you adopt such a small and mean policy. And by all means steer clear of the V-thread. It is not as strong as the U. S. standard and is more easily damaged on account of its sharp edges. When the V-thread and the U. S. standard get together in a shop, trouble begins, especially when one tries to use a V-standard screw in connection with a U. S. standard nut. Nothing but main strength and the compressibility of metal save the day under such circumstances!

Before speaking of the accuracy and errors of screws, it is well to distinguish between the two main purposes for

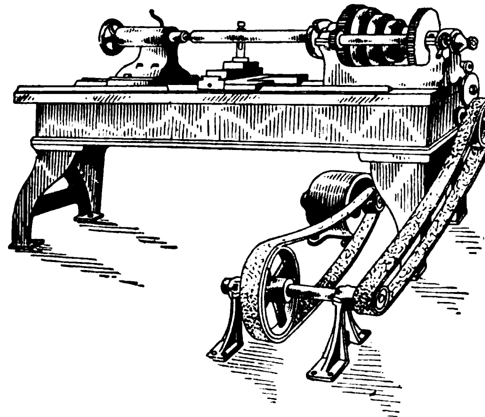


FIG. 2. RIGGING UP TO CUT A "QUICK" LEAD IN THE LATHE

which they are used: One class must be very accurate indeed, this comprising the lead screws, dividing screws and the like, which may be classed as "precision" screws. The broader application as fastenings, comprising bolts, studs, nuts, machine screws and the like, while they do not require the extreme precision of these former screws, must still be held to certain dimensions in order to reduce the shop owner's expense and the shop assembler's profanity, when it comes to putting things together.

In screw fastenings, errors of lead such as are ordinarily found in commercial taps and dies are not important, since the thickness of the tapped piece into which the screw is entered is ordinarily not greater than the diameter of the screw itself. There is small need to worry about slight errors of lead on this class of work, especially if the shop owner gives his taps and dies an accurate inspection after receiving them.

A great deal of tap wear and breakage can be eliminated from both small and large shops by the use of better judgment in the selection of tap-drill sizes. Size for size as compared with other tools the tap does a lot of work. The length of cutting edge in contact with the work in any tap is considerable. It is yanked through metal by main strength or driven through by an unfeeling machine, and in either case the cutting edges suffer accordingly, especially if the tap drill is small. In most places where screw threads are used for fastening pieces together the maximum strength of the thread is not required. It is merely a case of holding one piece of metal to another, and the strain which tends to separate them is not enough to stress the screw to anywhere near its safe limit.

Yet under these conditions you will find no distinction made in the shop as to the size of the tap drill used. In many such cases a drill is selected that is even smaller than the root diameter of the thread, which means that the tap must do the work of a reamer as well as its own. It has been shown that if the threads in a nut are made but 50 per cent. of the full depth of the standard thread, they are as strong as the bolt!

TABLE OF TAP-DRILL SIZES, U.S.S.

(For thread depths equal to 50, 75 and 90 per cent. of full thread)

Diameter	No. of Threads	Tap Drill for 50 per Cent. Depth	Tap Drill for 75 per Cent. Depth	Tap Drill for 90 per Cent. Depth
1/4	20	7/32	13/64	No. 11† (3/16)
5/16	18	J* (17/64)	1/4	D* (1/4)
3/8	16	Q* (21/64)	5/16	N* (19/64)
7/16	14	25/64	23/64	T* (23/64)
1/2	13	29/64	27/64	Z* (13/32)
9/16	12	33/64	31/64	15/32
5/8	11	9/16	17/32	33/64
11/16	11	5/8	19/32	37/64
3/4	10	11/16	41/64	5/8
13/16	10	3/4	23/32	45/64
7/8	9	51/64	49/64	3/4
15/16	9	7/8	53/64	13/16
1	8	59/64	7/8	55/64
1 1/16	8	63/64	15/16	59/64
1 1/8	7	1 1/32	63/64	61/64
1 3/16	7	1 3/32	1 3/64	1 1/64
1 1/4	7	1 5/32	1 7/64	1 5/64
1 5/16	7	1 7/32	1 11/64	1 9/64
1 3/8	6	1 17/64	1 7/32	1 3/16
1 1/2	6	1 25/64	1 11/32	1 5/16
1 5/8	5 1/2	1 1/2	1 7/16	1 13/32
1 3/4	5	1 5/8	1 9/16	1 33/64
1 7/8	5	1 3/4	1 11/16	1 41/64
2	4 1/2	1 55/64	1 25/32	1 47/64

*Letter-size drill; if not available, use size given in parenthesis. †Wire-size drill; if not available, use size given in parenthesis.

The relation between tap-drill size and the elbow grease required to drive a tap is not realized until you have pulled a 2½-in. tap through 3 or 4 in. of steel. I had this experience during the early days of apprenticeship at a Middle Western tool works. The job was given to the newest apprentice, with the idea that while he and the shop helper were pulling their lungs out at opposite ends of a double-end tap wrench he would absorb the first principles of machine-tool building, which in those days was more sweat than science. Fortunately the pipe shop was not far removed, and more fortunately there was plenty of room all around the casting which was to be tapped, so that, before long, science came to the aid with two 14-ft. lengths of 1½-in. pipe that reduced the pull and increased the walk.

But even so it was a slow walk, for the tap had been preceded by a drill that was scarcely larger than the root diameter of the threads and it took close to a day and a half to finish what might have been accomplished in an hour or two at most with equally good results, had the hole been drilled somewhat larger. Nothing on earth could have stripped those threads, I am sure, even had they been half-threads only, for that steel was the toughest material that ever escaped from a steel-foundry scrap heap!

The table of tap-drill sizes given here will enable the small-shop man to use judgment and save his taps. In no case should he use a tap drill smaller than 90 per cent. of the depth of the thread, such as is given in the third column. For machine tapping, a 75 per cent. depth is ample; and in fact if the hole is made smaller, tap breakage will be a considerable item. For ordinary screw fastenings where no great strain or pressure is brought against the parts, 50 per cent. of depth will answer the purpose except in cast iron. The speed of tapping is largely influenced by the selection of the tap-drill size and increases much faster than the percentage of full thread depth decreases.

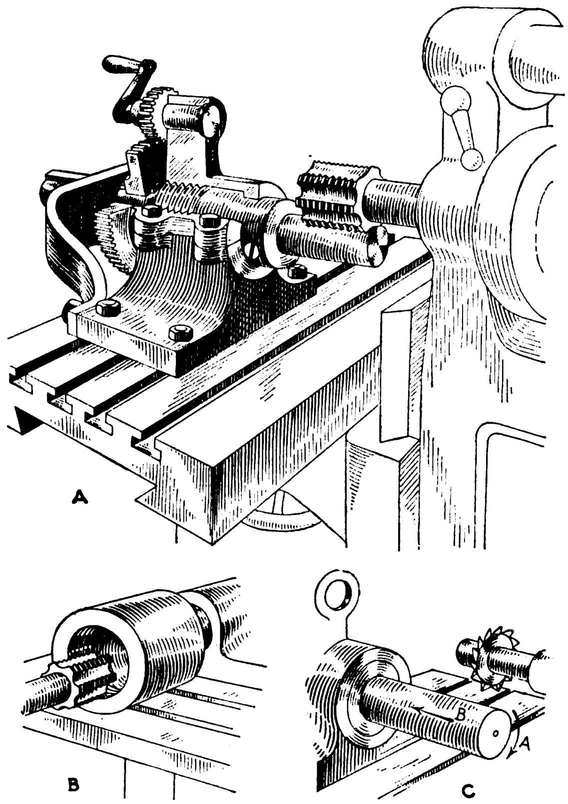


FIG. 3. MILLING THREADS WITH A SINGLE CUTTER AND WITH MULTIPLE CUTTERS

Hand tapping should be looked upon as a very expensive way to do the work; in fact, it should be regarded as similar to the crude method of ratcheting a hole instead of machine drilling it. Even when a close fit is desired, the holes should first be machine tapped with an undersized tap and then retapped to size by hand. Retapping with a sizing tap is the only way in which a large number of tapped holes can be kept to a close standard of size, as has

been discovered by those who have had experience in shell work. This is a natural thing to expect, as the shopman would scarcely think of using any other form tool but a tap for both roughing and finishing cuts, with the expectation of holding size. There is no reason why this cutting tool should be an exception to the rule, and shopmen are rapidly finding that it is not.

The only machine tapper available in small shops is quite likely to be the drilling machine. Even if this is not fitted with reversing gears, a tapping chuck can be obtained that is automatic in its action and that will start to back the tap as soon as the feed lever is raised. These tapping chucks are not only reliable, but are time savers, and no small shop can afford to be without one. When the work runs in large quantities of one or two tap sizes, it is time to consider a tapping machine. Some of these are very simple in construction, and in fact one of the most convenient I ever saw was a home-made affair in which a horizontal spindle was controlled by two friction gears, the tap going into the work when the operator pushed the piece against it and backing out with a fast reverse motion when he started to pull. A contrivance of this kind will tap an almost incredible number of holes without getting stiff in the joints, which is more than can be said for the average vise hand. Probably 90 per cent. of the screws used in the small shops are die cut. Like all female threads, those in dies are infernally hard to measure. The best test of the die is the work that it does; and its offspring being all of the male gender, one can readily measure and inspect them.

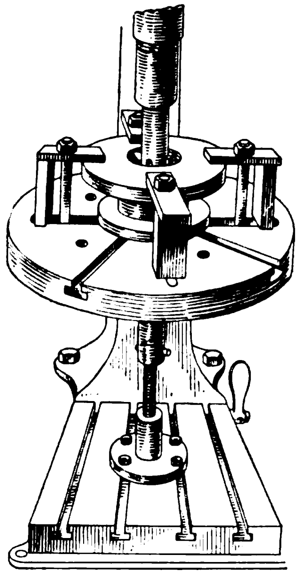


FIG. 4. THREADING WITH A LEADER ON THE DRILLING MACHINE

All threads come originally from the King of Machines, the engine lathe. One of the best kinks in cutting threads on a lathe with a single tool is that attributed to Professor Sweet, in which the compound rest is swiveled 30 deg., so that instead of feeding directly into the work and cutting on both sides of the thread the tool has a one-sided cut, as shown in Fig. 1. This scheme prevents torn threads and is not as widely used as it should be.

Screw Cutting on the Lathe

While the lathe has the ability to develop a thread through its lead screw by means of a single-pointed tool, it is not by any means restricted to such high-grade but expensive kind of work. It will carry either a tap or a die and thus transform itself without protest into a tapping machine or a bolt cutter. And speaking of bolt cutters, some very pretty screw threads are produced on these machines, which are sometimes considered to be crude. Their work is not by any means restricted to threading rough bolts, however, and they can be applied for short feed screws such as are used in blacksmith drills and the like, where the exact lead need not be held to close limits. A bolt cutter will produce just as finely finished threads as a screw machine, for in both cases the quality of the work and the lead depend upon the die, the machine simply being the means of making things go around and important mainly for driving power.

When the small-shop man gets up to leads of $1\frac{1}{2}$ in. or over, he begins to have trouble with the feed works of his lathe. Such leads are not common on screw threads pure and simple, but are not infrequent on its close cousin, the worm, and on some multi-thread screws. In such cases change gears can be saved from breaking and the job may be made easier by rigging up as shown in Fig. 2, on the principle that there is always less strain involved in slowing down than in speeding up.

Accurate Screws on the Thread Miller

Since the advent of the thread miller, the lathe with its single-point tool is not the only machine which can produce accurate screws. A positive lead is used in this milling process, the accuracy of the product, as far as lead is concerned, depending upon the accuracy of the miller lead screw, just as it does on the lead screw in lathe work. The thread miller has another advantage in being a semiautomatic machine and thus slicing off a large portion of the labor required to cut a screw. While a specialized machine of this type is possibly outside the range of most small shops, adaptations of the milling process are not. Some of these are shown in Fig. 3.

At *A* is an attachment rigged up on a plain miller of the knee and column type. The cutter is a plain grooved cutter and has no lead. The length of the cutter is equal to the length of the thread desired on the work, which is held in a fixture having a master screw of the same pitch as the cutter. One rotation of the work mills the entire length of thread and does it in about one-tenth the time that is required by any other method. This is a scheme that has been largely applied to milling internal threads in the base recesses of high-explosive shells where there is not room enough for a tap to clear, the recess at the bottom of the thread being just about equal to the width of one thread. This is shown at *B* in Fig. 3.

Milling Threads with a Single Cutter

It is not necessary to mill threads with a multiple cutter, for they can be handled as shown at *C*, in which a cutter is used having the form of a single tooth space. The work is held and moved as in the previous case. This is the principle employed in thread milling, except that the cutter is moved instead of the work. A more accurate thread can be produced by a single cutter than by a multiple cutter, owing to the changes in form and pitch which the latter undergoes in hardening. Any one of these three schemes may come in handy in a small shop when there is a quantity of work to be done at low cost and yet at a profit.

Even the vertical drilling machine may be made to cut a thread with positive lead and a single-pointed tool if it is rigged up as shown in Fig. 4. There are some jobs too large to be swung on a lathe, which may be handled this way to advantage, although to be sure it is a slow and clumsy way to do the work. Sometimes slow ways are the only ways, however, and this kink should be stored away in the small-shop man's mind for use on an occasion of that kind.

Tools for a Latch Ring

By Robert Mawson

SYNOPSIS—Tools for machining a latch ring for hosiery machines. They employ a large plug in a previously bored hole as locating means.

The firm of Scott & Williams, Inc., Laconia, N. H., manufactures a large variety of hosiery machines. From their practice the various tools used in machining a latch ring have been selected as the subject for this article. The piece itself is illustrated in Fig. 1 on page 1021.

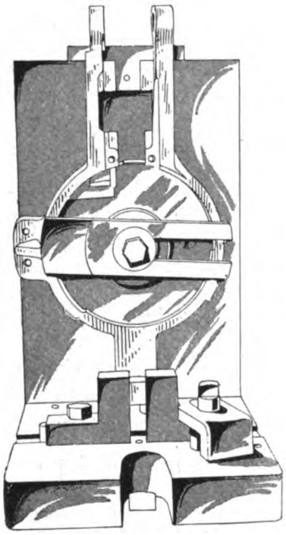


FIG. 2

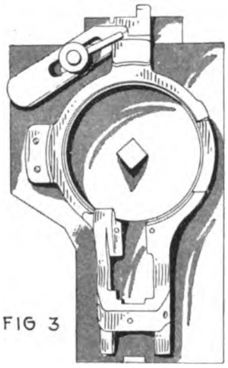


FIG 3

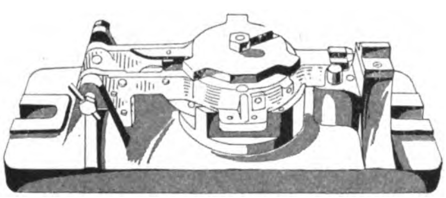


FIG. 4

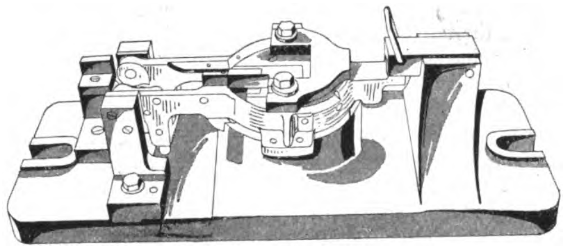


FIG. 5

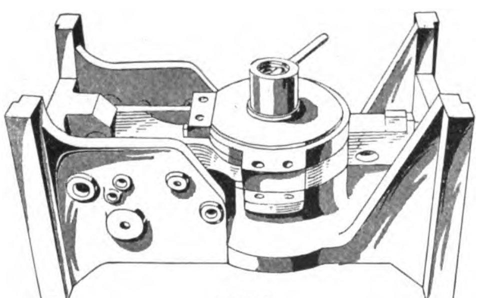


FIG. 6

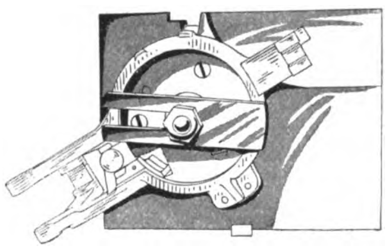


FIG. 7

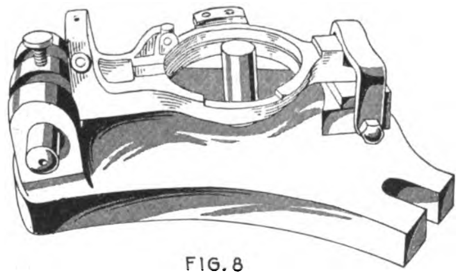


FIG. 8

TOOLS FOR MAKING A LATCH RING WITH WORK SHOWN IN POSITION

FIGS. 2 AND 2-A

Operation—Milling fork end of latch ring, Fig. 1. The casting is located on a $3\frac{31}{32}$-in. plug that fits into the hole bored in a previous operation. An open-end clamp is then tightened down on the casting by a nut.

Surface Machined—Inner surface at fork end, using an 8-in. by $\frac{3}{8}$-in. milling cutter operating at 200 r.p.m.

FIGS. 3 AND 3-A

Operation—Milling pads at back end of latch ring, Fig. 1. The casting, on a $3\frac{31}{32}$-in. plug, is tightened by a nut.

Surface Machined—End of back end, using two $3\frac{1}{2}$-in. by $\frac{1}{2}$-in. milling cutters operating at 200 r.p.m.

FIGS. 4 AND 4-A

Operation—Milling front end of latch ring, Fig. 1. The casting is placed on a $3\frac{31}{32}$-in. plug and located in contact with an adjustable screw. The washer is tightened by a setscrew.

Surface Machined—Tongue at the front end, using two straddle mills 3 in. by $\frac{3}{8}$ in., operating at 140 r.p.m.

FIGS. 5 AND 5-A

Operation—Milling outer surface at back end of latch ring, Fig. 1. The casting is placed on a $3\frac{31}{32}$-in. plug and located by a swing clamp that fits over the milled tongue.

Surface Machined—The fork end of the casting, using a milling cutter 4 in. by $\frac{7}{16}$ in. wide, operating at 140 r.p.m.

FIGS. 6 AND 6-A

Operation—Drilling and reaming latch ring, Fig. 1. The casting is placed on a plug fitting into the large center-bored hole and located by a steel tongue in the machined fork.

Holes Machined—One $\frac{23}{64}$-in. and one No. 5 drilled, one No. 19 and two No. 28 drilled, one $\frac{15}{64}$-in. drilled, two $\frac{1}{4}$-in. spot-drilled and reamed, three No. 33 drilled, four No. 20 drilled, one $\frac{3}{8}$-in. spot-drilled and reamed and one No. 31 drilled.

FIGS. 7 AND 7-A

Operation—Milling surface on latch ring, Fig. 1. The casting is placed on a plug and located by a pin in the milled surface at the fork. It is then held by the open-sided clamp.

Surface Machined—Notch on edge of casting, using a 5-in. diameter by $\frac{31}{32}$-in. wide cutter operating at 160 r.p.m.

FIGS. 8 AND 8-A

Operation—Last milling on latch ring, Fig. 1. The casting is located by a $\frac{3}{8}$-in. pin in the reamed hole at the fork. The tongue is set in a groove and held down with a clamp.

Surface Machined—The pads on the face of the casting, using a 1-in. end mill operating at 200 r.p.m.

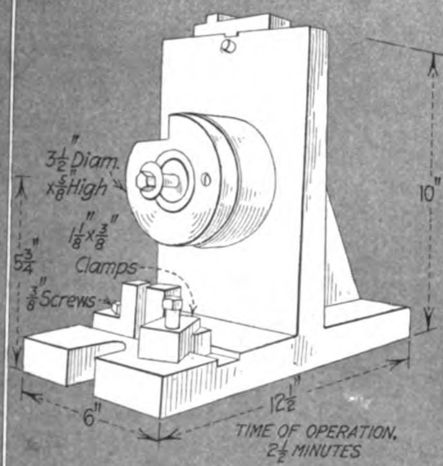


FIG. 2-A

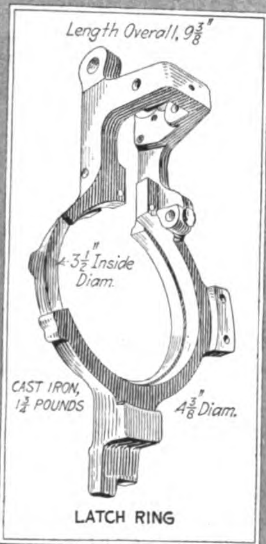


FIG. 1

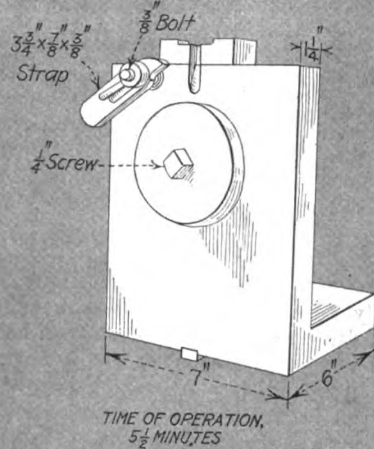


FIG. 3-A

FIG. 4-A

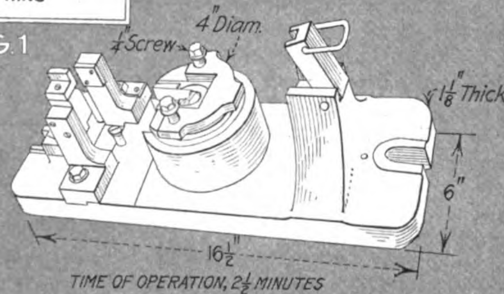


FIG. 5-A

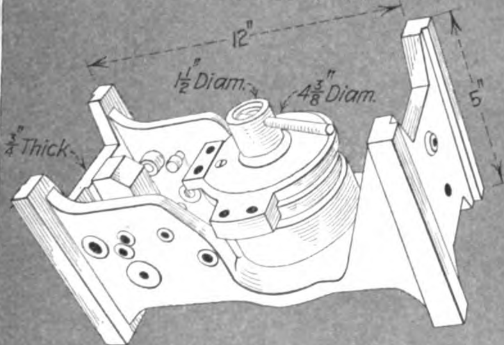


FIG. 6-A

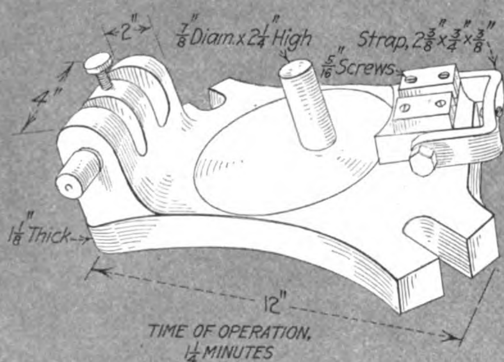


FIG. 8-A

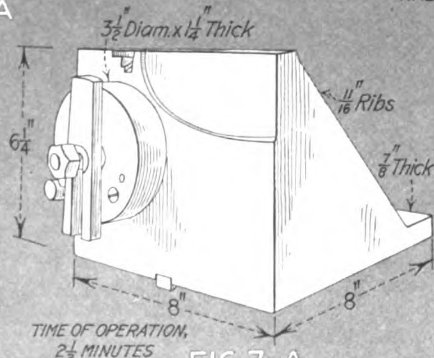


FIG. 7-A

THE JIGS AND FIXTURES SHOWN ARE MADE WITH THEIR BASES OF CAST IRON. THE PINS, SCREWS AND STRAPS ARE OF MACHINE STEEL, CARBONIZED AND HARDENED. THE LOCATING SURFACES AND GUIDE BUSHINGS ARE TOOL STEEL, HARDENED AND GROUND. ON THE MILLING FIXTURES TOOL-STEEL SURFACES ARE PROVIDED AND SET BLOCKS TO ASSIST THE OPERATOR IN SETTING THE MILLING CUTTERS. MACHINE-STEEL TONGUES ARE FITTED IN THE BASES OF THE MILLING FIXTURES SO THAT THE TOOLS WILL BE PLACED ON THE TABLE IN THE CORRECT ALIGNMENT. ALL BUSHINGS USED FOR GUIDING TOOLS ARE BLACKENED

DETAILS OF TOOLS USED IN MANUFACTURING A LATCH RING

The Purchasing Agent as a Safety Valve

By H. W. Wolff

The mere fact of being a successful buyer on market values, without a working knowledge of the materials bought, makes a purchasing agent nil in value to any company. If the agent is furnished with a requisition for 5,000 ft. of brass rod and is supposed to buy it at the lowest possible price, he would be an expense to any company at $10 a week. Any intelligent clerk could perform the work.

The real purchasing agent has been referred to as a safety valve. To explain the connection, we will suppose that a requisition for 5,000 ft. of brass rod is turned over to a purchasing agent who is following the safety-valve rule and observe how he handles it.

First, he would want to know how many feet of this size were in stock and how many feet were actually required for orders on hand. If he found that with stock on hand only 3,000 ft. was actually required, he would want a good reason furnished before making the over-investment.

Second, he would want a sample or print of the part for which the rod is ordered. If he found it was, say, ½-in. square stock, that a binding-post screw was being made from it—a square head on a No. 10-32 screw—and that about two-thirds of it was waste, he would want to know why a pressed or brazed head would not answer. Further, he would want to know the previous manufacturing cost or estimated cost, if a new part. This he would check against the purchase of finished screws; and if it was found that purchase was cheaper than manufacture, finished screws would be ordered.

Real Points in Purchasing

It is better to let a machine stand idle and figure 6 per cent. loss on machine investment than delude yourself with the idea of keeping it running or have a mistaken opinion, due to company pride, that your output is better than that of the specialist in screws—or any other article—and lose double or triple your 6 per cent. in higher shop cost.

On a requisition for brass castings the purchasing agent would raise the same question of stock on hand and actual requirements. Many a growing concern has lost its ability to pay dividends through excessive stock investment. The surplus stock of materials too often becomes obsolete before sale and is sacrificed at a "junk" price.

Further, on this casting proposition the agent would want to know why a die casting could not be used, eliminating machine work. If this was not practical, then he would question the use of extruded metal to size, ready for machining, thereby eliminating the work of preparing the castings, etc., as extruded metal can be purchased at approximately the same price as good castings. However, if nothing but a casting was practical, he would investigate the pattern, secure a price on castings from the pattern as it stood, then put the proposition to a foundry to make a price on it mounted, two on a board, or split the pattern on a board for machine molding. This change would double or triple the production and automatically reduce the purchase price.

This method of pattern investigation would be followed on gray iron, malleable and steel castings as well. Foundries have been known to take work at a pound price from the pattern furnished and then make duplicate patterns or equip them for machines at their own expense and make the equivalent of double the price. So with every requisition received, careful analysis would be made.

Like a safety valve requiring careful adjustment, the purchasing agent would adjust himself to the working out of reductions in quantities and changes in methods and designs. If he could not accomplish these results without friction, the ultimate savings would be minimized by antagonism of the different units in the organization.

He could not go or send to the stock or order departments and say, "Reduce your requisition from 5,000 ft. to 3,000 ft.," for immediately they would feel that their work, experience and efforts were being criticized. He could not go or send to the engineering department and make a summary request to change the plans of a screw to show a swaged or brazed head without that department's rightly feeling that its engineering experience was being questioned.

Diplomacy in Changing Requisitions

He could, however, go to the order or stock department and talk stock and values to them. He could point out that the additional 3,000 ft. of brass would cost approximately $500 without the lost interest that would accumulate and that for the ultimate good and success of the company a working capital in cash was as important as a large stock. The money to pay dividends would keep the invested capital interested and ready to supply additional money for growth and expansion. Realizing that the saving of lost interest on excessive stock investments would show a larger percentage of earnings and that their future depended on net earnings more than volume of business or stock, the stock keepers would soon begin to read their requisitions and orders differently. They would not say: "Well, order a gross of files; we'll use them up." Instead, they would figure out that a gross of files meant so many dollars and that a quarter of a gross would stock up for at least three months. They would learn to look at their stock as a bank looks at its deposits and not figure it simply in drills or in gallons of oil.

Possible Nature of the Agent's Suggestions

The purchasing agent could go to the engineering department and ask—not give orders or suggestions—if the use of brazed or forged heads had ever been considered, point out the advantage and cost reduction, show how designs affect the manufacturing cost and that reduction in cost through less expensive designs, equally good as far as service and requirements are concerned, means profit to the company and to the department. It would soon be understood that it was not a question of a little screw costing only 2c., but a question of dollars in purchasing and manufacture, and that the little screw at 2c. reduced to 1c. would mean $100 saving on every $10,000.

If the engineers, as naturally they might do, questioned the screw, die casting or whatever it might be, then the agent would have to take up with the engineers the question of reliable concerns who would recommend and guarantee certain articles as well as agree to furnish them. The engineering department would soon learn to be on its "mettle" and that the best engineering talent in the country was competing with it.

Making Piston Rings With Grinders for the Major Operations

By Ethan Viall

SYNOPSIS—The piston rings here described are made from individual castings and not cut from pot forms, as is commonly done. Except for a metallic gap-guard or saddle, the rings closely resemble the familiar type of concentric ring. A feature of the manufacturing process is that grinders are used for all the major machining operations

In making piston rings from pot castings, flaws, porous spots or widely varying grades of iron frequently develop, causing breakage or dead, unresponsive rings.

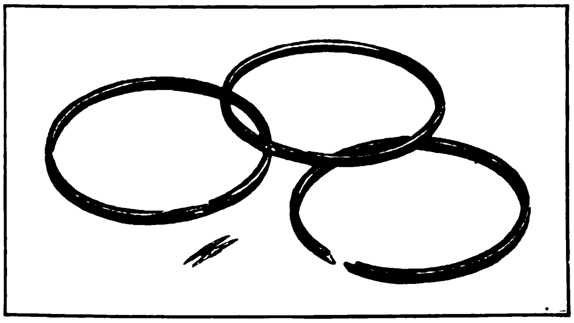


FIG. 1. SAMPLES OF BURD TYPE PISTON RINGS

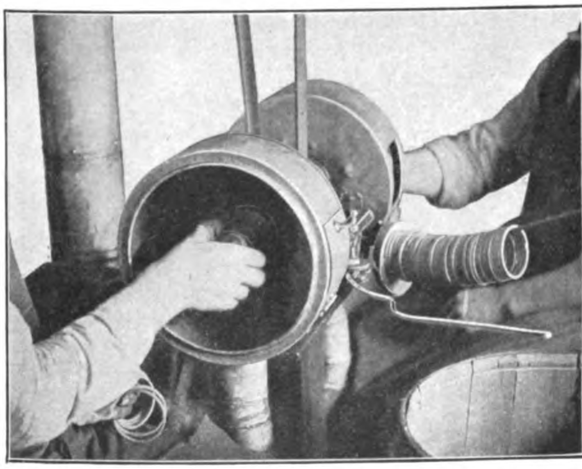


FIG. 3. SNAGGING INSIDE OF RINGS. PRODUCTION: 2,600 PER MAN PER 10-HOUR DAY

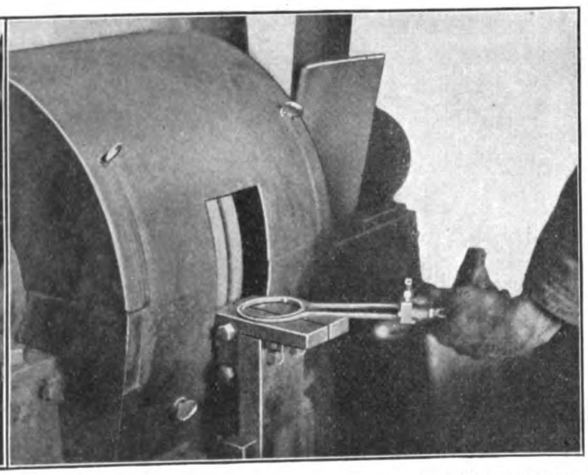


FIG. 4. ROUGHING OFF SIDES OF RINGS. PRODUCTION: 6,000 PER DAY

Individually cast rings, when properly finished, eliminate many of the difficulties encountered in the use of the other type. The Burd High Compression Ring Co., Rockford, Ill., makes all its piston rings from individual castings. These are so handled as to leave the harder skin on the inside of the rings, insuring resiliency and life without the use of objectionable alloys. A special mixture of gray iron finished by grinding on the outside gives a glass-like smoothness when fitted to the walls of the cylinder.

The rings made are of the concentric type, with a pressed-metal gap-guard or saddle that effectually seals the slit, yet allows all the expansion or springiness needed in the ring itself. This will be understood by reference to Fig. 1, where three of the rings are shown; also to Fig. 2, where one is shown in detail. The rings are

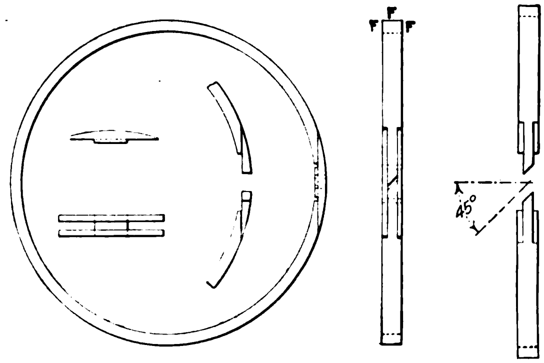


FIG. 2. DETAILS OF A BURD PISTON RING

practically solid, as the objectionable gap is sealed by the saddle. The rings are made in every size called for by the various makers of automobile or other engines. Special testing devices are also used to insure the users' receiving rings of the radial tension which they may specify.

The first operation on an individual ring is to grind the inside, as shown in Fig. 3. This is really a snagging process, and merely removes small lumps or projections and smooths up the inside without removing the skin to any extent. The workman simply holds a ring in his fingers and gives it a rotary motion over the grinding wheel. The wheels are hooded and connected to the exhaust system so as to effectually carry off all dust.

The next operation is the rough-grinding of the sides. The rings are held in a spring holder, as shown in Fig. 4, and then thrust in between the wheels of a Gardner double-disk grinder. This roughs them down to about 0.010 in. of finished size. Outside snagging is the next operation. In this they are held between two flanged holders, as shown in Fig. 5, and revolved against the grinding wheel. This operation, like the inside one, does not cut under the skin of the casting to any extent, but merely removes objectionable lumps. A bunch of the rough rings is shown at the right in Fig. 6, and at the left is a bunch after being ground as just described. It must be understood that while only individual operations are illustrated, numerous machines are employed on each step, both for the same and for different sizes. One of the slitting machines is shown in Fig. 7.

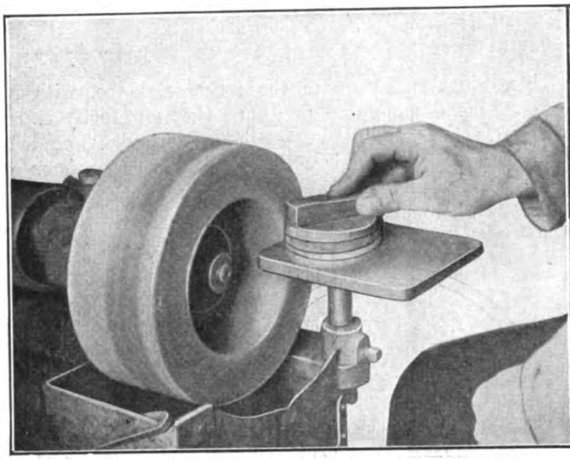


FIG. 5. SNAGGING OUTSIDE. PRODUCTION: 1,700 PER DAY

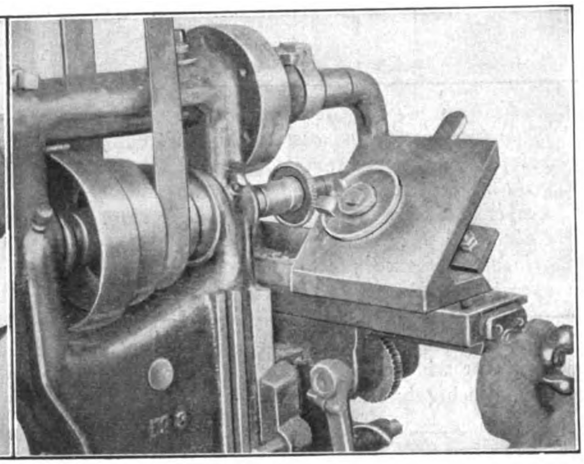
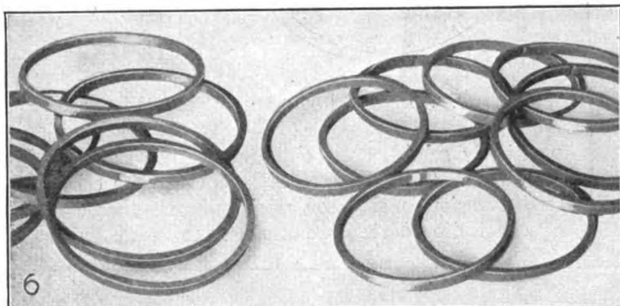
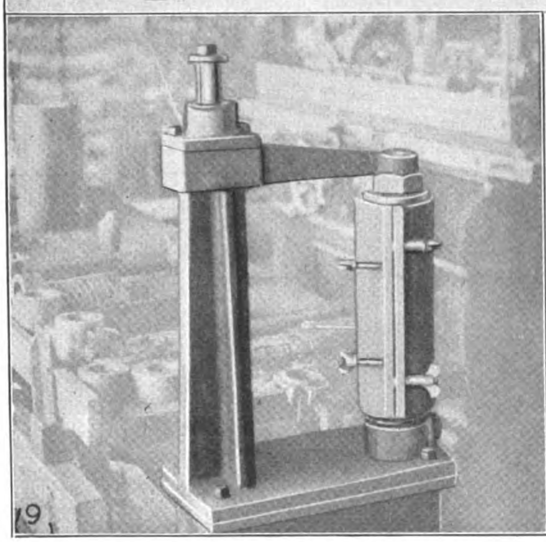


FIG. 7. SLITTING THE RINGS





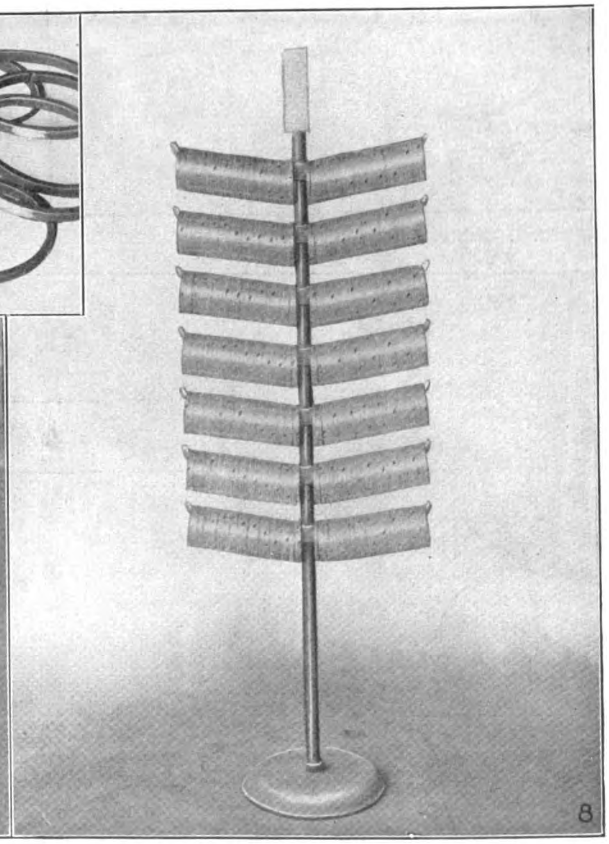


FIG. 6. SAMPLES OF ROUGH AND ROUGH-GROUND RINGS. FIG. 8. TYPE OF WORK RACK USED. FIG. 9. RETAINING SLEEVE AND MANDREL BRACKET

The ring to be slit is held on an angled plate by means of hooked clamps operated by an eccentric lever from underneath. Two milling saws are used on the arbor

After being slit the rings are compressed and placed in retaining sleeves, as shown in Fig. 9. The sleeves full of rings are slipped down over flanged mandrels and

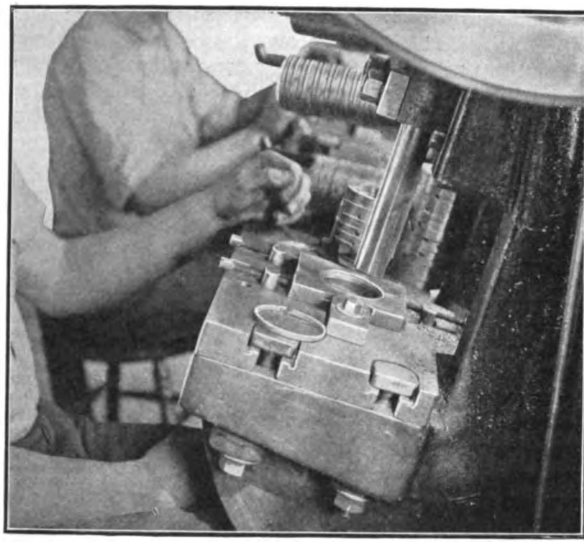


FIG. 10. ROUGH-GRINDING OUTSIDE DIAMETER. PRODUCTION: 3,000 PER DAY

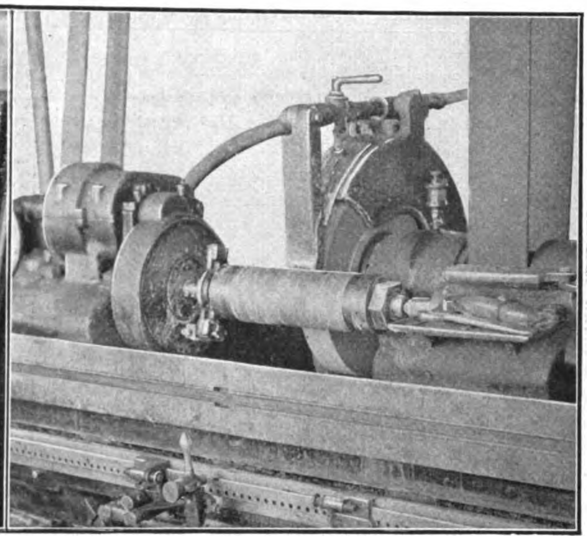


FIG. 11. BROACHING SADDLE SLOT. PRODUCTION: 2,800 PER DAY

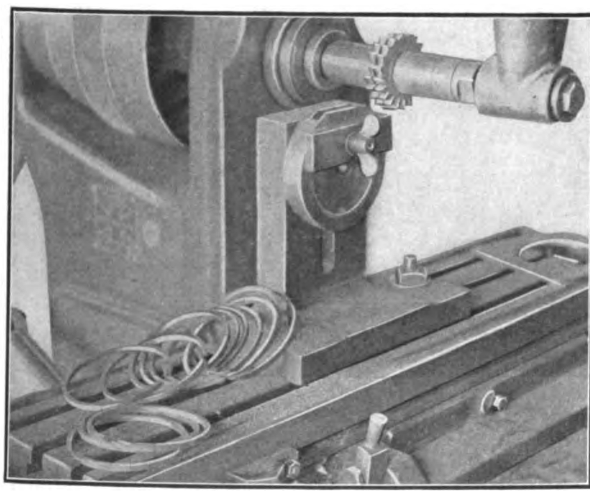


FIG. 12. STRADDLE-MILLING FOR SADDLE. PRODUCTION: ONE OPERATOR, TWO MACHINES, 1,500 PER DAY

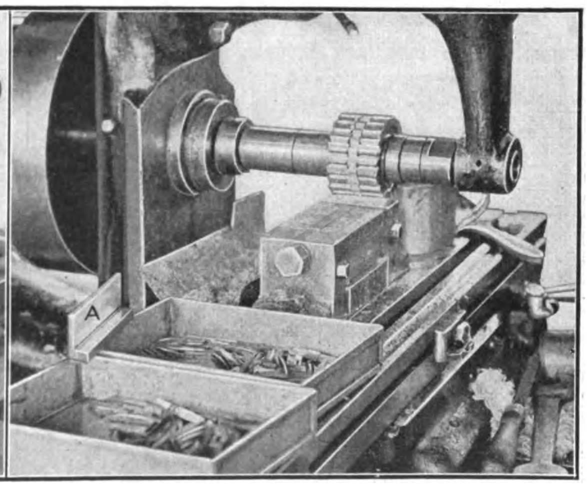


FIG. 14. MILLING BACKS OF SADDLES. PRODUCTION: SIX IN JIG, 1,000 PER DAY

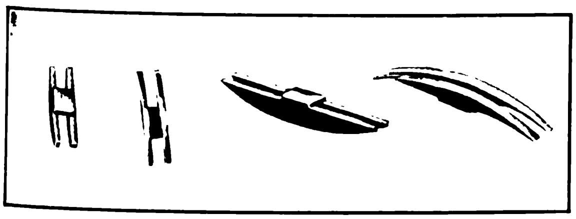


FIG. 13. ROUGH AND MILLED SADDLES

and feeding is done by hand, using the ball crank on the table feed screw. As the rings are slit they are placed on racks like the one shown in Fig. 8. These are used throughout the shop and are very convenient. They may be revolved or rolled from one machine to another with little trouble and no danger of losing their load.

clamped for grinding in the usual way. The mandrel is held in a special fixture while being loaded, and after the sleeve and removable flange with the locking nut have been put in place, the steadyarm is swung over to support the end of the mandrel while the nut is tightened. The arm is then swung out of the way, the sleeve loosened and removed and the loaded mandrel placed in a grinder as shown in Fig. 10. Plenty of water is poured over the work while grinding to prevent warping or distortion.

After being rough circle ground, as just described, the rings go to punch presses, where the slot for the cross-piece of the saddle is broached out. One of the presses is shown in Fig. 11. The ring is compressed so that the two ends are in contact, and then it is placed in the holder shown on the press platen. The broach is

held in the ram of the press and the slot is finished at one stroke.

Next the ends of the ring are straddle-milled for the sides of the saddle. This is done as shown in Fig. 12.

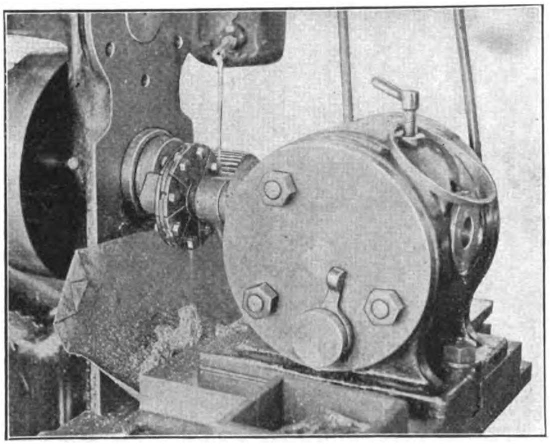


FIG. 15. MILLING RADIUS ON SADDLES. PRODUCTION: 1,500 PER DAY

are first milled as shown by the third one from the left, and then the radius is milled as shown at the extreme right. The milling of the backs is done as shown in Fig. 14. The rough saddles are set into the jig and are located by means of the setting gage A, which is laid over the corner of the jig, and the ends of the saddles butted against it. After being located the clamp bolt is tightened and the gang mill run across.

The radial milling is done as shown in Fig. 15. This is a continuous operation, as the holder revolves all the time. The operator removes the milled saddle as it comes up and clamps in another between the split flanges of the holder.

Numerous burring operations are interspersed at various places between grinding or machining operations. Fig. 16 shows a group of girls busy burring saddles after the milling operations. Fig. 17 shows a boy burring and assembling rings and saddles. Large numbers of both girls and boys are employed for the burring operations at various stages. After the rings have been burred and assembled, they are placed on magnetic chucks and the sides ground to size as shown in Fig. 18. The operators on this operation work in pairs. The first operator grinds one side and passes the ring to the second

FIG. 16. BURRING SADDLES

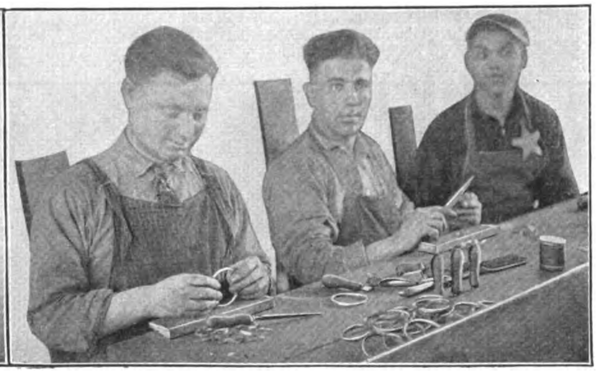


FIG. 17. BURRING AND ASSEMBLING

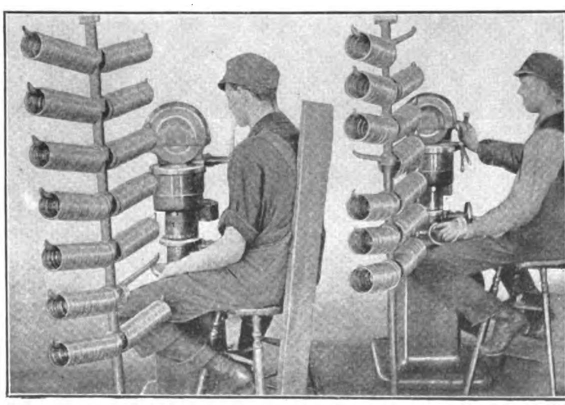


FIG. 18. FINISH-GRINDING SIDES. PRODUCTION: TWO OPERATORS, 1,200 EACH

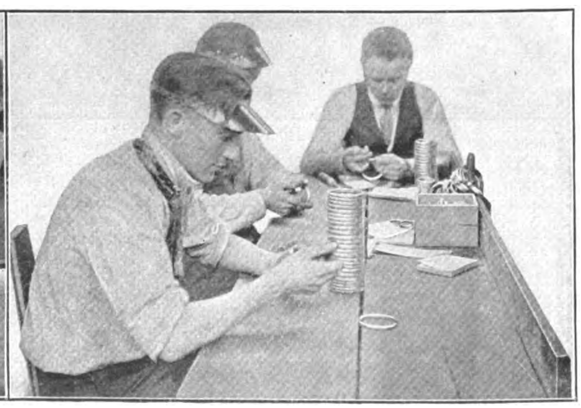


FIG. 19. FINAL INSPECTING, IN WHICH MICROMETERS ARE USED TO INSURE ACCURACY

The ring is compressed into a recess turned in an angle plate and then clamped in with a strap clamp as shown. The two cutters are then fed across.

The saddles are made of pressed metal, and are received as shown at the left in Fig. 13. The "backs"

operator, who grinds the other side and finishes it to size.

After the sides have been finish-ground, the rings are again placed in retaining sleeves and put on mandrels. They are then finish-ground to size on the outside diam-

eter, the saddles of course being in place as they were when the sides were ground. This grinding is practically the same as that for the rough circle grinding, so is not illustrated.

While several inspections have taken place during the progress of the rings through the shop, a final accurate inspection is given them by a group of special inspectors, as shown in Fig. 19. Micrometers are used, and the limits are very close. Many users specify just what radial wall pressure must be given by the rings they buy. To give them just what is called for, a special testing device is used. This is shown in Fig. 20. The ring to be tested is placed against the holder, with the slit to the left. The foot treadle is then pressed, bringing the upper plunger down on the ring. It is pressed down until the test indicator shows it to be the correct diameter, and then the radial pressure is read from the scale below.

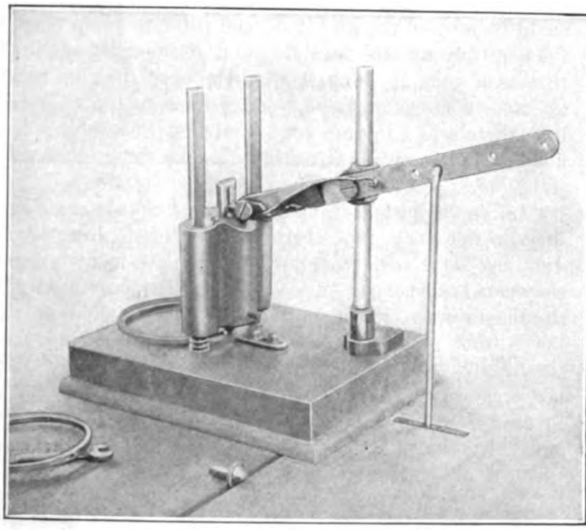


FIG. 21. TRADE-MARK STAMP

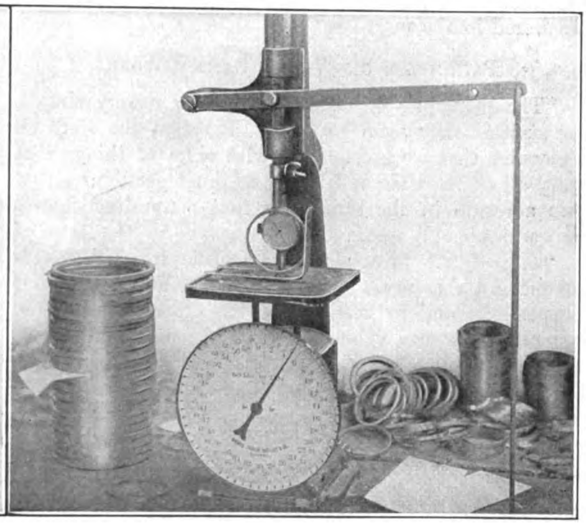


FIG. 20. DEVICE FOR TESTING RADIAL WALL PRESSURE

Small drop hammers like the one shown in Fig. 21 are used to stamp the trade mark on the sides of the rings. As a foot treadle under the bench is pressed down, the hammer head is raised until the dog slips out of the slot, when the hammer drops onto the ring below. As the treadle is released, the end comes down so that the dog or latch again engages the slotted piece on top of the hammer.

Sammy's Shop--Timekeeping for the Foreman

By W. Osborne

Fred W. Taylor started at the bottom of the ladder and reached the top. In doing this he did for the world a wonderful work that might be compared in some ways with the work done by scientists in other lines.

Lately we find on the market some gages that are known as Swedish gages. The workmanship on them astonishes mechanics.

Doctor Brashear does work that is recognized by the great societies of the world as of value in the advancement of human knowledge.

The child and the youth and the man are advised and urged to climb the ladder to the heights, but the fact remains that but few men are able to do the wonderful things.

Some practical fellow tried to analyze genius, and he said that "it is the *capacity* to take *infinite* pains."

An old joke told on a man who had struck oil and had sent a thick-headed boy to school was that when the boy had not made progress and the man was informed that the boy lacked "capacity" the rich man said, "Buy some for him." Old as this joke is, it always gets a laugh.

A friend who had dropped in was doing some "kicking" about the working of the latest cost-keeping system in his shop. He was general foreman.

"The job cost too much, all right. I am not denying that. The cost is away up, and that is wrong. But what are you going to do about it when it is not found out until it is all over but the funeral? Starting at the total and hunting back for the cost of the thing in detail, we found some steel priced wrong by a clerk, and we found too much time charged in by a man who has since quit. Sammy, it is lucky for you that you have a small shop that does not have to have much system. You can carry it all in your head, or most of it, anyway," he added, as he saw Sammy shake his head.

"If you had been able to get your people to look at the principle of the thing right, you should not have had so much trouble," said Sammy.

"What is the use of saying anything about principles?" asked the friend. "I have read articles written by Emerson and by Taylor and by Gantt and by Gilbreth and by Church and by others too numerous to mention, and they all seem all right when I am reading them; but when I try to get our principles and apply them to my own job, where am I? And when I look around and see the mess that a lot of folks make of it in trying to apply them, I feel sure that a lot of other fellows are in the same kind of a fix."

"Why don't you get up a system of your own that will just suit yourself?" Sammy asked in a way that carried doubt as to the answer.

"For at least two very good reasons: In the first place, my job is getting out the work; and in the second place, what is the use of another system gotten out by another man who does not know the principles on which he is trying to build? Now, honestly, Sammy, can you tell me the principles on which you run your own little private system?" queried the friend, as he settled back in his chair and looked at Sammy as though he knew he had asked a question that could only be answered in the negative.

Principles on Which Sammy Works

"The principles on which we work are very simple, or at least they seem so to us. Right at the start we recognize that we are dealing with a lot of things that vary all of the time and that we cannot get figures that are accurate in the same way that accounting figures are accurate.

"One of the principles of scientific investigation is to make a change on only one element at a time, if it is possible, and to keep all of the other elements the same. While you cannot do that if you call the complete job the thing under investigation, you can do it if you cut the jobs into small enough pieces and call each piece a thing under investigation.

"The machine-shop foreman knows that if the time that it takes to do a certain piece has not changed and that the wage that is paid the man is not changed, then the cost, as far as his share in it goes, has not changed.

"As I see it from the shop side of it, if you subdivide your jobs into operations and watch each operation so that the time on it does not increase, without any elaboration you know that the time on the completed machine has not increased. If the time on some operation does change, then the time on the completed machine changes; and by paying attention to those changes it is readily seen which way it has changed and how much.

"Just think of the position of your superintendent, or general foreman, or production boss, or whatever you may call the man who is held responsible for getting out the work in your shop. You put him into a shop with a lot of tools and a lot of men and give him a lot of material and supplies. He is not responsible for the shop's being built and filled as it is and very often is not given authority to rearrange the machines in the shop. The class of men that he has to use and the wages which they receive are often beyond his control. The material is not bought by him. In all fairness, how much should he be held responsible for? While the powers given to such men differ in different shops, yet as a general proposition all that he has it in his power to do is to have the operations performed on the machines best suited for them, by the men at hand who are best qualified to do the operations and in a time that is reasonable."

An Experience with Shop Burden

"I wish that you would come over to our shops and convert our cost department to that view. I was up on the carpet some time ago because some of the work was costing too much. The shop was running on short time. I had a chance to look after things closer than if we had been crowded with work and could not believe that I had been at fault. After they named pieces that they said cost more than they used to, I hunted things up and found that we were doing better on them than the average, but that it was the *burden* that had made the difference." The friend wiped the sweat from his face and continued. "How was I responsible for that burden and why, when they thought that something was wrong, did they jump onto me instead of onto some other one?"

"Don't you understand?" asked Sammy, laughing at his friend's earnestness. "You were there where you could be jumped on, and it seemed safer to jump on you than on anyone else in sight, and it must be admitted that as a general thing it would appear that, as being the man who got out the work, you were the only one that there was to jump on. You see, this subject has not received *scientific* investigation like some other subjects.

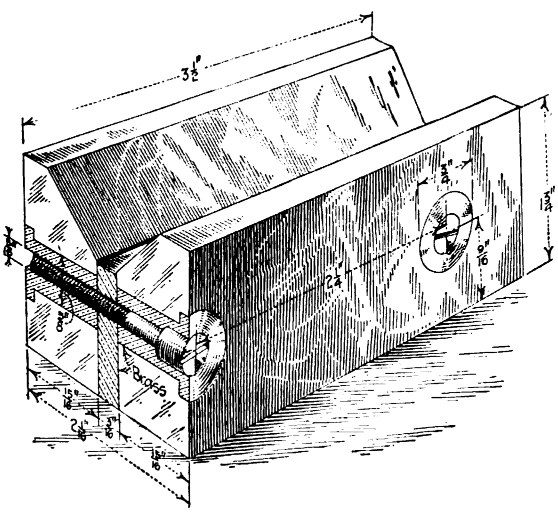
"As long as people think that their methods are right, they do not know that there is anything to investigate. Just the same, my friend, I believe that many a good shopman has lost out on cost-keeping evidence that put the blame where it did not belong. Dig right down to the bottom of these bonus systems and you find that the man has to get the work done in a *time*. The cost keeper should be able to show the shop from the time side in every system, and the shop be judged by that only, and after that the other things should be put on one by one and the rest of the organization judged."

"You want to look out a little, Sammy," said the visitor, as he started out. "You belong in some of the other places too. You may dodge a little trouble in the shop and get a lot more in the office. Mind about the fellow who said something about leaving familiar troubles for a lot that we can't size up until after we are in them."

V-Block for Magnetic Chuck

By J. C. Stuart

A very handy V-block to be used with the magnetic chuck on the surface grinder is shown herewith. Its



V-BLOCK FOR THE MAGNETIC CHUCK

usefulness on round work is readily seen. The block is ground all over after assembling.

Making 1-Lb. Cartridge Cases--II*

By Robert Mawson

SYNOPSIS—In this article are described the remaining tools and operations used in manufacturing the 1-lb. cartridge case. The illustrations give details of the punches, dies and other tools. Rates of production are also included. A novel method of packing is shown—a seamless casket that not only keeps the cases air-tight, thus preventing tarnish, but is also a convenient method of shipping.

After the cases have been trimmed to the 5½-in. length overall, they are washed in a tank containing "Carlsrhue" compound which has been heated to 210 deg. F. They are left in the liquid for about 1 min., afterward being rinsed in hot water, then in cold water. For the heading operation the shells are transferred to the

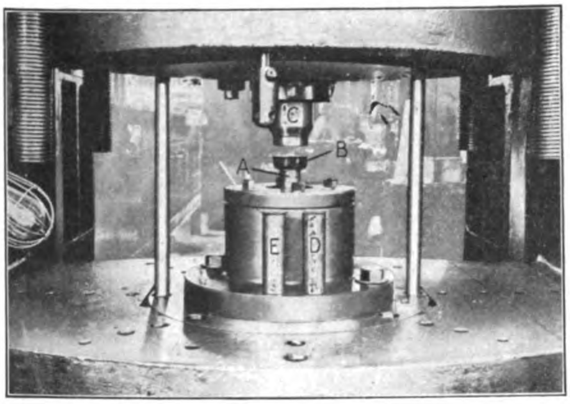


FIG. 45. HEADING THE SHELL

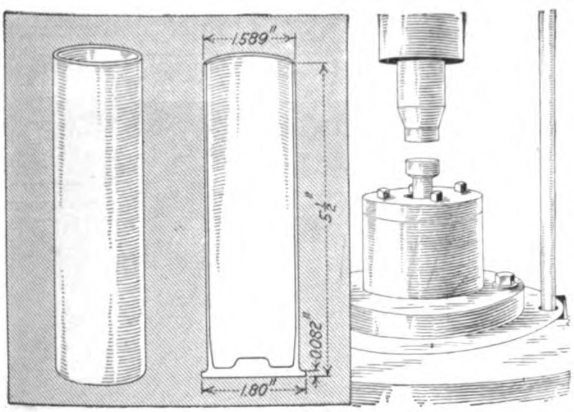


FIG. 46. OPERATION 17: HEADING
Machine Used—Bliss 12-in. stroke press.
Production—400 per hour.
References—Figs. 45 and 47.

machine seen in Fig. 45. The case is placed in the die *A*, and the bunter *B* is put on top of the shell. The punch *C* is then forced down onto the case and, pushing it down, forms the head. One of the shells before heading is illustrated at *D*, and after heading at *E*. The operation is shown in diagrammatical form in Fig. 46. Details of the punch, die, bolster, bunter and knock-out for the heading operation are given in Fig. 47.

The cases are washed in "Carlsrhue" compound, rinsed in hot water and afterward in cold water to remove the grease, as previously described. The cases are then annealed at the open end by dipping in saltpeter heated to about 760 deg. F., in which they remain for 2 min.

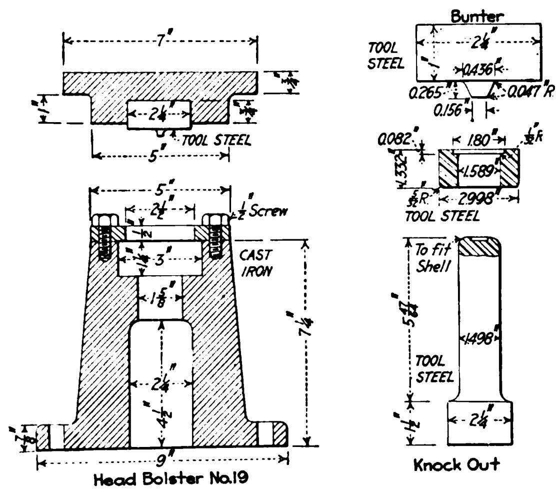


FIG. 47. DETAILS OF PUNCH, DIE, BOLSTER, BUNTER AND KNOCK-OUT FOR HEADING OPERATION

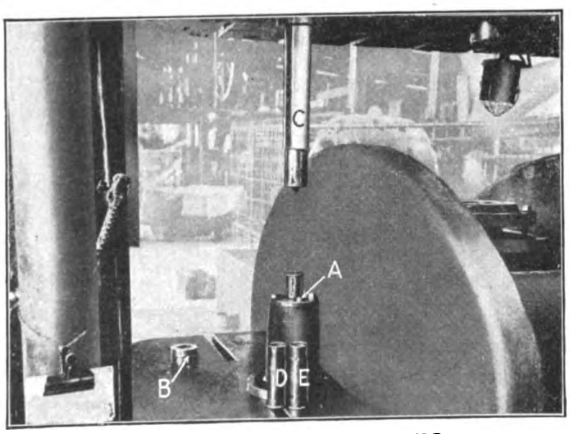


FIG. 48. TAPERING THE SHELL

The next operation is tapering, which is performed with the tools seen in Fig. 48. The case is slid into the die at *A* and the bunter *B* placed on the head. The punch *C* is fed down by the machine, and the case is forced into the die. As the die is made with a tapered surface, a similar contour is produced on the case. One of the shells before tapering is shown at *D*, and one after at *E*. The operation is given in diagrammatical form in Fig. 49. Details of the punch, bunter, die, bolster and knock-out for the tapering operation are shown in Fig. 50.

The shell is then taken to the small turret lathe, Fig. 51, the flange faced and turned to size and the primer

*Previous installment appeared on page 987.

hole roughed out. For this operation the shell is pushed into the chuck, being located against a stop surface. The handle A is pulled over. This operates the chuck, gripping it and holding the case so that it is revolved by the lathe. The tool B in the turret is pushed up by

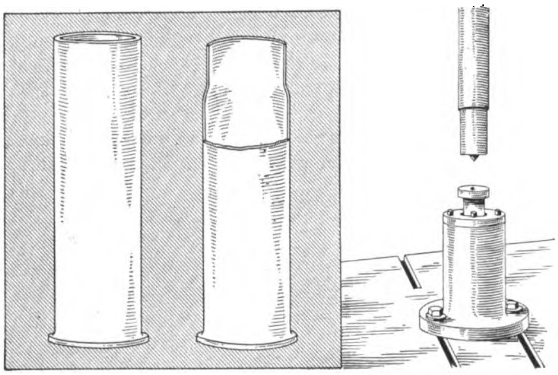


FIG. 49. OPERATION 19: TAPERING
Machine Used—Ferracute 20-in. stroke press.
Production—400 per hour.
References—Figs. 48 and 50.

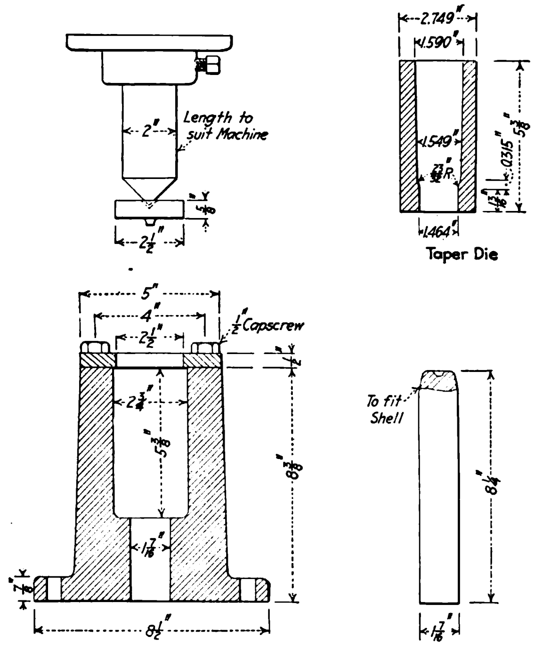


FIG. 50. DETAILS OF PUNCH, BUNTER, DIE, BOLSTER AND KNOCK-OUT FOR TAPERING OPERATION

the handle C, and the primer hole is rough-drilled and counterbored. The tool D machines the inside of the flange and its diameter to size.

The front post E carries two tools, one machining the outside surface of the flange and the other forming the radius in the flange. The tool posts are operated with the handle F. Stops are used on the turret slide and both tool posts, so that the correct dimensions may be obtained. The machining operation is shown in diagrammatical form in Fig. 52. Details of the tools for the operation are given in Fig. 53.

The case is transferred to the drilling machine, Fig. 54, and machined to length. The shell is placed on

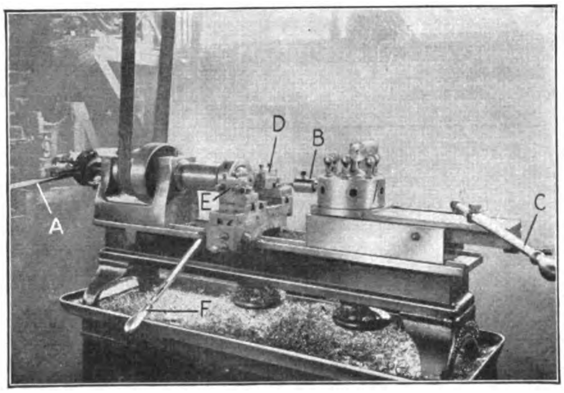


FIG. 51. MACHINING THE FLANGE

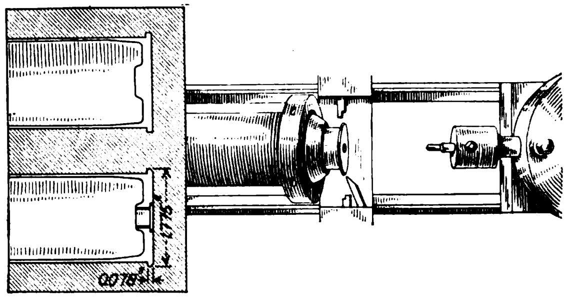


FIG. 52. OPERATION 20: MACHINING FLANGE
Machine Used—Dreses & Windsor turret lathe.
Production—100 per hour.
References—Figs. 51 and 53.

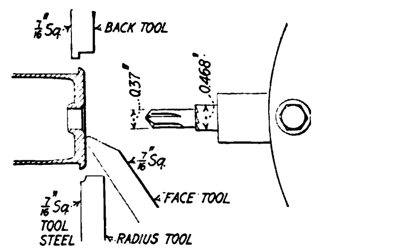


FIG. 53. TOOL SET-UP FOR MACHINING FLANGE

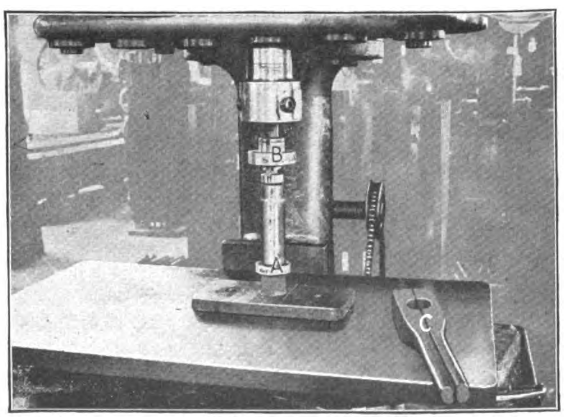


FIG. 54. MACHINING TO LENGTH

an arbor A and, the table being raised to a stop, the revolving tool B machines the case to length. It is held by the operator with the wooden clamp C. The machining operation is illustrated in diagrammatical form in Fig. 55.

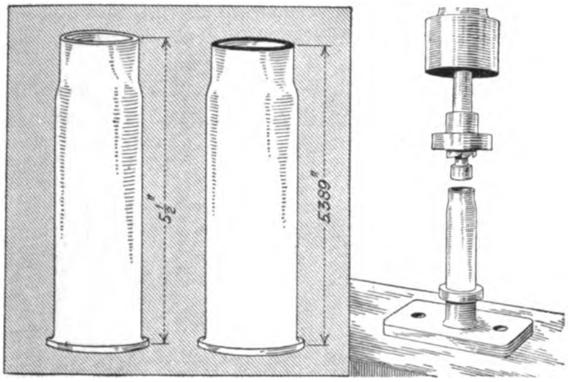


FIG. 55. OPERATION 21: MACHINING TO LENGTH
Machine Used—Pratt & Whitney drilling machine.
Production—200 per hour.
References—Figs. 54, 56 and 57.

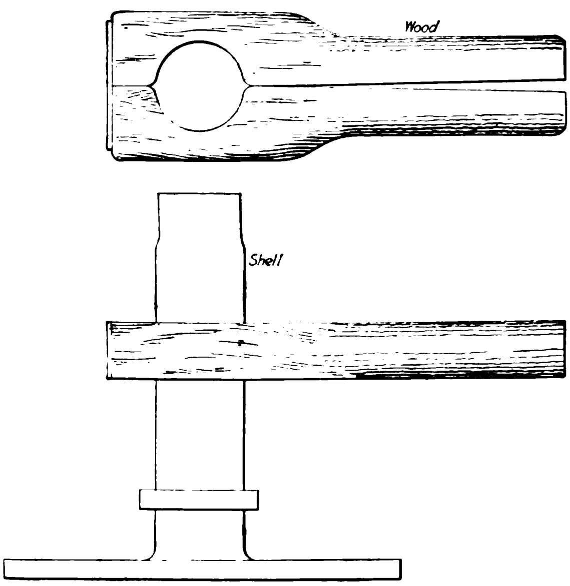


FIG. 56. DETAILS OF CLAMP AND HOLDING FIXTURE

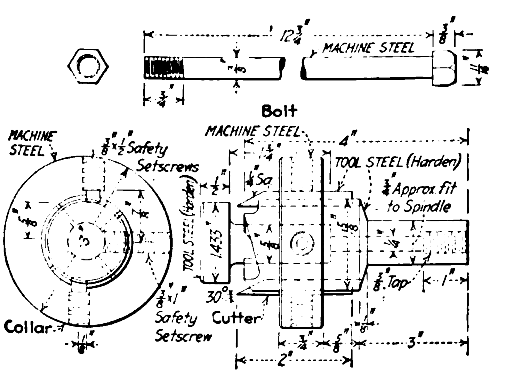
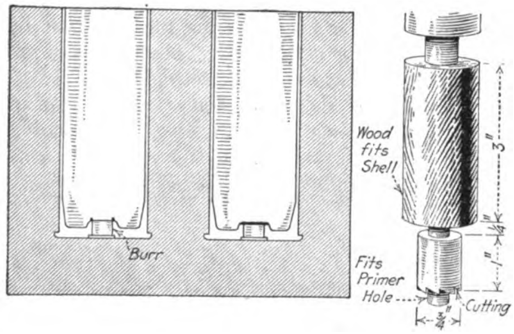


FIG. 57. CUTTER FOR FINISHING SHELL

Details of the clamp and holding fixture are given in Fig. 56, and the cutter in Fig. 57 is used for the machining operation. The inside of the primer hole is burred, as shown in diagrammatical form in Fig. 58. For this operation the case is held in a similar manner to that described for the preceding operation. The fixture and wooden clamp, Fig. 56, and the cutter, Fig. 59, do the machining.

The next operation—reaming the primer hole and forming the recess—is performed on the machine seen in Fig. 60. The shell is held on an arbor, as at *A*. The handle *B* enables the operator to hold and guide the case



FIGS. 58 AND 59. OPERATION 22: BURRING
Machine Used—Pratt & Whitney drilling machine.
Production—300 per hour.
References—Figs. 56 and 59.

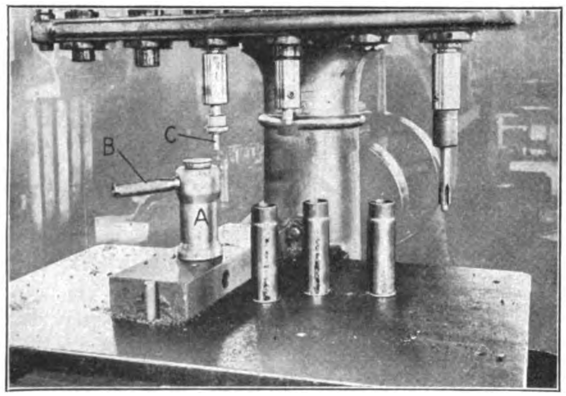


FIG. 60. MACHINING THE PRIMER HOLE

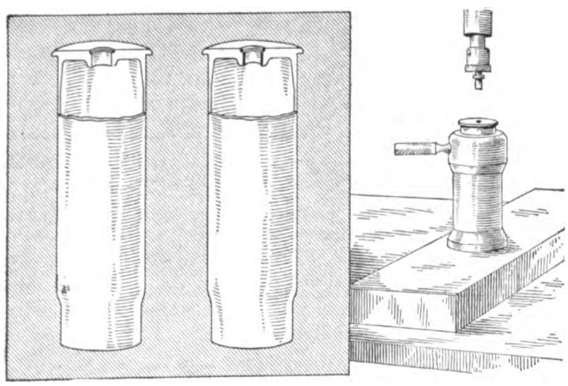


FIG. 61. OPERATION 23: FINISH MACHINING PRIMER HOLE AND RECESS
Machine Used—Pratt & Whitney drilling machine.
Production—200 per hour.
References—Figs. 60 and 62.

under the tools. The primer hole is reamed and counterbored with the combination. The operation is shown in diagrammatical form in Fig. 61.

The combination tool and holding fixture for the machining is illustrated in Fig. 62. The cases are then conveyed to the inspection department for the final ex-

amination. A view of the inspection bench is given in Fig. 63. The various gages used are shown in detail in Fig. 64.

After the final inspection the cases that have been passed are stamped with the foot-operated press seen in Fig. 65. The case is placed on an arbor resting on a steel base, with the head carrying the stamp *A* raised. The operator removes his foot from the rope that holds up the trip, which then descends. The stamp thus marks the end of the cartridge case as desired.

The operation is shown in diagrammatical form in Fig. 66. The cartridge cases are washed to remove the grease and afterward packed ready for shipment. A novel method of shipping the cartridge cases is employed at this factory. The firm was originally in the business of manufacturing seamless steel caskets. These are now being used for the finished cartridge cases.

Each casket will hold 516 cases, which are placed in two trays. Attached to each tray is a board properly spaced to keep the cartridge cases from moving. The advantage of this method of packing is the ease with

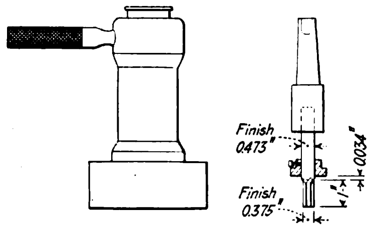


FIG. 62. COMBINATION TOOL AND HOLDING FIXTURE

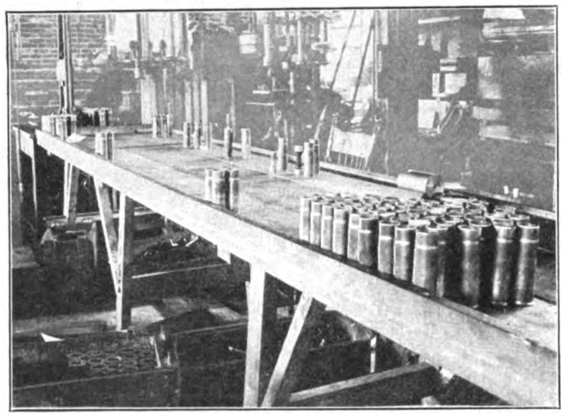


FIG. 63. INSPECTION BENCH

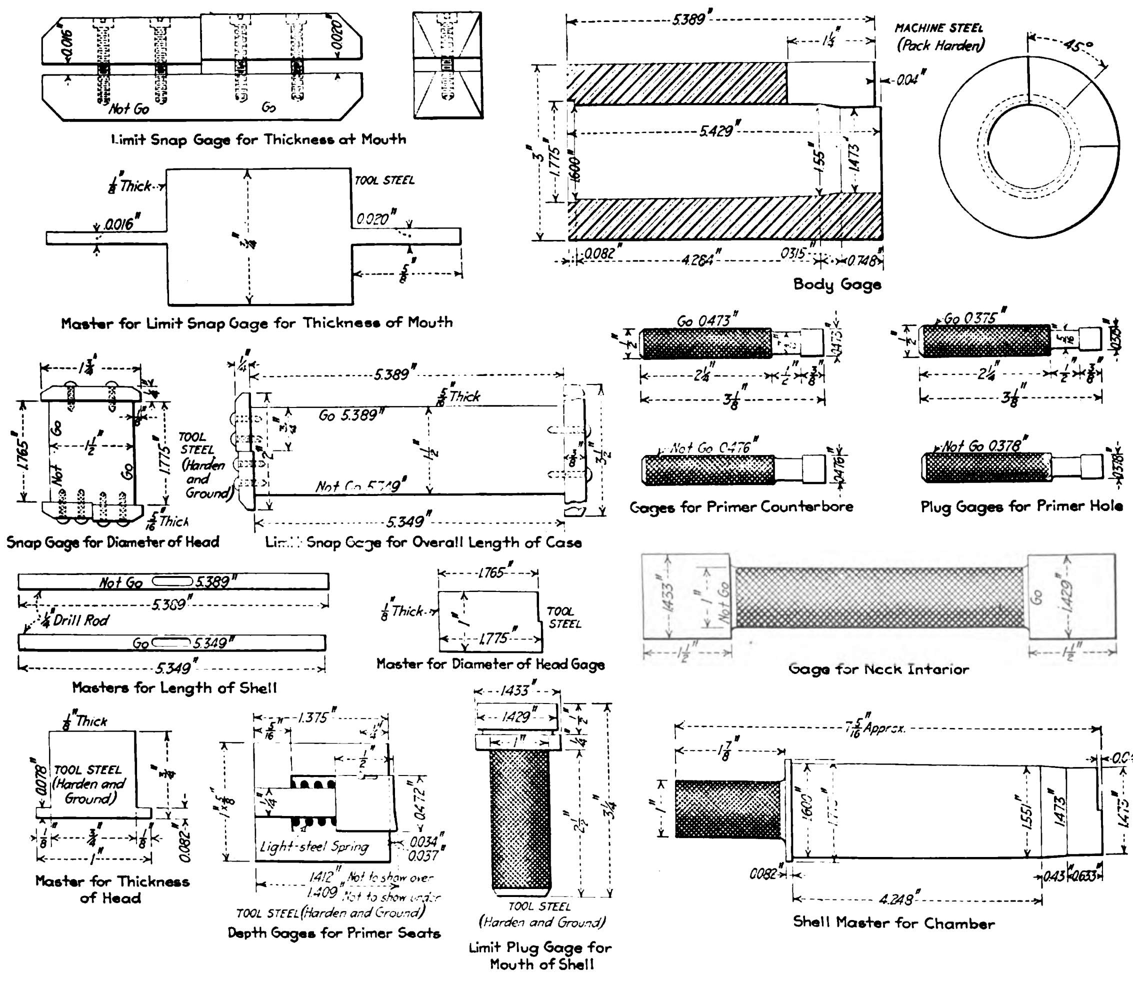


FIG. 64. GAGES FOR TESTING CARTRIDGE CASE

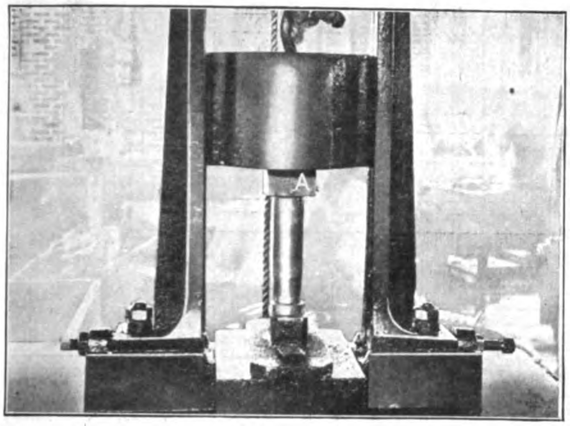


FIG. 65. STAMPING THE SHELL

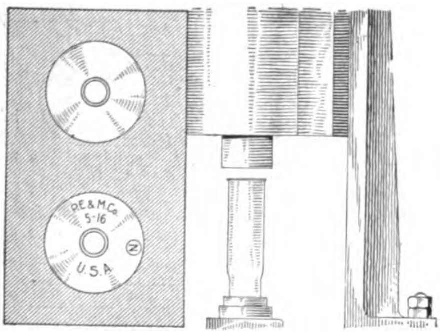


FIG. 66. OPERATION 26: STAMPING
Machine Used—Foot-controlled press.
Special Tools—Arbor and steel stamp.
Production—600 per hour.
Reference—Fig. 65.

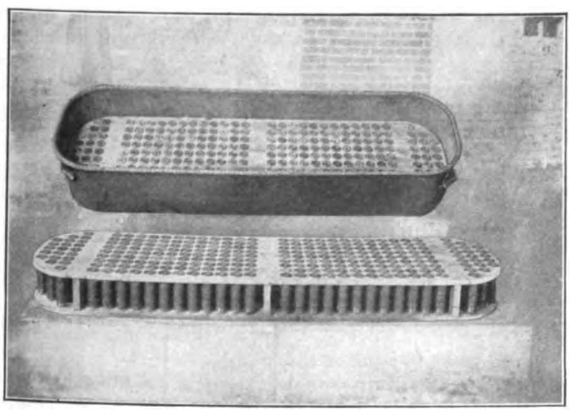


FIG. 67. PACKING CASE FOR CARTRIDGE CASES, WITH CAPACITY FOR 516 CASES

which the cases may be placed in the tray. Further, by removing the trays individually and turning them over, the cases will drop out straight and in a convenient position for forcing the steel projectile in position. Another advantage is that the shipper can readily see when the correct number has been put in, without the necessity of calculation.

One of these caskets is illustrated in Fig. 67 with the upper tray removed, so that the method of packing may be easily observed.

Packing Box for Shells

Packing boxes for shells have been made in almost every conceivable manner. Taking the 3-in. shell as an example, the practice of various manufacturers has been to place anywhere from four to twelve shells in a case. The way in which the boxes are made shows a similar variety, some being quite flimsy and others rather elaborate.

The International Steam Pump Co., Jeanesville Iron Works Plant, Hazleton, Penn., made an extensive study of the question, and the details of the type which it finally adopted are shown in Fig. 2. It will be seen that the box holds eight shells. The approximate weight of the loaded box is 129 lb.

FIG. 1. BOX PACKED WITH SHELLS

The boxes are marked consecutively, and a record is kept so that the actual number of shells exported in each case is known. The specifications for these packing boxes are as follows:

Box to be made of yellow-pine boxing lumber, free from knots and well seasoned; grids of white pine; battens and handle strips of yellow-pine. Sides, bottom, cover and ends to be preferably of single pieces; but, if not, material is to be tongued and grooved. Sides and ends to be jointed and battens to be worked over the joint at each corner. Battens to extend from bottom of box to top of cover, as shown, the upper and lower ends to be beveled to prevent splintering. Strips to be worked in between the battens to facilitate handling, as shown.

External dimensions of box over battens: Length, 10⅛ in.; breadth, 10¾ in.; height (including cover), 11⅞ in. Sides, tap ends and bottom to be of 1⅛ in. thickness net; to be surfaced on both sides. Internal dimensions of box: Length, 16⅛ in.; breadth, 8½ in.; depth, 9⅝ in.

Wood screws to be used in assembling bottom, sides and ends, as shown. In case bottom, side or end pieces are made of more than one piece, at least two wood screws shall be used at each end. All wood screws to be well countersunk; battens and handle strips to be securely nailed to box. No nail heads to enter box; or, if so, must be clinched flush with inner surface.

Grids: Two in number for each box, assembled as shown, and strips nailed together at each intersection, as shown. Nails to pass through both strips with ends clinched. The

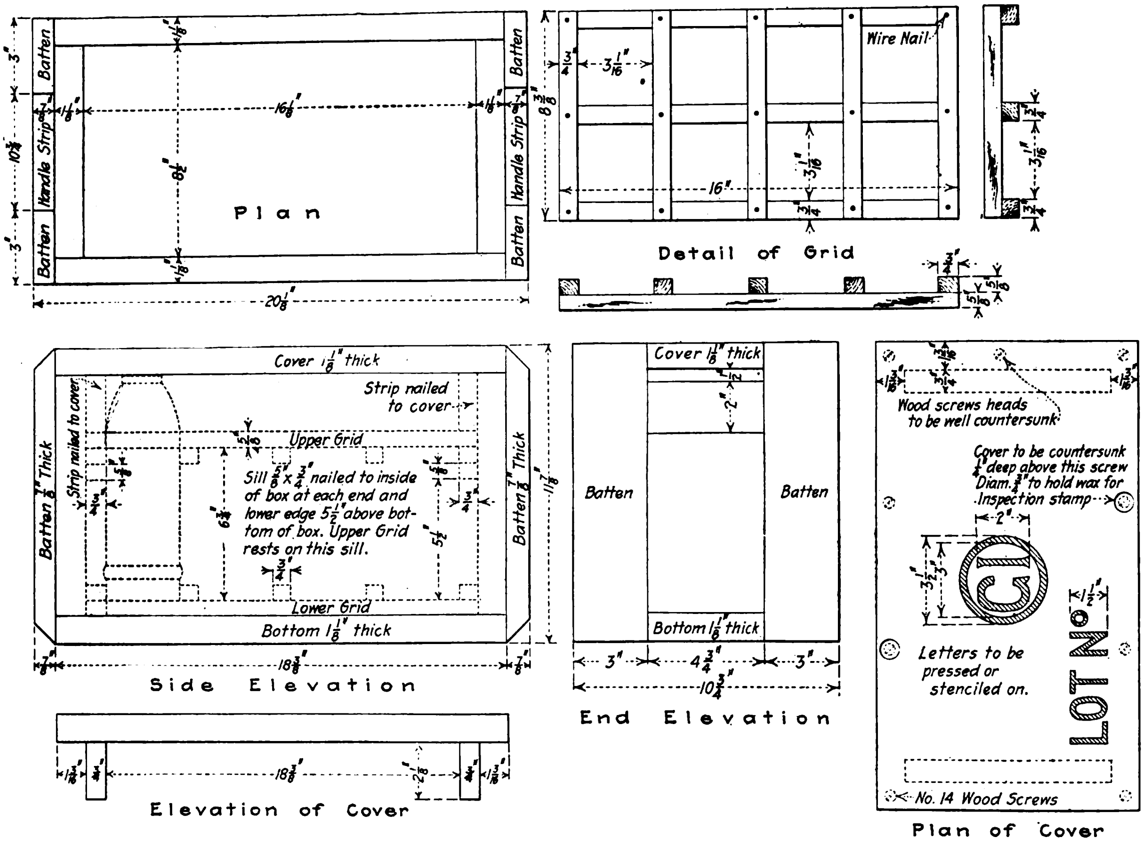


FIG. 2. DETAILS OF PACKING BOX FOR SHELLS

lower grid to be placed in bottom of box, as shown by dotted line, and nailed in place. The upper grid to rest on strips $\frac{5}{8}$x$\frac{3}{4}$ in., marked to ends of box inside, as shown. Lower edge of these strips to be $5\frac{1}{2}$ in. above bottom of box. To hold the upper grid securely in place, strips will be nailed to under side of cover, as shown by dotted lines on cover plan. Length of strips, $8\frac{3}{8}$ in.; width, $\frac{3}{4}$ in.; depth, $2\frac{5}{16}$ in.

Cover: The cover will be secured to box by 10 wood screws No. 14, spaced as shown. Then wood screws will be well countersunk. Two of these screws, shown on cover plan, will be countersunk somewhat more than $\frac{1}{4}$ in.; and above their heads will be worked a cylindrical countersink at least $\frac{1}{4}$ in. deep and of a diameter of $\frac{3}{4}$ in., to hold wax for the inspection stamp. On the cover will be stamped, pressed or stenciled the letter in black.

Bottom: The bottom is to be fastened to box in the same manner as the cover; heads of wood screws to be well countersunk. Sides and ends of the box will be fastened together with wood screws—heads countersunk—at least four screws to a joint. In cases where sides or end consist of more than one piece there shall be at least two wood screws at each end of each individual piece.

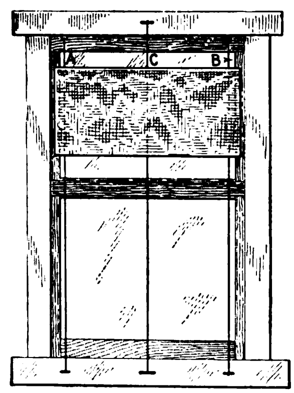
It will be seen from the detail that the shell rests in a grid at the bottom and in another which is attached to the cover. By this means the shells are held rigidly apart, preventing injury. A view of a box packed with shells, ready for screwing down the cover preparatory to shipment, is shown in Fig. 1. In this illustration may be seen the construction of the box and also the design of the grids on the cover.

Brittleness of Annealed Copper was made the subject of a paper at the annual convention of the American Electrochemical Society. The conclusion was drawn that brittleness of copper developed during heating in the process of manufacture and frequently ascribed to "burning" is in reality a deoxidation. With ordinary commercial copper, serious brittleness begins to appear at 400 deg. C. in dry hydrogen, at 600 deg. C. in wet hydrogen.

Light-Saving Window Blind

By J. H. Moore

What is more annoying to anyone working in an office than to have the sun beating directly on one while at work? Of course, to pull down the blind is the remedy, but good strong light is shut off before relief is experienced. The window blind shown in the accompanying illustration was made to overcome this defect and has proved to be a success.



LIGHT-SAVING WINDOW BLIND

It will be seen that the blind is of a narrow type, 14 in. wide, guided by the small wires *A* and *B* and pulled up or down by an endless cord *C*.

The Factory Transportation of Product and Materials*

By W. Rockwood Conover†

SYNOPSIS—The transportation of materials around a factory is a considerable item of expense. The author takes up the narrow-gage railroad, team, electric truck, elevating shop truck and mechanical conveyor, showing where each should be used and giving unit operating costs in some cases.

Transportation about large manufacturing plants constitutes an important item of expense. The old method of handling materials between shops by team and wagon is recognized as both slow and costly. Quick delivery of castings from foundry to machine shop, as well as the prompt unloading of incoming freight and its distribution to the various shops or departments, requires organization along systematic lines. Of equal importance are the rapid transfer of parts of apparatus on which labor is performed in more than one shop and the delivery of the finished product to the shipper.

The location of receiving and shipping departments as nearly central as possible reduces time and distance to the lowest practicable limit. A considerable percentage of bulky incoming goods, such as heavy castings and car lots of one kind of material, will of necessity and for economical reasons be unloaded at the platforms of the shops where they are to be used; but a large portion of the freight received at many manufacturing plants reaches the receiving building or central storehouse for tallying, storing and convenience of distribution.

The best results are uniformly obtained where the movement of materials is organized under the supervision of a superintendent or manager of transportation, whose function is to see to the prompt transfer of materials and shifting of trains in all parts of the plant. He should provide for the shifting of trains at the central receiving department so that the interval of delay is as short as possible. Under normal conditions the time required to make a shift should not exceed an average of 15 to 30 min. This is most important, as any delay at this point not only hinders the distribution of material to the shops, but also involves loss of time by the unloading gang.

The handling of broad-gage cars at the shipping department, and also of broad- and narrow-gage cars at the doors of shops or at platforms, so that materials or finished apparatus may be moved with facility and without delay, is equally important. The placing of cars at or within shops in large industrial plants is often a serious problem. Several departments frequently require cars for loading apparatus at the same time; and as often happens, the necessity for moving the material may be equally, or nearly equally, important in each case. Often the trackage at these shops is already occupied with cars containing incoming materials. Prompt action and judgment on the part of the superintendent of transportation are required to handle all these situations, which are constantly coming up, to the satisfaction of those who are being served.

It is necessary that the department foremen give their coöperation and direct the loading and unloading by the floor-labor gangs within their shops so that the work is accomplished in the shortest time practicable. Demurrage charges, which in many instances are unavoidable, are frequently the result of a lack of interest and attention on the part of those who should hold themselves responsible. In plants covering a large acreage, with numerous buildings, a division of the work into sections will render collection and distribution of materials much simpler, and the rapid movement of supplies will be greatly facilitated.

It is also advisable to provide some form of signal at the front of each shop to indicate to the train crews that service is desired in the hauling of either loaded or empty cars. The superintendent's office should be connected by telephone with all shops and departments, in order to afford quick notice of service required and also to provide for prompt action and remedy in the case of complaints or delays.

Careful attention should be given to the transfer of raw materials between the central receiving building and the various shops, as well as to the transfer of partly finished goods between departments, in order to avoid the delay and loss resulting from the delivery to wrong points of parts required for immediate production. This detail in frequent instances is of serious moment. In the hurry of business such materials may be thoughtlessly taken into stock, and only after long search and expenditure of time and labor are they located and returned to the proper department. The foremen in charge of the several departments should instruct each of their assistants to report immediately any articles received for which they have not already in possession the proper shop orders.

Moving Materials by Narrow-Gage Car System

The narrow-gage car system in general affords a rapid and satisfactory method of transportation about large plants for all classes of material, where the tonnage of individual pieces of apparatus or packages falls within appropriate limits. The adaptability of this system to short curves and narrow avenues, as well as to entering shops, renders it practicable and possible to reach nearly all points of the plant. It hardly need be stated that the electric-operated system is more practical than the steam operated and far more economical than the old method of transferring materials by team.

The cost per ton-movement, or per ton-haul, under the electrically operated system should not exceed 4½c. This cost should include the wages of the crews (motormen and helpers), cost of electric power for operating, repairs to motors or locomotives and cars, the necessary motor and car supplies, such as oils, etc., as well as the maintenance of tracks and overhead equipment. Among these items will necessarily also be included a charge for depreciation and also a fair proportion of the expense of superintendence of transportation. It does not include the time of loading and unloading cars, which labor is separate from transportation and is usually performed by the crane oper-

*Prepared for the author's forthcoming book on "Industrial Economics."

†Factory economist, General Electric Co.

ators and followers, the freight handlers in the receiving and shipping departments and by the floor-labor gangs of the several shops.

In certain lines of manufacture a large percentage of the material moved by the narrow-gage system will be heavy castings or packages of large size, which will be handled by crane operators and followers. The time occupied in loading and unloading this class of goods will be relatively less per ton than for lighter articles and smaller packages, which are loaded and unloaded by hand. It may be assumed therefore that the expense of handling will under normal conditions average approximately 2½c. per ton. The cost of this part of the labor should not exceed this figure, and the total expense of transportation, including loading and unloading, will therefore be 7c. per ton-haul under this system.

The average load per car for each haul should be between 5 and 7 tons, depending on the class of materials handled. When the pieces are castings, the average load will not be less than 5 tons; and on other goods it may reach an average of 7 tons.

Cost of Trucking by Team

The maintenance of trucking teams varies somewhat in different localities, necessarily affecting the cost per ton-haul of material under the old method. The average expense per year for operating a team and truck, including wages of teamster and helper, cost of feed, repairs and renewals to harness, wagons, shoeing, veterinary service, depreciation of wagons and trucks, etc., should not exceed $1,850, and under favorable circumstances may sum up as low as $1,600.

The class of materials usually hauled by team varies almost without limit, but in manufacturing plants in general throughout the country the average load will come within the limit of 2 tons. In plants of large acreage, 8 to 10 hauls per day may be adjudged a fair day's work for a team. The total distance traveled will average 8 to 10 mi. per day. If we consider the limit of 2 tons as the average of all hauls and 10 hauls as a day's work, the cost per ton-haul will be at least 27c., or nearly four times that by the narrow-gage electric system. It is reasonable to assume, however, that in the hauling of miscellaneous materials about factories by team the average weight of individual loads will more frequently approximate 1 ton to 1½ tons, and under these conditions the cost per ton-haul will be proportionately greater.

In comparing the cost of transportation of materials by the narrow-gage electric system with the old method by horse trucks I am considering plants covering an area not exceeding 100 to 125 acres in extent and am allowing for the operation of approximately 300 cars. It is evident in any such comparison that the acreage of the plant, number of miles of trackage, as well as number of cars operated, will materially affect the cost per ton-haul.

Economy of Electric Trucks

Electric trucks are valuable for rapid service about manufacturing plants for transferring goods from the receiving building to the various shops and for delivering material between shops as well as to the shipping building, express offices and railroad depots. These trucks will average at least 15 to 20 mi. total haul per day, not less than 10 tons of miscellaneous small pieces and a much greater tonnage of heavy articles for a day's work. They are specially adapted to the hauling of loads up to 3 tons' weight, where quick transfers and deliveries are essential.

The initial investment cost is lower than that of gasoline trucks, as is also the cost of operation and maintenance. Some types of storage batteries give a service of 30,000 to 40,000 mi.; and because of the fewer and simpler mechanical parts to get out of order, the amount spent for repairs to the truck is relatively lower. The cost of operation should include the wages of motorman and helper, expense of charging batteries, necessary repairs, supplies, etc., and this sum will vary considerably in different localities under different conditions as to cost of materials, service, etc.

The utility and economy of this method of transportation in comparison with trucking by team are self-evident in the rapidity and convenience with which materials can be transferred from point to point and in the reduced cost per ton-haul. Where a limited number of long hauls are made, the total mileage may be increased, while with short hauls the mileage will be greatly reduced, provided the average time of loading and unloading is approximately comparable in both instances. The character of materials hauled and the time required for loading and unloading will naturally affect the amount of business handled in any given period as regards both mileage and tonnage.

It is evident therefore that the manufacturer about to purchase an equipment of trucks should carefully consider the nature of the materials to be handled, the length of hauls and size of loads, as well as number of hauls it is desired to make per day, in order to select such capacities of trucks as will give the greatest efficiency and service at the lowest maintenance cost. This is an important point, which is apt to be overlooked in seeking a low initial expenditure. It has much to do with the final question as to whether the transfer of material by electrically operated trucks is economical and advantageous in the large degree that it should be.

Various Types of Hand Trucks

The equipment for plants manufacturing a variety of product, moving articles ranging in weight from very light to very heavy and making hauls of various lengths should consist of several or more trucks of varying capacity. It is obviously poor economy to operate large trucks of several tons' capacity for short, rapid hauls of light materials. In like manner the small-capacity trucks should not be used for the longer hauls of more or less heavy pieces.

The amount of service obtained in a day or a given period will necessarily depend in no small degree on the care and skill of the operator, and this, too, will affect in a large degree the life of the truck itself. In renewing or changing batteries the new battery should be put on the trucks that are making the longest mileage, and the partly worn-out batteries should be transferred to trucks making the shorter hauls and more frequent trips, where possible to do so. Some of the plates of batteries that have been removed can still be used in partly consumed batteries, thus greatly increasing their life and reducing the cost of maintenance in a very appreciable degree. The truck that receives the best care and attention, no less than the horse, will give the best economic results, other things being equal.

Hand elevating transfer trucks adapted to running beneath small platforms or boxes constructed upon lateral,

upright support pieces serve a valuable purpose in the moving of materials from one machine to another between operations or in transferring parts about shop floors or from one building to another. The trucks are so constructed that they can be pushed or backed beneath the platform, box or crate by the floor laborer. When the trucks are in proper position beneath the load, lowering the truck handle to its proper position for hauling the material to its destination lifts the load sufficiently to clear the shop floor. The manufacturers claim a marked saving in floor-labor expense by the use of these trucks, and their claim appears fully justified. Under this system the machine operator piles his castings or materials upon the platform or puts them in the box or crate, thus eliminating entirely the necessity of repeated rehandling by the shop-labor gang. Under normal conditions a laborer with one truck should serve not less than 80 to 100 platforms, and frequently one truck will take care of the handling of over 100. The number will depend upon the frequency with which the materials have to be moved between machines or from one section of the department or factory to another.

Accumulating trucks also perform a valuable service in the collection and transfer of materials. They are constructed with two or three tiers of trays on which to place all the parts for assembling a given piece or type of apparatus. These trucks are operated between the stockrooms and the assembly floor.

Material stands, composed of two or more trays for holding productive work, facilitate the moving and handling of articles between machine tools and benches or various parts of the shop floor. They should be constructed with wheels or casters, so that they can be transferred from one point to another with ease by the labor gang.

Advantages of Mechanical Conveyors

The economical advantage of mechanical conveyors is so generally known that no statement need be made in their favor. Where certain kinds of material are to be transferred at short intervals or continuously across open areas or courtways between the various shops or departments of a plant, the utility of the different types of belt or bucket conveyors has long ago been demonstrated. In the work of unloading coal, sand, cement or other supplies of a similar nature received in bulk or carload and transferred to storage piles or storage houses the conveyors are of especial value. Moving platforms can be installed in some factories for conveying materials between different points or along machine and assembly floors, thus eliminating the necessity of employing large floor-labor gangs.

Electric locomotives on the broad-gage system are of great worth in making hauls to and from sidings and in cases where definite, regular classes or kinds of productive goods are to be handled. For short shifts, also, or the placing of a limited number of cars and for the handling of irregular classes of work under special and difficult conditions the electric locomotives are not only giving excellent service, but are proving fully equal, if not superior, to the steam locomotive.

The wage of operating crews, it is apparent, should approximate closely the scale of wage on the narrow-gage electric system, while the expense for repairs in the present state of perfection in electric-locomotive building is relatively small, as is also the cost of supplies.

This type of broad-gage motive power is coming more and more into general use in large plants as the manufacturer is becoming more familiar with its economic advantages and utility.

In any system of transportation the providing of proper facilities for loading and unloading will be recognized as a most important factor in obtaining adequate or satisfactory results. Platforms should be placed at convenient locations near shops, storage sheds, warehouses and casting floors, so that materials may be transferred into and out of cars with as little handling as possible. Inclined approaches to platforms that are raised above the ground or floor level of the shop are a necessity where the materials have to be conveyed to or from the platforms by trucks.

The means for loading and unloading should also include a sufficient equipment of cranes of such types as are adapted to the specific conditions, in order to handle materials rapidly and save delay or stoppage in the movement of either cars or electric trucks. Overhead cranes of ample tonnage capacity are essential in conveying heavy castings or other bulky articles from point to point along the storage platforms or open storage areas, whenever it is desirable to pile these materials in stock until required for use.

Repairs to Rolling Stock

Repairs to locomotives and cars deserve consideration. These repairs generally constitute a large item of expense. Short curves, often required in laying the tracks around buildings and in carrying the shorter contributing lines into narrow areaways or shops, are frequently a source of trouble and accident. The placing of empty flats or lightly loaded cars between cars loaded with heavy machinery or castings should be avoided as far as possible. Even where reasonable care is exercised by the engineer or motorman in the handling of his trains, the shunting of the cars together in the rapid movement of goods often results in derailment of those lightly loaded and sometimes of those carrying heavy freight. These accidents not infrequently occur at switches and cause damage either to the cars themselves or to the tracks, with the consequent delay in the movement of materials and also the cost of repairs. The danger of breakage to fragile pieces that are being transported from one point to another has also to be considered.

While a considerable percentage of the renewals is the necessary result of legitimate wear and tear, the handling of the rolling stock should receive careful supervision and the cost of upkeep be brought within the lowest limit consistent with the demands of rapid service. The building devoted to the housing of locomotives should be of sufficient size to provide for a repair department, with necessary trackage and pits and a proper equipment of tools to keep in first-class shape both the locomotives and the broad-gage as well as narrow-gage cars. Sufficient space should be provided for carrying a stock of parts in such a convenient way that repairs can be rapidly made with facility and economy. The office of the superintendent of transportation is located in this building, which makes it possible for him to see that the work of keeping the transportation equipment in good condition progresses properly and without delay to the service.

The maintenance of broad- and narrow-gage tracks, especially during the winter months, also adds to the cost of transportation. The melting snow from roofs,

together with that which falls on the surface, at times renders difficult and costly the work of keeping clear the tracks through narrow areaways between buildings. In those narrow places the tracks should be raised above the surface as far as practicable, the shop roofs should be provided with suitable gutters, and a series of catchbasins and drains should be installed to carry off the surplus water. The expenditure necessary for these improvements will be found in most instances to represent a good investment.

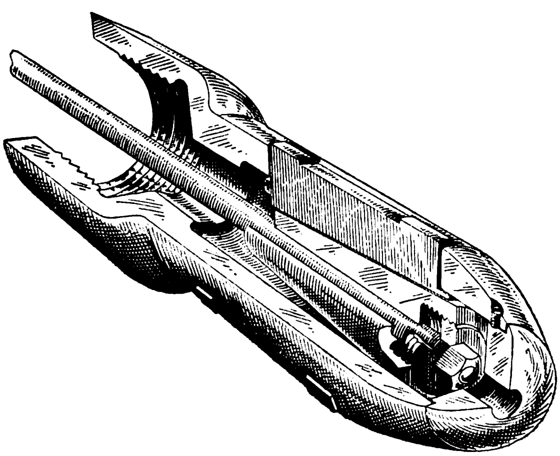
In a majority of plants there is a greater or less extent of trackage that lies below the adjacent ground surface and that is in consequence a constant source of expense. Even during the summer months the wash of earth and refuse caused by heavy rains makes it necessary that the switches receive frequent and special care. The labor of clearing these tracks is usually charged in with repairs or other yard expense, and by reason of this fact the matter does not commonly receive the full amount of attention that the subject merits. A moderate outlay for betterments will frequently save the manufacturer no inconsiderable yearly loss.

Expanding Mandrel for High-Explosive Shells

By John S. Watts

The illustration shows a mandrel devised for holding the British 4.5-in. high-explosive shell while rough-turning the body and finishing the base to thickness. This mandrel has been used successfully for over six months.

The chuck is operated by a 6-in. double-acting air cylinder attached to a ¾-in. rod passing through the hollow lathe spindle. It could of course be tightened



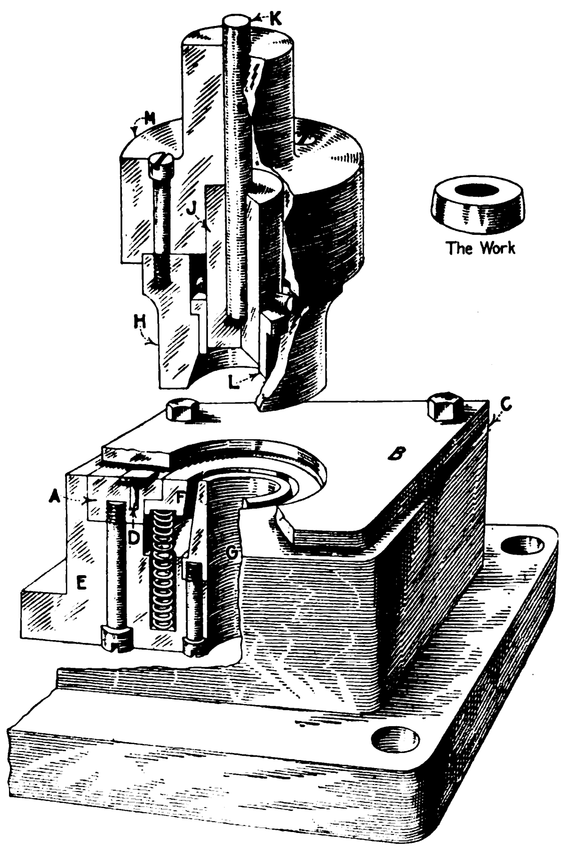
EXPANDING MANDREL FOR SHELLS

up by means of a handwheel on the back end of the lathe spindle, where compressed air is not available. The screwed bushing in the end of the sliding piston is to make it easy to adjust the position of the sliding piston longitudinally without having to disconnect the air cylinder. The mandrel itself is threaded to screw on the nose of the lathe spindle, so as to make the overhang as short as possible.

One-Operation Punch and Die for Making Ferrules

By Nicholas Ernzer

The tool shown was designed for making ferrules in one operation. The stock, which is 0.015 in. thick, is passed over the die *A*, under stripper *B* and held against the gage *C* at the back side of the die and also against the stop pin *D*. The stripper and gage are held down by two $\frac{5}{16}$-in. fillister-head screws tapped into the die, which is sunk into the shoe *E* and held by three $\frac{5}{16}$-in. fillister-head screws. It has a shoulder that keeps the spring pad *F* in place, allowing it to move down when a ferrule is being formed over the piercing die *G*, which



COMPOUND-TYPE PUNCH AND DIE FOR MAKING FERRULES

permits the slug to pass down through the bolster. The element *G* is sunk into the shoe *E* with three $\frac{3}{16}$-in. fillister-head screws to hold it in.

As the operation of cutting and forming with *H* is nearly completed, the punch *J* pierces the ⅞-in. hole in the ferrule and carries it to the top of the stroke, and the knock-out pin *K* strips it off the punch. With the press tilted back, the ferrule will readily drop free of the die.

The knock-out pin runs loose inside of the piercing punch, which is slotted to allow the $\frac{3}{16}$-in. pin to come in contact with the collar *L*, which in turn moves up when the ferrule is being formed and therefore does not cause any interference.

Tools Used for Machining Automobile Details

Editorial Correspondence

SYNOPSIS—In this article are shown some of the jigs and methods used in machining automobile details. The machine for boring the crank case is fitted with stops against which the fixture is placed in boring the crankshaft and camshaft holes. A planing machine that has been converted into a miller is also interesting. A miller on which an attachment is fitted for keyseating is worth noticing. Some aluminum jig templets are illustrated.

The Dile Motor Car Co., Reading, Penn., has a number of interesting tools for machining automobile details. In Fig. 1 is shown the machine for boring the bearings in the crank cases. The casting is located by dowels that fit into holes previously machined. It is held securely with clamps.

The head carrying the boring tools is fed down and also revolved by gearing driven by the pulley *A*. The table-feeding mechanism may be thrown out of mesh by a clutch operated with the handle *B*. The heads may then be fed by hand by the handwheel *C*. It will be seen that two stops *D* are fastened on the table. The fixture holding the casting is pushed against the stop, as shown, and against the stop *E* for machining the main and cam bearings respectively. The average time for boring the crank case is 30 min.

In Fig. 2 is a planer that has been changed over and is used as a miller. The casting is fastened on the table,

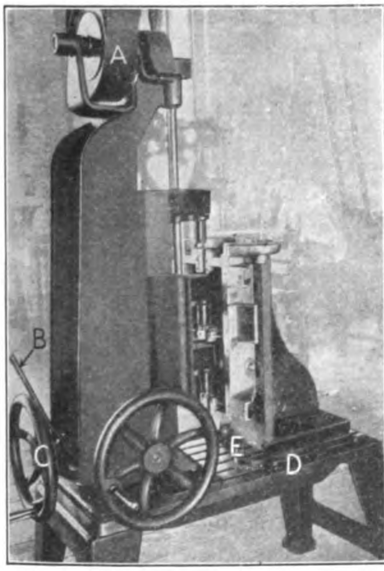


FIG. 1. MACHINING CRANK CASES

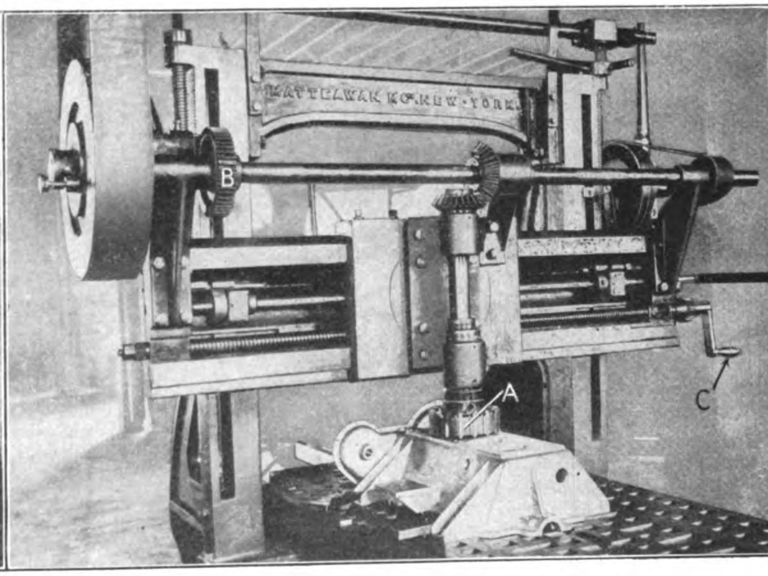


FIG. 2. PLANER CONVERTED INTO A MILLER

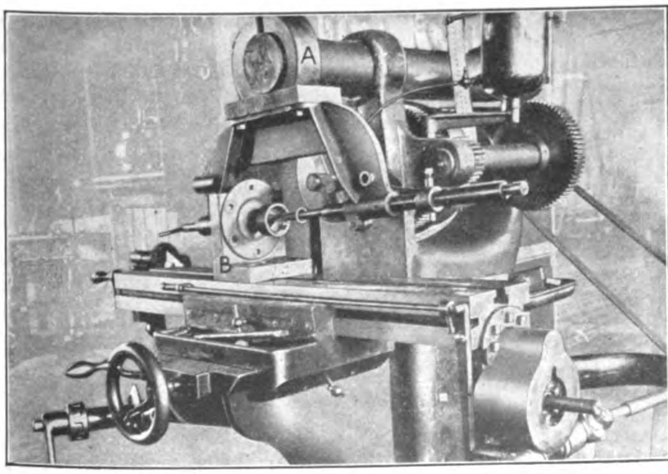


FIG. 3. KEYSEATING ATTACHMENT

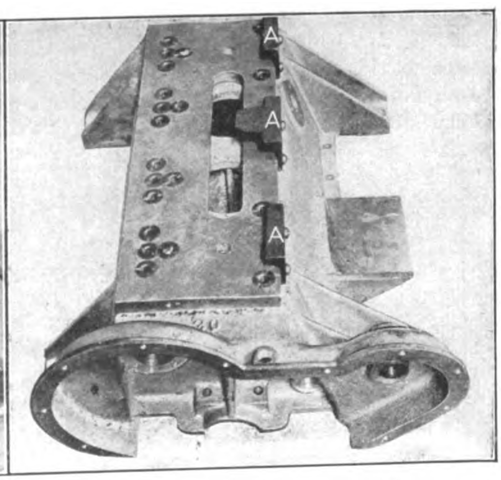


FIG. 4. JIG FOR CRANK CASE

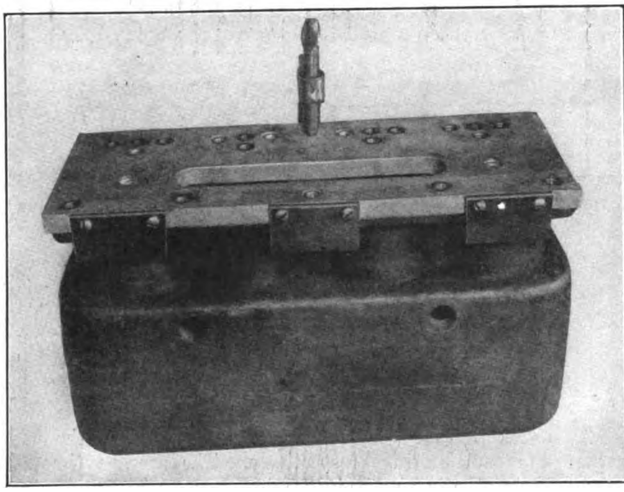


FIG. 5. DRILLING THE CYLINDER

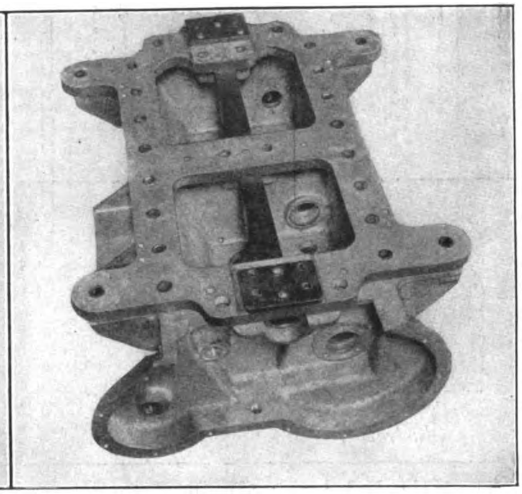


FIG. 6. DRILLING JOINT SIDE OF CASE

as shown. The milling cutter *A* is driven through bevel gears. The adjustment of the cutter is obtained through screws and nuts, the motion being received through the gearing *B*. The head is moved across the table with the handle *C* operating the screw shown.

In Fig. 3 is an attachment fitted to a miller for cutting keyways. It is fastened to the arm at *A*. The part to be machined—in this case a rear hub—is attached to a fixture *B* on the table. The bar *C*, carrying the correct size of tool, is held as shown. As the table carrying the part is fed along, the tool machines the desired keyway. An advantage of this method is that it machines not only straight splines, but also keyways with any degree of taper. To obtain a tapered spline, it is only necessary to slide around the attachment at *A* to the desired angle.

In Fig. 4 may be seen the jig templet used in drilling the cylinder side of the crank. The templet is placed on the milled casting, being located by the ears *A*. The various holes are then drilled through the bushings shown. The jig is reversed as in Fig. 5 for drilling the cylinder, being located again by the stop plates. With this method the holes will be in alignment with each other in the crank case and cylinder.

The jig for drilling the joint side of the crank case is seen in Fig. 6. The jig is located by pads that are set into the bored hole of the crank case. A rather novel feature of these jigs is the fact that aluminum is used in their construction. This material has been found satisfactory and has also the advantage of being much lighter than regular cast iron.

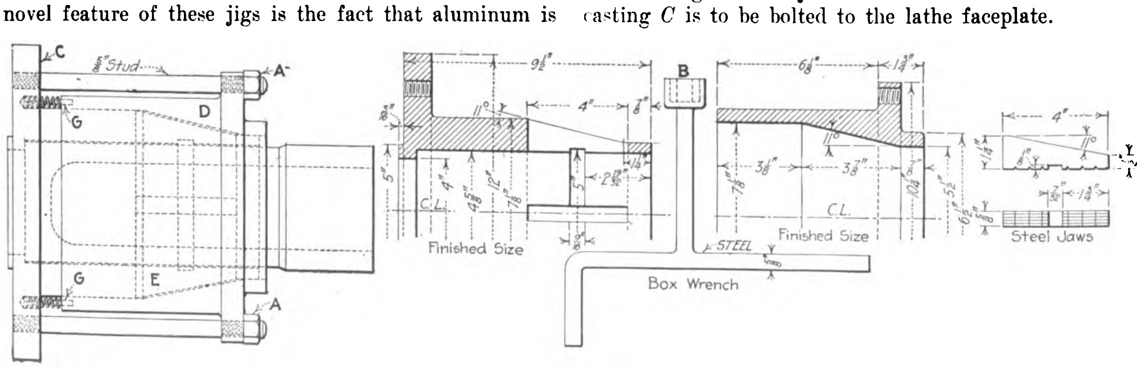
Nonslipping Shell Chuck

By H. P. Hoag

One of the annoying things in most shell shops is the slipping of shells as they are held for boring in the standard lathe chucks. After a careful investigation of this problem the chuck in the illustration was brought out. It is giving entire satisfaction on the 4.5-in. shell, as it will hold without slipping against the heaviest cut either on a rough or a finished shell. Not only is this chuck cheap to make and maintain, but it is quick to operate—simply tighten two hexagonal nuts *A* with the crank wrench *B*.

The chuck body *C* and the outer movable sleeve *D* are both made of close-grained cast iron. The hardened tool-steel jaws *E* are held in place by a clock spring. Should the chuck get out of alignment, it is only necessary to remove one of the jaws and grind off the back enough to make the work come true again. Two small springs *G*, between the main casting and the outer sleeves, keep the sleeve back against the tightening nuts.

One interesting feature of this chuck is that, should the back of the jaws wear into the movable sleeve *D*, two more holes may be drilled in the flange of the sleeve, which is thus moved around by the tightening studs to a new bearing for the jaws. It will be noticed that the casting *C* is to be bolted to the lathe faceplate.



DETAILS OF A NONSLIPPING SHELL CHUCK FOR USE IN THE LATHE

Letters from Practical Men

Progression Punch and Die

The illustration Fig. 1 shows a die that should be of interest to readers. The die and punch are shown at *A*, a section of the strip with the operations in sequence at *D* and three of the finished blanks at *C*. These blanks consist of a flanged cup with three perforations. The flange is $1\frac{3}{8}$ in. in diameter. The cup is $\frac{3}{4}$ in. in diameter by $\frac{1}{2}$ in. deep and is perforated with an $\frac{11}{32}$-in. hole. The flange has two $\frac{3}{16}$-in. perforations. In Fig. 2 is shown the lower half disassembled.

Buffalo, N. Y. F. C. MASON.

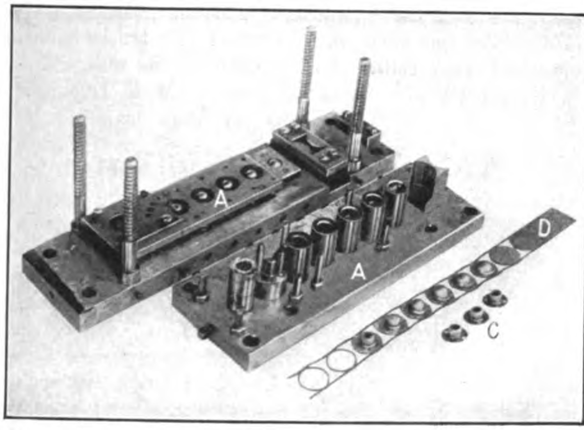


FIG. 1. PUNCH AND DIE AND PART PRODUCED

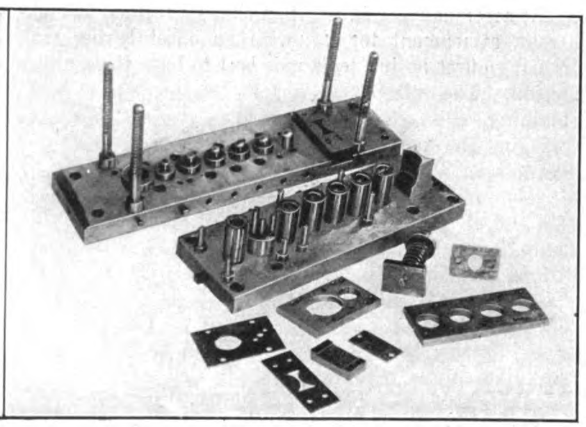


FIG. 2. PUNCH AND DIE DISASSEMBLED

Promoting the Right Man

I think that the methods used by various managers and superintendents in selecting department heads and substitutes would be of value, if related in the *American Machinist*. I am prompted to write this after seeing several what I call foolish promotions. These were generally made because the man advanced was thrown more in contact with the superintendent, or man with promoting power, than the rest of the men. My own experiences strengthen this belief.

I was working in a shop on a large special job that took about five months. It was not complicated work that needed any special skill; any good tool maker could have done it. It was out of the ordinary for this shop, so that the superintendent took particular interest in it and stopped very often to look it over and talk to me, which he was not in the habit of doing with the rest of the men. He therefore got better acquainted with me than with anyone else in the room.

Shortly after this job was finished, it became necessary to put on a night force in the machine room. This force consisted of 100 men, all but three or four of them green at our work. I was made general foreman of this force, over the heads of men who had been there several years longer than I and who had considerably more experience, some of them having been foremen in other places.

I received this promotion because, when the superintendent found himself up against it for a foreman in a hurry, his thoughts turned to me, simply because of our recent conversations over that special job. Of all the men in the toolroom I was foremost in his mind. There were several men better fitted for the position than I, right there before his eyes, but he could not see them. I have seen so many instances of this same kind of promotion that I am convinced it is often done.

When I was a young man, I worked beside a fellow whom I will call Tom. He was an exceptionally good man and I was very chummy with him, though he was ten years my senior. I worked beside him for about five years and knew his good and bad points.

About two years after leaving this shop I found myself superintendent of a shop and in need of a foreman. My first thoughts were of Tom. I had a foreman who was recommended by Tom's superintendent, but it became necessary to dispense with him. So I went up to Tom's superintendent and said, "I have come to swap you a poor foreman for a good tool maker." "Do you think Tom would make a better foreman than Frank?" he asked. "I know he would," I replied; "if you had worked beside him for five years, as I did, you would think differently. He does not move fast, but every move he makes counts. When he starts somewhere, he knows where he is going and what he is going for."

I saw Tom and put my proposition up to him. He was glad to see that I had remembered him, but he wanted a week to think it over. At the end of a week he told me that he would not be able to take up my proposition, as he had been made general inspector of the whole plant. He had been working there eight or nine years, and no notice had been taken of him until I opened the superintendent's eyes. How many managers and superintendents have a Tom in their shops? They should

dig him out instead of picking men on the impulse of the moment. Have them picked out in advance.

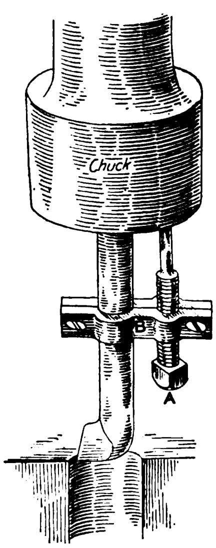
It makes discord among the other workmen to see a man less competent than themselves put over them, and discord never makes for the efficiency that we are all striving for. There is always some feeling, no matter who is chosen; but if he is a capable man, the others soon forget their jealousy. If he is not a capable man, he himself will not allow them to forget it, because he will always be doing or saying something to remind them of it.

Hartford, Conn. J. C. STUART.

Offset Boring Tool for Miller

The accompanying illustration shows a method of making an attachment for use with an offset boring tool. In using offset boring tools it is best to have them under tension. The setscrew *A* is for obtaining this effect and for springing the tool so that it will bore to size. This tool has proved of value in shops not equipped with offset boring tools. The clamp *B* can be made to take in various sizes of tools.

THOMAS W. R. MCCABE.
Waterbury, Conn.

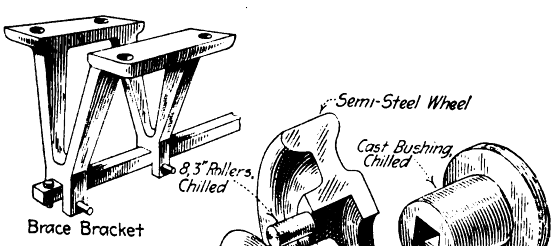


OFFSET BORING TOOL FOR THE MILLER

Truck Wheel with Chilled Roller Bearings

In the sketch are shown a heavy-duty truck wheel and bracket designed for rolling-mill purposes. Artistic designs and "mike" measurements are seldom considered in the make-up of trucks used around a rolling mill. A loose easy fit, a pound of grease—where an ounce would do—and a strong, able-bodied chunk of corned beef and cabbage pulling at the handle, his body bent at 45 deg. to the ground, answer all requirements in make and motive power in a rolling-mill truck.

The life of the truck is short, because the laborer at the handle thinks from his neck down. If there is one chance in a hundred to put the truck out of commission, he is Johnny on the spot.



TRUCK WHEEL WITH CHILLED ROLLER BEARINGS

The wheel here shown is of the underhung or caster type. There is very little machine work on the parts. The wheel itself, which is of cast semisteel, is assembled as it comes from the foundry. A dry-sand core is used to make the center hole, better results being obtained when the hole is made in the core. The roller bearings are of chilled cast iron 3 in. in diameter and 5 in. long. The axle bushing, or sleeve, is of chilled cast iron, having a cored hole to receive the square axle. The retainer washer is of cast semisteel.

The cast-steel bracket, of Y-design, with plenty of spread where it bolts to the truck, is fork shaped, to fit down over the square axle, and has holes to receive bolts. As compared with some of the trucks now in use, it is easy rolling for the man in the mill.

Kenosha, Wis. M. E. DUGGAN.

Valve-Seat Facing Tool

Fig. 2 illustrates a self-contained facing tool which we had occasion to use in facing off the valve seat of a T-head cylinder, as shown in Fig. 1.

The valve-seat boss of this cylinder was ¼ in. larger than the port plug hole through which the facing tool must go, so it was necessary to have some way of expanding the tool after it had gone through the port hole. Accordingly, we constructed the tool shown. The shank *A* is made to pilot into the port hole before it is tapped. This shank has a T-slot cut across it and the tool holder *B* fitted into it, so as to slide back and forth. A groove is cut in the tool holder to hold a spring, and a pin *G* is set in as a stop. The stop *F* holds the spring in place. It in turn holds the tool holder even with one side of the shank.

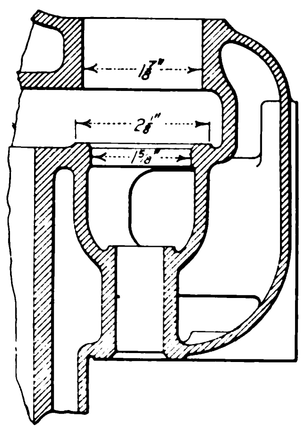


FIG. 1. THE VALVE SEAT

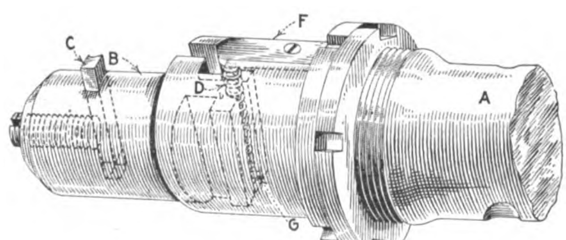


FIG. 2. THE FACING TOOL

The tool *C* is set into the holder so that the end comes even with the opposite side of the shank. In operation the tool passes through the port hole; and as the taper on the tool holder strikes the taper of the valve seat, it centralizes the tool holder, taking the tool out over the surface to be faced. When the tool is withdrawn, the

holder springs back and is able to come up through the port hole. The notched stop nuts determine the height of the boss. We have used this tool with great successs at the Rochester Motors Co. FRED F. BOWEN.

Rochester, N. Y.

An Oxyacetylene Job at Sea

A novel job was recently done at sea on board a vessel belonging to the United States Navy. A bucket on a direct-connected air pump was broken beyond repair. For temporary purposes an auxiliary feed pump was connected to the channel way, after the links to the disabled air pump had been disconnected. With the assistance of an oxyacetylene outfit an emergency bucket was made as follows:

The bore of the cylinder was 30 in. To allow for machining and for the removal of iron oxide two circular steel plates 32 in. in diameter were cut. The top plate, $\frac{3}{4}$ in. thick, carried the spiders for the valves and the lower $\frac{1}{2}$ in. plate. A templet was then cut out of sheet tin, embracing one-fifth of the top of the bucket, which included a nest of three valves. The sections to be cut out were then accurately laid off from the templet to the $\frac{3}{4}$-in. plate and center-punched for easy burning. To allow for the free passage of the water, circles 5 in. in diameter were cut out in the lower plate.

In all, about 25 ft. of cutting was done in the $\frac{3}{4}$-in. plate and about 19 ft. in the $\frac{1}{2}$-in. plate. The work was completed in less than three hours, while the vessel was steaming in the trough of a heavy ground swell.

To make the bucket of the proper depth, a distance or filling piece of teak was placed between the top and bot-

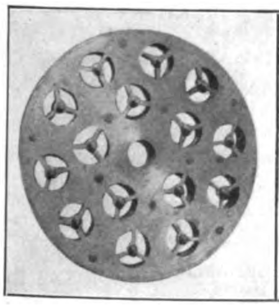


FIG. 1. TOP OF VALVE BUCKET

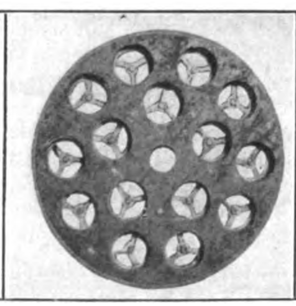


FIG. 2. BOTTOM OF THE BUCKET

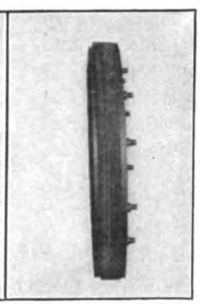


FIG. 3. SIDE VIEW OF BUCKET

tom plates, which were then riveted together, as the use of bolts and nuts was not considered desirable.

The bucket was chucked in the lathe and bored to suit the taper of the rod, which was then forced home. Next the rod was swung between centers and a cut taken across the upper surface of the top plate to provide a true surface for the valves to seat against.

The outer surfaces of the top and bottom plates were then turned down $\frac{3}{16}$ in. smaller than the bore of the cylinder of the pump. The teak filling, or distance piece, was then turned down $\frac{1}{16}$ in. smaller than the bore of the cylinder, water grooves being also cut to obviate the use of soft packing. Teak was employed as a distance piece on account of its oily nature, which makes it impervious to water.

Fig. 1 shows the top of the bucket, with the rod, valves and springs removed to illustrate the design used in cutting out the $\frac{5}{8}$-in. plate so as to provide a spider for carrying the studs, springs and valves.

Fig. 2 illustrates the bottom of the bucket, while Fig. 3 is a side view showing the teak filling piece. Although the bucket has not as yet been put into actual service, it is being held as a spare part for an emergency. It was completed and made ready for service in less time than it would have taken to make a pattern of it for casting. F. A. SAAR.

U. S. S. "Prometheus."

Grinding-Wheel Experiences

One of the few points that grinding-wheel experts are agreed upon is that different kinds of work require different kinds of grinding wheels. Carried to its logical conclusion, this also means that, although work may be similar in character, if the material is different the grinding wheels may also have to vary to get the best results. Not only may we have to change the grade and grain, but we may have to use wheels made up from another basic material.

To the average shopman who takes only a superficial interest in grinding wheels this shifting from one make of wheel to another presents many difficulties, and for this reason changes are not as frequent sometimes as results warrant. What we really need is to have the wheel makers give in their catalogs a close comparison between their own wheels and those of their competitors for a given class of work. There is, to the best of my knowledge, no catalog of grinding wheels in existence that gives a table showing the comparative hardness of the wheels. Such a policy might be advertising the product of other manufacturers, yet for the purpose of changing over from one make to another it is essential that the various hardnesses should be known.

Possibly the wheel makers may point out that close comparisons are out of the question. But suppose a would-be customer asked a manufacturer to supply a wheel for work that had been done previously by a competitor's wheel of a certain grain and grade. Would the manufacturer say he could not form any comparison or would he send a wheel? We rather think he would send a wheel. This being so, then the information is really available and could be tabulated. Failing this comparative list, we want more data about the wheels in service; that is, users should tell us of wheels that have been successful on certain classes of work and should detail the conditions. A statement of some of the writer's experiences with the grinding wheels in an ordnance factory may be of interest and possibly may also draw out the grinding-wheel experiences of other readers of the *American Machinist*.

The wheels in both the foundry and the forge were 24x3 by 2-in. hole and were set on ordinary floor stands. The peripheral speed of these wheels was between 5,000 and 5,500 ft. For the rough work that they had to do—snagging castings, forgings, etc.—probably the best all-round wheels that came under observation were those made by the Sterling Emery Wheel Co. They were corundum wheels—grain 24, grade *Q*, and grain 20, grade *P*.

Another corundum wheel that did well was a Sundale grain 24, grade *O*. A batch of wheels supplied by the Pike Manufacturing Co.—grain 16/14, grade *Q*—gave excellent service. A remarkable point about these large wheels for rough work was that none of the wheels made from artificial abrasives did nearly as well as those made from corundum. This showing we believe to be due to the greater toughness of the natural abrasive. Probably the best wheel of artificial abrasive tried on this group was Alundum grain 24, grade *O*, and grain 20, grade *P*.

The last experience to be mentioned on this size of wheel was with some sent in by the American Emery Wheel Co. They were corundum wheels. For the foundry, wheels of grain 14, grade *P*, performed well. For the forge, grain 2820, grade *Q*, was tried, but the wheels were found to be too hard until the peripheral speed was dropped to about 4,800, when they cut very well. However, this wheel—grain 2820, grade *Q*—was found later to give excellent service in grinding the edges of bullet-proof plate.

Another large wheel in this factory was a 24x2 by 5-in. hole, for use on Norton cylindrical grinders. On this class of work the artificial abrasives seem to have the field to themselves. The writer cannot remember a case where corundum was as good as Alundum or Aloxite for grinding on precision work—that is, where both work and wheel are rigid.

The best Norton wheels in this group were Alundum 24 combination grain, grades *K* and *L*—with a preference for grain 46, grade *L*, when working on nickel steel. These grades were also found to do good work on the larger Landis machines where the wheels were 18x1½ by 8-in. hole. For the smaller Landis wheels 14x1 by 5-in. hole Alundum 24 combination, grades *K*, *L* and *M*, were good, but the best wheels of this size for general service on steel were Aloxite grain 60, grade *P*, and Aloxite grain 403, grade *O*.

For grinding ball-race rings (flat faces) with this size of wheel on the Landis, Alundum grain 3860, Grade *J*, and grain 3846, grade *J*, gave splendid results. For cast iron and manganese bronze, Carbolite wheels, made by the American Emery Wheel Co., grain 60, grade *K*, and grain 46, grade *L*, were good.

On surface grinders we had fine results from Alundum grain 2846, grade *G*, on steel. Other good wheels were Alundum grain 24 combination, grades *F*, *G* and *H*; and for cast iron, Carbolite grain 46, grade *G*. These wheels were 12x2 by 5.9-in. hole and ran, according to material operated on, between 4,000 ft. for mild steel and 3,200 ft. for certain hardened cast steels and cast iron. It should be noticed that these low speeds are essential for good work on the surface grinder.

When a good finish is desired, preference may be given to a straight-grit wheel of fine grain (such as 46 or 60 grain), but a fine-grit wheel should be softer in grade than a combination grit, to work equally well. Fine finish here is more a question of correctly truing the wheel than of choosing a finer grain. The writer tried Aloxite wheels for surface grinding in this size of wheel and found that grain 60, grade *T*, was better than grain 403, grade *S*, for steel.

Both wheels, however, were a trifle too hard to be efficient when running as low as 3,200 ft. per min.

A large number of wheels 10x1½ by 1-in. hole were used in this plant on floor grinders for the convenience of the workmen in touching up their tools. Alundum wheels grain 36, grade *O*, and corundum wheels made by the American Emery Wheel Co., of similar grain and grade, did well. Another good wheel that was selected subsequently after a comparative trial was grain 46, grade 4½ *W*, a corundum silicate wheel made by the American Emery Wheel Co.

For toolroom work generally, Norton's Alundum wheels were used, grain 46 in grades *L* and *K*, also grain 60 in grades *K* and *J*.

For internal grinding the wheels ranged from ½ to 1½ in. in diameter. Alundum grain 60, grade *J*, and grain 46, grade *K*, were good on steel. Satisfactory work was also done by some American Emery Wheel Co.'s corundum silicate wheels grain 60, grade 2 *W*, and grain 46, grade 2½ *W*.

A good many wheels were provided for saw sharpening. For gulleting, Alundum wheels 8x⅛ by $3\frac{9}{16}$-in. hole were used, grain 80, grade 5½ elastic. For topping the saws a somewhat wider and softer wheel was selected—Alundum 8x¼ by $3\frac{9}{16}$-in. hole, grain 60, grade 5 elastic. We also tried an Alundum vitrified wheel for topping. This was grain 60 and grade *P*. While this wheel did very well for a short time, it eventually broke; and undoubtedly for this class of work no vitrified wheel of this size should be thinner than ⅜ in.

Similar-sized wheels made from corundum by the American Emery Wheel Co. were: For gulleting, grain 80, grade 5½ *E*; and for topping, grain 60, grade 5½ *E*. For saw sharpening there was little choice among the different makes of wheel. In closing these notes it might be mentioned that, except where definitely stated otherwise, all the wheels referred to were made by the vitrifying process.

WALTER G. GROOCOCK.

Guilford, England.

Pitch of Broach Teeth

The making of broaches has been more or less on the cut-and-try plan. In order to systematize it a little the following data have been compiled.

The table herewith gives the pitch of broach teeth for work varying from ¼ in. to 12 in. in length. These pitches are calculated from the formula $P = \sqrt{L} \times 0.35$,

PITCH OF BROACH TEETH

Length of Hole in Work, In.	Theoretical, In.	Practical, In.	Length of Hole in Work, In.	Theoretical, In.	Practical, In.
¼	0.175	3/16	4	0.700	11/16
⅜	0.214	7/32	4¼	0.721	23/32
½	0.247	¼	4½	0.742	¾
⅝	0.277	9/32	4¾	0.763	¾
¾	0.303	5/16	5	0.782	25/32
⅞	0.327	5/16	5¼	0.802	13/16
1	0.350	11/32	5½	0.820	13/16
1⅛	0.371	⅜	5¾	0.839	27/32
1¼	0.391	13/32	6	0.857	27/32
1⅜	0.410	13/32	6½	0.892	29/32
1½	0.429	7/16	7	0.926	15/16
1⅝	0.445	7/16	7½	0.959	31/32
1¾	0.463	15/32	8	0.990	1
1⅞	0.479	15/32	8½	1.020	1 1/32
2	0.495	½	9	1.050	1 1/16
2¼	0.525	17/32	9½	1.079	1 3/32
2½	0.553	9/16	10	1.106	1 3/32
2¾	0.580	19/32	10½	1.134	1⅛
3	0.606	19/32	11	1.160	1 5/32
3¼	0.631	⅝	11½	1.187	1 3/16
3½	0.655	21/32	12	1.212	1 7/32
3¾	0.678	11/16			

where *P* equals the pitch and *L* the length of the work. The table shows the theoretical length and the nearest fractional dimension to which it is practical to make broach teeth.

R. C. HAYNES.

Hudson, Mass.

Discussion of Previous Question

Cutting Off Steel in the Lathe

Gustave A. Remacle, on page 294, while pointing out the most elementary fact—the setting of the tool—in parting still leaves plenty of opportunities for chatter, which he claims to have overcome.

Leaving out the setting of the tool and the coolant used, chatter may be due to width of tool, distance of tool from chuck, state of headstock bearings and, last, but by no means least, the manner in which the tool is held.

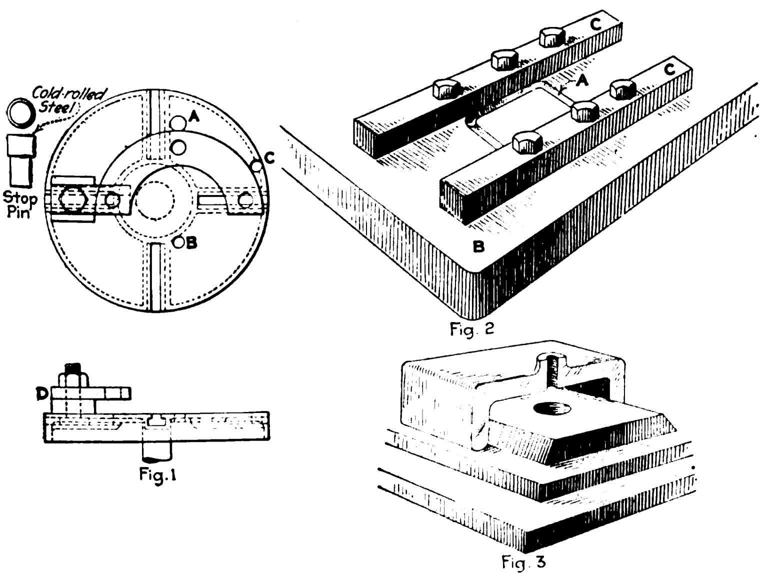
The typical American tool post is not an ideal one to use in parting, particularly for large-diameter stock, and the larger the diameter the greater the inclination of even the best-behaved tool post of this type to allow the tool to dig and chatter.

John H. Van Deventer demonstrated this point admirably in his "Small-Shop Lathe Lecture—No. 1," with two sketches and descriptions to suit. The first, "A rakish appearance, but no good for work," is applicable to the case in point; and the second, "Give a dog teeth if you want him to bite," shows a four-way tool box with the double grip on each tool. JOHN C. WELLS.

Dumfries, Scotland.

Simplifying Drilling Operations

Mr. Hampson's article in the *American Machinist*, on page 558, reminds me of some similar work I have come across. In view of the heavy rush of business at the present time we would hardly go to the expense of designing a special jig, even if it should be a very simple one. On the other hand, because of the present rush, the quick methods herein described may be particularly interesting.



SIMPLIFYING DRILLING OPERATIONS

In any of these methods accuracy is not attempted, but for general approximate work at high speed they answer exceptionally well.

In Fig. 1 is illustrated a brass locomotive-hub liner to be drilled and countersunk, as shown at one of the end holes. The various operations for producing this work in quantities are as follows: First, the liners are brought to the bench, and the location of each hole is center-punched through a plate jig. A very heavy punch mark will enable the hole to be drilled close enough. After being center-punched the liners are taken to the drilling machine, in the table of which the three holes *A*, *B* and *C* have been drilled.

The rig *D* is merely a leaf jig, so to speak, and is made up of a leaf and a drilled block secured to the drill-press table by a ¾-in. bolt. A stop pin is provided, as shown. The distance between the under side of the leaf and the table is about $\frac{1}{32}$ in. greater than the thickness of the liner, to allow for possible burrs, etc.

One end of the liner is slipped under the leaf, the ¾-in. drill is brought down into the punch mark and the first hole drilled, the stop pin being placed in the hole *A*. All the liners are so drilled at this setting. Then the stop pin is placed in the hole *B*, and the center hole in all the liners is drilled. Last, the stop pin is placed in hole *C*, and the last hole is drilled in all the liners. The stop pin, as its name indicates, is merely a stop. The leaf is to prevent the liner from breaking the drill by running up on it under the excessively heavy feed.

After the drilling, another machine does the countersinking, using a stop for depth, of course. Since the center-punch mark is used to locate the hole, some might think the leaf a superfluity; but the fact remains that the quickest and the safest way (for the operator) is shown here.

In Fig. 2 is shown a jig for the same purpose as Mr. Hampson's jig, but in design, construction and operation this one can hardly be excelled for simplicity. The work is kept from turning by the two straps *C* and is centered by the shallow grooves *A*. As a piece is drilled it is readily pushed out of the way and another piece placed in position. To save the drill-press table, the grooves are cut in a separate plate *B*, and to this plate the straps *C* are secured by the six capscrews shown, the whole then being bolted, or clamped, to the drill-press table.

In Fig. 3 is illustrated a device of some use on brass, or where the stock is pretty close to size. Good brass or malleable castings can often be drilled to advantage in this way. The slightly tapered square boss on the base plate fits loosely inside the casting, as shown—within 0.005 in.

or so. If the central chip hole is lined up with the drill-press spindle, this will center the work; but the edges of the piece being drilled must be set down firmly, all around on the shoulder, as illustrated, in order to bring the hole straight as well as central. Accuracy, of course, cannot be attained by any of these methods; but where production is the first essential or where the hole is to be used for an arbor for further machining, etc., these methods will deliver the production.

Besides, it ought to start a good line of thought as to how much can profitably be done in using jigs of this sort in the absence of jigs or fixtures of a better kind. It seems to me that a great deal of duplicate work might be handled, especially where the quantity has seemed too small to justify the designing and building of more elaborate jigs. These built-up jigs are also capable of considerable elaboration. J. B. MURPHY.

Plainfield, N. J.

Practical Points in Operating the Suggestion Plan

I have observed of late that managers are reviewing the suggestion system from a more practical viewpoint than formerly. [See pages 78, 212, 561, 692 and 815, Vol. 44, also editorial, page 1001, Vol. 43.] The profit from the specific suggestion has been the prime reason for its adoption in the past, and only few employers recognize the possible coöperation and loyalty features that are the outgrowth of a suggestion plan.

Not long since a boastful employer said, "Why, I have over 3,000 men working for me." I answered, "Yes, I know that, but how many men have you working *with* you?" He nearly lost his breath for a second and finally concluded by saying, "We supposed they all were, but I doubt it."

There is no other system that will assist to determine who is or who is not loyal to a company quite as efficiently as a well-managed suggestion plan. It may be well to quote a few lines from my letter published in the *American Machinist* some eight years ago: "The objects of the suggestion box are justice, coöperation and profit."

The first requisite of such a system should be a man at the head of the department who merits the confidence of both employer and employee; one who can readily detect evil motives in the suggestion or criticism and put a stop to it.

Second, give to each communication a thorough investigation and, if rejected, give evidence to the suggestor of the impracticability of the considered project that will convince him beyond any doubt of the company's square policy.

Third, if the suggestion is accepted and the employer installs it, the suggestor should receive a compensation in proportion to its value, the value being based upon a percentage of the net saving to the company for a stated period of time, dating from the actual application of the suggestion.

It is important that all three of these requirements be complied with, and any fundamental change in them will bring the plan into disfavor and failure. Every breakdown of the suggestion system to date is attributable to modifications affecting these points.

In the last six years I have observed several suggestion systems dry up and blow away because one or more of these requisites was disregarded. In one case shop politics, through the incompetency of the committee in charge of the suggestion department, caused the help to distrust the motive of the company, and valuable suggestions stopped coming in. The men with a pull got good pay for suggesting, and the honest fellow got left.

There is hardly a man who has worked at a trade 10 years that cannot recall at least one incident where his suggestion was taken to the management as an idea of the foreman or superintendent, thereby giving credit to one to whom it did not belong. The disloyalty among employees that such methods develop is incalculable, and the right system will obviate it.

The suggestion system brings an employee in close touch with the other elements of the business, such as cost of supervision, maintenance, interest, taxes, insurance, depreciation, etc., which the regular day's work salary, piecework and bonus methods fail to do. The employee hears of these items; but when he sees the percentage that must be added to the cost of bringing his suggestion into actual service, an appreciation of the true condition dawns upon and impresses the suggestor as no other method will.

The suggestion system should be divided into three divisions—observation, criticism and suggestion. An employee may be able to observe and report things of interest that should be investigated and corrected, and yet he may be unable to criticize or offer a suggestion to correct the condition observed. However, such a person should receive credit for the discovery made. It is also true that a person may observe and criticize a condition that escaped the notice of persons competent to suggest a remedy. Such a person should receive a greater credit than the one who only observed the condition. While the person who observed the condition, criticized it and offered an accepted suggestion to remedy it should receive credit in proportion to the service rendered. Such grading of merits, whether it is represented or recorded by merit points or dollars, will surely enlist all intelligent employees to work with the employer and create an enthusiasm and loyalty that will increase efficiency beyond the calculation of the most enthusiastic advocate of the system.

The employee's record card should show the number of suggestions offered or accepted every month. If an employee presents suggestions every month, we know he is trying to do his best for the company, although the idea may not be very valuable. The suggestion system properly operated is one of the best methods of discrimination between the loyal and disloyal employee ever devised, as well as a profitable department in any business, wherever it is installed; but justice must prevail. Shop politics must be eliminated and the management must not expect results too quickly. It is a process that should be developed on practical lines, and each branch of the business will present a different problem to solve. The greatest handicap under which such a system is installed is the general lack of confidence on the part of the employees. When they are convinced that absolute fairness will prevail, the inherent advantages of the plan assure success. CYRUS F. RAYMOND.

Akron, Ohio.

Editorials

Progress of Industrial Education

The advance of industrial progress has been so rapid during the past decade that the corresponding advance in the environment and ideals surrounding technical education, as depicted in the new buildings of the Massachusetts Institute of Technology described on page ??? of this issue, seems in harmony with the trend of events. It is no doubt the most finished and impressive example of architecture that has ever been applied to such a purpose.

Quite a contrast is presented when one considers the disadvantages under which were developed many of the great names which have been handed down to us for their discoveries in science and engineering. Newton, Watt, Maudsley and Sweet had no palatial buildings in which to ferret out the secrets of nature; neither had they laboratories containing all manner of appliances, nor had they instructors who were ready at hand to fill in the missing gaps in their supply of information.

And yet the names of Newton, Watt, Maudsley and Sweet come down to us and will outlive most of the names of those who acquire their knowledge and training in modern educational institutes.

Just as an unexplored country develops rugged pioneers who surpass in physical hardihood, so the unexplored regions of knowledge of years ago developed intellects of a magnitude that is hard to equal under present conditions of uniformity and standardization.

For the purposes of present-day civilization the modern scheme is no doubt a better one. Science has to a large extent taken the place of inspiration, and it is better for us to have a large number of scientists and engineers trained in a comparatively standardized manner as they are, than to look, probably in vain, for the reappearance of inspired genius of bygone days. And it must be said that the Massachusetts Institute of Technology has an enviable reputation in turning out those equipped to advance industrial and scientific progress.

Do not be discouraged, however, if it has not been, or will not be, your lot to acquire information amid such beautiful and impressive surroundings. Remember that, while a man can acquire knowledge within a building, he must learn to reason within his own head.

And what a contrast it will be for some of the coming Tech grads when they leave these marble halls for the unæsthetic shops and factories which will be the scene of their life work!

What Is the Economical Length of Workday?

One of the effects of the widespread making of munitions seems likely to be the general shortening of hours in the machine shops of the country, even though this change may not be accomplished immediately. It has already taken place in many localities; and if history is to repeat itself, as it generally does, this shorter day will become more common rather than give way to the old schedule.

As a sidelight on the situation it is interesting to mention the experience of a number of shops that are now running two shifts in order to get out their production of shells in the shortest possible time. The usual method seems to be to run a 10-hr. day shift and a 13-hr. night shift. For while this seems like an unequal and almost absurd division, it has some advantages. The night man might just as well go to work at 6 as to wait an hour or so. On the other hand, there is nothing to be gained by quitting much before 7 in the morning. The advantage is that it keeps the automatics going and gives them a longer day on the payroll. But the economy of it is quite another matter.

In most of the shops we know that are running in this way the management is more than satisfied if the night shift of 13 hr. gets an output equal to that of the day shift of 10 hr., giving an hourly production much below the day rate. In other words, the extra 3 hours can be called entirely nonproductive.

To just what extent this policy can be carried economically remains to be seen. It cannot be forecasted with any certainty. But it does show that many of our predictions about the bad economical effects of the shorter workday have not come true. The difference in the quality and in the quantity of light between the day and night shifts will account for some of the difference, but there can be no question as to a man's ability to work at a higher efficiency during a short period. And it is really the efficiency that counts, for on this depends the output of the machines.

The worst problem in all such cases is to know what is best to do when an output is demanded which is larger than can be had in 8 hr., but which does not require working two shifts. Overtime work is a makeshift, to be put into practice only in emergencies; yet the organizing of a night force is more of a problem than many realize. The shorter hours seem to produce a normal day's work as well as the longer day we formerly thought necessary, and the old 60-hr. week has a diminishing number of advocates. If we remember that in most cases efficiency is in getting the most work out of a machine rather than the greatest amount of physical labor, it may change the solution of the problem to some extent.

Storing the Capacity for Making Ammunition

There is much discussion as to the relative merits of government and private plants for the making of arms and ammunition. Unfortunately, this talking is too often done by those who know little or nothing of actual manufacturing conditions. There are many sides to the question, all of them more or less debatable; but the best solution depends largely upon conditions.

Huge government plants tie up vast amounts of capital, which would be—fortunately, in most ways—idle most of the time. This sum represents a far larger expenditure than would appeal to the average taxpayer, although it is barely possible that such procedure might be cheaper in the end. Then too, the average arsenal is not run as economically as might be desired, although no one has been able to show just why it is impossible to run a government shop so as to produce goods at fair prices; in fact, we have some very good examples of this possibility in our own country.

On the other hand, the arsenals, with a large surplus capacity, might serve as a balance wheel to prevent exorbitant prices being charged for munitions supplied by private concerns. In fact, arsenals should go farther than this and act, in a measure, as experimental shops to find the best way of making such products as they are likely to be called on to make in large quantities. They should determine the best methods for varying shop conditions, determine fair standard times in which the work can be done and use these results as a basis for prices of contracts that may be let at any time.

While no arsenal in this or in any other country has carried on such investigation to any extent or is in position to do it at the present time, we in the United States have an excellent opportunity to secure these data for future use. It is this consideration, in fact, that has prompted the *American Machinist* to publish in detail so many of the operations of shell making in the various shops. These data, backed up by the experience of our own arsenals and of the best private plants, give us a basis for standardizing times that should prove of great value in future work.

It has been suggested that the machinery of some of the large munition plants that have been especially equipped for the purpose might well be purchased by the Government and stored for future use. Such machines should be bought at a nominal price, because they are practically of junk value, owing to their being very special and having no market value except to the Government, and because they have already earned a large profit on the investment. Any attempt to secure high prices for such machines would tend to prevent their purchase, as it would give the best of arguments to those who contend that all preparedness is for the personal profit of those with material to sell.

With enough special equipment stored in various arsenals, or in special shops that can be secured at low cost in inland cities, to turn out 100,000 shells a day in case of need and with a skeleton organization that understands the machines we are a long way on the road to practical preparedness at a very low cost. It must be remembered that the question of labor hardly enters into this problem, as most of the special machines have been designed especially so as to be readily handled by men who never saw a machine shop before.

An equipment of this kind, slushed to prevent rusting, could be maintained at a low cost and could be put into commission at short notice. While it might not supply all that would be needed, it would give an excellent foundation and enable at least a good beginning to be made.

This is very different from the proposition to purchase gages and fixtures which might be altered to suit our conditions. The machines are made for just this work and only need sets of tools to suit our type of shells. With gages, on the other hand, almost all would require alteration that would be as costly as new gages in many cases. Making new gages in large numbers, however, so as to have them ready, would be of real value.

We must not overlook the fact that there is a deep-rooted conviction (which unfortunately has too good a foundation in some cases) that personal profit is behind much of the urging for preparedness. Any plan that succeeds must disarm this suspicion. The best way of accomplishing such an end is to show that national service, as well as personal profit, is being considered.

Russian Credits--Shipping Documents for Russia

As Russia is principally an agricultural country, sales there are made on credits maturing with the yearly harvests. In seasons when crops have been poor it has been found necessary to extend some credits to the following year. Russians, as a class, are disposed to guard their financial standing jealously, although the fact that bankruptcy is not uncommon there shows the necessity for care in obtaining credit information.

Our leading bankers have made arrangements to handle Russian-American business direct, and through branches established in Russia they will find means to finance the loans required there after assuring themselves of the soundness of the security offered. Now is the time for American manufacturers to get the information they require, connect with agents, provide catalogs, etc., so that they will be able to place their sales campaign in full swing at the end of the war.

The economic similarity between Russia and the United States indicates that soon after the war Russia may place a still higher tariff wall around her territory, so that manufacturers intending seriously to enter that market should keep in mind the examples of two successful American firms, one manufacturing agricultural machinery, the other sewing machines. Both these concerns do a world-wide business and both found it advantageous to establish branch factories in Russia. There the heavier pieces of their machines are made, the lighter and more complicated parts being imported from the United States.

In shipments made from the United States to Russia the documents may be in English. The Department of Commerce in Washington, D. C., publishes the consular regulations covering shipments in all countries. Machine builders may also turn over all these details to commission merchants or forwarding agents who specialize on Russian shipments. Correspondence from Russia should be answered in the language in which the inquiry is written.

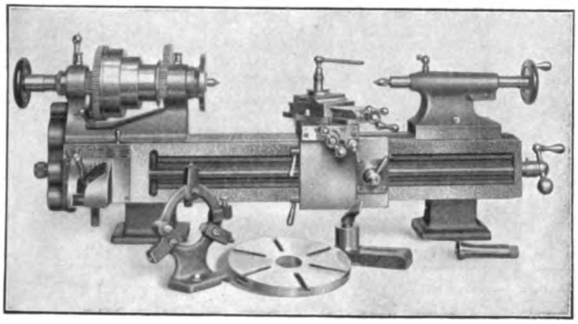
During the war the principal exports to Russia have consisted of munitions of war, while the imports from Russia have greatly decreased, owing to laws prohibiting the export of certain articles and to the high freights demanded.

This has caused the ruble, ordinarily worth 61½c., to drop to about 31c., but the normal rate of exchange will doubtless be reached as soon as peace is declared. This may not be far off, and American machine builders should start now a comprehensive campaign to extend their interest in Russian markets.

Shop Equipment News

Bench Precision Lathe

The precision lathe illustrated represents a recent product of Walter H. Wade, 311 Atlantic Ave., Boston, Mass. Although this lathe is designed primarily for



BENCH PRECISION LATHE
Swing, 8½ in.; distance between centers, 24 in.

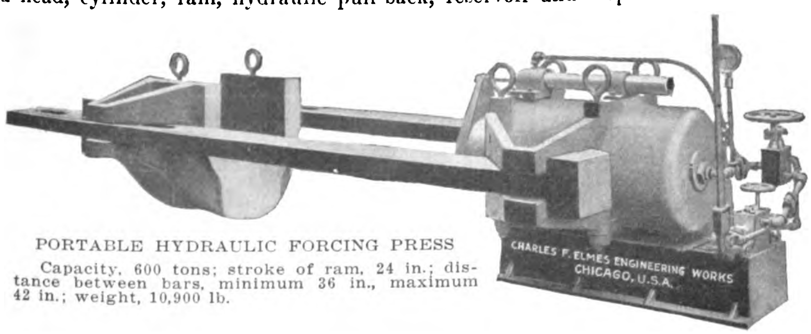
toolroom use, the various classes of accurate work for which it is especially adapted will come to mind.

The bearings are of tool steel, hardened and ground. The lathe is equipped with a quick-change gear box through which threads from 12 to 120 per in. can be cut.

The machine is furnished with either two-speed and reverse treadle countershaft or friction countershaft.

Portable Horizontal Hydraulic Forcing Press

The press shown was designed for pressing shafts out of dredge tumblers, rolls, large gears, etc. It consists of a head, cylinder, ram, hydraulic pull-back, reservoir and



PORTABLE HYDRAULIC FORCING PRESS
Capacity, 600 tons; stroke of ram, 24 in.; distance between bars, minimum 36 in., maximum 42 in.; weight, 10,900 lb.

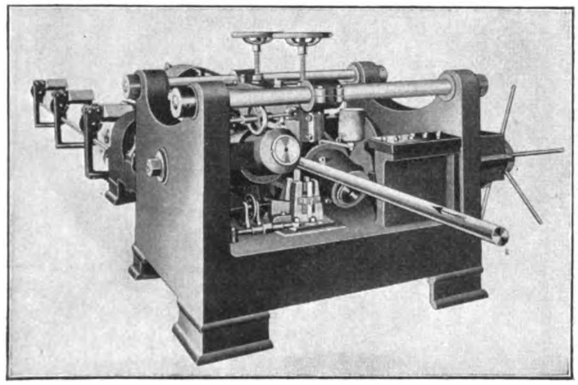
double-plunger hand pump with valves and hydraulic gage, all self-contained.

The low-pressure pump bypass is closed until the ram comes up to the work; then it is opened by means of a handwheel, and the heavy-duty work is completed by the high-pressure pump. The geared screw stem transfer valve alternately operates the hydraulic ram and pull-back.

The press is a recent product of the Charles F. Elmes Engineering Works, Chicago, Ill.

Bar-Straightening Machine

The machine shown is automatic in action and, while designed for straightening and polishing steel shafting, is found equally suitable for straightening iron, brass and



BAR-STRAIGHTENING MACHINE

bronze bars. The operation is continuous after the rolls are set for a certain size of bar. The rate of straightening is about 30 ft. per min.

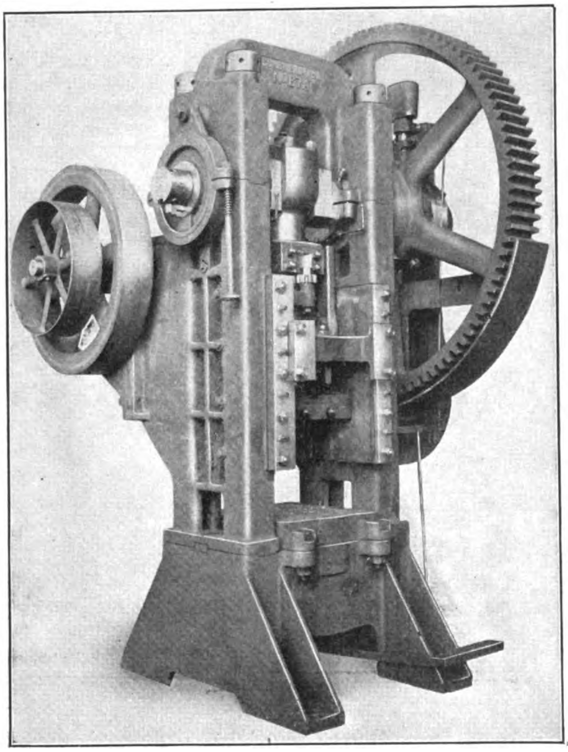
The shaft, or bar, is straightened by passing between two rolls, one of which is ground concave, the other straight. These rolls are set at an angle with each other so that the face of the roll ground straight will be nearly parallel with the concave surface of the other roll. By this means the bar operated on is bent uniformly its entire length, thereby removing all crooks and leaving the bar as straight as is possible to make it by machine operation. These rolls are made of very hard chilled iron, and two sets are furnished: One for rough-straightening—that is, straightening the bars before they are turned—and the other set for restraightening, removing all tool marks, finishing and polishing the shaft after it is turned.

Either set of rolls can be used for polishing to start with, but after using rolls for rough-straightening they should be kept for that purpose only, as they become rough in time and it is not necessary that the rough-straightening rolls have as good a surface as the polishing rolls, which should be kept ground smooth to get good results. The machine is readily set up for the different-sized shafting, and the adjustments are easily made.

The type o' machine shown is made in a variety of sizes and represents a late product of the Medart Patent Pulley Co., St. Louis, Mo. A machine accommodating bars from 1 to 3 in. in diameter and 25 ft. long will occupy a floor space of 30x3 ft.

Heavy Press for General Automobile Work

The press shown was made especially for producing Ford brake drums, but may be used for general automobile or other work of all kinds within its capacity. It is known as No. 67-A and is manufactured by the



PRESS FOR GENERAL AUTOMOBILE WORK

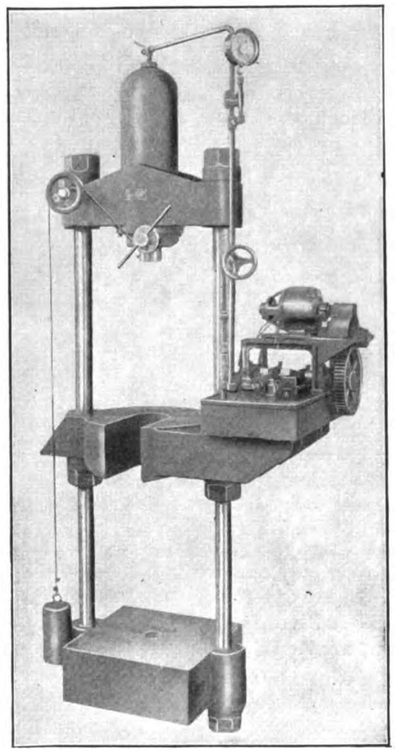
Width between uprights, 28 in.; opening in bed, 12x14 in. (but this can be made to suit customer); die space from top of bolster to face of slide, stroke down, adjustment up, 12 in.; stroke of slide on standard, 4 in.; maximum stroke of slide, 10 in.; adjustment of slide, 4 in.; thickness of bolster, 3½ in.; hole in slide for shank of punch, 3 in. (this is made dovetailed on order); distance between gibs, 18 in.; area of bolster, 30x26 in.; area of face of slide, 18x18 in.; height from floor to center of shaft, 93 in.; flywheel, geared, 48x9 in.; pulleys, 26x7½ in.; ratio of gearing, 8 to 1; floor space, 85x98 in.; weight, about 30,000 lb.

Consolidated Press Co., Hastings, Mich. It is made with either single or double pulleys and is double geared. The frame is grooved and tongued at every joint. Gears and dangerous places are guarded, and nothing has been overlooked to make the machine satisfactory for long and hard shop service.

Hydraulic Forcing Press

The hydraulic press shown is a recent design developed by the Hydraulic Press Manufacturing Co., Mount Gilead, Ohio. It is a double-purpose press, especially intended for two distinct forcing operations, and was constructed primarily for use in forcing locomotive piston rods into the piston heads and also for removing the piston head from the piston rod. However, it can be readily seen that the press is adaptable to a wide range of miscellaneous forcing work coming up in general machine, repair, automobile and railroad shops. The press is also suitable for certain classes of arbor and broaching work, the open slot in the press proper allowing ample space for the arbor forcing operations and providing a place for a broach to pass through.

For forcing the piston head on, the piston head is set on the lower base with the rod passing up through the press base proper, the pressure then being applied from



HYDRAULIC FORCING PRESS

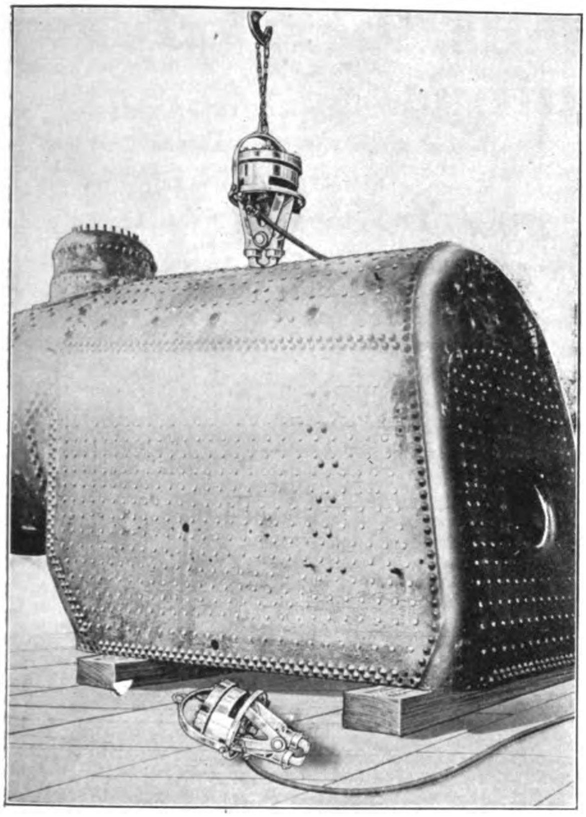
Maximum pressure capacity of upper part, 100 tons; lower part, 50 tons; diameter of ram, 10 in.; length of run, 22 in.; total daylight space, 86 in.

the end of the piston rod, forcing it into the piston head. When the press is used for forcing the piston head off the rod, the piston head with the rod is hung on the press base proper and the pressure applied from the end of the rod, forcing the rod out of the piston head.

This press is self-contained, the pressure being furnished by a direct motor-driven horizontal double-plunger pump with double gear reduction. A T-screw hydraulic operating valve controls the pressure from the pump to the press cylinder.

Pneumatic Stay-Bolt Cutter

The machine shown was primarily intended for cutting locomotive-boiler stay-bolts, but by using an extra set of blades suitable for cutting rivet heads it may be used for all kinds of car, boiler and structural repairs. The machine is composed of an air cylinder and frame combined, the jaws being worked by a lever and toggle movement attached to the 15-in. piston. It is operated at a working pressure of from 90 to 100 lb. of air and will cut off, leaving the proper amount for heading, about 1,200 stay-bolts, ranging from ¾ to 1⅛ in. in diameter, per hour.



While the machine itself differs but little from similar types, the big feature is that it is hung in a sort of universal joint, which is perfectly balanced, so that the operator can with perfect ease swing the big machine to any angle desired. It weighs about 300 lb. and is made by the Baird Pneumatic Tool Co., Topeka, Kan.

Handy Woodworking Vise

It will be observed from the illustrations that the form of vise shown may be used in either a horizontal or a vertical position. The vise automatically locks at any point on the complete circle. The tightening of the jaws simultaneously clamps the vise on its base. The jaws are $2\frac{1}{2}$x$3\frac{1}{2}$ in. and open 5 in. The vise weighs 15 lb.

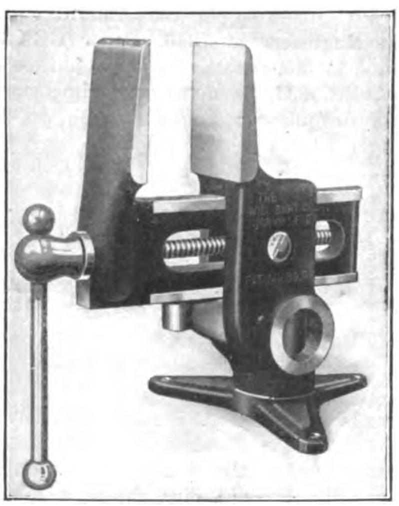


FIG. 1. WOODWORKING VISE

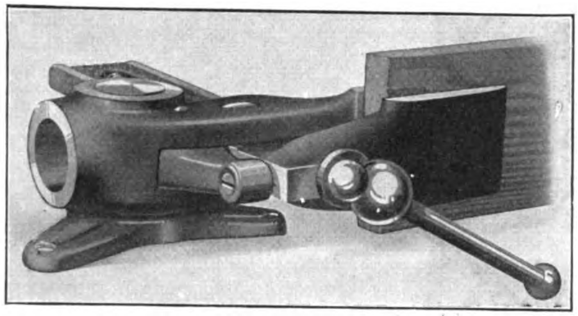


FIG. 2. VISE IN HORIZONTAL POSITION

It is a recent product of the Will-Burt Co., Orrville, Ohio.

Federal Government Will Build a Nitrate Plant

The Army Reorganization Bill as finally enacted authorizes the President to make an investigation to determine the best process "for the production of nitrates and other products for munitions of war and useful in the manufacture of fertilizers and other useful products." He is further authorized to select a water-power site or other site and to construct a plant for the manufacture of such product. The products of the plant are to be used for military and naval purposes to such extent as the President may deem necessary, and any surplus may be sold under such regulations as he may prescribe. The bill does not specify the capacity of the plant, but $20,000,000 is appropriated for its construction and an issue of Panama Canal bonds to raise the money is authorized in case sufficient funds in the treasury are not available. A provision is inserted that the plant must be operated "solely by the Government and not in conjunction with any other industry or enterprise carried on by private capital."

In view of the widely published fact that one of the most needed measures for national defense is the provision of a supply of nitrates that will be available for use at any time the shipment of nitrates from Chile is interrupted, there is no doubt that the Government will proceed promptly with the construction of the plant.

A Rapid Planting Machine

A machine that plants from 10,000 to 15,000 forest-tree seedlings a day is now being used at the Letchworth Park Forest and Arboretum, in Wyoming County, N. Y., according to officials of the Forest Service, who are acting as advisers in the work. Previously the planting has been done by hand at the rate of 1,200 to 1,500 trees each day per man.

The machine was designed to set out cabbage and tomato plants, but works equally well with trees. It is about the size of an ordinary mowing machine and is operated by three men and two horses. One man drives the team while the other two handle the seedlings. The machine makes a furrow in which the trees are set at any desired distance, and an automatic device indicates where they should be dropped.

Straight Pipe Threads for Fixtures and Fittings

Report of A.S.M.E. Committee

SYNOPSIS—This report summarizes the findings of a committee appointed by the American Society of Mechanical Engineers and gives in condensed form the suggested dimensions, formulas and gages for straight pipe threads for fixtures and fittings.

The term "outside diameter" used in this report refers in the case of male threads to the top of the threads or largest diameter, and in the case of female threads to the bottom of the threads or largest diameter. The term "root diameter" similarly refers to the smallest diameter. The "pitch diameter" is of course determined by subtracting from the outside diameter of a theoretical full V-thread the single depth of the thread. Fig. 1 illustrates these various diameters.

Straight Threads Not To Replace Tapers

This report is in no way to be considered as recommending the use of straight pipe threads on pipe in place of taper threads made to the American Briggs Standard. On certain classes of female fittings, however, straight pipe threads are used with entire satisfaction when the engaging male thread is taper and to American Briggs Standard, as a "make up" nonleaking joint is obtained. The use of straight male threads under these conditions is therefore not to be recommended, as an excessive amount of cement is necessary to prevent leaks. Often, however, in fixture work such a joint is not necessary and is in many cases undesirable for purposes of finish, and in such cases straight male threads may be used to advantage. It will be manifest upon inspection of the figures given in Tables 1 and 3 that a female threaded fitting will not screw down to the end of the thread, but will "make up" at a proper point, which is normally to be desired; further, from inspection of Tables 1 and 5, that the ⅛-in. socket caps will screw down to end of the thread without "make up," which in this particular case is desired. Also, by comparison of Tables 2 and 3 together and Tables 2 and 5 together, it will be noted that the female fitting will not "make up" at any point, but will show a slight looseness at all points, making the use of a considerable amount of cement necessary if a nonleaking joint is desired.

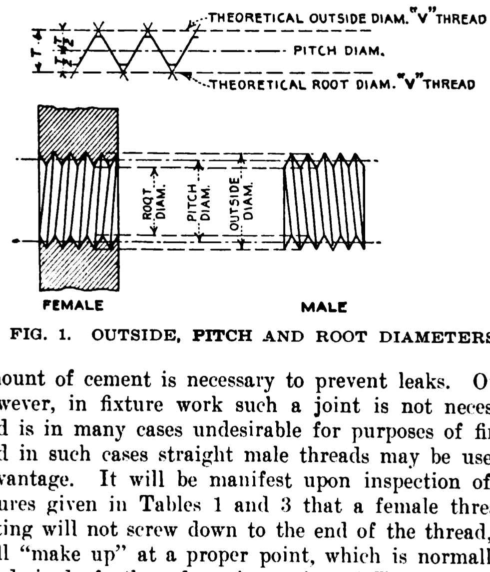


FIG. 1. OUTSIDE, PITCH AND ROOT DIAMETERS

The notch on the American Briggs Standard which is located by the thickness of the American Briggs Ring is well recognized as locating the proper point on the standard for the measurement of the pitch diameter of straight pipe size threads. The thickness of this ring was recommended for each size of pipe by the Committee on Standardization of Pipe Thread Gages appointed by the American Society of Mechanical Engineers, working in conjunction with the Committee of Manufacturers on Standardization of Valves and Fittings. Further, this latter committee adopted the sizes at the notch as correct for straight pipe threads. The angle, form and pitch of the thread are of course the same as on the American Briggs Standard.

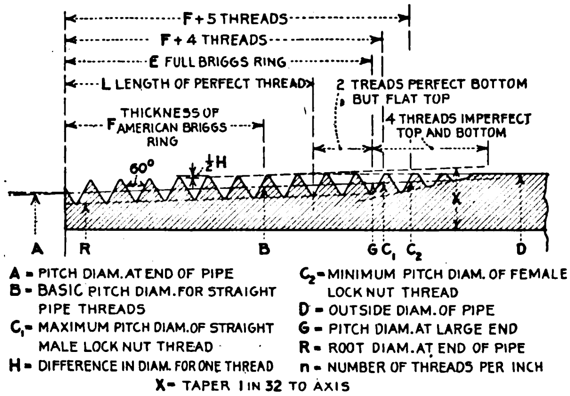


FIG. 2. BASIC STRAIGHT PIPE SIZES

Formulas for Basic Pitch Diameter

The report of the Committee on Standard Pipe and Pipe Threads presented to the American Society of Mechanical Engineers in 1886, Paper CCXXVI, and supplemented by the report of the Committee on Gages previously mentioned, gives standard dimensions of pipe and certain formulas shown in Fig. 2. In this figure

$$L = \frac{0.8D + 4.8}{n} \qquad E = L + 2\left(\frac{1}{n}\right)$$

$$R = D - \frac{0.05D + 1.9}{n} \qquad A = R + \frac{0.8}{n}$$

$$B = A + \frac{F}{16} \qquad G = A + \frac{E}{16}$$

$$H = \frac{1}{16n}$$

The sizes shown in Fig. 2 and previously described were adopted by the Committee of Manufacturers on Standardization of Fittings and Valves on Sept. 17, 1913, except the straight pipe thread and the locknut sizes, which were later adopted by the same committee

on Mar. 16, 1915. The figures for the various pipe sizes as published by that committee are given in Table 1, with the addition of columns headed *D, G* and *H.*

Tolerances Suggested

The maximum tolerances taken on the pitch diameters by the Committee of Manufacturers on Standardization of Fittings and Valves are one thread above and one thread below *basic* sizes, or a total of twice *H*, Table 1.

While your committee recommends the same *basic* sizes as the foregoing committee and concurs with it in its recommendation for tolerances on pipe fittings with straight threads, yet for the special fittings hereafter mentioned it is necessary to use different tolerances. The straight pipe threads recommended by the Committee of Manufacturers are almost universally used on female fittings only, and the tolerance that is taken above and below *basic* size is therefore eminently a proper one. This is not the case, however, when both male and female fittings have straight threads, and a careful survey of the product in consultation with manufacturers and users developed that the following maximum tolerances be allowed on pitch diameters: 0.004 in. on 1/8-in. pipe size; 0.005 in. on 1/4-in. and 3/8-in. pipe size; 0.006 in. on 1/2-in. and 3/4-in. pipe size; 0.007 in. on 1-in. pipe size.

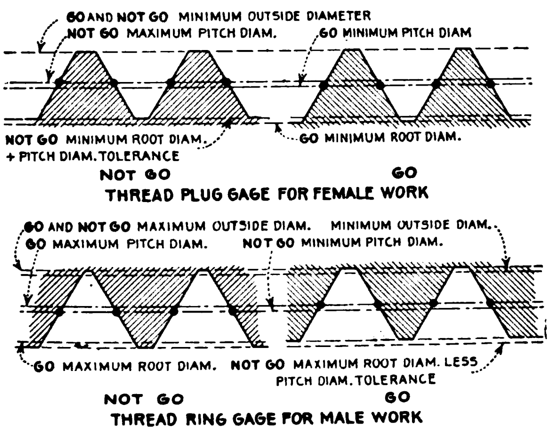


FIG. 3. "GO" AND "NOT GO" GAGES

These tolerances should be taken over *basic* sizes for female fittings, and under *basic* sizes for male fittings. When female fittings with these tolerances are used with male fittings made taper to American Briggs Standard, a proper "make up" joint will result. One inch is the largest pipe size in use on this work.

In order to allow sufficient wear for taps and dies and as it is further recognized that a thread three-quarters full depth is not too flat for commercial practice, it is recommended that the minimum outside diameter of female threads and the maximum root diameter of male threads be made United States Standard and that the maximum root diameter of female threads and the minimum outside diameter of male threads be such that three-quarters of the depth of a full V-thread results. The maximum outside diameter of female threads and the minimum root diameter of male threads is purposely not specified so that manufacturers may, if so desired, start their taps and dies full V-thread and allow them to wear to the specified limits already given. All calculations for root and outside diameters should be based on the pitch diameters.

The length of thread should not be less than the full Briggs ring.

Threaded gages should be made primarily to check the pitch diameters. The maximum allowable flatness of thread should be checked by plain gages. Gages for female fittings made to maximum sizes should not enter, and made to minimum should enter, the fittings. Gages for male fittings made to maximum sizes should be entered by, and made to minimum sizes should not be entered by, the fittings. This will insure the fittings being made with less variation than the allowed tolerances.

Reference Gage Dimensions for Male and Female Fittings

It will be noted above that a flatness of three-quarters of a full V-thread is recommended in extreme cases. This is to cover commercial practice in tapping and threading sheet-metal shells. Working gages for fittings turned from rod may, however, ignore this allowance. Further, in order that the pitch diameter may always be properly gaged, clearance should be allowed on the outside thread diameters of the gages; Fig. 3 and the dimensions given hereafter in connection with Tables 2, 3, 4 and 5 cover these points.

The tables on the following page give the results of the findings of the committee in a condensed and readily usable form.

TABLE 1. AMERICAN BRIGGS PIPE STANDARD LOCKNUT THREADS AND BASIC STRAIGHT PIPE SIZES

Pipe Size In.	Threads per In.	Depth Thread	Pitch Diameter End of Pipe	Pitch Diameter at Notch Basic Straight	Maximum Pitch Diameter Straight Male Lock-nut Thread	Minimum Pitch Diameter Straight Female Lock-nut Thread	Outside Diameter Pipe	Thickness Full Briggs Ring	Inches Thickness American Briggs Ring	Pitch Diameter at Large End	Difference in Diameter One Thread
	n	0.8 ÷ n	A	B	C_1	C_2	D	E	F	G	H
1/8	27	0.02962	0.36350	0.37475	0.38400	0.38632	0.405	0.2638	0.180	0.37999	0.00232
1/4	18	0.04444	0.47739	0.48989	0.50378	0.50725	0.540	0.4018	0.200	0.50250	0.00347
3/8	18	0.04444	0.61201	0.62701	0.64090	0.64437	0.675	0.4078	0.240	0.63750	0.00347
1/2	14	0.05714	0.75843	0.77843	0.79628	0.80075	0.840	0.5337	0.320	0.79179	0.00446
3/4	14	0.05714	0.96768	0.98886	1.00671	1.01118	1.050	0.5457	0.339	1.00179	0.00446
1	11½	0.06956	1.21363	1.23863	1.26036	1.26580	1.315	0.6828	0.400	1.25630	0.00543
1¼	11½	0.06956	1.55713	1.58338	1.60511	1.61055	1.660	0.7068	0.420	1.60132	0.00543
1½	11½	0.06956	1.79609	1.82234	1.84407	1.84951	1.900	0.7235	0.420	1.84131	0.00543
2	11½	0 06956	2.26902	2.29627	2.31801	2.32344	2.375	0.7565	0.436	2.31630	0.00543
2½	8	0.10000	2.71954	2.76216	2.79341	2.80122	2.875	1.1375	0.682	2.79063	0.00781
3	8	0.10000	3.34063	3.38850	3.41975	3.42756	3.500	1.2000	0.766	3.41563	0.00781
3½	8	0.10000	3.83750	3.88881	3.92006	3.92787	4.000	1.2500	0.821	3.91563	0.00781
4	8	0.10000	4.33438	4.38713	4.41838	4.42619	4.500	1.3000	0.844	4.41563	0.00781
4½	8	0.10000	4.83125	4.88593	4.91718	4.92499	5.000	1.3500	0.875	4.91563	0.00781
5	8	0.10000	5.39074	5.44930	5.48055	5.48836	5.563	1.4063	0.937	5.47863	0.00781
6	8	0.10000	6.44610	6.50597	6.53722	6.54503	6.625	1.5125	0.958	6.54063	0.00781
7	8	0.10000	7.43985	7.50235	7.53360	7.54141	7.625	1.6125	1.000	7.54063	0.00781
8	8	0.10000	8.43360	8.50003	8.53128	8.53909	8.625	1.7125	1.063	8.54063	0.00781
9	8	0.10000	9.42735	9.49797	9.52922	9.53703	9.625	1.8125	1.130	9.54063	0.00781
10*	8	0.10000	10.54532	10.62094	10.65219	10.66000	10.750	1.9250	1.210	10.66563	0.00781

* For sizes above 10 in. the preceding formulas should also be used.

FOR MALE FITTINGS

Reference Gages

"Not Go" Threaded Ring

Outside diameter = Maximum
Pitch diameter = Minimum
Root = Maximum less pitch-diameter tolerance

"Go" Threaded Ring

Outside diameter = Maximum
Pitch diameter = Maximum
Root = Maximum

"Not Go" Plain Ring

Diameter = Minimum outside diameter

"Go" Plain Ring

Diameter = Maximum outside diameter

Working Gages

For sheet-metal work same as reference gages above.
For turned work threaded rings and "Go" plain ring same as reference gages above.

"Not Go" Plain Ring

Diameter = Maximum outside diameter less pitch-diameter tolerance

FOR FEMALE FITTINGS

Reference Gages

"Not Go" Threaded Plug

Outside diameter = Minimum
Pitch diameter = Maximum
Root diameter = Minimum plus pitch-diameter tolerance

"Go" Threaded Plug

Outside diameter = Minimum
Pitch diameter = Minimum
Root diameter = Minimum

"Not Go" Plain Plug

Diameter = Maximum root diameter

"Go" Plain Plug

Diameter = Minimum root diameter

Working Gages

For sheet-metal work same as reference gages above.
For turned work threaded plugs and "Go" plain plug same as reference gages above.

"Not Go" Plain Plug

Diameter = Minimum root diameter plus pitch-diameter tolerance

The tolerance on pitch diameter will be known as T. The formulas are:

MALE FITTINGS

$$\text{Maximum pitch diameter} = B$$
$$\text{Maximum root diameter} = B - \frac{0.64952}{n}$$
$$\text{Maximum outside diameter} = B + \frac{0.64952}{n}$$
$$\text{Minimum pitch diameter} = B - T$$
$$\text{Minimum outside diameter} = B - T + \tfrac{1}{2}\left(\frac{0.86603}{n}\right)$$

FEMALE FITTINGS

$$\text{Maximum pitch diameter} = B + T$$
$$\text{Maximum root diameter} = B + T - \tfrac{1}{2}\left(\frac{0.86603}{n}\right)$$
$$\text{Minimum pitch diameter} = B$$
$$\text{Minimum root diameter} = B - \frac{0.64952}{n}$$
$$\text{Minimum outside diameter} = B + \frac{0.64952}{n}$$

Tables 2 and 3 are given for convenience, being derived from the foregoing formulas.

TABLE 2. SPECIAL STRAIGHT FIXTURE PIPE THREADS; MALE THREADS

Dimensions in Inches

Pipe Size	Threads per In.	Maximum Diam. Outside	Maximum Diam. Pitch Basic	Maximum Diam. Root	Minimum Diam. Outside	Minimum Diam. Pitch	Tolerance Pitch Diam.	Minimum Length of Thread
1/8	27	0.3989	0.3748	0.3507	0.3868	0.3708	0.004	0.2638
1/4	18	0.5260	0.4899	0.4538	0.5089	0.4849	0.005	0.4018
3/8	18	0.6631	0.6270	0.5909	0.6460	0.6220	0.005	0.4078
1/2	14	0.8248	0.7784	0.7320	0.8033	0.7724	0.006	0.5337
3/4	14	1.0353	0.9889	0.9425	1.0138	0.9829	0.006	0.5457
1	11½	1.2951	1.2386	1.1821	1.2692	1.2316	0.007	0.6828

TABLE 3. SPECIAL STRAIGHT FIXTURE PIPE THREADS; FEMALE THREADS

Dimensions in Inches

Pipe Size	Threads per In.	Maximum Diam. Pitch	Maximum Diam. Root	Outside	Minimum Diam. Pitch Basic	Root	Tolerance Pitch Diam.	Minimum Length of Thread
1/8	27	0.3788	0.3628	0.3989	0.3748	0.3507	0.004	0.2638
1/4	18	0.4949	0.4709	0.5260	0.4899	0.4538	0.005	0.4018
3/8	18	0.6320	0.6080	0.6631	0.6270	0.5909	0.005	0.4078
1/2	14	0.7844	0.7535	0.8248	0.7784	0.7320	0.006	0.5337
3/4	14	0.9949	0.9640	1.0353	1.9889	0.9425	0.006	0.5457
1	11½	1.2456	1.2080	1.2951	1.2386	1.1821	0.007	0.6828

While the sizes given in Tables 2 and 3 should be satisfactory on gas burners, fixture nipples, insulating joints, hickeys and the general run of similar fittings for all female threads and for male threads when straight threads are necessary, they are not safely usable on electric socket caps, as the fit with the nipple or coupling should be sufficiently loose to permit the cap to be easily screwed down to the shoulder without strain.

ELECTRIC SOCKET CAPS

Pipe couplings into which male electric socket caps are screwed are commercially made with a tolerance of one thread each side of the notch on the American Briggs Standard as adopted by the Committee of Manufacturers on Standardization of Fittings and Valves. Therefore, it is desirable that the maximum be less than basic size by 0.001 in. more than one thread. Referring to Fig. 2,

$$\textit{Maximum pitch diameter} = B - (H + 0.001)$$

The tolerances as well as the relative root and outside diameters are given in Table 4; in this the minimum lengths of thread recommended are also shown.

TABLE 4. SPECIAL STRAIGHT ELECTRIC FIXTURE THREADS; MALE ELECTRIC CAPS, ETC.

Dimensions in Inches

Pipe Size	Threads per In.	Maximum Diam. Outside	Maximum Diam. Pitch	Root	Minimum Diam. Outside	Minimum Diam. Pitch	Tolerance Pitch Diam.	Minimum Length of Thread
1/8	27	0.3956	0.3715	0.3474	0.3835	0.3675	0.004	0.250
1/4	18	0.5215	0.4854	0.4493	0.5044	0.4804	0.005	0.281
3/8	18	0.6586	0.6225	0.5864	0.6415	0.6175	0.005	0.281
1/2	14	0.8193	0.7729	0.7265	0.7978	0.7669	0.006	0.375
3/4	14	1.0298	0.9834	0.9370	1.0083	0.9774	0.006	0.375
1	11½	1.2887	1.2322	1.1757	1.2628	1.2252	0.007	0.500

The ⅛-in. size female is most largely used; and owing to the oversize fixture nipples now in use an arbitrary minimum pitch diameter of 0.3790 in. is recommended. This size will not be too loose on standard nipples. For sizes above ⅛ in. a minimum pitch diameter one thread larger than basic is taken:

$$\textit{Minimum pitch diameter} = B + H$$

Tolerances on all sizes should be the same as previously established, the root and outside diameters being proportional. Table 5 is derived for convenience, and in it the minimum length of thread recommended is shown.

The committee recommends the use of straight pipe threads and locknut threads as adopted by the Committee of Manufacturers on Standardization of Fittings and Valves, as described, and also the use of the special straight threads. It further recommends that there be deposited with the Bureau of Standards, Washington, D. C., master gages, the expense of such gages to be borne by the manufacturers.

TABLE 5. SPECIAL STRAIGHT ELECTRIC FIXTURE THREADS, FEMALE ELECTRIC CAPS, ETC.

Dimensions in Inches

Pipe Size	Threads per In.	Maximum Diam. Pitch	Maximum Diam. Root	Outside	Minimum Diam. Pitch	Root	Tolerance Pitch Diam.	Minimum Length of Thread
1/8	27	0.3830	0.3670	0.4031	0.3790	0.3549	0.004	0.2638
1/4	18	0.4984	0.4744	0.5295	0.4934	0.4573	0.005	0.4018
3/8	18	0.6355	0.6115	0.6666	0.6305	0.5944	0.005	0.4078
1/2	14	0.7889	0.7580	0.8293	0.7829	0.7365	0.006	0.437
3/4	14	0.9994	0.9685	1.0398	0.9934	0.9470	0.006	0.437
1	11½	1.2510	1.2134	1.3005	1.2440	1.1875	0.007	0.500

The straight pipe threads recommended by the Committee of Manufacturers on Standardization of Fittings and Valves are known by that name. The committee, therefore, recommends the use of this name for these standards only, and that the special standards previously described be known as special straight fixture pipe threads and special straight electric fixture threads respectively.

Edward S. Sanderson, Chairman, Harry E. Harris, William J. Baldwin, Stanley G. Flagg, Jr., Charles R. Hare, A. H. Moore, W. R. Webster and George B. Thomas, Secretary.

NEW PUBLICATIONS

LATHE DESIGN, CONSTRUCTION AND OPERATION—By Oscar E. Perrigo. Revised edition; four hundred and sixty 6x9 in. pages; 341 illustrations; indexed; cloth bound. The Norman W. Henley Publishing Co., New York City. Price, $2.50.

This is a new edition of a work originally brought out in 1907. In its present form the book has been revised and enlarged. A chapter has been added, detailing all kinds of lathe work, treating of lathe installation and management, milling, drilling and grinding attachments and their use, methods of turning tapers, turning spherical surfaces, making oil grooves and many other processes pertaining to practical lathe work. This matter has been prepared in such a form as to be readily followed by any apprentice, student or amateur machinist.

THE "MECHANICAL WORLD" POCKET DIARY AND YEAR BOOK FOR 1916. Two hundred and sixty-three 4x6-in. pages; illustrated; indexed; cloth bound. Price, 25 cents; 30 cents postpaid. The Norman, Remington Co., Baltimore, Md.

This is the twenty-sixth year of the issue of this pocket book, which is in keeping with those that have been published before.

A number of new features have been introduced, among them being the following: The section on steam boilers has been largely rewritten. There is a separate and enlarged section on the Diesel engine, embodying many concisely arranged data. Notes are given dealing with brazing and soldering, also new tables on these subjects, and on Lancashire and Cornish boilers, steel plates, friction clutches and one table for circle spacing.

The book is in a convenient form and contains much valuable information for the designer, the draftsman and the machinist.

PERSONALS

W. H. Neumeister, for sometime past a member of the machinist ranks of the Sioux City Welding and Machine Works, Sioux City, Iowa, has been promoted to the superintendency.

A. F. Orcutt, for some time past a member of the executive force of Deere & Co., Moline, Ill., has been appointed general manager of the Rivett Lathe and Grinder Co., Boston, Mass.

C. S. Maurer, formerly superintendent of the Independent Motor Co., Port Huron, Mich., has become agent and distributor of the Republic Motor Co., Alma, Mich. Mr. Maurer's headquarters will be in Findlay, Ohio.

Jack C. Carlton, formerly with the Lodge & Shipley Machine Tool Co., has organized and become president of the Carlton Machine Tool Co., Cincinnati, Ohio, successors to the William E. Gang Co., of the same city.

Otto Faber, until recently sugar engineer with the Palmarito de Canto, Oriente, Cuba, has become associated with the George L. Squier Co., Buffalo, N. Y., for which he will be in charge of the design and erection of sugar machinery.

J. E. Greensmith, formerly general manager of the Mason Machine Works, Taunton, Mass., and more recently assistant general manager of the New England Westinghouse Co., has resigned the latter position to become president of the Boston Scale and Machine Co., Boston, Mass.

OBITUARY

Mortimer H. Wright, one of the founders and superintendent of the Pennsylvania Shafting Co., Spring City, Penn., died in that city on May 28, after a brief illness. Mr. Wright was 49 years old.

James B. Wise, of Watertown, N. Y., who had attracted considerable attention since the outbreak of the war by his rapid development of a large cartridge and cartridge-machinery manufacturing business, died at Atlantic City, N. J., on June 7. Mr. Wise's regular business was the manufacture of plumbing supplies. He was 58 years old and a native of Stamford, Conn.

John Barnes, president and for many years the guiding mechanical spirit of the W. F. & John Barnes Co., Rockford, Ill., died at his home in that city on May 29 after a long illness induced by old age. Mr. Barnes was born in Mt. Morris, N. Y., in 1833 and when a young man migrated to Rockford, Ill. In 1872 he formed a partnership with his brother W. F. Barnes for the manufacture of foot-power machinery which partnership culminated in the formation of the present company which has become so well known in the field. In addition to his business capacity, to which much of the growth of his company was attributed, Mr. Barnes had a fertile mechanical imagination and was responsible for many of the designs and devices developed by his company during its existence from the pioneer days. While retaining the presidency of the organization Mr. Barnes withdrew from active management in 1908, since which time his sons Aubrey T. and John S. have been in charge. Mr. Barnes was for many years a conspicuous figure in the civic affairs of Rockford and at the time of his death was chairman of the Board of Trustees of Rockford College.

BUSINESS ITEM

To meet the requirements of its growing business the Norma Company of America announces plans for the erection of a four-story reinforced-concrete, 70x350-ft. building on a 10-acre site in Elmhurst, Long Island, which is on the outskirts of Long Island City.

TRADE CATALOGS

Rex Tool Post. Rex Mfg. Co., Hyde Park, Boston, Mass. Circular. Illustrated.

Screw Plates. Russell Mfg. Co., Greenfield, Mass. Catalog No. 2. Pp. 48. 5x7½ in.

Mr. R. Boehnke, Jr., 7 Tooronga Road, Upper Hawthorn, Victoria, Australia, would like to receive catalogs of machine tools used in the manufacture of automobile parts, including gear-cutting machines, drillers, slotters, grinders,

FORTHCOMING MEETINGS

Master Car Builders' Association. Annual meeting, June 14-17, Atlantic City, N. J. Joseph W. Taylor, secretary, Karpen Building, Chicago, Ill.

American Railway Master Mechanics' Association. Annual meeting, June 17-21, Atlantic City, N. J. Joseph W. Taylor, secretary, Karpen Building, Chicago, Ill.

American Society for Testing Materials. Annual meeting June 27 to July 1, 1916, Hotel Traymore, Atlantic City, N. J. Edgar Warburg, secretary, University of Pennsylvania, Philadelphia, Penn.

American Foundrymen's Association and American Institute of Metals. Annual meeting, September 11-16, Cleveland, Ohio, A. O. Backert, secretary, American Foundrymen's Association, Cleveland, Ohio.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Wednesday each month. J. A. Brooks, secretary, Brown University, Providence, R. I.

New England Foundrymen's Association. Regular meeting second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. J. H. Warder, secretary, 1785 Monadnock Block, Chicago, Ill.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Technical League of America. Regular meeting second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York, N. Y.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	June 9, 1916	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$14.75	$15.00	$9.50
No. 2 X Northern Foundry, New York	20.25	20.75	14.00
No. 2 Northern Foundry, Chicago	19.00	19.00	13.00
Bessemer, Pittsburgh	21.95	21.95	14.55
Basic Pittsburgh	18.95	18.95	13.45
No. 2 X, Philadelphia	20.25	20.50	....
No. 2 Valley	18.00	18.50	....
No. 2, Southern Cincinnati	17.65	17.90	....
Basic, Eastern Penn.	20.00	20.50	....
Gray forge, Pittsburgh	18.70	18.70	....

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger and plates ¼ in. and heavier from jobbers' warehouse at the places named:

	New York June 9, 1916	New York One Month Ago	New York One Year Ago	Cleveland	Chicago
Steel angles, base	3.50	3.25	1.85	3.25	3.10
Steel T's, base	3.55	3.30	1.90	3.25	3.10
Machinery steel (bessemer)	3.50	3.25	1.80	3.25	3.10
Steel plates	4.25	4.25	...	3.65	3.50

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse at the places named:

	New York June 2, 1916	New York One Month Ago	New York One Year Ago	Cleveland	Chicago
No. 28 black	3.65	3.65	2.60	3.20	3.20
No. 26 black	3.55	3.55	2.50	3.10	3.10
Nos. 22 and 24 black	3.50	3.50	2.45	3.05	3.05
Nos. 18 and 20 black	3.45	3.45	2.40	3.00	3.00
No. 16 Blue Annealed	4.45	4.45	2.35	3.70	3.60
No. 14 blue annealed	4.35	4.40	2.25	3.60	3.50
No. 12 blue annealed	4.30	4.30	2.20	3.50	3.45
No. 10 blue annealed	4.25	4.25	...	3.55	3.50
No. 28 galvanized	5.65	5.65	5.50	5.50	5.50
No. 26 galvanized	5.35	5.35	5.20	5.20	5.20
No. 24 galvanized	5.20	5.20	5.05	5.05	5.05

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot for carload lots f.o.b. mill:

	Black June 9, 1916	Black One Yr. Ago	Galvanized June 9, 1916	Galvanized One Yr. Ago
¾ to 2 in. steel butt welded	70%	81%	50½%	72½%
2½ to 6 in. steel lap welded	68%	80%	48½%	72½%
Diameter, In.				
¾	3.45	2.19	5.69	3.16
1	5.10	3.23	8.42	4.68
1¼	6.90	4.37	11.39	6.33
1½	8.25	5.23	13.61	10.18
2	11.10	7.03	18.32	10.18
2½	18.72	11.70	30.13	16.09
3	24.48	15.30	39.40	21.04
4	34.88	21.80	56.14	29.98
5	47.36	29.60	76.22	40.70
6	61.44	38.40	98.88	52.80

From New York stock the following discounts hold:

	Black	Galvanized
3½ to 6 in. steel lap welded	61%	36%
¾ to 3 in. steel butt welded	64%	42%

Malleable fittings, Class B and C, from New York stock sell at 30 and 5% from list price. Cast iron, standard sizes, 55%.

Bar Iron—Prices are as follows in cents per pound at the places named:

	June 2, 1916	One Month Ago
Pittsburgh, mill	2.60	2.50
Warehouse, New York	3.25	3.25
Warehouse, Cleveland	3.25	3.25
Warehouse, Chicago	3.10	3.10

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-size lots, the following quotations hold:

	June 9, 1916	One Month Ago
New York	List price plus 20%	List price plus 20%
Cleveland	List price plus 20%	List price plus 20%
Chicago	List price plus 10%	List price plus 10%

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York Today	New York One Year Ago	Cleveland	Chicago
$6.00	$3.75@4.00	$6.30	$5.25

In coils an advance of 50c. is usually charged.

Drill Rod—Discounts from list price in New York are as follows: Standard, 65%; extra, 60%; special, 55%.

High Speed Tool Steel containing from 10 to 18% tungsten sells as follows per pound in New York:

Billets ....$2.40 Bars $3.25

METALS

Miscellaneous Metals—The present quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	New York June 9, 1916	New York One Month Ago	New York One Year Ago
Copper, electrolytic (carload lots)	29.00	30.50	19.00
Tin	45.00	51.50	38.00
Lead	7.00	7.50	5.00
Spelter	13.75	18.00	27.00
ST. LOUIS			
Lead	7.00	7.37½	...
Spelter	13.62½	17.87½	...

At the places named, the following prices in cents per pound prevail:

	New York June 9, 1916	New York One Month Ago	New York One Year Ago	Cleveland	Chicago
Copper sheets, base	37.50	36.50	24.00	38.50	37.50
Copper wire (carload lots)	37.50	36.50	21.50	33.00	38.00
Brass, rods, base	44.50	44.00	20.50	42.00	38.00
Brass pipe, base	46.50	44.50	23.50	45.00	46.00
Brass sheets	44.50	43.00	20.50	42.00	38.00
Solder ½ and ½ (case lots)	28.00	31.62½	28.00	32.50	28@30

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York June 9, 1916	New York One Month Ago	Cleveland June 9, 1916	Cleveland One Month Ago
Copper, heavy and crucible	23.50	25.00	23.50	25.00
Copper, heavy and wire	23.00	24.50	23.00	24.00
Copper, lhite and bottoms	19.50	22.00	20.00	24.00
Lead, heavy	5.50	6.00	6.00	7.00
Lead, tea	5.00	5.50	5.00	6.00
Brass, heavy	13.50	14.50	13.50	20.00
Brass, light	10.50	12.50	11.50	13.00
No. 1 yellow rod brass turnings	14.25	15.25	14.00	14.50
Zinc	9.00	12.00	8.00	16.00

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	35.50	36.00	36.50	37.00	38.00
¼ to 5/16	35.25	35.75	36.25	36.75	37.75
⅜ to 1⅞	35.00	35.50	36.00	36.50	37.50
1 15/16 to 2⅞	35.75	36.25	36.75	37.25	38.25
Rounds					
3 to 3 7/16	36.50	37.00	37.50	38.00	39.00
Squares					
3	36.50	37.00	37.50	38.00	39.00
Rounds					
3½ to 3 15/16	36.25	36.75	37.25	37.75	38.75
Squares					
3 1/16 to 3 15/16	36.25	36.75	37.25	37.75	38.75
Rounds—Squares					
4 to 4 15/16	37.00	37.50	38.00	38.50	39.50
5 to 6 15/16	38.00	38.50	39.00	39.50	40.50
7	38.50	39.00	39.50	40.00	41.00
Flats	36.50	37.00	37.50	38.00	39.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Antimony—Chinese and Japanese brands are quoted in cents per pound for spot delivery, duty paid:

	June 9, 1916	One Month Ago
New York	23.00	38.00

Zinc Sheets—The following prices in cents per pound prevail:

Carload lots, f.o.b. mill 21.50

	In Casks June 9, 1916	In Casks One Month Ago	Broken Lots June 9, 1916	Broken Lots One Month Ago
New York	24.00	26.00	24.50	26.50
Cleveland	....	26.00	26.50	26.50
Chicago	26.00	26.50	26.50	27.00

Copper Bars from warehouse sell as follows in cents per pound:

	June 9, 1916	One Month Ago
New York	43.00	42.00
Cleveland	37.50	32.50
Chicago	40.25	38.25

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places named:

	New York	Cleveland	Chicago
Best grade	60.00@65.00	52.50	60.00
Commercial	30.00@35.00	18.50	25.00@28.00

SHOP SUPPLIES

Nuts—From warehouses at the places named, on fair sized orders the following amount is deducted from list:

	New York June 9, 1916	New York One Month Ago	Cleveland June 9, 1916	Cleveland One Month Ago	Chicago June 9, 1916	Chicago One Month Ago
Hot pressed square	$2.50	$2.50	$3.25	$3.25	$3.25	$3.70
Hot pressed hexagon	2.50	2.50	2.75	3.25	3.25	3.80
Cold punched square	2.00	2.00	3.00	3.00	3.00	4.25
Cold punched hexagon	2.50	2.50	3.00	3.25	3.50	4.00

Semifinished nuts sell at the following discounts from list price:

	June 9, 1916	One Month Ago
New York	50-10%	50-10%
Cleveland	65%	65-10%
Chicago	65%	65%

Carriage Bolts—From warehouses at the places named the following discounts from list price are in effect:

	New York	Cleveland	Chicago
⅝ by 6 in.	45—5%	50—10—5%	60—5%
Larger and longer	35%	40—15%	50%

At this rate the net prices are as follows:

Length, In.	New York ¼	New York ½	New York ¾	Cleveland ¼	Cleveland ½	Cleveland ¾	Chicago ¼	Chicago ½	Chicago ¾
1½	$0.53	...	...	$0.43	...	...	$0.38	...	...
2	.58	...	...	.48	...	...	.42	...	...
2½	.63	$2.12	$5.53	.51	$1.39	$3.63	.46	$1.63	$4.25
3	.68	2.30	5.85	.55	1.51	3.85	.50	1.77	4.50
3½	.73	2.48	6.18	.60	1.64	4.06	.54	1.91	4.75

Machine Bolts—From warehouses at the places named the following discounts hold:

	New York	Cleveland	Chicago
⅝ by 4 in. and smaller	50%	60 and 10%	60 and 10%
Larger and longer up to 1 in. by 30 in.	40%	50 and 5%	50 and 10%

At this rate the net prices per 100 follow:

Length In.	New York ¼	New York ½	New York 1	Cleveland ¼	Cleveland ½	Cleveland 1	Chicago ¼	Chicago ⅝	Chicago 1
2	$0.83	$2.32	$9.60	$0.67	$1.46	$6.08	$0.64	$1.74	$7.20
2½	.89	2.84	10.14	.70	1.57	6.32	.67	1.85	7.60
3	.97	2.63	10.68	.73	1.66	6.86	.70	1.97	8.00
3½	1.01	2.79	11.22	.77	1.77	7.48	.73	2.08	8.40

Wrought Washers—From warehouses at the places named the following amount is deducted from list price:

New York.... $4.00 Cleveland.... $6.00 Chicago.... $6.00

At this rate, the net prices follows:

Diameter, In.	New York	Cleveland	Chicago
3/16	$10.00	$8.00	$8.00
¼	8.20	6.20	6.20
5/16	7.40	5.40	5.40
⅜	6.50	4.50	4.50
7/16	5.80	3.80	3.80
½	5.40	3.40	3.40
9/16	5.30	3.30	3.30
⅝	5.20	3.20	3.20
¾	5.10	3.10	3.10
⅞, 1, 1⅛	5.00	3.00	3.00
1¼, 1⅜, 1½	5.20	3.20	3.20
1⅝, 1¾, 1⅞, 2	5.50	3.50	3.50
2¼, 2½	6.50	4.50	4.50

For cast-iron washers the base price per 100 lb. is as follows:

New York.... $2.50 Cleveland.... $2.00 Chicago.... $2.10

Rivets—The following quotations are allowed for fair sized orders from warehouse:

	New York	Cleveland	Chicago
Steel 7/16 and smaller	45%	45—10%	50%
Tinned	45%	45—10%	50%

Button heads ¾, ⅞, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.:

New York.... $5.25 Cleveland.... $3.85 Chicago.... $3.50

Cone heads, same sizes:

New York.... $5.35 Cleveland.... $3.95 Chicago.... $3.60

For the following sizes, the extras over the above prices in cents per 100 lb. are as follows:

1⅛ to 1⅞ in. long, all diameters	$0.25
⅝ in. diameter	0.15
½ in. diameter	0.50
1 in. long and shorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

Nails—Wire nails f.o.b. Pittsburgh sell at $2.50@2.60; galvanized 1 in. and longer, $4.50@4.60, and shorter, $5@5.10. These prices are to regular customers and delivery is made at the mill's convenience. From warehouse wire and cut nails sell as follows:

	Wire June 7, 1916	Wire One Month Ago	Cut June 7, 1916	Cut One Month Ago
New York	$3.15	$3.15	$3.15	$3.15
Cleveland	3.05	3.05	2.95	2.95
Chicago	2.85	2.75	2.85	2.75

Copper Rivets and Burs sell at the following rate from warehouse:

	Rivets June 7, 1916	Rivets One Month Ago	Burs June 7, 1916	Burs One Month Ago
Cleveland	List price	List price	List price	List price
Chicago	List price	List price	List price	List price
New York	10-2½% from list	20% from list	10-2½% from list	List price

MISCELLANEOUS

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire	
⅜, 11/32, 5/16, ¼, 7/32, 3/16	10.00
No. 8, 5/32 and No. 10	11.00
⅛	12.50
No. 12	13.50
3/32, No. 14 and 1/16	15.00
No. 18	16.50
No. 20	17.50

Special Welding Steel	
⅛	33.00
5/32	30.00
3/16	28.00

Cast-Iron Welding Rods	
¼ by 19 in. long	22.00
3/16 by 12 in. long	26.00
⅜ by 19 in. long	20.00
½ by 21 in. long	20.00

Vanadium Wire in Coils or Sticks	
1/16	15.50
3/32	15.00
⅛	14.00
5/32	12.00
3/16 and larger	11.00

Tin Plates—The following prices are in effect from warehouses at the places named:

			New York June 9, 1916	New York One Month Ago	Cleveland June 9, 1916	Cleveland One Month Ago	Chicago June 9, 1916	Chicago One Month Ago
100 lb.			$6.25	6.00	$5.40	$5.40	...	$5.60
Coke tin plate, 14x20:								
I. 1. 107 lb.			6.40	6.15	5.55	5.55	...	5.75
Terne plate, 20x28:								
Base Wgt.	Net Wgt.	Coating						
100 lb.	200	8	$10.50	$10.00	$9.10	$9.10	$8.90	$8.70
I.C.	214	8	10.80	10.30	9.35	9.35	9.25	9.25
I. X.	270	8	12.80	12.30	11.60	11.60	11.50	11.40
I. C.	218	12	12.00	12.00	10.50	10.50	10.75	10.75
I. C.	221	15	13.00	13.00	10.50	10.50	11.60	11.60
I. C.	226	20	13.50	13.50	12.50	12.50	12.50	12.50
I. C.	231	25	14.25	14.25	13.50	13.50	13.75	13.75
I. C.	236	30	15.50	15.50	14.50	14.50	14.75	14.75
I. C.	241	35	17.00	17.00	15.75	15.75	15.85	15.85
I. C.	246	40	19.00	19.00	16.75	16.75	17.10	17.10

Seamless Drawn Tubing—The base price per pound from warehouse is as follows:

	New York	Cleveland	Chicago
Brass	43.50	46.00	43.00
Copper	48.00	48.00	45.00

For immediate stock shipment the following quotation prevails:

Diameter, In.	Copper New York June 9, 1916	Copper New York One Year Ago	Copper Cleveland	Copper Chicago	Brass New York June 9, 1916	Brass New York One Year Ago	Brass Cleveland	Brass Chicago
¾ to 2½	51.50	22.50	48.00	45.00	46.60	19.50	46.00	43.00
3	51.50	22.50	48.00	45.00	46.60	19.50	46.00	43.00
3½	52.50	23.50	48.00	46.00	47.50	20.50	46.00	44.00
4	53.50	24.50	49.00	47.00	48.50	21.50	47.00	45.00
4½	55.50	26.50	51.00	49.00	50.50	23.50	49.00	47.00
5	57.50	28.50	53.00	51.00	52.50	25.50	51.00	49.00
6	58.50	29.50	55.00	52.00	53.50	26.50	53.00	50.00
7	60.50	31.50	55.00	54.00	55.50	28.50	53.00	52.00
8	62.50	33.50	59.00	56.00	57.50	30.50	57.00	54.00

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	May 20	May 27	June 3	June 10
Prompt furnace	$3.50@3.75	$2.25@2.40	$2.50@2.75	$2.50@2.75
Prompt foundry	3.50@3.75	3.50@3.75	3.25@3.50	3.25@3.50

Cotton Waste—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	11.00@13.00	11.00@14.00	11.00@13.50
Colored mixed	8.00@10.00	7.50@11.00	8.00@10.50

Sal Soda sells as follows per 100 lb.:

New York	$2.05	Cleveland	$2.25
Philadelphia	1.80	Chicago	1.90

Roll Sulphur in 360-lb. bbl. sells as follows per 100 lb.

New York.... $2.75 Cleveland.... $2.75 Chicago.... $2.75

Foundry Supplies—In New York, the following quotations prevail:

Foundry blacking	1½c. per lb.
Foundry flour (best grade)	$1.75 per bbl.
Foundry rosin	12c. per lb.
Core oil	40c. per gal.
Core wash	1½c. per lb.

Sponge Cloths (Wiping Towels) in New York have advanced 5c. per dozen and sell as follows: 16x18 in., 35c.; 18x20 in., 40c.; 18x22 in., 43c. In Chicago prices are $24 to $28 per 1,000. In Cleveland, per 1,000, 13¼x13¼ sell at $29.50 and 13¼x20½ at $35.

Fire Clay in Chicago sells at 50c. per bag of 100 lb.

Linseed Oil—These prices are per gallon:

	New York	Cleveland	Chicago
Raw in barrels	$0.71	$0.73	$0.73
5-gal. cans	.81	.83	.83

Boiled, it is 1c. per gal. higher.

White and Red Lead, in cents per pound, sell as follows:

	Red Dry	Red In Oil	White Dry and In Oil
100-lb. keg	10.50	11.00	10.50
25- and 50-lb. kegs	10.75	11.25	10.75
12½-lb. keg	11.00	11.50	11.00
1- to 5-lb. cans	12.50	12.50	12.50

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

The contract has been awarded for the construction of an auto service building at Boston, Mass., for S. Altman, 720 Commonwealth Ave.

The Cadillac Auto Co. plans to build an addition to its plant on Commonwealth Ave., Brookline, Mass.

Plans are being prepared for the construction of a garage at Oak and West St., Gardiner, Mass., for O. A. Sylvester. Estimated cost, $20,000. Noted Mar. 2.

Dydak Piekos, 147 Lyman St., Holyoke, Mass., has awarded the contract for the construction of a 1- and 2-story garage at Holyoke. Estimated cost, $18,000.

The contract has been awarded for the construction of a factory on Front St., Holyoke, Mass., for George W. Prentiss & Co., manufacture of wire.

James T. Owens has awarded the contract for the construction of a 1-story garage at Lee, Mass. Estimated cost, $30,000.

The contract has been awarded for the construction of a factory at Palmer, Mass., for the A. B. & J. Rathbone for the manufacture of wire.

Plans are being prepared for the construction of a 2-story garage at Salem, Mass., for Goldberg Bros. Estimated cost, $20,000.

The contract has been awarded for the construction of a 1-story garage for the Worcester Woolen Mills Co. at Worcester, Mass.

The J. H. Tower Iron Works plans to construct a 1-story factory at Oxford St. and Allens Ave., Providence, R. I.

The Bryant Electrical Co., Railroad Ave., Bridgeport, Conn., is constructing a 5-story factory at Bridgeport.

The A. H. Nelson Co. is constructing an addition to its factory at Bridgeport, Conn., for the manufacture of wire and special machinery.

The Eagle Lock Co. will build an addition to its factory at Plymouth, Conn.

MIDDLE ATLANTIC STATES

The contract has been awarded for the construction of a 1-story garage on Putnam Ave., New York, N. Y., Borough of Brooklyn, for Charles Strickland. Estimated cost, $12,000. Noted Feb. 10.

The American Express Co. has awarded the contract for the construction of an addition to its garage at New York, N. Y. (Borough of Manhattan.) Estimated cost, $40,000. George C. Taylor, 120 Broadway, New York, Pres.

The Weeks Brass Foundry Co., Buffalo, N. Y., has taken over the plant of the Farr Manufacturing Co., Schenk St., North Tonawanda, and will remodel it for a brass foundry.

The contract has been awarded for remodeling the factory of the Taylor Instrument Co., 95 Ames St., Rochester, N. Y., manufacturer of thermometers. Estimated cost, $7,000.

The General Electric Co., Schenectady, N. Y., has awarded the contract for the construction of Wire and Cable Factory No. 89. Estimated cost, $90,000. C. G. Hulth, Ch. Engr., in charge of construction.

T. L. Goodwin, 4 East 39th St., New York, N. Y., has awarded the contract for the construction of a garage at Woodbury, N. Y. Estimated cost, $10,000.

The contract has been awarded for the construction of a 2-story auto repair shop for Mrs. Mary J. Chadburg, 33 Radford St., Yonkers, N. Y.

The Hotel Traymore, Atlantic City, N. J., has awarded the contract for the construction of a new garage. Estimated cost, $30,000. Noted Mar. 9.

The contract has been awarded for the construction of a garage at East Orange, N. J., for George F. King, 837 Broad St., Newark.

The Aeromarine Plane and Motor Co., Newark, N. J., has acquired property at Keyport and plans to construct a new plant. Estimated cost, $25,000.

Gould & Eberhardt, 111 New Jersey Railroad Ave., Newark, N. J., has awarded the contract for the construction of a 4-story manufacturing plant at Irvington, N. J., for the manufacture of machine tools. Estimated cost, $50,000.

Kraeuter & Co., Newark, N. J., manufacturer of punches, chisels, etc., will build an addition to its plant on 18th Ave. M. N. Shoemaker, Arch.

The Newark Pattern Works, Newark,, N. J., will alter and enlarge its plant.

The National Player Action Co., Newark, N. J., manufacturer of piano-player apparatus, has had plans prepared for a 2-story plant on South St.

The Security Novelty, Co., New York, N. Y., has acquired property on South St., Newark, N. J., and will establish a plant for the manufacture of metal and celluloid buttons and novelties.

The contract has been awarded for the construction of a dye house for Harry Mazzaro and Anthony Popper, 35 Garfield Ave., Paterson, N. J. Estimated cost, $8,000.

Bids have been received for the construction of a 1-story, 72x210-ft. addition to the plant of the Pond Machine Tool Works at Plainfield, N. J.

The Mercer Automobile Co., Trenton, N. J., has acquired property adjoining its manufacturing plant and is having plans prepared for the construction of a large addition.

The contract has been awarded for the construction of a machine shop at Athens, Penn., for the Ingersoll-Rand Co., Athens.

The Hershey Machine and Foundry Co., Manheim, Penn., is building a new machine shop.

The contract has been awarded for the construction of a 4-story garage and service station for McAllister Bros., Pittsburgh, Penn. Estimated cost, $95,000. Noted Mar. 9.

The Bethlehem Steel Co. plans to construct an addition to its plant at South Bethlehem, Penn. Estimated cost, $500,000.

The Penn Steel Co., Pittsburgh, Penn., is building a new plant at Tarentum, Penn.

The contract will soon be awarded for the construction of a garage at Hagerstown, Md., for B. P. O. E. Estimated cost, $15,000.

The Maryland Steel Co., Baltimore, Md., has awarded the contract for a fabricating building and mold loft at its plant at Sparrows Point. Address F. W. Wood, Morris Bldg., Philadelphia, Penn.

SOUTHERN STATES

The contract has been awarded for the construction of a garage for C. W. Phellis, 1348 6th Ave., Huntington, W. Va. Noted Feb. 17.

G. N. Tillman, Nashville, Tenn., has been granted a permit to construct a garage at 1505 Broadway. Estimated cost, $15,000.

The Sylvan Cotton Mills, Shelbyville, Tenn., is in the market for electrical machinery and supplies, especially wiring for generators and motors.

The School Board, Somerset, Ky., plans to equip a machine shop as part of preparation of manual training course.

MIDDLE WEST

The Universal Machine Co., Bowling Green, Ohio, will increase its capital stock $75,000 for the construction of several additions to its plant.

The contract has been awarded for the construction of an addition to the plant of the Berger Manufacturing Co., manufacturer of steel roofing, ceilings and metal filing devices, at Canton, Ohio. Estimated cost, $75,000. Noted Apr. 20 and June 8.

According to press reports the J. Baum Safe and Lock Co., Cincinnati, Ohio, recently incorporated with $180,000 capital stock, plans to increase its manufacturing facilities. Walter J. Baum is interested.

The Crucible Steel Forge Co., Carnegie Ave., Cleveland, Ohio, is in the market for 1 or more direct connected motor driven engine lathes, 25 ft. between centers with a 40-in. swing, two carriage machines being preferred.

The contract has been awarded for the construction of an addition to the factory of the White Sewing Machine Co. at Cleveland, Ohio. Estimated cost, $40,000.

Plans are being prepared for a new reinforced-concrete factory on Reynolds St., Columbus, Ohio, for the Shaw Wire Fence Co. A. Kelly is Mgr. Noted June 8.

Plans are being prepared for the construction of a 1-story bolt shop at Columbus, Ohio, for the Standard Belt and Forging Co.

Plans are being prepared for the construction of a garage at Lakewood, Ohio, for A. C. Bishop, 416 Citizens Bldg., Lakewood.

The capital stock of the Thomas & Armstrong Co., London, Ohio, manufacturer of sheet metal products will be increased from $75,000 to $150,000. The company plans to construct several additional buildings.

The contract has been awarded for the construction of an addition to the plant of the Newark Stamping and Foundry Co., Newark, Ohio.

The Excell Manufacturing and Sales Co., Springfield, Ohio, recently organized by J. B. Gaines and associates, plans to construct a factory for the manufacture of a patented lawn sprinkler.

The capital stock of the Houghton Elevator and Machine Co., Toledo, Ohio, will be increased from $25,000 to $400,000. Company also plans to construct a new plant.

The Packard Electric Co., Warren, Ohio, manufacturer of machinery, etc., will construct a new factory.

The Dockray Brass and Iron Co., Zanesville, Ohio, plans to enlarge its plant.

An addition is being built to the plant of Gray & Son, 18th and Jackson St., Anderson, Ind., to be used for the manufacture of general machines and tools.

The Ft. Wayne Oil Tank and Pump Co., Ft. Wayne, Ind., plans to construct an addition to its plant.

The contract has been awarded for the construction of an enameled iron manufacturing plant at Indianapolis, Ind., for Ingram, Richardson Co., Beaver Falls, Penn.

The National Machine and Tool Co. has awarded the contract for the construction of a 1-story addition to its plant at Indianapolis, Ind. Estimated cost, $14,000.

Plans have been prepared for an addition to the plant of the T. W. Warner Co., Muncie, Ind., manufacturer of automobile parts. New machinery will be required.

The American Nickeloid Co., Peru, Ind., has awarded the contract for the construction of an addition to its plant.

The Pennsylvania Lines West of Pittsburgh plans to enlarge its repair shops at Richmond, Ind. Estimated cost, $500,000. Thomas Rodd, Pittsburgh, Penn., Ch. Engr.

The H. B. Sherman Manufacturing Co., manufacturer of brass goods, Barney and Kalamazoo St., Battle Creek, Mich., is in the market for a second-hand, high-grade, good condition, short use Allis-Chalmers or equivalent 250-hp. engine, horizontal boilers 125-hp. each or an engine of similar capacity direct connected with generator 200-kw., alternating-current, 3-phase, 220-volt current.

Plans have been prepared for several additions to the plant of the Detroit Heating and Lighting Co., Detroit, Mich., manufacturer of sheet metal specialties for automobiles.

Dodge Bros., Detroit, Mich., manufacturer of automobiles, plans to construct an addition to its plant.

The England Manufacturing Co., manufacturer of automobile parts, is constructing a new factory at Leavitt and Campbell Ave., Detroit, Mich.

An addition will be constructed to the plant of the Fisher Body Co., Detroit, Mich., manufacturer of auto and carriage bodies. Estimated cost, $10,000.

The Studebaker Corporation, Detroit, Mich., manufacturer of automobiles, contemplates another addition to its plant.

The O. E. Aëroplane Co., Fenton, Mich., recently incorporated with $25,000 capital stock, plans to construct a factory at Fenton for the manufacture of aëroplanes.

Plans have been prepared for the construction of a factory for the manufacture of heating furnaces for the Home Furnace Co., Holland, Mich. New foundry machinery and sheet metal tools will be required.

An addition is being built to the plant of the Michigan Crank Shaft Co., Lansing, Mich., manufacturer of machinery.

The Globe Manufacturing Co., Northville, Mich., manufacturer of automobile trucks, will construct an addition to its plant.

Bids are being received for the construction of a 2-story garage at Pontiac, Mich., for Howard Fawcett. Estimated cost, $20,000. Noted Apr. 27.

According to press reports the W. O. Lee Co., Port Huron, Mich., manufacturer of brass goods and injectors, plans to increase the capacity of its plant.

The Alemite Metal Co., manufacturer of metal specialties, has moved its plant to 341-51 West Chicago Ave., Chicago, Ill., and plans to install new machinery.

The contract has been awarded for the construction of a machine shop at Chicago, Ill., for the Chicago Junction Railway Co.

The contract has been awarded for the construction of a new factory for the Englander Spring Bed Co., 39th St. and Lowe Ave., Chicago, Ill.

The contract has been awarded for the construction of a 1-story garage at 1227-29 Cleybourn Ave., Chicago, Ill., for A. F. Mayer & Bros. Estimated cost, $12,000.

The Santa Fe System is in the market for a number of machine tools. C. F. W. Felt, Chicago, Ill., Ch. Engr.

Plans are being prepared for an addition to the factory of the Templeton, Kenly & Co., Ltd., 1020 South Central Ave., Chicago, Ill., manufacturer of railway supplies.

The Shankin Manufacturing Co., Springfield, Ill., manufacturer of brass, is building a factory at 11th St. and Stanford Ave. Estimated cost, $10,000.

An addition is being built to the plant of the Lyon Metallic Manufacturing Co., Yorkville, Ill., manufacturer of metal lockers. Estimated cost, $15,000.

R. A. Boehme, Alma, Wis., and B. L. Bruggeman, Minneapolis, Minn., will establish a machine shop and automobile business in the Boehme Bldg., Alma, Wis.

Plans are being prepared for the construction of a 1-story garage at Black River Falls, Wis., for August Berg, Melrose, Wis. Estimated cost, $10,000.

J. R. McDonald, Main St., Black River Falls, Wis., will construct a garage at Black River Falls. Estimated cost, $10,000.

The Hudson Sharp Machine Co. and the Sectional Roll Manufacturing Co., Green Bay, Wis., have merged into company with a capital of $60,000 and plan to equip a plant with lathes, shapers and other iron working machinery.

Paul H. W. Pagel, Kaukauna, Wis., will construct a garage and service station at Kaukauna.

The Laursen Automatic Pump Co., Menomonee, Wis., manufacturer of mining and irrigation pumps, plans to establish a branch plant at Green Bay, Wis. George D. Nau, Green Bay, is interested.

The contract has been awarded for the construction of a 1-story garage for Ira Ludwig, 2316 Aurer Ave., Milwaukee, Wis. Estimated cost, $10,000. Noted Apr. 27.

Bids will be received until July 1 by Fred Maettig, Arch., 2906 North Ave., Milwaukee, Wis., for the construction of a garage and factory. Estimated cost, $25,000.

Plans are being prepared by R. E. Oberst, Arch., 353 National Ave., Milwaukee, Wis., for the construction of a garage and machine shop at Lapham St. and 2nd Ave.

Demars Bros., Washburn, Wis., will construct an addition to their service garage to be used for machine shop purposes.

Press reports state that the Jersild Fire Escape Co., Neenah, Wis., plans to establish its permanent works at Waupaca, Wis. J. N. Jersild is Pres. and Gen. Mgr.

WEST OF THE MISSISSIPPI

The Globe Manufacturing Co., manufacturer of washing machines, plans to rebuild its factory at Perry, Iowa, which was recently destroyed by fire. Estimated cost, $30,000.

The contract has been awarded for the construction of a garage at Sheffield, Iowa, for J. P. McCammant. Estimated cost, $13,241.

Preliminary plans are being prepared for the construction of a 2-story garage for H. A. Wetmore, 515 6th St., Sioux City, Iowa. Estimated cost, $35,000.

Plans are being prepared for the construction of a factory at North St. Paul, Minn., for the Minnesota Manufacturers Association, manufacturer of elevator and gravity carriers.

The Willys-Overland Automobile Co. has purchased a site on University Ave., St. Paul, Minn., and plans to construct an addition to its plant.

The Drake-Williams-Mount Co., manufacturer of boiler, tank and sheet iron, has been granted a permit for the construction of a factory at 23rd and Hickory St., Omaha, Neb. Estimated cost, $5,900.

The contract has been awarded for the construction of a 2-story garage at 9th St. and Broadway, Hannibal, Mo., for Thomas L. Anderson. Estimated cost, $12,000. Noted Mar. 9.

The contract has been awarded for the construction of a garage at St. Louis, Mo., for the Velie Motor Car Co., 3021 Locust St., St. Louis.

Bids have been received for the construction of a garage at Abilene, Tex., for J. M. Radford.

Thomas S. Causey and associates plan to construct a plant at Dallas, Tex., for the manufacture of a newly patented thermal generator.

The Moore-Schillinger Co., Inc., plans to construct a plant at El Paso, Tex., for the manufacture of ornamental iron and wire work.

The Farmers Coöperative Gin Co. plans to construct a cotton gin at Seguin, Tex.

The contract has been awarded for the construction of a garage at Sherman, Tex., for Lee Simmons. Estimated cost, $10,000.

WESTERN STATES

J. J. Callahan plans to construct a garage at Yakima and Naches Ave., North Yakima, Wash. Estimated cost, $22,000.

Plans are being prepared by H. Ryan, Arch., Northern Bank Bldg., Seattle, Wash., for the construction of a 120x120-ft. garage and machine shop at Seattle for the Winton Motor Car Co. Estimated cost, $65,000.

Plans are being prepared for the construction of a garage and machine shop at Big Pine, Calif., for J. H. Kispert, Los Angeles.

CANADA

The Dominion Bridge Co., Ltd., is constructing an addition to its copper mill and a new forge shop at Lachine, Que. Estimated cost, $17,000.

E. C. Dennert, care of Hill Bros., Essex, Ont., will construct a factory at Essex for the manufacture of auto tractors, machinery, etc.

F. Callendar plans to construct a foundry at Guelph, Ont. Estimated cost, $7,000.

Work will soon be started on the construction of a plant at Weston, Ont., for the Canada Cycle and Motor Co. Estimated cost, $100,000.

GENERAL MANUFACTURING

NEW ENGLAND STATES

The Knox Woolen Co. is constructing an addition to its plant at Camden, Maine.

The contract has been awarded for the construction of a 2-story shoe factory at Manchester, N. H., for the F. M. Hoyt Shoe Co., Sulver St. Estimated cost, $30,000.

The Quincy Market Cold Storage and Warehouse Co. plans to construct a 9-story cold-storage plant at Boston, Mass.

The contract has been awarded for the construction of an addition to the box factory of Atwood & McManuson, Vale St., Chelsea, Mass.

The International Worsted Mills has awarded the contract for the construction of a 1-story weave shed at Methuen, Mass. Estimated cost, $12,000.

The contract has been awarded for the construction of a 2-story, 70x120-ft. mill on Dexter St., Providence, R. I., for the Simmons Braid Co. Noted June 1.

MIDDLE ATLANTIC STATES

Plans are being prepared by Pierce & Bickford, Arch., 118 Lake St., Elmira, N. Y., for the construction of a 1-story dye plant. Estimated cost, $20,000.

The Wyckoff Knitting Co., Perry, N. Y., plans to construct a large addition to its plant.

The Rochester Folding Box Co., Rochester, N. Y., is in the market for lithographing presses, box machinery, etc., for the new factory which it is building on Elizabeth St. between Lake Ave. and Genesee River, Rochester. Estimated cost, $175,000. H. C. Stevenson, Secy. and Treas. Noted June 1.

The United Paper Board Co., Thomson, N. Y., has had plans prepared for alterations to its factory. Estimated cost, $5,000.

The Vacuum Oil Co., Bayonne, N. J., has had plans prepared for several additions to its plant. L. V. Van Leuven, Engr.

The American Lead Pencil Co., Hoboken, N. J., has acquired property on 8th St. for extensions to its plant.

The Celluloid Co., 290 Ferry St., Newark, N. J, has awarded the contract for the construction of a 2-story manufacturing building. Estimated cost, $20,000. M. Martin, Supt., in charge.

The Hoboken Ribbon Co., 11th St., Hoboken, N. J., has awarded the contract for the construction of a 4-story factory at North Bergen, N. J. Estimated cost, $35,000. William Strittmater, Hoboken, Supt., in charge.

The Atlantic Silk Co., Paterson, N. J., plans to install new equipment in its plant.

B. E. Davis, 366 Godwin St., Paterson, N. J., will construct a 3-story addition to its silk mill. Estimated cost, $12,000.

The Pearl Silk Co., Paterson, N. J., plans to install new equipment in its plant.

The Perth Amboy Chemical Works, Perth Amboy, N. J., will construct a 2-story brick and steel addition to its plant.

Stork Bros., Adamstown, Penn., have leased and are remodeling building at Akron, Penn., for hosiery mill.

Plans are being prepared for the construction of a 1- and 2-story plant at New Brighton, Penn., for the Beaver Refrigerator Manufacturing Co.

Plans are being prepared for the construction of an addition to the plant of the Johnson Bronze Co. at New Castle, Penn. Estimated cost, $85,000.

The Barrett Manufacturing Co., manufacturer of chemicals, Philadelphia, Penn., has awarded the contract for the construction of a reinforced-concrete and brick addition to its plant on the east side of Bermuda St. south of Tucker St.

The Electric Storage Battery Co., Philadelphia, Penn., is building a 6-story factory at 19th and Allegheny Ave. Estimated cost, $250,00. Noted May 11.

The contract has been awarded for the construction of a 2-story packing plant for Fried & Reineman, Pittsburgh, Penn. Estimated cost, $8,000. George M. Myers, Spring Garden St., Mgr.

The Linde Air Products Co., 30 East 42nd St., New York, N. Y., manufacturer of oxygen, etc., has awarded the contract for the construction of a plant at Baltimore, Md. Noted May 18.

The Curtis Bay Chemical Co., Curtis Bay, Md., has awarded the contract for several additions to its plant. Estimated cost, $1,000,000. J. P. McGovern, 27 William St., New York, N. Y., Secy. Noted June 8.

SOUTHERN STATES

The Libby Owen Sheet Glass Co., Toledo, Ohio, recently incorporated with $6,000,000 capital stock, is building a plant at Kanawha City, near Charleston, W. Va., estimated to cost, $1,200,000. A. F. Fowle, Vice-Pres. of Toledo Glass Co., interested.

The Groves Mills Co., Gastonia, N. C., plans to construct a cotton yarn mill. L. F. Groves, Pres. and H. H. Groves, Secy.

The Piedmont Mills Co., High Point, N. C., plans to construct 2 additions to its plant.

The Rocky Mount Mills, Rocky Mount, N. C., manufacturer of warps and yarns, contemplates an expenditure of $100,000 for improving and enlarging its plant.

The contract has been awarded for the construction of an addition to the plant of the Georgia Cordage Mills, Scottdale, Ga.

The Buckeye Cotton Oil Co., Memphis, Tenn., will construct a plant. Estimated cost, $100,000.

The Excelsior Oak Tanning Co. plans to construct an addition to its plant at 9th St. and Ormsby Ave., Louisville, Ky.

MIDDLE WEST

The General Tire and Rubber Co., Akron, Ohio, has taken over the plant of the Western Tire and Rubber Co., Kansas City, Mo., and will enlarge same.

The Punctureless Auto Tire Co., Akron, Ohio, plans to construct a factory at Barberton, Ohio.

The Damascus Manufacturing Co., 3447 East 52nd St., Cleveland, Ohio, plans to construct a 4-story factory near Cassius Ave. and East 93rd St., Cleveland, for the manufacture of oil specialties. Estimated cost, $75,000.

The Lederer Furniture Co., Rose Bldg., Cleveland, Ohio, plans to construct a new 4-story building at Euclid Ave. and East 61st St., Cleveland. Estimated cost, $150,000.

The Pittsburgh Glass Co., Court St. and Broadway, Cincinnati, Ohio, plans to construct a plant at Cleves, Ohio.

The Wolf Lanning Co., Uhrichsville, Ohio, recently organized by G. A. Wolf and T. A. Lanning, Uhrichsville, plans to construct a clay products plant east of Thornwood Park, Dennison, Ohio. Estimated cost, $150,000.

The Toledo Storage Battery Co. plans to construct a factory at Toledo, Ohio.

The De Vilbis Manufacturing Co., manufacturer of atomizers and air brushes, plans to construct a factory at West Toledo, Ohio.

The Mazuria Clay Products Co., Uhrichsville, Ohio, recently incorporated with $100,000 capital stock, will construct a plant for the manufacture of clay products.

William Gresbach, Bedford, Ind., is in the market for machinery for the manufacture of excelsior and also desires location for such plant.

Plans are being prepared for the construction of a factory at Marion, Ind., for the Lindley Box Co. Estimated cost, $20,000. Noted Mar. 2.

The Stout, Deuckwall Manufacturing Co., manufacturer of cabinets, has awarded the contract for the construction of an addition to its factory at Salem, Ind.

The Universal Chemical Co. plans to construct a plant at Battle Creek, Mich.

The Brown & Sehler Co., manufacturer of carriages, implements, saddles and harness, plans to build a factory at Ionia Ave. and Cherry St., Grand Rapids, Mich. Estimated cost, $45,000.

The Sligh Furniture Co. will build an addition to its plant at Grand Rapids, Mich.

The W. D. Allen Manufacturing Co., manufacturer of belting, rubber goods and mill supplies, plans to construct a plant at West Lake and Jefferson Ave., Chicago, Ill. Estimated cost, $110,000.

The J. D. Freese & Sons Co., manufacturer of furniture, is constructing an addition to its factory at 2501 Homer St., Chicago, Ill. Estimated cost, $25,000.

The Salter Manufacturing Co. is constructing a 3-story addition to its factory on Oakley Blvd. near Northwestern Ave., Chicago, Ill., for the manufacture of furniture. Estimated cost, $15,000.

The Fond du Lac Church Furniture Co. has purchased a site at Oak St. and Oak Pl., Fond du Lac, Wis., and plans to construct an addition to its plant. William Mauthe is Pres.

The contract has been awarded for the construction of a 75x175-ft. addition to the plant of the Hoberg Paper Mill Co. at Green Bay, Wis. Estimated cost, 70,000. Noted May 25.

The North Side Yarn Mills plans to enlarge its factory at La Crosse, Wis., and install new machinery.

The Northern Paper Co., Green Bay, Wis., contemplates the construction of a sulphite plant.

WEST OF THE MISSISSIPPI

Bids have been received for the construction of a shoe factory at Minneapolis, Minn., for the T. A. Foot, Schultz & Co. Kees & Colburn, Donaldson Bldg., Minneapolis, Arch. Noted Feb. 17.

Plans are being prepared for the construction of a packing plant at South St. Paul, Minn., for Armour & Co. Estimated cost, $3,000,000. Notel Nov. 11.

The Billings Beet Sugar Co., Billings, Mont., contemplates constructing a factory at Great Falls, Mont. W. L. Lawson is Mgr.

The contract has been awarded for the construction of a factory at St. Louis, Mo., for the manufacture of chemicals for John T. Milliken & Co., 316 Clark Ave., St. Louis. Estimated cost, $100,000. Noted Mar. 23.

The Cottonseed Oil Co. of Texas plans to construct a mill at Dallas, Tex. Estimated cost, $100,000.

The Southland Cotton Oil Co. plans to rebuild its cottonseed oil mill at Waxahachie, Tex., which was recently destroyed by fire with a loss of $75,000.

WESTERN STATES

The Voorhees Fireproof Wall Board Co. plans to construct a factory at Martinez, Calif. Estimated cost, $15,-000.

CANADA

The Ha Ha Bale Sulphite Co., Chicoutimi, Que., has awarded the contract for the construction of a paper pulp mill at Bagotville, Que.

Plans are being prepared for the construction of an addition to the plant of the Grasselli Chemical Co. in Burlington St., Hamilton, Ont. Estimated cost, $18,000.

The contract has been awarded for the construction of woolen mills at Lindsay, Ont., for Horn Bros., Windsor St., Lindsay. Noted Mar. 16.

The McKinnon Sash and Hardware Co. has awarded the contract for the construction of a factory at St. Catharines, Ont. Estimated cost, $10,000.

Classified Advertising

The Classified Advertising section appears on pages 180, 181, 182, *of this issue and will in future appear in the same relative position in the paper.*

American Machinist

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Contents, First Page
Advertising Index, Last Page

Another P. & W. Success

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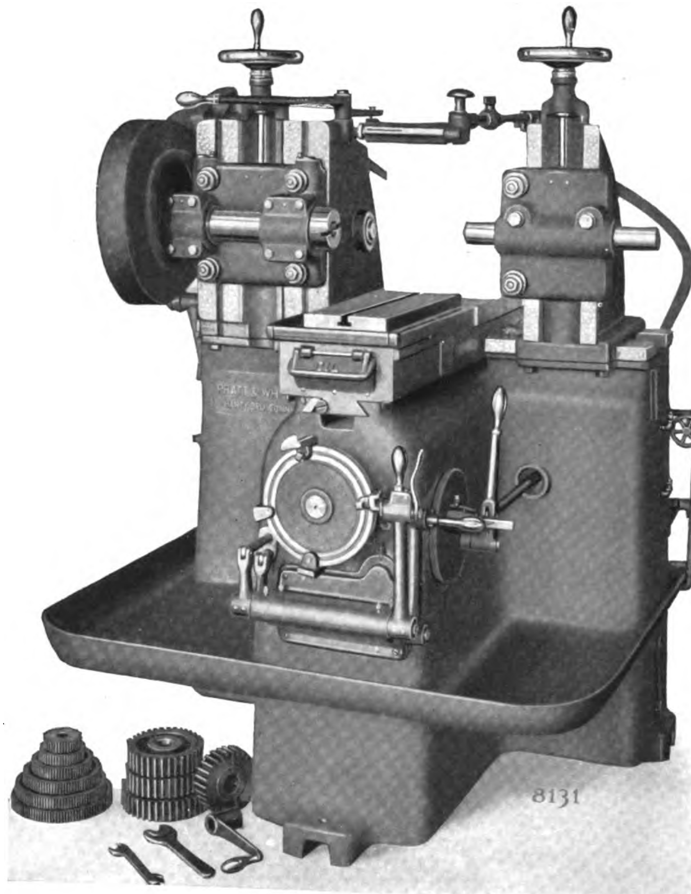
Has been developed to meet the need for a manufacturing tool, automatic in operation and better adapted to the diversified requirements of milling work, than has heretofore been available.

Automatic Features

The table is provided with power rapid traverse in either direction automatically controlled. The table receding feature described below also operates automatically. In operation, the work approaches the cutter on the forward rapid traverse and when the cutter is about to engage the work the regular feed is automatically thrown into operation. After the milling operation has been performed, the return rapid traverse is automatically engaged and the table quickly returned to its original position for re-loading.



12-inch Automatic Milling Machine

6 to 8 Machines Operated by One Man

Automatic features reduce non-working time of machine to a minimum. With usual hand operations eliminated, machines are handled by operator without physical exertion. Practically all operator has to do is to supply machine with work. On[illegible] of from 6 to 8 [illegible]ter of work.

[illegible]feature on [illegible]ing table. This feature permits the work to clear the cutter on the return stroke, and therefore prevents marring of the finished surface. After the milling operation has been performed the table recedes a sufficient amount for the work to clear the cutter. As the table approaches the end of the return stroke, it is automatically elevated to its former position.

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American Machinist

L. P. ALFORD, *Editor*

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CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

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Talks With Our Readers

By the Publisher

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You can't go wrong when you deal with "Black and White" manufacturers—

Think it over.

Women and Machine Tools

By I. William Chubb

SYNOPSIS—One effect of the European War has been to show that the number of skilled men engaged in industry and in engineering is entirely inadequate to meet both civil and military needs, and all countries have attempted to fill gaps by the employment of women. This article describes what has been accomplished in this way in four prominent English machine shops.

In Great Britain some time ago it was officially stated that the number of persons engaged in the metal and chemical trades, including those employed in the ordnance factories, was about 1,900,000, of whom 200,000 were women and girls. The latter, according to a still more recent statement, number now 300,000 or more. The woman worker has long been known in some British metal-working industries. Cradley Heath and certain machine shops of the Birmingham and Manchester districts may be cited. But her presence in mechanical engineering has of late greatly extended, and even the shipyard now knows her for such branches of labor as scraping, painting and countersinking.

FIG. 1. BACKING OFF MILLING CUTTERS IN THE LATHE

The employment of women on the work of shell turning is of course easily arranged, for the processes can be divided into units each of a simple character and, given a simple machine tool, an ordinary woman does not require much in the way of training to become efficient. Such plants are in fact being run almost entirely by women. In one instance known to the writer instruction extending over four days, on the average, is quite sufficient training. With the simple tools given to them, the women usually learn before long how to set up the machines for themselves, the limit occasionally being fixed only by the muscular effort required for lifting the job or fastening it in the machine.

To cut it short, in shell work repetition methods can easily be applied. The women do one job all the time and are content, being in that respect unlike the skilled workman and perhaps even still more unlike the male youth, who, entering the shop for the purpose of "learning a trade," objects with as much vigor as circumstances allow to being kept on one process or detail for any length of time. Again, as compared with lads, women value more highly the money earned. In an engineering sense they have no past to help or to hamper them, and in many instances they can have no future; they therefore make the best possible use, at least as regards money earning, of the present.

In the production of machine tools and small tools for engineers the same conditions do not prevail. Unless the firm makes up its mind or is compelled officially to produce an extremely limited range of types and sizes of machines or appliances, the same job does not recur with anything like the same frequency as in shell making. Nevertheless, the British machine-tool firm producing tools up to a medium size and not employing women must by now be the exception. The work of the fitter, however, requiring at least a more continuous expenditure of muscular energy, does not afford so many opportunities for feminine employment. Still, women are engaged in some measure in assembling and fitting, and there are tool shops in which they are undertaking the work of scraping.

This article is concerned more directly with the work of four firms, taken merely by way of example. They are E. G. Wrigley & Co., Ltd., Birmingham, manufacturers of twist drills, milling cutters, etc.; H. W. Ward & Co., Ltd., Birmingham, who confine themselves mainly to capstans and turret lathes; the Churchill Machine Tool Co., Ltd., Pendleton, Manchester, which produces precision grinders and some special drilling machines; and H. W. Kearns & Co., Ltd., Broadheath, near Manchester, makers of drilling machines, combined surfacing, boring and milling machines and shapers.

The illustrations give a series of reproductions of photographs that are fairly representative, though it may be mentioned that a light planer is not included—a type of machine on which at least some women are employed. A broaching machine also is omitted, the writer not having met with women working on these tools.

Although one or two cases of failure might be mentioned, the work of women generally is entirely satisfactory. When once accustomed to moving parts, they rapidly get expert. Often, they apparently cannot get beyond a somewhat uncertain limit, though whether this is inherent in the sex or is simply due to an insufficient period of training is not determined. The best results seem to be obtained when a woman superintendent is provided to deal with such matters as conduct, timekeeping and dress, while as regards actual production of work the women are always responsible to the shop foreman or other male official. Commonly the women enter the works a few minutes later and go out earlier than the men, and in most instances they are spread

about the shop according to the position of the machines they have to control, though some few firms prefer to segregate the women.

One experience has been fairly general—namely, the advantage that accrues from providing a cup of tea about four o'clock in the afternoon, with in some instances definite stoppage of work for from five to ten minutes.

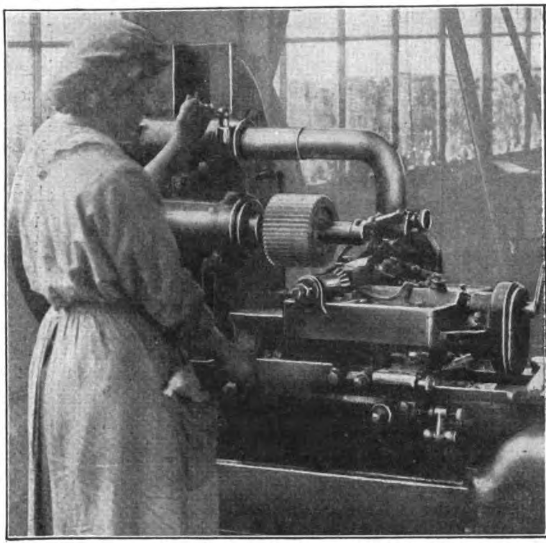


FIG. 2. MILLING CUTTER TEETH

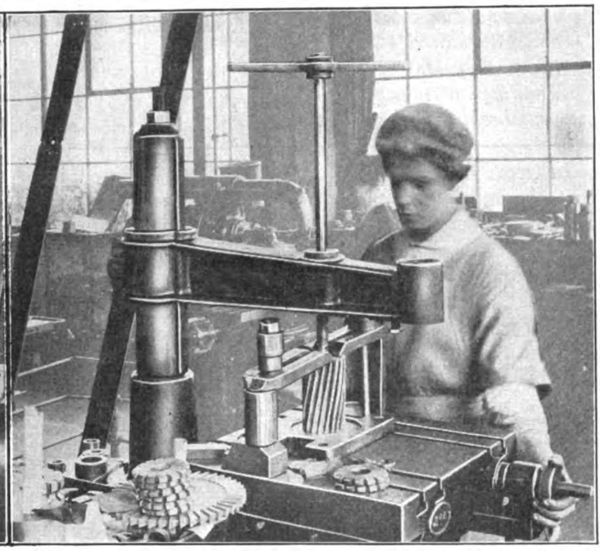


FIG. 3. A WOMAN KEYSEATER OPERATOR

Chairs and stools too are quite usual, often being taken away at the end of the woman's period when the man comes on to work the same machine. The effect of industrial employment on the health of women is in fact receiving attention from government officials with a view both to the present and to the future. Overalls and caps are commonly given and gauntlets and special aprons on particularly dirty jobs. Two sets are often provided, but the woman has to look after such matters as their washing and maintenance. As to the work undertaken by the women, an idea of this can be gathered from the illustrations.

At E. G. Wrigley & Co., Ltd., women are engaged on all operations in the production of twist drills and milling cutters, employment ranging from girls in the stores to women for viewing and inspecting, including women for floor sweeping. Drills are turned, pointed, fluted, tongued, ground, etc., the women working to micrometer and Morse taper gages, and the output is found equal to that of men and the quality good. One girl will manage two lathes, turning shanks on one and the bodies on the other. The fluting of wire sizes and of twist drills generally up to 1½ in. in diameter and grinding by women of work up to 2 in. in diameter are common.

In the cutter section the work of women includes turning, milling, backing off and relieving, slotting and grinding, all up to the capacity of the machines employed. A universal grinder is under the charge of a woman. A backing-off lathe with a woman turner is illustrated in Fig. 1; a woman engaged in milling the teeth of cutters appears in Fig. 2, while Fig. 3 shows a keyway-cutting operation. In milling, the woman does her own setting up; but, as is common, before proceeding draws the attention of the charge hand. The products include gear cutters of all kinds, angle cutters, side and face cutters, twist-drill cutters, etc. A woman is shown in Fig. 4 engaged in grinding valve-seating cutters about 6 in. in diameter, hardly an unskilled job. In the toolroom, where the nature of the work varies more, the proportion is about one woman to seven or eight men. They are engaged in shaping dies, backing off reamers, grinding hobs, running up the flutes of taps, surface-grinding flat gages, form-tool work, etc. After a time here the woman can deal with most jobs as they come along, though occasionally a setter-up is needed. The viewing department relating to the twist-drill and milling-cutter section is seen in Fig. 5. Here five girls are employed with one in charge. Work begins with the inspection of the raw material and includes complete inspection and gaging of the product, and the women are found at least as

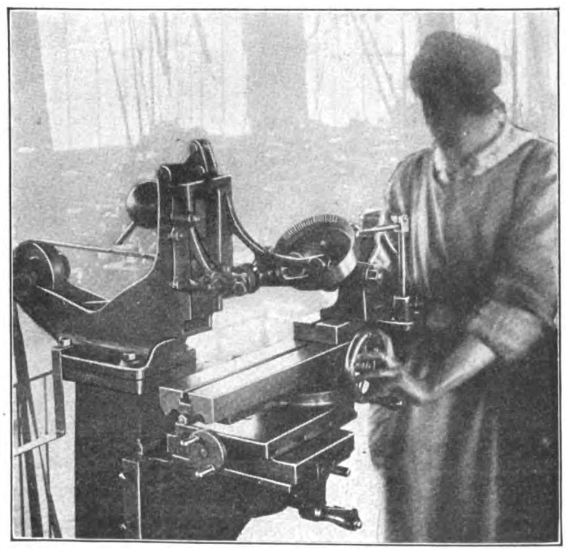


FIG. 4. GRINDING VALVE-SEATING CUTTERS

competent as men. The women have their own library, restroom and messroom and have their own representatives on the general messroom committee. When these notes were taken, out of a total shop force of about 550 some 110 were women.

At the works of H. W. Kearns & Co., Ltd., a section has been partitioned off from the main works, and the girls and women, to the number of two dozen or more, have their own entrance, with a lady superintendent in charge of cloakroom, messroom and so on. The women work 51 hr., while the general hours of the shop are 53 to the week, and it has been found necessary to check timekeeping carefully. The women are engaged on daywork, and their places are taken at night by skilled men who generally finish the jobs left by the women before proceeding with their own work. Jobs are divided into really skilled and comparatively unskilled, the first being undertaken by men and the older apprentices at night, the second class being for women. The latter, as soon as they get accustomed to the machines, so as to avoid the nipping of fingers, etc., readily get expert. In most instances they do all their own setting up under the charge hand and all their own fastening, except of course for heavy jobs, as slot-drilling large shafts. The dressmaking and milliner type of girl has been found specially suitable; when once they have undertaken a given piece of work, they can do it again without trouble, though the firm has had to do some weeding out.

Fig. 6 shows girls on small shapers. The younger girls are usually employed for this work, shaping, say, the bottom of a bracket, working from the center of the boss. In the turret-lathe department the work is largely gear blanks, and the tools are set up by the girls. They work to plug and socket gages and to solid end blocks or lengths for diameter, calipers being set to them. No screw cutting has yet been done by women, although this will be attempted. After the gear blanks are turned, they are stamped for pitch, etc., and in the gear-cutting section a girl sets the machine to these particulars, following the instructions issued with the machines and working to the indexes. Solid block gages are employed for depth on milling and shaping machines. In the drilling section, Fig. 7, are Cincinnati, Kearns and two-spindle Herbert drills. The work is here mainly to jigs. In the gear section, Fig. 8, one woman as a rule works two machines—a gear hobber and the milling-cutter type of machine. Wheels up to 3 ft. in diameter are cut, but heavier gears are kept for men at night.

It is found that the woman at the semiautomatic Bilgram bevel-gear machine can be left to herself pretty well after about three weeks, but in all cases the charge hand has to check. Occasionally a girl on a lathe will change over to a horizontal miller, and the woman on the bevel-gear cutter will change to spur gear. As to pay, piece rates prevail with time rates guaranteed. In some instances, as when the girl may require a considerable amount of help, the charge hand has a percentage of the balance. He therefore gets the benefit of teaching the girl to do the work quickly. The balance is of course the difference between the amount earned at piece rates and the ordinary time rate, and this balance or difference is divided, as stated, between the girl and the charge hand, the latter taking one-third of it. The system is found to work well. Then in regard to the gear-cutting section, in addition to the weekly rate a bonus payment

FIG. 5. INSPECTION DEPARTMENT AT THE WRIGLEY PLANT

FIG. 6. SHAPERS RUN BY WOMEN

is made for each tooth cut, whatever the size. A lengthy schedule of prices for gears of various pitches and widths is avoided, and large gears have to be taken with the small.

At the Churchill Machine Tool Co., Ltd., women are turning, drilling, fitting and grinding, internal and external. They take the place of lads rather than of men, as applied to skilled work. No young girls are employed. The women engaged are those who enter the factory with a serious purpose and have homes to keep. Several widows of men who were previously employed in the same shops and have been killed in the European War are included. The firm is very well satisfied with the result of its experiment, for under competent supervision the women are proving efficient. Women are also employed in the stores and on the sawing-off machines, cutting off steel for use in the small-tool department. In lathe work the women after one week were regularly roughing-out such details as small handwheels, bushings and pulleys, using calipers that are set to a sample. In short, they do here the work that younger apprentices would undertake. The turning foreman, an assistant to the general foreman, has the duty of training the women, who in some instances work to limit gages. In the fitting shops women undertake such jobs as tapping small parts, removing burrs and assembling. Fig. 9 shows women fitting small detail parts of the grinders. A woman will also be seen at a radial drill and on a machine for graduating the scales that register the tapers on the grinder tables. Drilling is to jigs.

In the small-tool department women are milling cutters, and they are also installed in the milling shop for such work as keyseating shafts and spindles. Women again are employed in the material stores, serving out and packing under the charge of the storekeeper, and they pack casehardening material in boxes. It is, however, in the grinding department that women have proved most successful. They control internal and external, plain and cylinder-grinding machines and work well within the half-thousandth limit. They will talk in quarter-thousandths and are in fact very skillful in the use of the micrometer. In internal grinding about one week's training is found sufficient. A woman does her own setting up for such jobs as finish-grinding internally grinder workheads and tailstocks. The foreman checks, of course, both machine and work. The kind of job that is usual in this section cannot always be regarded as repetition work, yet the firm mentions that little time is lost in transferring from one job to another.

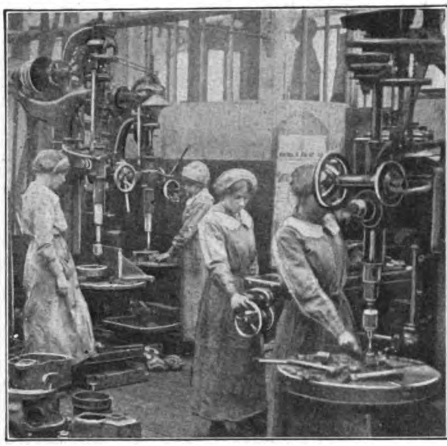


FIG. 7. DRILLING OPERATIONS CARED FOR BY WOMEN

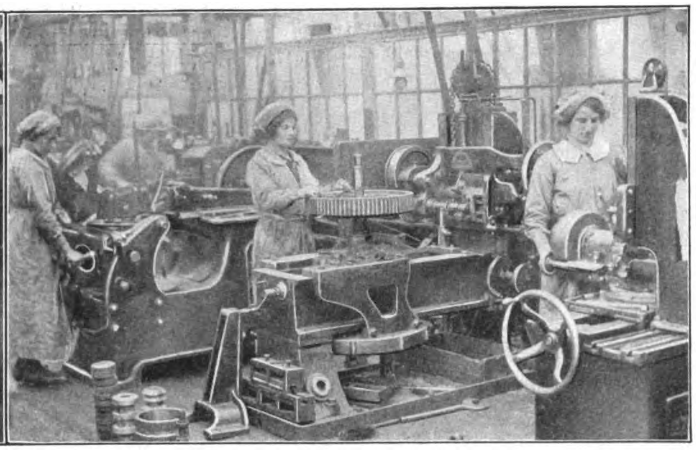


FIG. 8. WOMEN IN THE GEAR-CUTTING DEPARTMENT—EACH OPERATOR ATTENDS TWO MACHINES

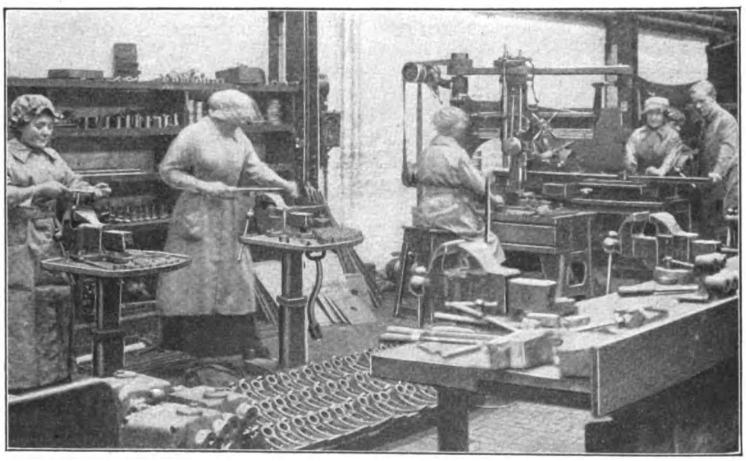
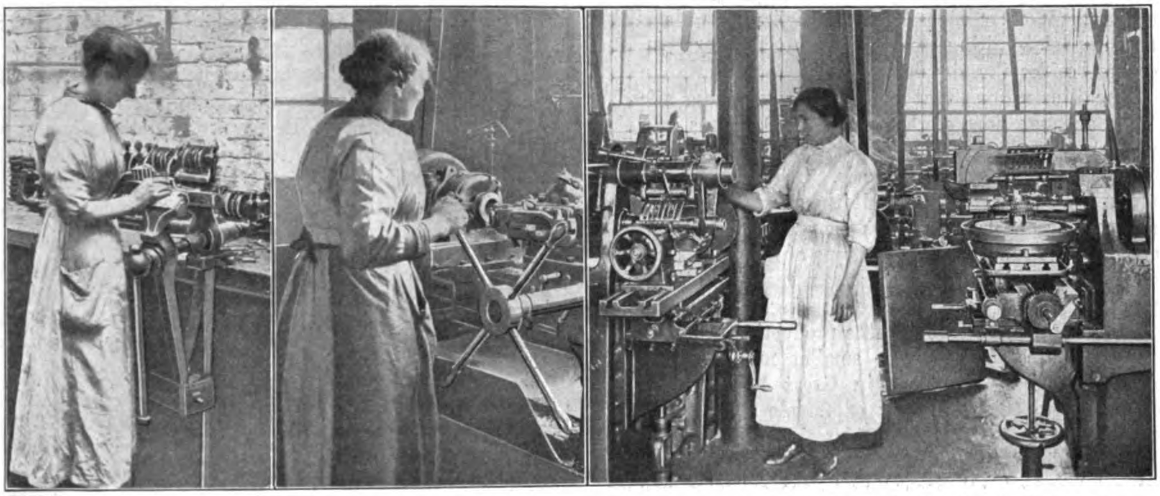


FIG. 9. FITTING GRINDER PARTS AND GRADUATING SCALES

At their two works H. W. Ward & Co., Ltd., Birmingham, are employing more than 120 women. A feature is that the firm has set up a special department in which women are taught for a week or so before being passed into the shops, and this plan is now being followed by some other concerns. Besides working machines, girls are employed to act as shop clerks in the foremen's offices. The range of work undertaken can best be gathered from the illustrations of sections of the two works, given in Figs. 10, 11 and 12, which relate to the Lionel St. works, and Figs. 13, 14 and 15,

which have reference to the Bournbrook works. In Fig. 10, women are seen fitting up countershaft parts and rotary pumps. The work here is tapping, drilling and filing, besides assembling the parts and painting them, "war finish" alone being permitted for machine tools by the Ministry of Munitions. In the screw-machine section exceptionally good work is done, perhaps because there is more repetition than in other departments, grosses of one type of screw, pin, bolt, etc., not being uncommon. Automatics and capstan lathes of the firm's own manufacture are under the control of women, who can do their own setting up. In Fig. 12 a woman is seen working two machines—on the one side a horizontal miller using a plain dividing head and producing pinions, while on the other side she runs a wormwheel hobbing machine—two types generally operated by men.



FIGS. 10, 11 AND 12. FITTING ROTARY PUMPS; SCREW-MACHINE WORK AND OPERATING GEAR CUTTERS

FIGS. 13, 14 AND 15. WOMEN OPERATORS AT THE BOURNBROOK PLANT

FIG. 16. REST AND RESTAURANT DEPARTMENT FOR WOMEN WORKERS

In other sections of these works women are employed to circular-mill wedges for tool posts and in the toolroom in fitting work on collets after they come from the miller, in finish-turning collets to a collar gage for taper and boring to size. They also drill die-holder and turret parts to jigs, drill tool posts to marking out, drill countershaft collars, etc., a girl on a four-spindle drill undertaking drilling to jigs, reaming and tapping on turret rest parts. Another fits lubricator tubes to countershaft pulleys. Jobs not shown include boring and turning countershaft pulleys in turret and center lathes, pulleys up to say 16 in. in diameter being machined, the woman in this case fastening them herself. In the grinding shop, women work plain external, surface, ring and internal machines.

Fig. 13 shows a part of the inspection department at Bournbrook, a woman gaging with a micrometer the parts required on turret and capstan lathes produced by the firm. In Fig. 14 the woman is drilling friction rings to jig, and Fig. 15 shows a turning operation

relating to stops for cross-slides and saddles, which are machined from a square bar. Fig. 16 shows the type of messroom for women, as fitted up by H. W. Ward & Co., Ltd., and by other firms. Women are also employed here in working Fellows gear shapers, a woman attending both to a machine for cast-iron gears and to one producing steel gears, both of which are set up by a man. Women with the Birmingham firm are also running slot-milling machines, cutting keyways and others besides the simple type.

The illustrations that have been given here afford a fairly adequate idea of the workshop operations in which women are engaged in Great Britain for the production of machine tools and small tools. Clearly, however, they are not all-embracing; and if the whole of mechanical engineering had been taken as the province of the article, a good many more new applications of female labor would have been considered, ranging from marking off to such processes as acetylene welding, brazing, the building up of rotors for steam turbines, the production of aëroplanes and of course many of the smaller munitions details. Any engineering employer in Great Britain who has doubts as to the possibility of female labor can often get them set at rest by consideration of official photographs. The Ministry of Munitions has a collection of several hundred, all, according to the official announcement, "indexed and arranged under the trade or operation which they represent; they are at the service of firms considering the dilution of labor and can be examined at the offices of the ministry." The illustrations to this article, having been specially taken, form no part of these official photographs.

South American Trade

By Anthony Brown

I have noticed on your editorial page in several recent issues discussion of the question of American manufacturers entering the South American field. Having a number of notes made at the time I was engaged in furthering American trade in South America a few years ago, I append them herewith, as they may be of interest in this connection:

This point should be emphasized here: A branch manager or representative should speak the language—Portuguese for Brazil, Spanish for the other countries. How much business would a German manufacturer do if he sent to the United States a representative who spoke only German and who was loaded with advertising matter in the same tongue?

We Americans are notoriously wretched linguists, and our attitude is well illustrated by that of a fellow-traveler encountered in Peru, who protested: "You are making a great mistake in speaking French or Spanish or any other foreign language. Speak English only. Then all the others will have to learn it, and it will become the world language!" This course is not recommended to him who would do business in South America. Of course, there are many English-speaking people with whom business can be done; but to be in an unassailable position to do business permanently, you must reach the citizens of the country.

Attractive advertising matter should be prepared in the proper language and designed to appeal to the prospective buyer in the country where distributed. His attitude of mind is somewhat different from that of our purchasers at home.

All samples, drawings, etc., should be especially designed to catch the eye of the nontechnical buyers, the majority being of this type. A blueprint or line drawing means little to the average man, but a handsome picture in colors, a clever working model, souvenirs that bring out the value of the article for sale—all count heavily.

Especial stress should be laid upon the appearance and social qualifications of those who would do business with the government officials. Proper introductions are very valuable, especially good letters to prominent persons.

A suggestion is here offered that has been made to several firms, and that is to ransack the American technical schools and colleges for Latin-American students, with a view to securing some of the better ones at graduation, training them for a year or two in the shop and sales ends and then sending them out to Latin-America to "push the line" in a way that only a representative with this equipment is prepared to do.

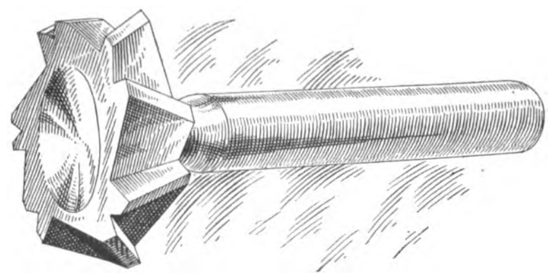
A striking example of what results may be obtained by this course is the case of a young Colombian of fine old Spanish descent, a graduate of an American college. He entered the employ of a large wire-fence firm, and after a short training in both the shop and sales departments he started for South America to introduce the fencing. In Chile alone he placed agencies and secured guaranteed orders for at least $50,000 worth of business per year, while in Argentina, where I met him a couple of months later, his prospective business was already over $100,000.

Reducing Keyway-Cutter Cost

By J. E. Brackett

The wear on an ordinary cutter makes the cost of cutting Woodruff keyways high enough to cause the department head much thought.

The cutter shown has proved itself to have a life at least twice as long as that of an ordinary cutter, probably due to the fact that the shearing effect of the tooth not only eliminates chatter, but also seems to hold



SPECIAL KEY CUTTER

the cutter to size much longer than is the case with ordinary straight teeth. The cutter is made with the teeth cut at 25 deg. to the center, right and left hand, and this angle by experiment seemed to give the best results.

By making these cutters in one long bar, then parting them off to the correct width and welding the cutter proper to a cold-rolled steel shank, the cost of making can be considerably reduced.

Measuring Screw Threads in the Small Shop

By John H. Van Deventer

SYNOPSIS—Measuring screw threads is a task that is undertaken with uncertainty in many shops. Ring and plug screw gages are commonly used, but do not always throw true light on the existing errors. This article tells how the small-shop man can measure threads with certainty, and also points out the sources of error to be looked for.

Casey was a good Irishman and a better mechanic, and was disgusted with the loss of time in his shop when it came to fitting screw threads. There were a good many studs to drive, and it was always a matter of sort and try to find those which would go in with the proper amount of pull. Some of them would fall in like a shot in a barrel and others would not even enter the hole. So Casey rigged up a block as shown in Fig. 1 in order that he might establish a standard. He succeeded in having his screws made to fit the block, but found that tapmakers seemed to have a difference of opinion regarding the size of a half inch. "Begorry," said Casey, "what an argument them fellows would have about the diameter of the earth if they've got such a difference of opinion on a half inch!"

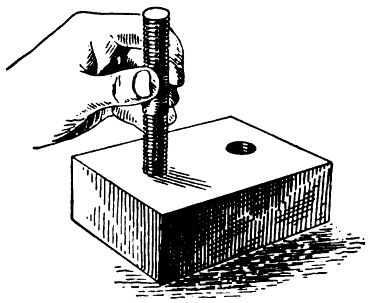


FIG. 1. THE OLD METHOD OF TRYING A SCREW IN A STANDARD HOLE STILL ANSWERS

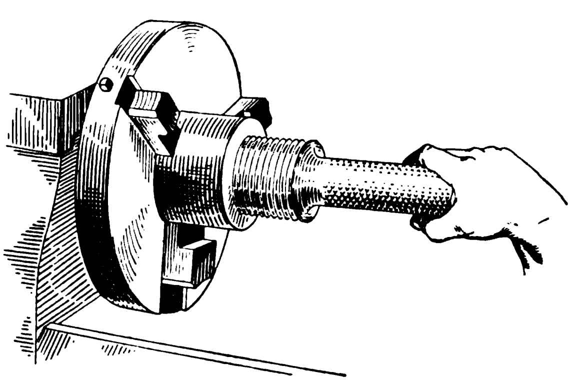


FIG. 2. CRUDE AS IT IS, THE SCREW PLUG SEEMS TO HAVE A MONOPOLY ON THREADED HOLES

This variance in the sizes of taps exists for the simple reason that the learned bodies mentioned in the article on page 1017, when establishing the various screw thread standards, did not complete their job and also establish a set of maximum and minimum limits on them. But the matter of importance and interest is not what these gentlemen did *not* do but what the small-shop man must do in order to be sure that threads will fit the holes for which they are intended.

There are twelve errors which may creep into the thread of a nut and there are twelve similar errors which may creep into the threads of a screw, so all together we have twenty-four reasons why one will not fit the other. These, for the sake of clearness, are arranged in the accompanying table.

Making the outside and root diameter of a screw too small will not affect the fit unless these errors are excessive. Conversely, making the root and outside diameters of a nut too large often helps things instead of harming them. When the reverse is true, however, and the outside diameter of a screw is larger than the root diameter of the nut, there is trouble. This is usually what is encountered when one tries to screw a V-thread into a U. S. S. nut. The way to overcome this difficulty is to keep the V standard out of the shop. Sometimes the wrong thread angle on either screw or nut makes a defective fit which cannot be noticed because the pitch happens to be right. A case of this kind is shown in Fig. 3, where there is

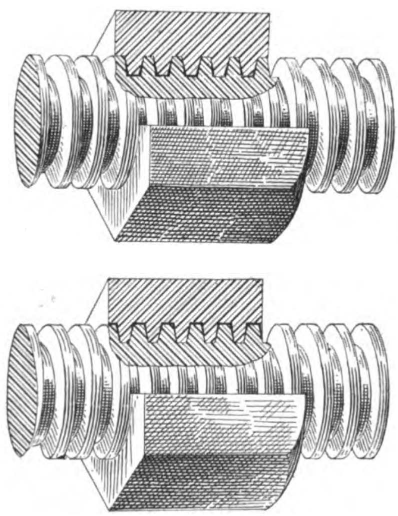


FIG. 3. THE RIGHT PITCH, BUT THE WRONG THREAD ANGLE FOR A PERFECT FIT

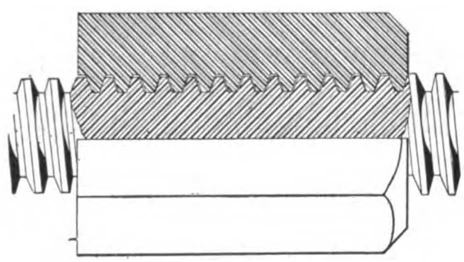


FIG. 4. THE SCREW TOO SMALL, BUT BINDING IN THE LEAD, SO THE CONTACT IS LIMITED

contact at the extreme corners of the threads and consequently no shape but a very poor fit. Another poor fit is shown in Fig. 4, in which the lead is stretched, apparently making a tight driving fit, but in reality having contact only on the surfaces of two or three threads.

Sometimes the pitch of both nut and screw may be right, the lead right, the angle right, the outside and root

ERRORS IN THREADED WORK

Diameter (outside)	Too large Too small
Diameter (pitch)	Too large Too small
Diameter (root)	Too large Too small
Angle of thread..............	Too large Too small
Pitch of threads.............	Too large Too small
Lead—Not uniform	
Burrs and bruises	

diameters right, but everything all wrong nevertheless. This is because of the vital dimension, which cannot be seen and which is hard to measure, which is known as the pitch diameter. A case of this kind is illustrated in Fig. 6 and would give a very shaky fit, while an error of the opposite kind in which the threads of the screw were too thick would make it impossible to enter the screw. Fortunately for most small-shop purposes, it is safe to assume that the angles of threads on purchased taps and dies are correct. Also for this class of work it is quite possible to test the lead of a screw by means of a gage such as shown in Fig. 7. These gages run from 2 to 4 in. in length, depending on the fineness of the pitch, and a little experience will make the shop man an expert in their use.

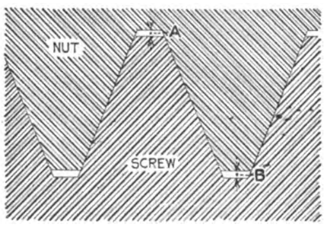


FIG. 5. SOME VARIATIONS IN DIAMETER ARE HARMLESS

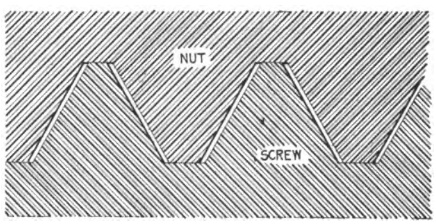


FIG. 6. THE PITCH RIGHT, THE LEAD RIGHT, THE ANGLE RIGHT—BUT ALL WRONG, NEVERTHELESS

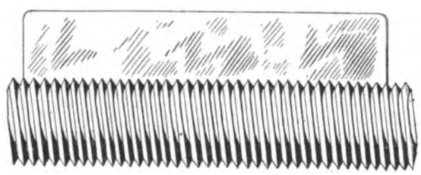


FIG. 7. TESTING THE LEAD WITH A SCREW PITCH GAGE

Limit thread gages for testing pitch diameters form a means of inspection that is absolutely decisive. These are used on precision work, but an individual gage is required for each diameter and pitch, which usually limits their application to shops in which a large quantity of pieces having a limited number of thread sizes are handled. For average small-shop requirements, which will not call for measuring every screw used, three methods of measuring pitch diameter are available—the thread micrometer, the ball-point micrometers and the two- and three-wire systems. The latter can be used with an ordinary pair of mikes such as will be found in every small shop, and will give as accurate results as any method of measurement, although a little slower than the special micrometers made for this purpose. The method of using the two- and three-wire systems is indicated in Fig. 9. Wires are taken of proper size and measurement made across their outside diameters when laid in opposite thread spaces. The micrometer readings are compared with a table which gives the reading in terms of pitch diameter. Tables for this purpose for all of the standard threads can be found in the "American Machinist Handbook," pages 30 to 40.

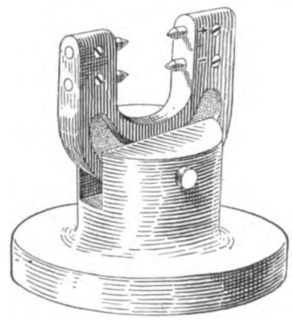


FIG. 8. LIMIT THREAD GAGES FOR TESTING PITCH DIAMETER

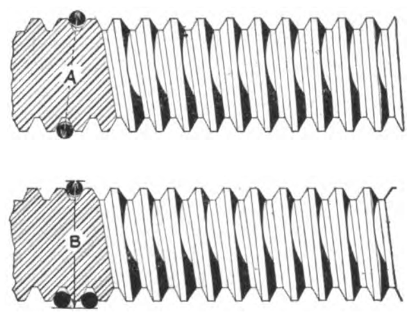


FIG. 9. MEASURING THREADS BY THE TWO- AND THREE-WIRE SYSTEMS

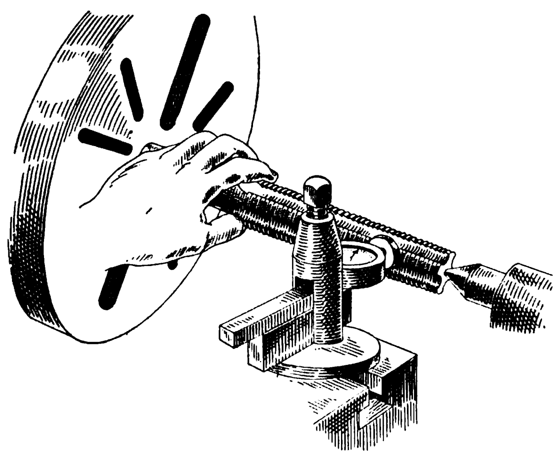


FIG. 10. TESTING A TAP FOR WARP BETWEEN LATHE CENTERS

While the thread angles on taps may be assumed to be correct, there are other things which it would be well to check up as soon as the taps come into the shop. A set of inspections for checking up taps are illustrated in Figs. 10 to 13. The first illustration shows a tap placed between lathe centers and being tested for warp and eccentricity due to distortion in hardening. Fig. 11 shows the

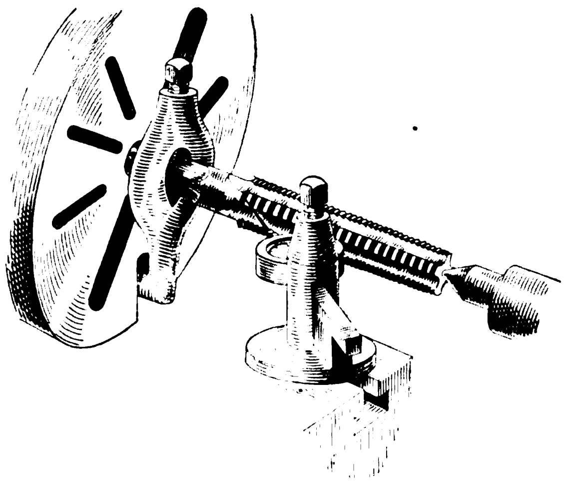


FIG. 11. COMPARING THE LEAD OF A TAP WITH THAT OF THE LATHE LEAD SCREW

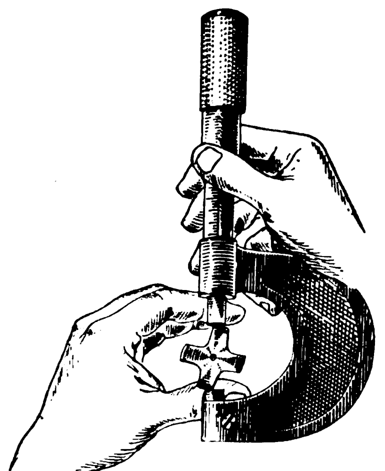


FIG. 12. MEASURING THE OUTSIDE DIAMETER OF THE TAP TO INSURE A FULL ROOT DIAMETER

means of comparing the lead of a tap with that of the lathe lead screw, which will indicate an error in the tap provided the lathe screw itself is accurate. An indicator is held in the tool post with its needle against one side of the tap face, the lead screw is engaged, the operator turns the belt by hand and eases off on the indicator needle from space to space, observing any fluctuation as the needle comes to rest on successive flutes. If the tap lead is right and the lathe screw lead is right, there should be no variation on the indicator.

The outside diameter of the tap must be large enough to insure a full root diameter of the tapped hole. This is measured with a pair of "mikes" as shown in Fig. 12. The final test is that of the pitch diameter, which is made as shown in Fig. 13, and which has been explained in the description of the three-wire system. If a tap passes these four inspections satisfactorily, it is a pretty good tool as far as accuracy is concerned. To insure that the bolts, screws and studs that are purchased outside will fit properly into threads made with such a tap, it is advisable to inspect one or two of such studs, bolts or screws in every one hundred by means of running them into a block such as shown in Fig. 1. This, called selective inspection, will call attention to batches of screws which are running over or under size, in which case a further inspection of each screw in that batch may be made if desired before returning them to the maker. It is advisable for the small-shop man to protect himself in buying such screws by submitting a similar gage at the time that he gives the order.

Dies are best inspected by examining the work that comes from them. Do not, however, make the mistake as did one small-shop man of testing an adjustable die

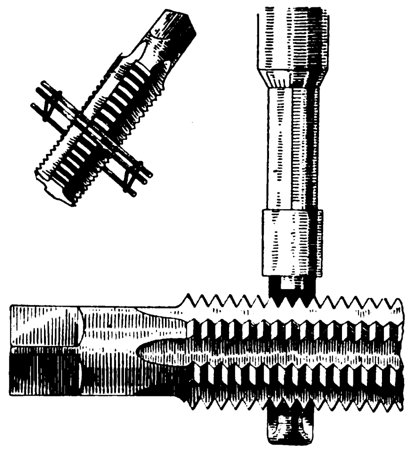


FIG. 13. MEASURING THE PITCH DIAMETER WITH "MIKES" AND WIRES

with stock that was larger than that intended for the chasers that were used. The chasers were supposed to cut twelve threads to the inch, but after the work came out of the die he could find but thirty-five threads in 3 in. One of them had disappeared mysteriously, and he is still hunting for it!

Lifting the Shaper Chuck

By G. A. Remy

The vise, or chuck, on large shapers is heavy and, owing to its form, difficult to lift and place in position on the shaper table. Recently I saw three men put a large chuck in position without trouble, in the following manner:

Before the chuck was removed from the shaper, a piece of iron pipe was clamped between the vise jaws, the ends of the pipe protruding from the chuck far enough to furnish a grip. A man on each side lifted the chuck and, thanks to the pipe, easily held it in position over the table while a third man inserted the binding bolts and wiped away any chips that had fallen from the chuck to the table.

This is a simple method, but one not generally practiced. Besides avoiding the strain on the men in lifting, the machine is saved many hard knocks, which generally result when the men lifting the chuck have a poor grip. This idea is not original with me. I have seen it used by shaper hands.

Cast-Iron Punches and Dies for Car-Fender Details

By Robert Mawson

SYNOPSIS—In the punch and die used in making the carrier arm two operations are performed. The bar is first placed on the die, and the end of the part is flattened with the punch. The bar is then slid against a stop in another position of the die, and a depression is formed with a pin in the punch. The tool for forming the side hanger is fitted with an equalizing device.

On pages 894 and 978 are illustrated some of the punches and dies designed and used by the Narragansett Machine Co., Providence, R. I., in making parts of car fenders. In this article other similar tools are shown. Their interesting feature is that cast iron is used in their manufacture. They are not machined, as the scale on the faces provides a hard wearing surface. These tools, as well as those illustrated in the previous articles, are good examples of this type of punches and dies. The stock is heated before the various bending or forming operations. The rate of production is also given in the articles. Some of the simpler machine-steel or iron fundamentals on car fenders are here illustrated as made with cast-iron punches and dies. Many companies are using punches and dies of either machine steel or tool steel for similar work. With tools of these materials, expensive machining operations are necessary. The block of steel must be machined to the desired contour; and when this shape is somewhat complicated, the work demands high skill and is comparatively slow.

When the tool is made with a combination of machine-steel shank or base and tool-steel forming element, the task is even more difficult. The machine-steel part must be machined. The tool-steel element must also be machined to the required contour. Then the latter must be hardened and ground. This is often a difficult operation, as there is danger of cracking during hardening. The grinding takes a long time, as much of the surface must be finished by hand with an oil stone. The two elements are fastened together with screws and dowels to form the completed punch or die.

When the tools are of cast iron, most if not all of this machine-shop work is avoided. Patterns are built up to agree with the design furnished by the drawing office. Castings are then made from these patterns and in most cases used without any machining whatever. Where machining is performed, it is only on the shank, to make it fit the punch press. The hard skin surface left on the castings is an advantage, as it resists wear that would be caused by the punch and dies coming in contact with the bar being bent or formed.

On the tool used in forming the carrier arm two operations are performed. The bar is first flattened with two flat surfaces on the punch and dies. The flattened bar is then placed in a depression on the die and the punch fed down. This punch is made with a button and, as it is forced down, forms a hollow in the carrier arm.

The next tool is designed to bend the end of the pilot-board bracket into a circle. This is done by dropping down a loose circular bar over the heated bracket; and when the punch is fed down, it bends the piece around the guide bar. The last tool is provided with a fulcrum pin on the punch. This is an advantage in forming long parts from rough stock, as it allows the tool to conform to any variation in thickness.

It will be seen from this and also the previously mentioned articles how elements may be formed by the use of cast-iron dies. Other parts can be made with similar type of tools and their advantages completely utilized.

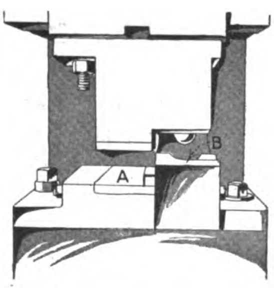


FIG. 2

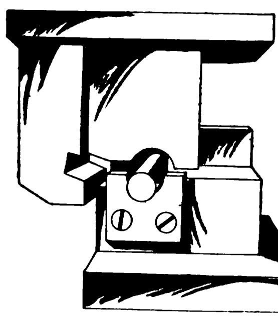


FIG. 4

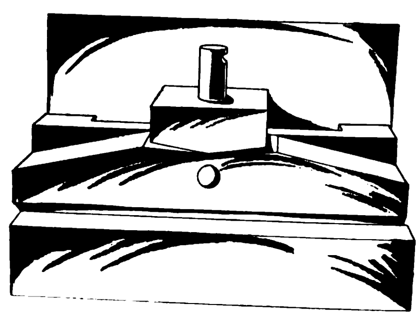


FIG. 6

CAST-IRON PUNCHES AND DIES FOR CAR-FENDER DETAILS WITH WORK SHOWN IN POSITION

FIGS. 2 AND 2-A

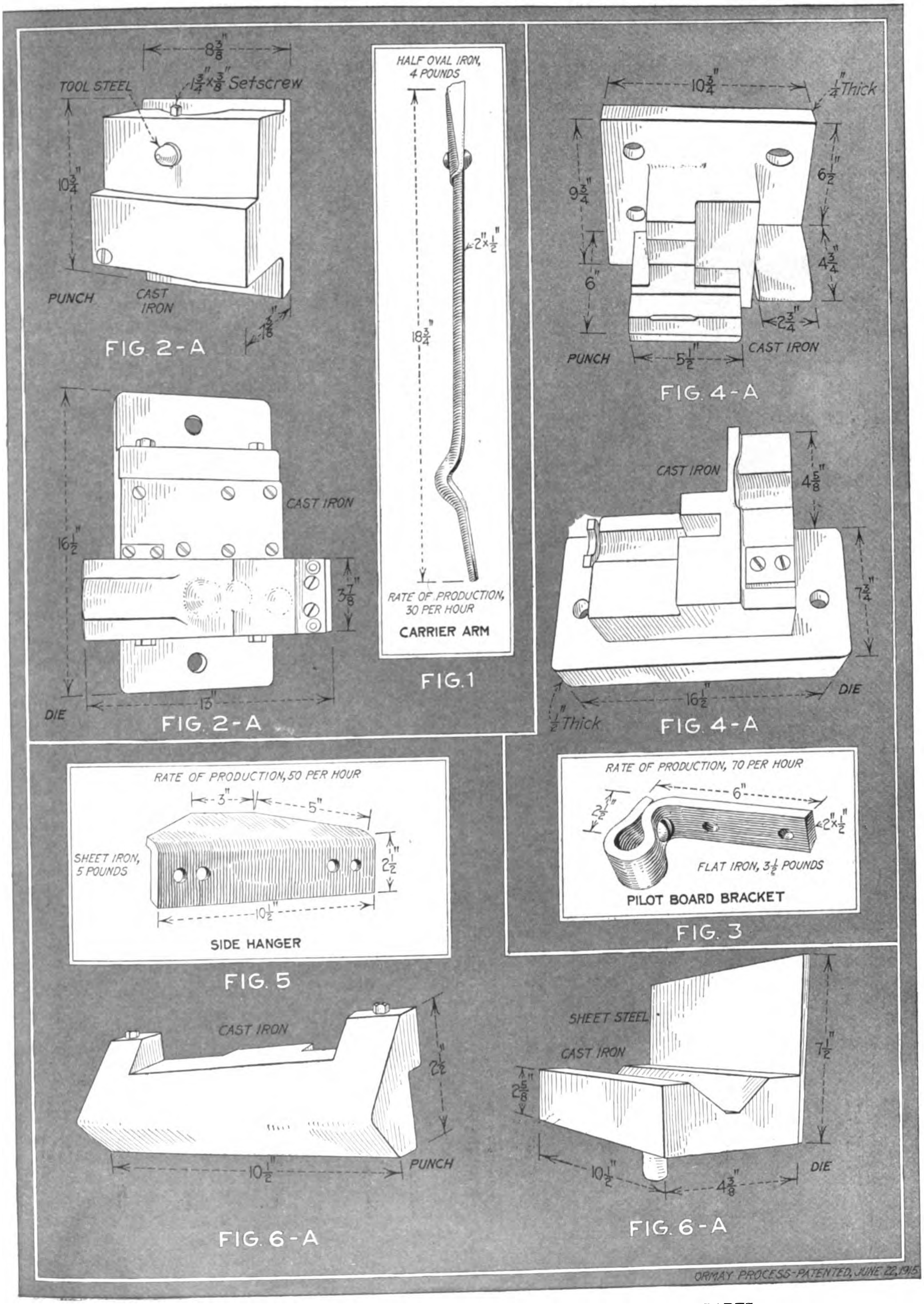
Operation—Forming the carrier arm to the contour shown in Fig. 1. The bar is first placed on the die at A and the end flattened with the punch. The bar is again heated and placed on the die at B. When the punch is forced down, a depression is formed in the bar, as shown.

FIGS. 4 AND 4-A

Operation—Bending pilot-board bracket, Fig. 3. The heated bar is placed over the rod in the die. When the punch is forced down with the press, the end is bent over. A rivet is placed in position, as shown, in a subsequent operation.

FIGS. 6 AND 6-A

Operation—Bending side hanger, Fig. 5. The plate is placed on the die, being located by the stop plate at the rear. The punch, forced down, bends the parts to shape. It will be observed that, as the part is long, the punch can fulcrum on a pin to form an equalizing means.



DETAILS OF CAST-IRON PUNCHES AND DIES FOR CAR-FENDER PARTS

Balancing Ways with Drilling Attachment

By E. V. Allen

The balancing ways shown in Fig. 1 were made by the Western Foundry and Machine Works, Topeka, Kan., some 25 or 30 years ago. The drilling-machine attachment is very handy for drilling weight holes. An

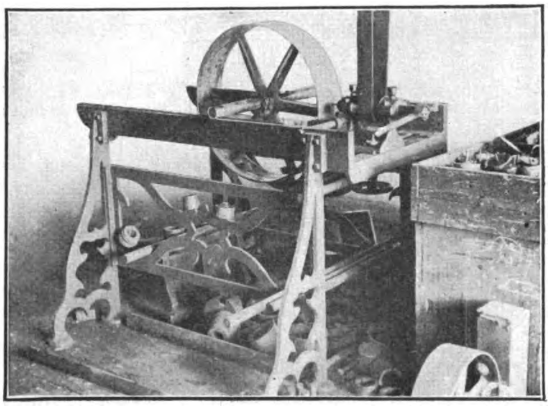


FIG. 1. BALANCING WAYS WITH DRILLING ATTACHMENT

assortment of weights is kept close to the machine, and it is but a matter of a few minutes to find a weight that will balance. A special set of holding jaws, shown more clearly in Fig. 2, holds the pulley while drilling

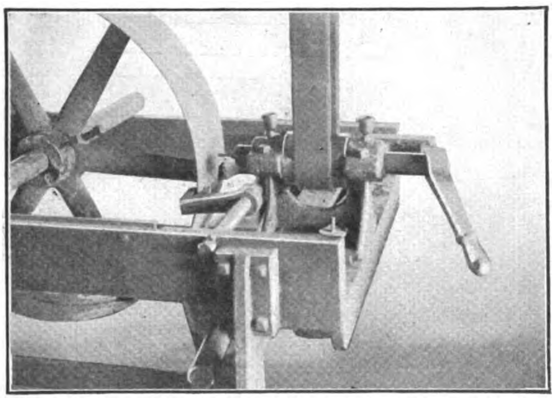


FIG. 2. CLOSE VIEW OF PULLEY-HOLDING JAWS

into the rim. These jaws slide on a crossbar and simply hook over the rim of the pulley. The drilling spindle is fed in or out by a hand lever. The entire drilling head has a cross-adjustment intended for use on very wide pulleys where more than one hole has to be drilled.

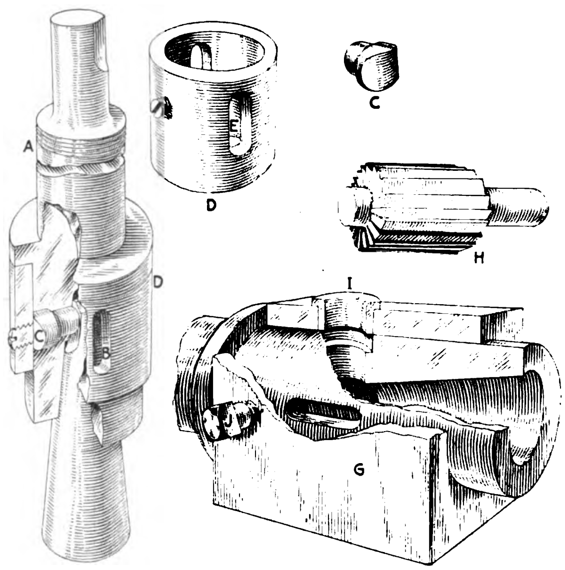
Repairing Drill Spindles

By Paul Cyr

After some years of hard usage 20 drills were so worn in the tang slot *B* in spindle *A* that it was almost impossible to hold drills in them. To repair them, I worked out the following scheme, which has proved successful after three years of hard work, with the advantage that a spindle can be repaired at a small cost, should the same trouble again arise.

I made a fixture *G* with removable bushing *I*, in which the spindle was inserted. Screw *J* was tightened, to steady it, and the bushing was drilled through at *B*. It was then removed and the counterbore *H* inserted in the hole and counterbored deep enough to take the head of the plug *C*, the plug being flush with the outside of the spindle. The spindle was turned and the operation repeated on the other side.

The plugs *C*, of hardened tool steel, were then inserted in the holes. The collars *D*, of machinery steel, were



REPAIRING DRILL SPINLDES

made and bored to fit the spindle. The slots *E* were cut for the drift and a threaded hole for a screw to hold it in position. The collar was put on the spindle and the slots brought to correspond with the slots in the spindle. The spindle was spotted for holding the screw and the screw tightened down. The plugs *C* are of sufficient length to bear against the tang of a drill or collet and, should they become worn at any time, can be removed and new ones put in place in a few minutes.

Fitting Dovetailed Patches

By Alfred Strother

A dovetailed piece is a convenient means of patching or piecing on metal-pattern work, etc. When driving, if the male member is a little large or fits imperfectly, the edges are apt to curl, buckle, turn up or tear out. This is especially true if the "tail" is thin.

A simple stunt that prevents this trouble is to back up the two pieces against each other when ready to drive. If the size and shape of the work permit its use, the bench vise is handiest for this; if not, C-clamps will serve. When the dovetail is fitted so that it will enter, begin to drive, then clamp tight enough to hold securely and drive. If there is any crowding, the male will stall, which can be easily remedied; and the misfit is found without tearing out the slot or bruising and curling the edges. The surfaces in sliding contact should be smooth, and a little oil should be used.

Making Wire Guards for Electric Incandescent Lamps

By Ethan Viall

SYNOPSIS—While the wire guards for incandescent lamps are made in a large variety of forms, the general principles of manufacture apply closely to all. The factory where this article was obtained turns out huge quantities of guards of all kinds, but only the more representative or unusual methods are shown.

Disregarding the various individual forms of incandescent-lamp guards, they may be broadly divided into two classes—those which are locked on and cannot be removed, except with a special key or tool, and those which can be put on or removed with the fingers. With the rapidly increasing use of tungsten and other valuable lamps, some protection against easy theft is imperative. A good locking type of guard not only protects the bulb against breakage to a large extent, but also from unlawful removal. The McGill Manufacturing Co., Valparaiso, Ind., makes a large variety of both kinds, the former being marketed under the name of Loxon. Some of the principal methods employed in its factory for quantity production will be described in this article.

A few representative forms of guards are shown in Fig. 1. *A, B* and *C* are handled guards, for drop lights, trouble hunting or any place where a portable light is desirable. Some of these are provided with a hook by which they may be hung from shelves, nails or any projection. The guards at *D* and *E* are the kind that may be put on or taken off with the fingers alone. Those at *F, G, H* and *I* are of the Loxon type, the last one being fitted with a reflector. All of the last-indicated guards are locked by means of a small screw having a triangular-shaped head set into a socket, so that the screw cannot be turned except with a special form of socket wrench or key. This forms a simple and effective lock that is very difficult to operate without the proper means.

The basic wire in the common guards will run from 13 to 17 gage. The "ribs" vary in size and shape according to the form of guard. Two of the different shapes of ribs are shown at *A* and *B*, Fig. 2. The "hoops" may be made of sheet metal, straight wire bent to circular form, or corrugated, as *C* and *D*. The wires *E, F* and *G* are used for "cushions"; that is, on some of the guards these wires are so placed as to prevent the guard from contacting with the glass of the lamp and are so strung as to have a cushioning effect. These wires are wound on a long mandrel, then cut as at *E* and next bent to the form shown by the last two. Two

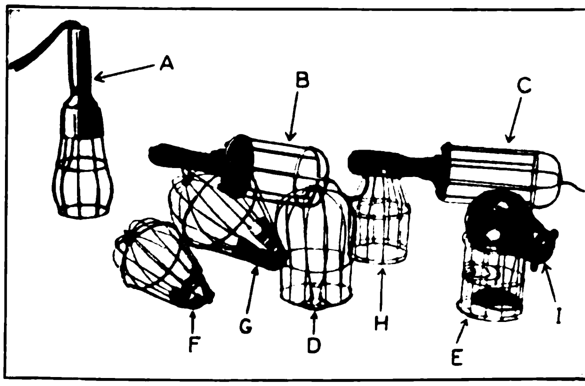


FIG. 1. SAMPLES OF WIRE LAMP GUARDS

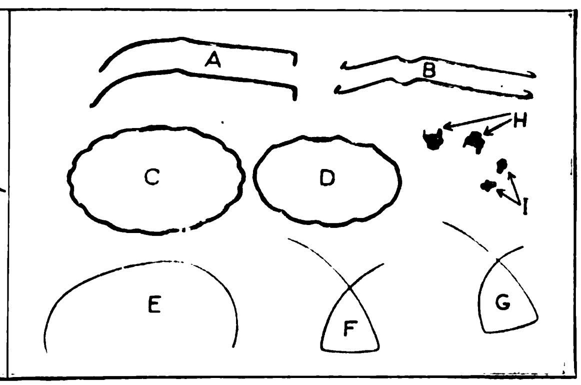


FIG. 2. SOME OF THE PARTS USED

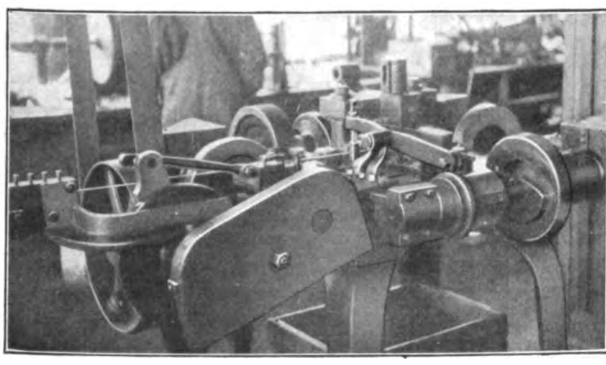


FIG. 3. ONE OF THE WIRE-FORMING MACHINES

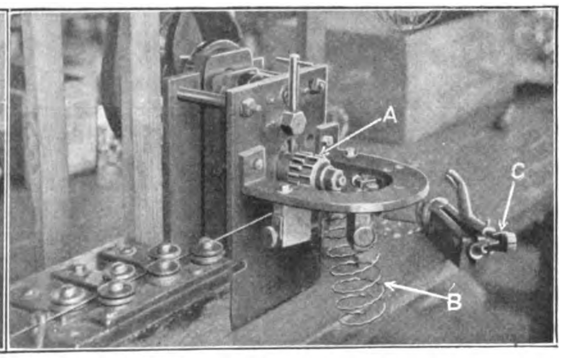


FIG. 4. MACHINE FOR CORRUGATED RINGS

screw sockets for the Loxon type are illustrated at *H*. The screws, with three-cornered heads, for these sockets may be seen at *I*.

Some of the ribs on certain portable or other guards are not bent at all, but are made from short, straight pieces of wire rod. These are shouldered or threaded on the ends as desired. Some of the ribs are quite complicated in form. However, the majority of the ribs wound, the operator pushes the guide along the bar *C* by means of the handle *D*. The mandrel has a slot in it running lengthwise, deep enough for the insertion of one jaw of a special pair of shears. After the mandrel is full, the shears are worked down this slot, cutting the wire as it goes. This makes short pieces like the one shown at *E*, Fig. 2. The special shears for this work are shown in Fig. 6. *A* is the jaw that is placed

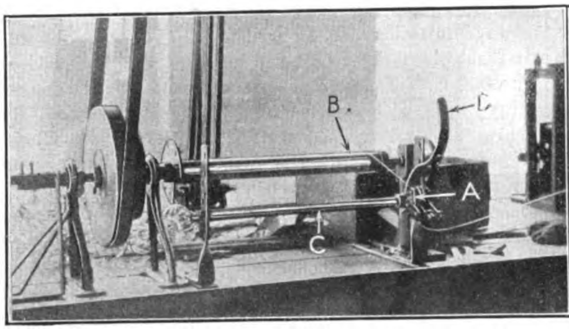


FIG. 5. WINDING WIRE ON A MANDREL

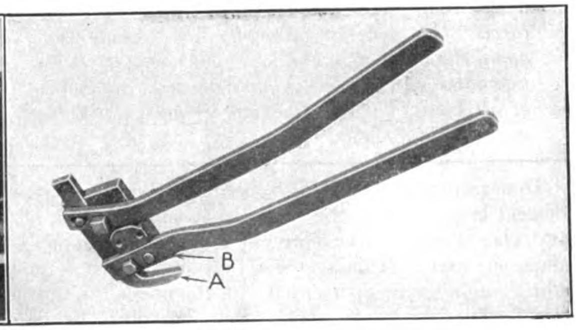


FIG. 6. WIRE-CUTTING SHEARS

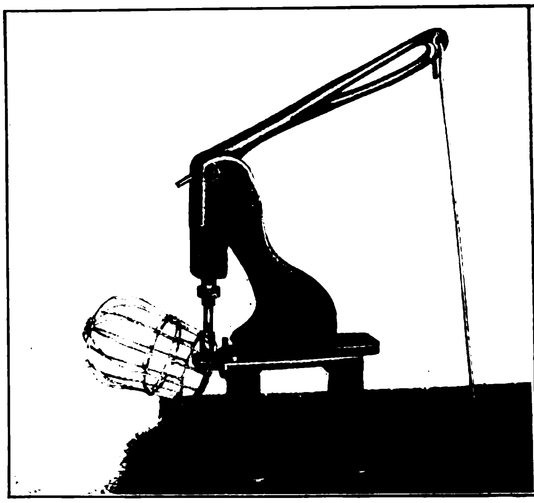


FIG. 7. SMALL WIRE-CLINCHING PRESS

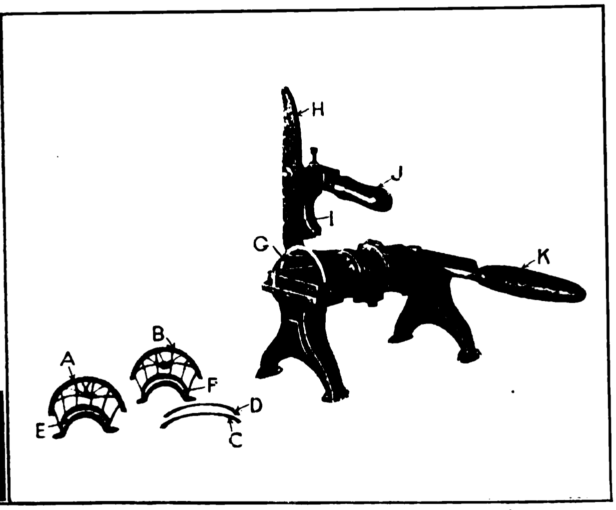


FIG. 8. SPECIAL CLINCHING MACHINE

are made on standard four-slide wire-forming machines, like the one shown in Fig. 3. These take the wire from the reel, bend, cut and drop the ribs into a box. On most of the work, only three slides are used. The machines run at about 75 strokes per minute.

The corrugated "hoops" are made in the machine seen in Fig. 4. The wire feeds through the straighteners at the left and in between toothed rolls, geared together, as at *A*. After passing through the rolls, the wire strikes a deflector that causes it to curl against another, and so on, the result being a spiral, as at *B*. The setting of the deflectors determines the diameter of the spiral formed. A cutter at *C* cuts the wire into rings. While this cutter is shown swung out away from the work, it can be swung in so as to clip the wire as it feeds down.

The fine spring-wire cushions previously referred to are wound on a mandrel, Fig. 5. The wire feeds from a reel into a set of friction rolls at *A* and from there onto the revolving mandrel at *B*. As the mandrel is in the slot and pulled along as the upper one *B* is worked by means of the upper handle.

The assembling methods are almost as varied as the forms of the guards. Some are simply "hooked" together by hand and are clinched with small hammers. Others are assembled and then the hooks clinched, as in Fig. 7. The rams of these little bench presses are worked by a foot treadle, so that the operator has her hands free to manipulate the work.

One of the Loxon type of guards is made in two semicircular parts *A* and *B*, Fig. 8. The hoop in this case is made of two semicircular pieces *C* and *D*, which are perforated for the insertion of the rib wires. The collars are made of sheet metal, formed as shown at *E* and *F*. The ends of the ribs where they are inserted in the holes in the collars are first bent at right angles. The halves of the guard are assembled by hand substantially as indicated by the parts shown. A half is placed in the clinching device, as indicated at *G*. The

part H is then swung down on the work, bringing part I snugly around the ends of the ribs where they enter the collar. The lever J operates the locking latch. With the work locked in, the lever K is pulled; six slides move in their individual slots under the projecting ends of the ribs inside the collar and bend them close up against the inner surface. This securely clinches them in place.

The screw sockets are clinched, or staked, into the locking collars in small hand presses, Fig. 11. One is shown in clinching position at A. About one gross per hour is turned out on each of these little presses.

Nearly all the guards are tinned. This is done in the usual dipping way. Fig. 12 shows an operator holding a guard in special tongs ready to dip it into the melted

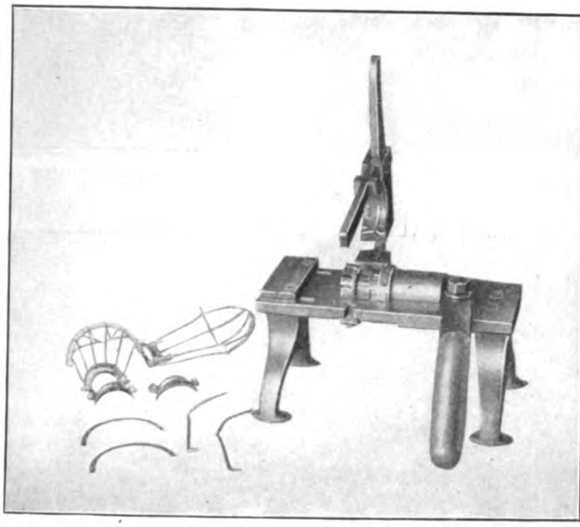


FIG. 9. ANOTHER VIEW OF CLINCHING MACHINE

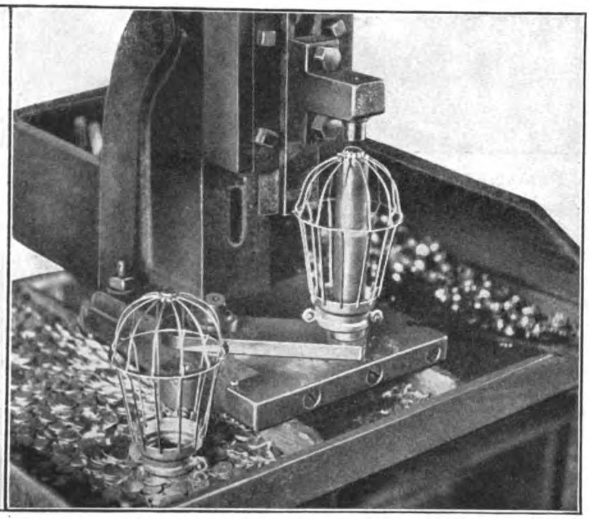


FIG. 10. CLINCHING BUTTONS ON THE WIRE ENDS

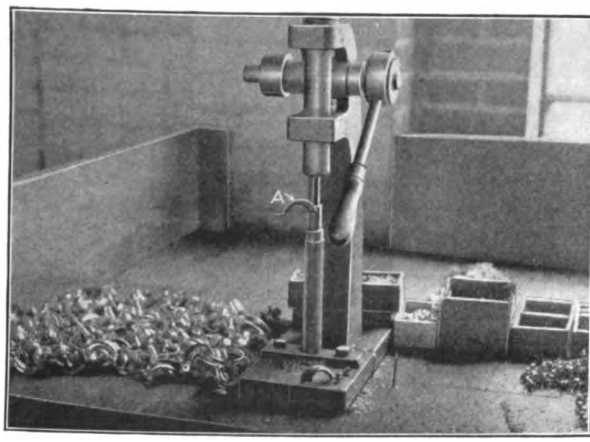


FIG. 11. CLINCHING SCREW SOCKETS INTO THE COLLARS

FIG. 12. TINNING THE GUARDS

Another view of this same fixture is given in Fig. 9, together with the parts differently placed, so as to give a good idea of the work and mechanism. A large number of these machines are used for the different guards having sheet-metal locking collars. On the average guard an operator will turn out about four gross in nine hours.

On some forms the outer ends of the ribs are held in a sort of spider, or "button," as it is called. The ends of the ribs are placed in one of these buttons, and then the guard is placed over a slotted post, as in Fig. 10. A pressure on the foot treadle of the press clinches the projections of the button tightly onto the rib ends. The post is placed on a swinging arm, so as to be easily swung away from under the press ram for loading or unloading. About eight gross will be turned out by a good operator on one of these presses.

tin. After being tinned, the guards are placed on rods, as shown, just back of the workman.

Since the tinning is done after the guards are completely assembled, the tin gets into the threads and screw sockets. This is remedied on the apparatus seen in Fig. 13. A small gas jet is made so as to shoot a flame up into the socket placed above it. Six or more of these jets are made in the horizontal pipe, and the guards are laid in place. As fast as the tin melts, the operator takes the guard and with a quick jerk knocks the tin out of the threads and sockets.

Where short wire rods are employed, as in some of the portable guards, the ends are turned down so as to form a shoulder where the retaining ring goes on. This is done with a hollow mill in a lathe fitted as in Fig. 14. The hollow mill is held in the chuck at A and the

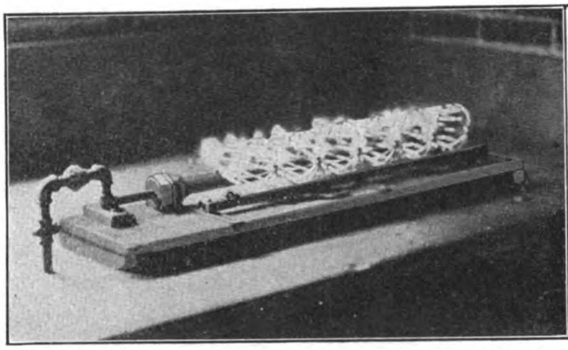


FIG. 13. MELTING TIN OUT OF THE SOCKETS ON A SPECIAL GAS FIXTURE

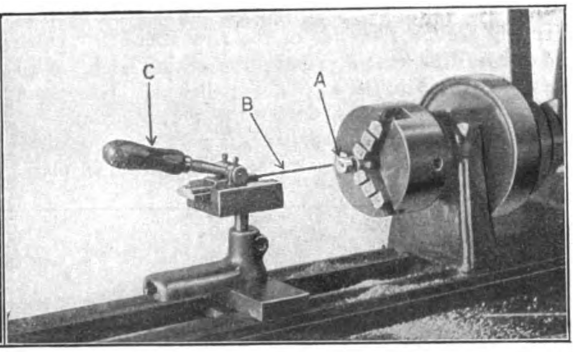


FIG. 14. HOLLOW MILL AND QUICK-ACTING WORK HOLDER FOR THE LATHE

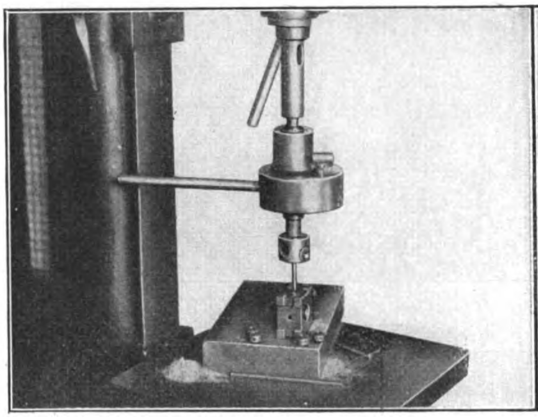


FIG. 15. TAPPING HOLES IN END NUTS WITH REVERSING ATTACHMENT

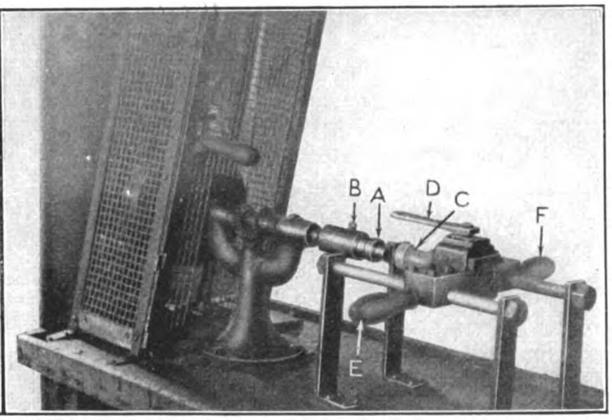


FIG. 16. SCREWING ON WOODEN HANDLES ON PORTABLE GUARDS

rod *B* fed into it. The rod is held in an eccentric-jawed vise operated by the lever *C*, which acts both as a locking lever and a handle to push the carriage with. Where the ends are threaded, a die is used in place of the hollow mill, but the holding fixture is practically the same.

Rapid Drilling and Tapping with the Aid of Small Box Jigs

On guards having ribs made of rods curved in at the ends, the buttons are made of brass, with holes drilled and tapped in them for the curved ends to screw into. These brass buttons are drilled in little box jigs, like the one in Fig. 15. When tapping the holes, an Errington tapping head is used, as shown. An operator will drill about 170 of these buttons, or top nuts, per hour, four holes each. Tapping is done at the rate of about 160 per hour, four holes each.

The wooden handles on the portable guards are screwed on in the machine illustrated in Fig. 16. The guard part is held in the spindle socket at *A* by means of the setscrew *B*. The wooden handle *C* is locked into the sliding carrier by the wrench *D*. The operator then grasps the handles *E* and *F* and pushes the handle onto the piece *A*. The spindle drive is through a regular tapping mechanism, so that forward pressure engages the drive and forces the threaded part into the handle. Retarding the work stops the spindle. The mechanism of the drive is shown at the left. It consists of three bevel gears, two facing each other on the spindle, with the driving gear between them and facing upward. The output of one of these machines is about 100 per hour, though this varies with the operator, as in all other cases of machine work.

Grinding Gages in the Miller

By Gustave A. Remacle

At the present time many plants making gages are not properly equipped for that class of work, the absence of a good surface grinder being the cause of most concern. Happily, magnetic chucks are plentiful, and it is surprising how much a miller resembles a surface grinder when equipped with a magnetic chuck.

One concern, after fixing up the bearings and spindle of an old hand miller, mounted a wheel upon the arbor in the same manner as a cutter. A handwheel was substituted for the lever, for moving the table transversely. Another simpler, though less efficient, manner of converting the miller to a grinder is to bolt a tool-post motor grinder to the overhanging arm, the bolt running through the hole where the center was formerly.

While millers may be fitted up so as to grind somewhat flat surfaces in an emergency, they do not begin to compare with real surface grinders, especially for grinding gages. One reason why these converted machines do not produce good results is that the machine is generally so badly worn that it is unfit for milling, not to mention grinding.

Designing and Drafting*

By W. Rockwood Conover†

SYNOPSIS—The relations of both engineer and draftsman to the work of drafting and to the finished drawing. The change in the quality of machine-shop labor has put new burdens on the one who makes shop drawings. Today they must be explicit and covered with details. The care, changing and issuing of prints are also discussed.

The relation of designing and drafting to efficient productive work in the shop is a vital and intimate one. Some of the important features of this relation merit consideration. Relatively speaking, there are few details of manufacture that may be said to be free from the influence, either direct or indirect, of the work of the engineer. Designing has as much to do with successful manufacturing as any other of the several processes preliminary to and connected with the actual production in the foundry and shop. In so far as the engineer realizes this basic principle in his labor, to that extent will his work prove to be successful and valuable.

It is essential for the engineer to study manufacturing conditions in the shop, in order that he may design apparatus that can be built with the greatest efficiency and economy at the same time that it fulfills the requirements of the trade or the individual customer for whom it is designed. He should familiarize himself with the tool equipment of the factory in order to avoid, as far as possible, calling for sizes and dimensions that will involve special processes on the machine floor and render the purchase or making of special tools necessary. If the purchase or making of special tools cannot be avoided in the construction of the design, the possibility of these tools being adapted to other work or to future designs is worthy of consideration.

The subject of materials and inventories should receive the engineer's attention. Each new design made should embody the use of standard commercial sizes of materials carried in stock, as far as possible, including bar and sheet metals and other rolled stocks, standard sizes of bolts, studs, nuts, collars, etc. The careful designer will bear in mind that the size of inventories depends in no small degree on his own labor and that he is to a great extent responsible for the carrying of special sizes and odd stocks of materials. He should also keep in touch with the purchasing department and learn the relative market cost of the materials he proposes to use, in order to effect economies in production. All deviations from commercial sizes of materials and from regular shop practice, which involve special or additional operations, mean the carrying of greater or lesser stocks of these odd-shaped parts for the filling of future orders, either for supply parts or for complete apparatus.

A reasonable degree of familiarity with machine practices and labor operations in the shop is desirable in order that these processes may receive proper consideration before the new design is turned over to the draftsman or sent to the pattern department or machine floor. The tool maker, pattern foreman, foundry and machine-shop foremen are all interested parties in the work of designing. They constitute a valuable aid to the engineer. Constant consultation with these men and constant investigation of shop methods and practices appear essential in order to avoid the work of rebuilding and changing apparatus in the regular manufacturing departments.

Coöperation of Engineer and Shop

It is desirable, also, for the engineer to cultivate the good will of the mechanical forces in the shop. Many shop mechanics possess the genius for improvement and invention and are filled with valuable ideas that are often useful to the engineer. Some measure of the high cost of manufacturing is doubtless due to the design being placed in the hands of the draftsman and shop foreman in too incomplete a form and also to the omission of gathering all the useful facts possible from the shop before the draft is made. All this means waste of time and material and a delay caused by working over the design after it has reached the manufacturing department, with a consequent stoppage to the progress of production.

It is a far more economical procedure to thrash out the majority of these questions as to materials, foundry and shop practice, etc., through investigation and conference in the initial stages of the design and to turn over to the shop a practically perfect working drawing. By following this practice it will often develop that valuable changes can be made either in machine processes or materials. As an example, small parts called for in the design to be made of castings can often be made more cheaply of bar or rod stock on the automatics or semiautomatics or stamped and formed out of sheet in a punch press or made as drop forgings. It is also possible in many cases so to reduce the amount of surplus stock to be removed as to admit of finishing the surface by grinding instead of on the planer or miller.

An incomplete or faulty design throws upon the shop a burden that does not belong there. It compels the foreman to inspect and analyze each drawing before turning it over to the machine or bench hand, in order to ascertain if it is practicable and profitable to follow out its provisions and requirements without question or alteration. He does this often with the feeling that, if omitted, the workman will discover inconsistencies after the materials have been gathered and the machine tools set up for the work. He is also on record with his manager or superintendent in the matter of living up to his schedules of productive output, which he cannot do if the drawings are not in proper shape for his men to proceed.

An incorrect design may also prove to be responsible for expensive errors in manufacturing. It may involve changes in operations or materials and the building or purchase of special tools that are afterward discovered to be unnecessary. To it, also, may sometimes be directly attributed high labor prices and prohibitive factory costs.

One of the elements that limit the work of the young engineer just graduated from the technical school is the fact that he has had but a comparatively abbreviated experience in the field of technical research and study and practically no experience in the field of invention and

*Prepared for the author's forthcoming book on "Industrial Economics."

†Factory economist, General Electric Co.

design. Unless he exercises proper caution, there is a tendency to develop the habit of depending on the knowledge and experience of others rather than striving earnestly to develop his own inventive genius and power and accumulate valuable knowledge along the lines of designing and engineering work.

Some of these young men who have had a fair degree of preparatory instruction and training lack initiative and do not possess the proper amount of inventive spirit to make them successful in their work. They too often go to the shop foreman and machinist and draw from them the knowledge needed to fabricate a design and, after the labor of putting the shopman's ideas into a preliminary draft is performed, issue instructions to the drafting room and manufacturing floor. This is not designing in the true sense.

The young engineer should seek rather to construct the design as fully as possible, first, in his own mind. He should develop by minute, critical analysis the picture of the apparatus he proposes to build and study it in all its phases relating to patterns, molding, machine labor, materials, etc., before going to the shop to interview the foreman. He will then be prepared to discuss all the important points relating to processes in the construction with a fair degree of intelligence and will not only create a favorable impression of his ability, but will also secure the valuable coöperation of those whose help he needs. He must not lose sight of the fact that he can get more practical knowledge in the shop than he has received from his books; and if he is fortunate enough to have received a thorough mechanical education through direct personal contact with the work of the foundry and machine shop, he is all the better equipped for his profession and is to be congratulated for the advantage he possesses over many of his fellow-engineers.

It is desirable that the company's designs embody distinctive features of originality and avoid, as far as possible, any duplication of essential details covered by the patented designs of competitors. The engineer should aim to have his design distinctive in many important features, embodying not only the elements of new constructive thought, but also the elements of improvement in utility and efficiency.

Copying Is Not Good Designing

Copying the designs of competitors is not, in general, good designing, nor is it indicative of engineering skill. Although the copy may embody sufficient changes to avoid legal complications, it not infrequently involves the use of more material and additional labor operations that increase the factory cost above that of the competing concern. The engineer is required to produce something better than his competitor—a design that will perform the same or additional functions at a lower cost both for labor and material. He must place the company that employs him in the lead in producing new designs and superior product, if he is to render his services of practical economic value to his employer. And to do this he must be a constant student of local factory conditions and of shop practices in general throughout the country.

So much is required of the engineer in these days of unprecedented progress in mechanical science that it is difficult to enumerate and properly classify all the varied qualifications and elements of knowledge which he must possess in order to fully meet the expectations of the bigger corporate industries. The fact that he must study his design from so many different viewpoints in their relation to utility, economy and efficiency makes it all the more certain that his knowledge and training must be well-nigh without limit in the breadth of their scope.

The Art and Practice of Drafting

In our discussion in the present article we have been considering the relation of designing to manufacturing. We must not overlook the work of the drafting department nor view it as separated from that of the engineer and the factory, for the drawing is the medium through which the design is interpreted to the shop. Too much emphasis cannot be laid on the importance of making that interpretation sufficiently clear and complete in detail so that errors in manufacturing will be reduced to a minimum. Nor can he emphasize too strongly the imperative need for the draftsman to have had a thorough instruction in his work and a fair amount of knowledge of shop practices, in order that he may render efficient service to both the engineer and the department foreman.

The draftsman of the present day in frequent cases labors under difficulty. One of his chief handicaps is the character of the instruction that he has received in the drawing school. The schools, in general, have failed in a large measure to keep pace with the trend of modern manufacturing and to recognize the revolution in shop practices within recent years. They do not take into consideration the fact that a majority of the employees in the modern factory are not tradesmen machinists. A large percentage of machine and assembly operations have become specialized until the all-round tradesman mechanic exists in a minority only. The pupil is taught to make drawings technically correct and for the most part sufficiently clear to the foreman and skilled machinist; but for the unskilled workman these drawings are frequently a maze of incompleteness and filled with obscure marks of form and dimension largely unintelligible.

We must have drawings that these partly skilled and specially trained workmen can read; otherwise, the time of the high-salaried foreman or assistant foreman will be taken up chiefly with the work of interpretation, when his energies should be applied to getting out product rapidly at low labor costs. It is possible for one of these workmen to become familiar enough with the methods of an individual draftsman to get along fairly well in reading the prints that come from his hands. If, however, he is transferred to other work and is compelled to use drawings made by another person whose methods are different, it is quite likely he will be laboring under the same disadvantages and difficulties under which he originally labored.

All draftsmen do not work alike in the matter of making drawings explicit for the workmen in the shop. Some make drawings much easier to read than others. There should be a uniformity of system. Every drawing should embody complete information on finishes, clearance, limits, etc., and contain sufficient notes of explanation to enable the machine or bench hand to read the drawing readily and accurately. A large amount of time is wasted in the shop in an effort to read and understand incomplete and ambiguous prints.

The draftsman must remember that his drawings are subjected to severe criticism in the factory when they show imperfections and lack of information. If drawings have to be returned frequently for correction, the work-

man gains a poor opinion of drafting work in general. He develops a sort of contempt for the higher-salaried man's inefficiency and in time loses his cheerful spirit of coöperation.

Coöperation Between Draftsman and Shop

The draftsman needs to know more about factory conditions, tool equipment and shop practices in general. He needs to understand the point of view of the workman in the modern shop, who labors under the present-day system of specialization. He should know that under this system the employee requires much more detail and general information on his blueprints than in former years when the greater percentage of tool operators and bench hands were tradesmen machinists. Many draftsmen are handicapped by the lack of this shop training and personal contact with present shop practices; and it is evident that the young beginner will be far more successful later on, if he takes a course of apprenticeship in the factory before entering the drafting school. He will then understand what a drawing ought to show and will more fully appreciate the value of the information it is intended to convey to the workman.

The drafting room must always recognize the requirements of the shop. There is no getting away from this principle and avoiding serious loss. Sending out incomplete drawings is a poor way to begin manufacturing. Insufficient information on blueprints is a common cause of wasted time and labor in the factory and often responsible for wrong patterns, faulty castings, the scrapping of valuable materals, delays in shipment and other difficulties. A poor drawing is a direct cause of high piece prices, inefficiency of operation, and is expensive from any point of view whatsoever.

Need of Explicit Drawings

If the engineer is not sufficiently explicit in outlining and detailing his design, the draftsman should insist upon more information. The outline and assembly arrangement should be complete and show such views and angles as will enable the workman to proceed intelligently and without delay with his operations. It is hardly necessary to state that the drawing should show views that are useful to the workman and omit those which are of no value. The detail parts on the print should be carefully drawn. There should be no confusion of dotted lines and uninterpreted details which the workman must have translated by his foreman before he can start gathering materials or setting up his machine. Location of details, too, is important. If the workman learns to find these always in the same or nearly the same place, this lessens the amount of time he spends in studying the print.

Uniformity of practice in the making of drawings has more to do with reducing the cost of productive labor in the shop than most managers recognize. Unless the draftsman spends ample time making his drawings lucid in details and with sufficient notes of explanation to render them simple and easy of comprehension by the average lathe hand and assembler who is not an educated tradesman machinist, the loss involved in the factory must of necessity be large. The workman is not at fault if he does not know from an examination of the print what he is required to do. He may put a file or polish finish on the surface of a casting where it needs only to be milled or planed, or he may finish on the lathe or planer surfaces that should be finished on the grinder, but it is not his fault. He has not been furnished with proper instructions on his blueprint, and too much is left for him to guess at or, as an alternative, to bother his foreman with questions which should not be necessary.

In like manner the pattern maker is at a loss to know how much extra material to allow for in making the pattern, for the draftsman often fails to state whether a given surface requires planing or simply surface grinding. It happens as often as otherwise that the pattern maker makes allowance for planing or turning by adding stock to the pattern, and the foundry continues to cast according to pattern. Thus, the useless and costly process of machining goes on until someone discovers the waste and error. Now all this trouble emanated from the engineering and drafting department, where it could easily have been foreseen and prevented and where a vast amount of economy in manufacturing processes and materials could be provided for by the establishment of a proper system of uniformity of practice and harmonious coöperation of all departments concerned.

Neither the designer nor the draftsman can do his best work independently of the other. This is one of the faults of the present system. There is too much tendency to throw responsibility on the other man, and this tendency costs the management a lot of money. The burden of straightening out the difficulties and errors falls finally upon the shop, where it obviously does not belong. We need to change the system if we are to prevent loss and delay in the factory. Sending drawings of new designs and new details into the shop without first ascertaining whether the shop is provided with the necessary tools and facilities to do the work is bad business from any standpoint. The amount of new tools and equipment, if any are required, and their cost should be known, as should also the stocks of materials available.

All these questions of factory equipment should be fully investigated before the print goes out; otherwise, the cost of producing the design or part may show a loss, which is frequently the case where proper consideration to this phase of the subject has not been given.

Inspection of Drawings

And here we come to the subject of inspection of drawings. No drawing should be sent to the shop without first having been properly inspected. The inspector of drawings must necessarily be a broad-gaged man—above the average. He needs to know pretty nearly everything about manufacturing, including the work of the pattern shop, tool-making department and foundry in order to act as censor and criticize the work of both the engineer and the draftsman and correct their mistakes. He needs to be familiar with the conditions and processes of production in each individual department in order to see that the workman gets exactly what he requires in the shape of detail or diagrammatic information. It is important that he secure the coöperation of both the engineer and the draftsman in his labors to this end. He should be able in looking over the designer's sketches and the tracings in the drafting department to make many suggestions that will not only save labor operations and material and cheapen the total cost of production, but which will also improve the detail and render the design more efficient and salable as a finished product. His field is one of unlimited value and assistance from an economic standpoint, both to the factory management and the shop.

The shop has an important part to play in the production of drawings. If errors are discovered, a notice should be sent to the drafting department at once and the correction made before the materials have been put through the several machine processes and expensive alterations or repairs incurred. If drawings received by the foreman are indistinct, imperfect or in any manner unsatisfactory or unavailable for use, they should be returned and duplicates called for. The coöperation of the shop in checking the work of the drafting department is invariably beneficial in its results.

A bulletin of new prints and of changes made on existing prints should be issued daily by the drafting department and supplied to the foremen of the manufacturing departments. The notice of changed prints should give the name of the engineer by whom the change was authorized, with the date affixed; also the character and cause of changes, with reasons for making the alteration. If the change is due to error, the name of the person or department responsible should appear. The notice should also embody any action to be taken by the foreman on finished or partly finished material on hand.

In addition to the regular daily bulletin covering all new prints and changed prints that have been issued during the preceding day it is good practice to attach a "Change" slip to all drawings that have been altered before sending them to the shop. The "Change" slip embodies the features of the daily bulletin and serves to bring more emphatically to the foreman's attention the alterations that have been made in the particular drawing or apparatus in which he is directly interested.

This system not only provides for prompt and complete notification to the foreman of all prints issued, but it also prevents many serious and expensive delays and errors. It renders the foreman without excuse for not being posted on all new issues or modifications as rapidly as they occur.

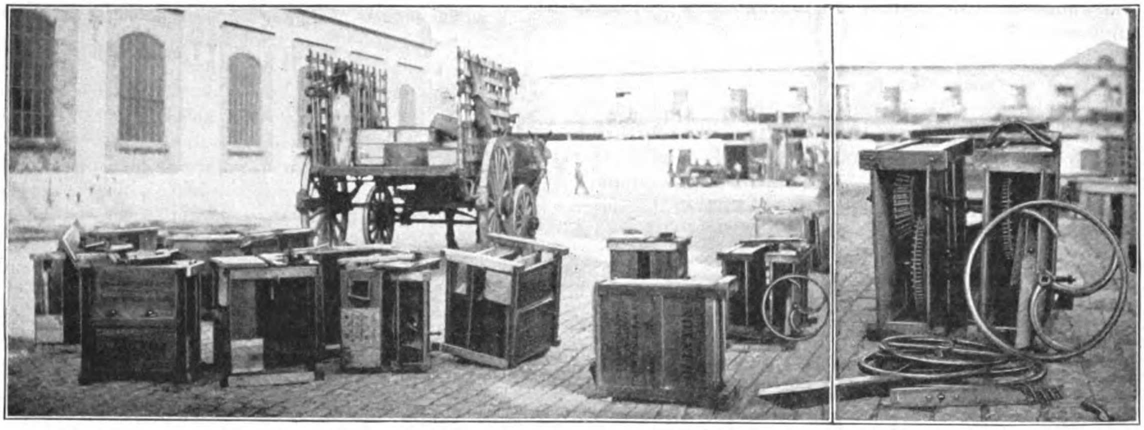
A card record should be made of all new prints issued, embodying the drawing number and name of the apparatus or detail shown. A record of changed prints should also be provided, which may be kept for reference for any arbitrary period desirable. As this record, however, is written upon the original tracings, the retention of the cards beyond the period of their active use becomes unnecessary. Drawing lists and casting lists should also be recorded in a similar manner to that provided for the recording of blueprints. All these records should show the location of the tracings in their proper compartments within the drafting-department storage vaults.

Improper Crating of Machinery

Special Correspondence

Evidence as to the foundation for complaints of poor boxing of shipments to South American ports can be plainly seen in the accompanying illustrations. These photographs were taken by our own representative on the docks at Montevideo, Uruguay.

The flimsy and inadequate boxing is clearly shown in Fig. 1, where a number of cases in a more or less dilapidated condition can be seen in the street. A closer view of the one on the right is seen in Fig. 2, showing the damage sustained. This breakage is not only annoying to the consignee, but it prevents the sale of the machinery, ties up money and disappoints customers until the broken parts can be replaced.



FIGS. 1 AND 2. RESULTS OF IMPROPERLY CRATING MACHINERY FOR EXPORT

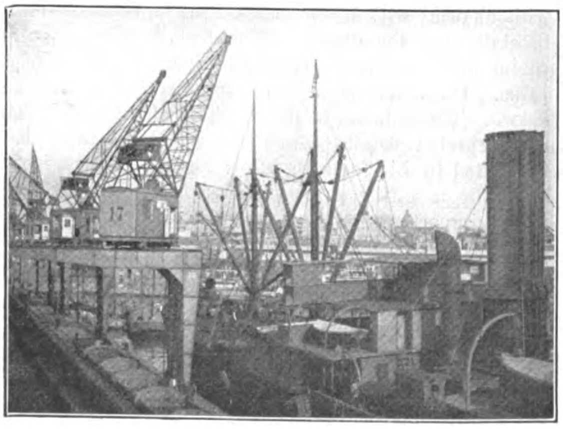


FIG. 3. THE DOCK EQUIPMENT AT MONTEVIDEO, URUGUAY

Lest some assume that these mishaps are due to inadequate methods of handling freight, attention is directed to the gantry and boom cranes with which the dock is supplied.

Making Shells with Regular Shop Equipment

By Fred H. Colvin

SYNOPSIS—Utilizing the standard shop equipment of engine lathes, turret lathes and automatics and securing rapid production with them, building all necessary machines and tools for less than the value of the scrap metal secured in machining and earning a good profit constitute a somewhat unusual story. Only high-grade mechanical ability, coupled with experience and good commonsense, makes such an achievement possible.

The first interesting feature of the methods to be illustrated is the fact that the contract has been filled by utilizing old equipment of an average shop for nearly all operations. All special tools, fixtures and in one or two cases special machines have been made for less than the value of the scrap or waste metal machined from the shells, and a good, fat profit has been made besides. This policy had the double advantage of avoiding the payment of war prices for new machinery and of wearing out the old equipment, so that new can be purchased when prices get back to normal.

The way in which old machines have been utilized to get good production from them by means of ingenious devices, the introduction of new and different ways of handling the work and the careful calculations as to the value of scrap metal are all of peculiar interest. These methods are of particular value to small shops that can be utilized for shell making, if necessary. The shells in question are 3.3-in. British shrapnel made from forged blanks. The first operation is to cut in the open end of the shell a notch that is used in driving the shell during subsequent operations. This work is done in an ordinary punch press, something as shown in Fig. 1, the shell being supported in a holder C under the punch B and located by the rod D. In this way a uniform distance is secured between the bottom of the forging and the punch slot.

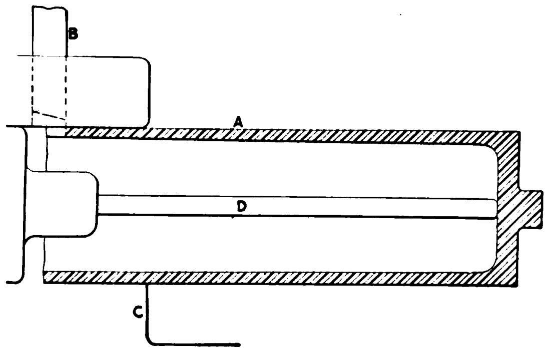


FIG. 1. PUNCHING DRIVING SLOT: OPERATION 1

Machine Used—Any punch press.
Fixtures—Length stop and holder.
Gages—Length—First inspection.
Production—1 man, 1,000 in 6 hr.

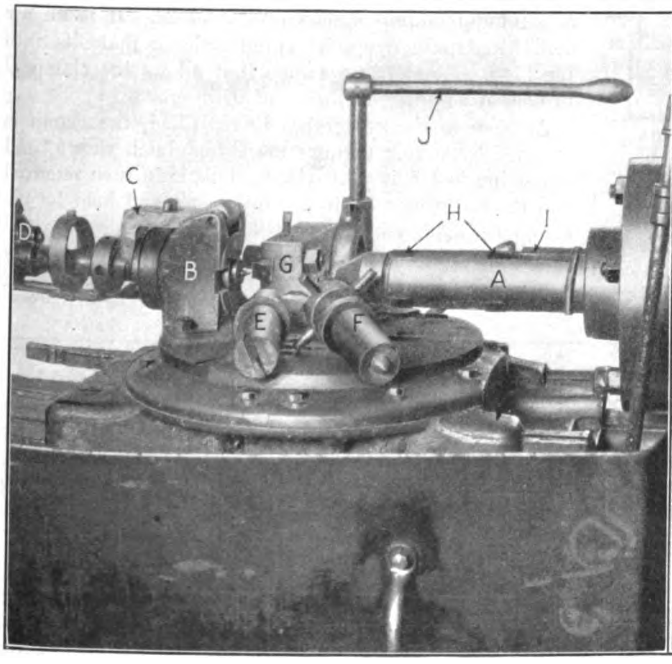


FIG. 2. CENTERING SHELLS: OPERATION 3

Machine Used—Old Jones & Lamson turret.
Fixtures—Aid drill, facing cutter, center, center holder, facing tool block, expanding mandrel.
Gages—Flat steel templet.
Production Time—4½ min.

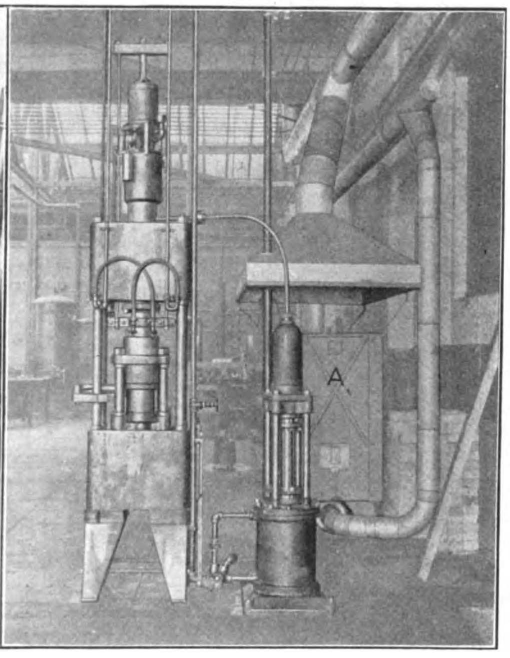


FIG. 5. CLOSING IN NOSE: OPERATION 7

Machine—Home-made hydropneumatic press and heating furnaces.
Fixtures—Dies and tongs.
Gages—Templets.
Production—2 men. 1,400 in 12 hr.

Occasionally a shell is too long to be handled on the driving mandrel, and in such cases the surplus metal is punched off by simply rotating the shell under the punch for a complete turn. Then the driving slot is punched in the usual manner and is ready for machining.

bar centering itself in the forged cavity. Soda water is fed in through the center of the bar itself, this operation requiring 3 min.

An old Jones & Lamson turret has been utilized for operation 3, and it also performs the three suboperations

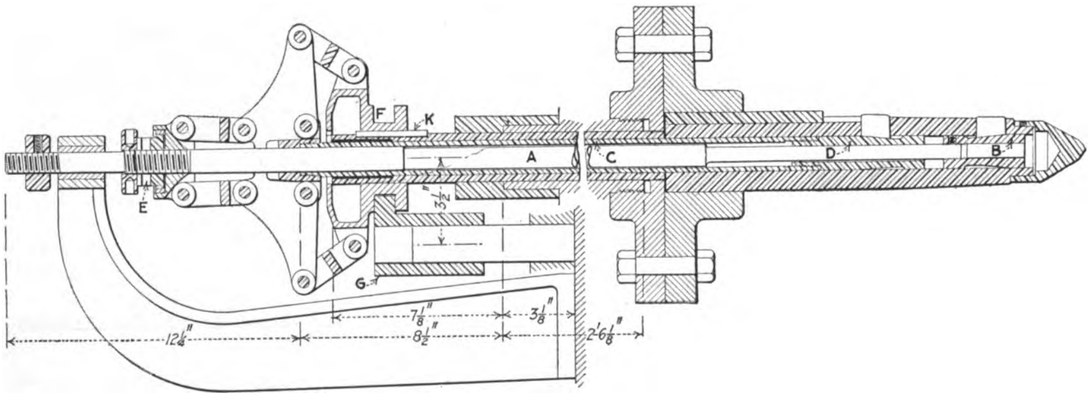


FIG. 3. DETAILS OF EQUALIZING EXPANDING MANDREL FOR TURNING SHELLS

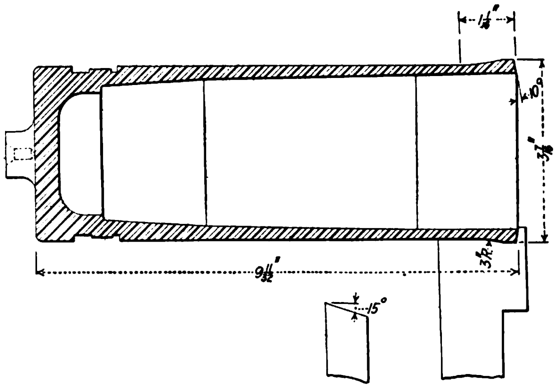


FIG. 4. CUTTING OFF AND FORMING OPEN END: OPERATION 6

Machine Used—Cleveland automatic.
Fixtures—Forming tools.
Gages—Templets of form shown.
Production—9.5 per hr.

of facing the center projection, centering and counterboring, and facing the back end of the shell. The turret is not revolved during these operations, but is locked in a fixed position on the bed.

Fig. 2 shows the driving mandrel *A* with the centering jaws *H* and the driving key *I*. Bolted to the turret is the substantial tool block *B* with the locking device *C*, which is in reality a tool holder. The drill for centering and countersinking is shown in position. It is an air drill fitted with a special spindle sleeve that fits into the block *B* and has a flange that allows the clamp *C* to hold it against the thrust of drilling.

As soon as the center has been drilled, the clamp is removed by simply turning the thumb-latch shown, and the facing tool *E* is substituted. This is in turn removed and the tail center *F* slipped into place and held by the clamp *C*. This center has a screw that allows the tail center to be forced against the work as hard as may seem desirable and is used during the suboperation of

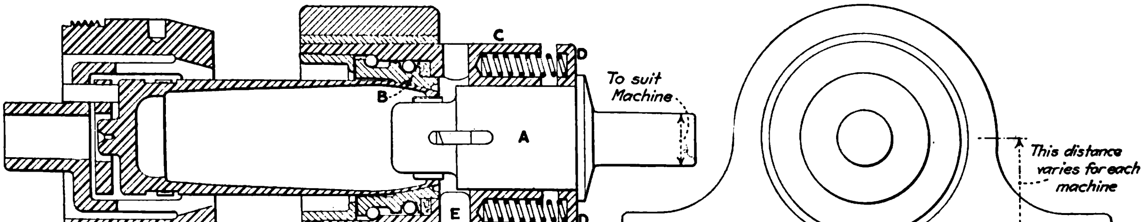


FIG. 6. DETAILS OF FIXTURE FOR TAPPING NOSE: OPERATION 8

Machine Used—Bardons & Oliver turret.
Fixtures—Chuck and steady-rest shown.
Gage—Plug thread gage and nose form.
Production—3 min. each.

The stop *D* was first made rigid; but as it persisted in breaking off under these conditions, it is now loosely mounted in the supporting center and no further difficulty is experienced along this line. A preliminary inspection also takes place during this operation, one man handling 1,000 shells in 6 hr. without difficulty. The second operation bores the powder chamber under the spindle of a heavy Baker drill, the vertical boring

facing off the back end. The side tool that does this facing, shown in the tool block *G*, has a sliding movement across the turret, through a rack and pinion, the latter being operated by the lever *J*. This arrangement gives a good leverage and makes it easy for the operator to face the ends. This operation takes 4½ min.

The fourth operation is the turning of the outside of the shell nearly its whole length, the turning tool

running up practically to the notch cut for driving. This cut is handled by two tools in an ordinary lathe, so that each travels only half the length of the shell. A cutting speed of 42 ft. per min. is maintained, this operation requiring 7 min.

The shells are held on a special equalizing expanding mandrel during the turning operation, illustrated in Fig. 3. This mandrel holds the shells at two points of their length and equalizes the pressure so as to insure equal bearing and equal driving power. It also centers the shells along their entire length. It is shown attached to almost any type of screw machine or other lathe, the headstock being omitted and only the faceplate and end of the headstock shown, the rest being unnecessary.

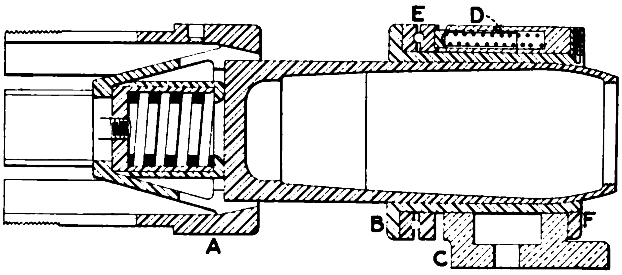


FIG. 7. SCRAPING INSIDE OF NOSE: OPERATION 9
Machines Used—Any suitable turret or engine lathe.
Fixtures—Cross slide and form tool.
Gage—Templet or contour gage.
Production—2 min. each.

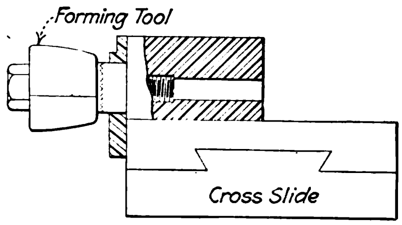


FIG. 8. FORM TOOL USED IN OPERATION 9

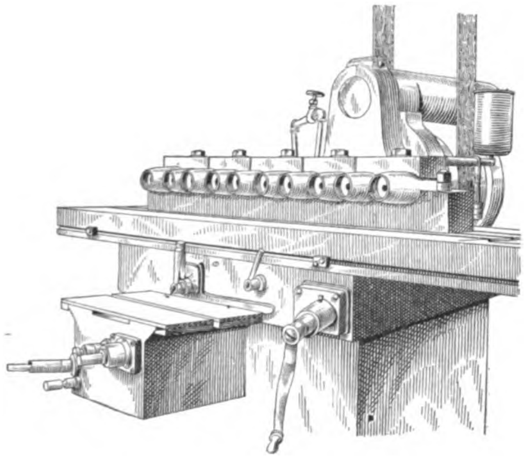


FIG. 10 CUTTING OFF ENDS: OPERATION 12
Machine used—No. 4 Cincinnati miller.
Fixture—Holder for shells.
Gages—Templets.
Production—2 men, 1,400 in 22 hr.

The mandrel consists primarily of the inner rod *A* carrying the wedge *B*, which is turned taper as shown, and the tube *C* with its wedge *D*. Both *C* and *D* operate separate sets of jaws, three in number in each case; and as will be noticed, the inclines are in opposite directions.

The spools *E* and *F* run free, the latter being feather-keyed to the lathe spindle at *K* and revolving with it, but free to move endwise both on the key and with the spool *G*. The chucking lever controls the movement by means of the sliding spool *G*. When this is moved, it pulls back the rod *A* and pushes forward the tube *C*, or vice versa, by means of the toggle levers shown. This movement forces the jaws up the incline and tightens the shell on the mandrel. Should one set of jaws take hold before the other, they act as the stationary member and the other cone forces out the second set of jaws until all bear equally. This is a particularly interesting device that can be adapted for many other uses.

Next comes the roughing out of the band groove, operation 5, done on a Jones & Lamson turret, which also chamfers the corners, the production time being 2½ min. This operation requires no illustration.

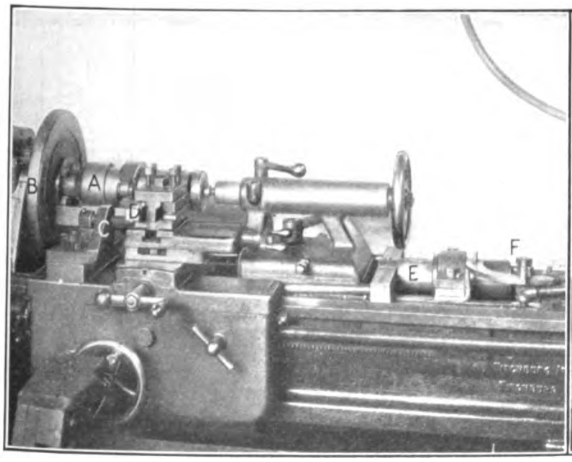


FIG. 9. CUTTING THE WAVES: OPERATION 10
Machine Used—Old Fitchburg lathe.
Fixtures—Cam, tool block, air spring.
Gage—Usual templet.
Production—3 boys, 1,400 in 10 hr.

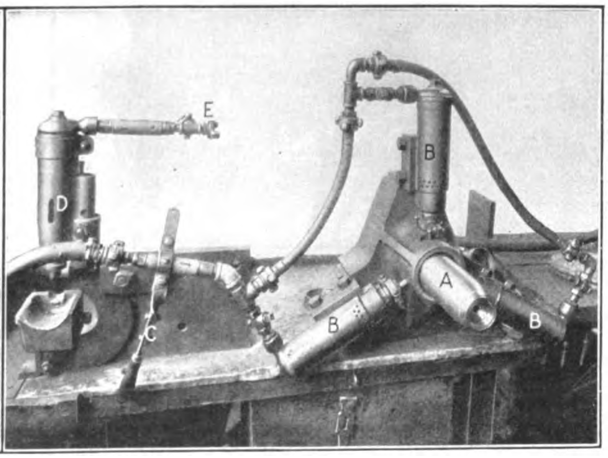


FIG. 11. VENTING WAVE GROOVES: OPERATION 13
Machine Used—Specially arranged air hammers.
Fixtures—None.
Gages—None.
Production—Man and boy, 1,400 in 12 hr.

The ends are cut off and formed for closing in, in the sixth operation. This is done on Cleveland automatics, which happen to be available. Considerable experimenting developed the proper shape of nose to be closed into the desired shape for boring and tapping. The dimensions are shown in Fig. 4, where it will be observed that the open end of the shell is beveled back 10 deg. After being closed, this bevel is turned in and simply requires a little trimming to fit the fuse or adapter.

The closing in of the nose is done on the hydro-pneumatic press, Fig. 5. This illustration also shows

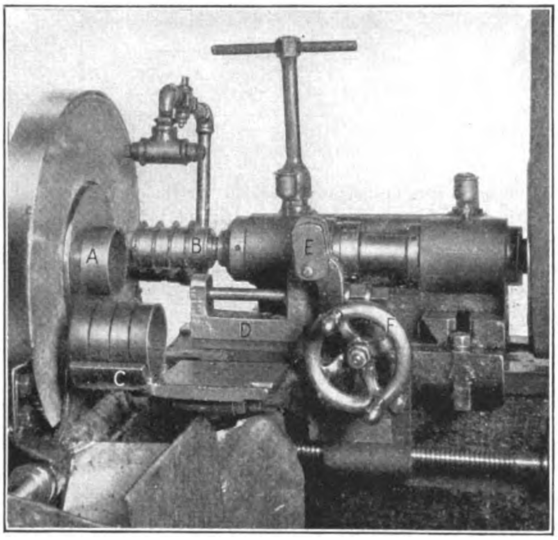


FIG. 12. CUTTING OFF BANDS

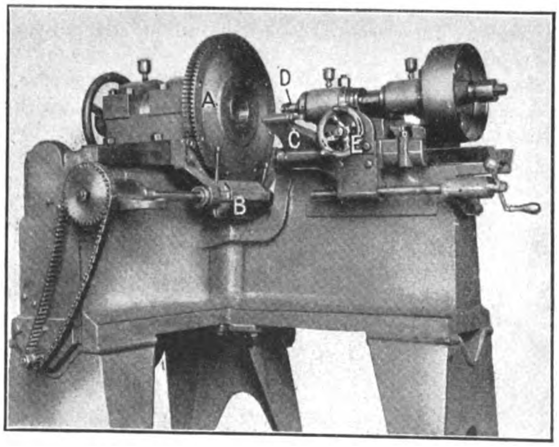


FIG. 14. FORMING THE BANDS: OPERATION 15

Machine Used—Special rotary miller.
Fixtures—Formed cutters.
Gages—Templets.
Production—3 men, 1,400 in 22 hr.

the heating furnaces, which are very conveniently placed. This press has a 12-in. air cylinder with a possible stroke of 12 in. The hydraulic ram is 3 in. with a 12-in. stroke. A 7-in. stroke is sufficient to close the shell nose. The form die comes to a positive stop on the base which clamps the shell. This secures a uniform nosing and eliminates the necessity of turning afterward. Two men handle 1,400 shells, the daily output, in 12 hr. The diaphragms are slipped inside before closing the nose.

The nose is bored and tapped in a Bardons & Oliver turret, equipped with special holding chucks and steady-rests. The boring and facing tool is shown at *A*, Fig. 6, the nose of the shell resting in a revolving support. This sleeve *B* forms the inner race of the double ball bearing and takes care of both the radial and the end

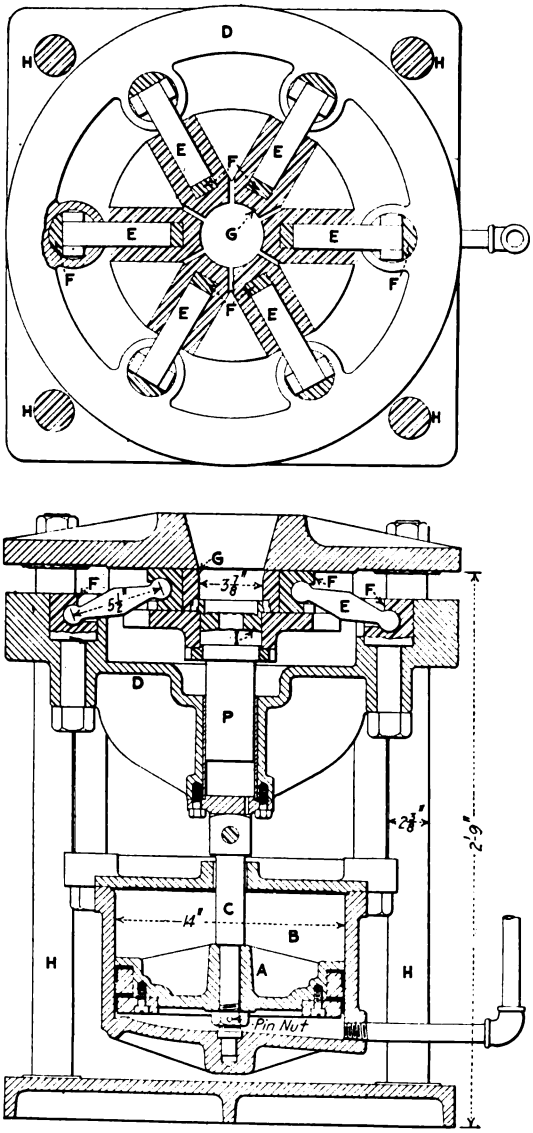


FIG. 13. PNEUMATIC COPPER-BANDING MACHINE: OPERATION 14

Machine Used—Special 30-ton press.
Fixtures—None.
Gages—None.
Production—Man and boy, 1,400 in 12 hr.

thrust, while the felt washer keeps out dirt and chips. It will also be noticed that the outer case *C* projects so as to act as a guide for the boring and facing tool.

The tool *A* is provided with a shoulder that makes contact with the collar *D* and compresses the spring as the tools feed into the shell. The opening *E* provides escape for chips. This guiding the tool with relation

to the shell insures the hole being concentric with the outside, which is quite an important point in inspection.

The tapping is done in the same fixture and at the same setting. This complete operation takes 3 min.

After the boring and tapping of the nose the inside of the shell just beyond the thread is scraped out with a round-formed cutter, Fig. 8. This is a circular form- is mounted in the cast-iron block *C*. The spring plunger *D* regulates the pressure on the thrust bearing *E* and also prevents the front race from turning. The threaded collar *F* holds the other end of the quill in position.

The next, or ninth, operation is to grind the shell all over, a very heavy wheel saddle weighing 400 lb. being employed for this purpose. A formed wheel is

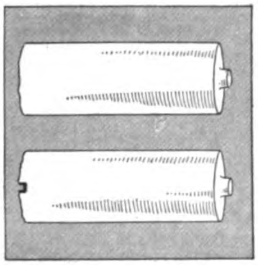


FIG. 1-A. OP. 1. NOTCH FOR DRIVER

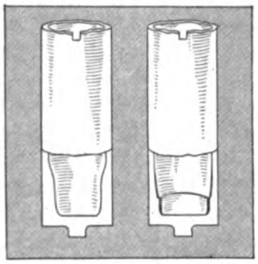


FIG. 2-A. OP. 2. BORE POWDER POCKET

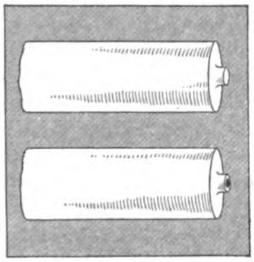


FIG. 3-A. OP. 3. CENTER AND FACE END

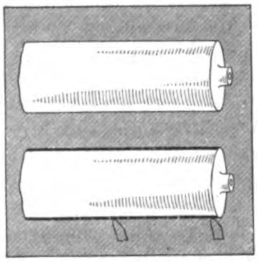


FIG. 4-A. OP. 4. TURN OUTSIDE

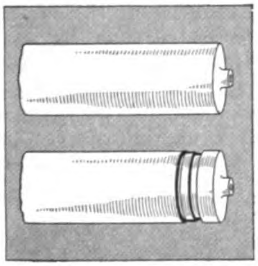


FIG. 5-A. OP. 5. ROUGH BAND GROOVE

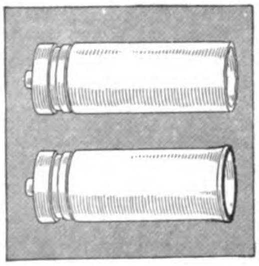


FIG. 6-A. OP. 6. CUT OFF OPEN END

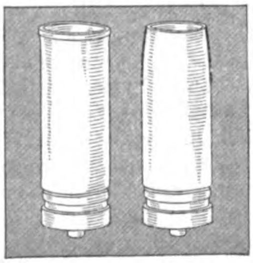


FIG. 7-A. OP. 7. CLOSE IN NOSE

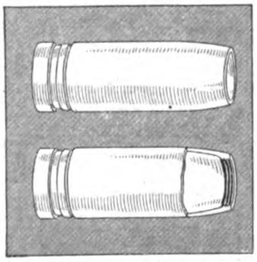


FIG. 8-A. OP. 8. THREAD THE NOSE

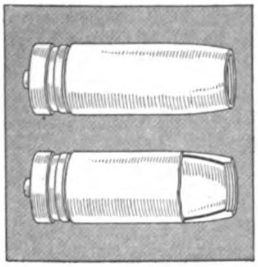


FIG. 9-A. OP. 9. TRIM INSIDE NOSE

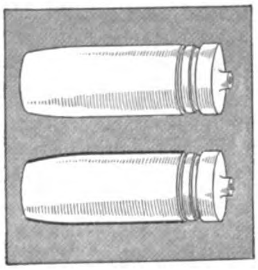


FIG. 10-A. OP. 10. GRIND OUTSIDE

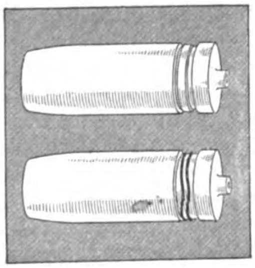


FIG. 11-A. OP. 11. CUT WAVE GROOVES

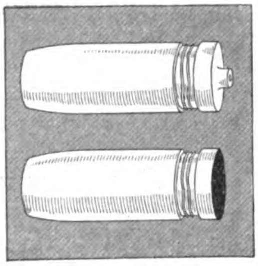


FIG. 12-A. OP. 12. CUT OFF SMALL END

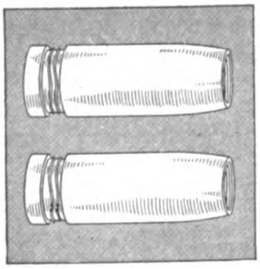


FIG. 13-A. OP. 13. NICK BAND WAVES

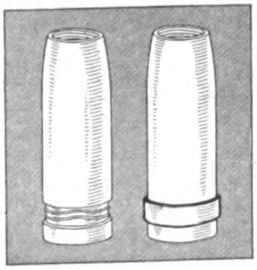


FIG. 14-A. OP. 14. PUT ON BAND

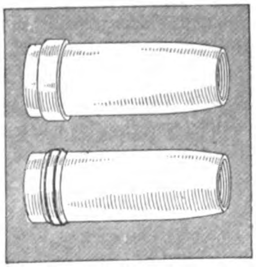


FIG. 15-A. OP. 15. TURN BANDS

ing cutter of the regular type, held from turning by the serration shown at the end, where it bears against the tool rest. The cutter is mounted on a Jones & Lamson cross-slide, the shell itself being held in the draw-in chuck and the special bearing, Fig. 7. The contracting sleeve *A* clamps the jaws on the back end of the shell, the front end being supported by the steel quill *B*, which used for shaping the nose of the shell, the straight part being ground by a plain-faced wheel 6 in. wide. The grinding allowance is 0.015 in., and eight men—four men to each shift—grind 1,400 shells in 22 hr.

Waving in the groove already roughed out in operation 5 is done in an old lathe, as indicated in Fig. 9. The nose of the shell is supported in a sort of bell chuck

A and held in position by the strap shown in front of it. The cam is on the faceplate *B*, while *C* is a stop to locate the position of the waved tool *D*, which is held in the compound rest set parallel with the lathe ways.

The unusual part of the arrangement is the use of the air cylinder *E* in place of the usual spring or weight. A spring was first tried, but the inconvenience of getting it out of the way when it was not needed led to the adoption of the pneumatic cylinder.

When the spring action is necessary, the cock *F*, swung on the quadrant between the two pins shown, admits air to the cylinder and forces the roller on the lathe carriage against the cam on the faceplate. When the spring is not needed and it is desired to move the tailstock or the carriage, the cock *F* is swung into the other position, which shuts off the air and opens an escape vent from the cylinder. This arrangement has worked out much more satisfactorily than the spring formerly used. Three boys handle 1,400 shells in 10 hr., or about 45 shells per hour for each lathe.

The projection on the closed end of the shell is next milled off, as shown in Fig. 10. The fixture is a simple one that goes on a No. 4 Cincinnati knee-type miller and holds ten shells at one setting. It will be noticed that these shells are held by five separate straps, these being used so that as soon as a section has passed the milling cutter the milled shells can be removed and others put in their places. In this way almost continuous milling can be done, two men handling the 1,400 shells in 22 hr.

The device for cutting the air grooves across the waves is illustrated in Fig. 11. The shell *A* is acted on by the three air hammers *BBB*, the piping connections being shown. Needless to say, these vent or nick the waves very rapidly, as fast as a man can handle the shells. The handle *C* controls the air to the hammers.

At *D* are a single air hammer and a simple holder for the shells. They are solely for use in case the triple arrangement gets out of order from any cause. Should this occur, all that is necessary is to connect the air hose at *E* and go ahead.

The banding is handled in a somewhat different manner than usual, both the machine for cutting off the bands and the one for pressing them into place being built especially for this job. The cutting-off machine is shown in Fig. 12, with a tube in place at *A* and with the four milling saws *B* properly spaced for the width of band desired. The backrest *C* is shown thrown down and holding the four rings, which have just been cut off. It effectually supports the rings being cut against the thrust of the milling saws; and when the cut is completed, lifting the latch *E* releases the rest and allows the four rings to be easily removed. This backrest is located in position by the surface *D*. The cutters are fed into the work by the handwheel *F*. These four saws are but $\frac{1}{32}$ in. thick, so that the waste of copper is very slight. The machine cuts 180 bands per hour and while this may not be as fast as in some other cases, the saving in copper probably more than compensates for any loss of time. Furthermore they are very true to length.

The banding machine, Fig. 13, is operated by air at the regular shop pressure of 100 lb. to the square inch. This acts on the 14-in. piston *A* in the cylinder *B*, giving a total pressure of 30 tons to the square inch. By means of the toggle *F*, pressure is transmitted through the rod *C* to the head *D*, which slides on the four round guides *H* and also the central plunger *P*. The toggles *E*, working in the thrust blocks *F*, force the six steel jaws *G* against the copper band, compressing it into the band groove from all sides. This press is very quick acting, and five or six strokes are usually employed, turning the shell slightly each time, as is usual. One man and a boy band 1,400 shells in 12 hr. The main dimensions of the press are given in Fig. 13.

Instead of turning the bands as usual, this shop found it advisable to build two special millers, Fig. 14. These are simple affairs, as can be seen, consisting of a work-holding spindle carrying a wormwheel *A* and being driven by the worm *B*. The shell, with the band in place, is slipped into the hollow spindle and held by a draw-in chuck operated by the wheel at the end. The shell is located by the swinging stop *C*, which drops out of the way as soon as the shell is in position. The milling cutter *D*, which is formed to give the shape of the copper band, is driven by an independent belt and can be moved either longitudinally for location or fed into the work by the crossfeed wheel *E*. This method of finishing the bands has been found very satisfactory, three men and two machines finishing 1,400 bands in 22 hr.

Altogether this makes a very interesting plant, and the output of 1,400 shells per day, with an average of 28 min. each, reflects credit on the mechanical ability of those in charge.

Third Annual Convention of Drop Forgers

The third annual convention of the American Drop Forgers Association was held at the Hotel Adelphia in Philadelphia, Penn., on June 9 and 10. One hundred and fifty members and guests were present and displayed an interest in the proceedings which forecasts a bright future for this three-year-old association.

The address of welcome was delivered Friday morning by Howard B. French, president of the Philadelphia Board of Trade, followed by an address by E. J. Cattell, city statistician. Twenty-five years of Mr. Cattell's life were spent studying industrial conditions in the countries now at war, and from conclusions based on his knowledge of conditions and resources abroad he made the following statements of interest to manufacturers in this country: "The war will end within one year, leaving Europe far from exhausted in the matter of financial resources. Countries abroad have been 100 years in making and saving money and are now in the position of a man who must get along with 13 motor cars instead of his usual 15. The enforced economies have resulted in a new power of self-denial of unnecessaries which will offset the unusual expenditures." Mr. Cattell predicts a great volume of business for American manufacturers in helping to rebuild Europe.

An opening address was made by the president of the association, F. A. Ingalls, in which he dwelt upon the importance of the drop-forging industry and told of the vital effect of this art upon the automobile industry to the mutual upbuilding of both. He referred to the necessity of a free interchange of information and ideas for the full development of the drop-forging art and urged the furthering of association membership to this end.

At the forenoon session a paper entitled "Selection of Proper Machines for Making Forgings" was read by R. T. Herdegen, of the Dominion Stamping and Forging Co. The author pointed out the necessity of the selection of machine units suited to the particular job in question for the purpose of securing minimum costs. Three types of machines were considered—board drops, steam drops and upsetting machines—and examples were given, showing a minimum-cost job for each type, the figures including die cost, material, direct labor and the complete overhead charges.

"A Floating Type Head for Board Hammers," by Howard Terhune, of the Chambersburg Engineering Co., presented a description of the floating head of the Chambersburg board drop and told of the conditions leading up to its adoption. Mr. Terhune also sketched the historical development of the board drop from the first hammer at Colt's armory to the present-day hammer.

"Multiple Mechanical Die Sinking," a paper by Jules Dierckx, of the Keller Mechanical Engraving Co., was read by S. A. Keller. It pointed out the fundamental advantages of the mechanical sinking of dies as done on the Keller machine. The flexibility of control of output under varying labor conditions and the separation of the functions connected with die sinking requiring skill not heretofore combined in one individual, were outlined as important advantages aside from the reduced cost of dies thus made.

At the afternoon session "The Forging of Automobile Front Axles" was read by J. F. Zwicker, of the Willys-Overland Co. Mr. Zwicker gave an interesting and detailed description of his method of producing the Elliott type I-beam section front axle as used in the Overland car. He also produced some examples of work done on the upsetting machine with plain and sliding dies at a minimum cost. The discussion of this paper brought out the feasibility of thin-forging alloy-steel flanges, according to Mr. Zwicker's experience this being possible on a 7½-in. diameter flange, $\frac{5}{16}$ in. thick, gathered from 1½ stock, this case being the wheel flange on a rear axle.

"The Heat-Treatment of Drop Forgings," by W. C. Peterson, of the Packard Motor Car Co., presented a series of personal investigations on various methods of heat-treatment, applicable to drop-forged products and particularly to automobile forgings. Mr. Peterson told of tests on the structure of the same forgings, made under a various number of blows, and pointed out the advantage in granular structure and tensile strength secured by a large number of blows.

In " Modern Methods in Making Six-Throw Cranks," A. A. Motherwell, of the Buick Motor Car Co., described the method and dies used in producing the six-throw crank for the Buick car and also his experiences in developing these methods. Mr. Motherwell outlined his mode of increasing production by the use of two furnaces and two forging gangs at one hammer, whereby he is able to get 600 six-throw cranks from one hammer in 22 hr.

"The Manufacture of Drop-Forging Steel," by H. N. Taylor, of N. & G. Taylor Co., dealt with the method of rolling billets into bars with a view to eliminating pipes and seams, as applied to the carbon-steel forging stock produced by this company.

The association banquet was held at 6:30 p.m., followed by a theater party and buffet supper.

At the session of Saturday morning, June 10, "Sand Blasting of Forgings" was read by W. C. Lytle, of the Pangborn Corporation. The author described the various methods of cleaning forgings by pickling, tumbling and various types of sand-blast apparatus, including the barrel type, cabinet type, hose type and table type. He classified the purposes of sand blasting as to the removal of scale before and after heat-treating and to secure a matte surface for painting. During the discussion the purpose of sand blast for uncovering defects was discussed. The difficulty in cleaning alloy-steel forgings by the sand-blast process was said to be overcome by the use of No. 5 round chilled-steel shot. Mr. Motherwell told of the installation of wire brushes at his hammers at the Buick plant for the purpose of uncovering defects prior to completing the forging.

In his paper, "Sources of Heat for Forging Furnaces," A. A. Holbeck, of the Bonnot Co., described the operation of a powdered-coal plant adapted for small furnaces, using the central distributing system and distributing the coal by means of air in galvanized pipes. As small a fuel consumption as 10 lb. per hour per furnace is possible with this system. The temperature of combustion is 3,400 deg., and the final cost results with coal at $3 per ton are equivalent to fuel oil at 1½c. per gallon.

"The Hammer-Hour Overhead System," by A. A. Motherwell, Buick Motor Car Co., described the system of overhead distribution to individual machines and groups of machines which has been worked out at the Buick plant. Each machine must make a showing for itself, and the burden is spread over each piece, a loss or gain in burden and production being reported daily on a form provided for that purpose. The hourly burden rate for hammers varies from $1.50 for a small machine to $17 per hour for a 12,000-lb. hammer. Mr. Motherwell also pointed out how savings can be made by specializing and studying concrete problems, a saving of $13,000 having been made in one year simply by studying and reducing the flash and gate-ends on connecting-rods.

"Recent Developments in the Use of Upsetters," by F. O. Andrews, of Acme Machinery Co., illustrated the possibilities in the use of these machines by showing a forged spiral beveled-gear blank in which the teeth had been produced in a total of three operations on an upsetter. The ring was produced from flat stock by two operations aside from those described.

"The Practical Use of the Pyrometer," by C. R. Cary, of Leeds & Northrup Co., pointed out the errors to be guarded against in the practical use of pyrometers and told of temperature differences ranging from 25 to 100 deg. F. at different portions of the same furnace. The author emphasized the necessity of placing the fire end so that it will correctly measure the work that it is heating.

The following officers were elected for 1916: President, R. T. Herdegen; vice-president, T. W. Sieman; secretary and treasurer, E. B. Horne.

During the executive session the following resolution presented by President Ingalls was passed unanimously:

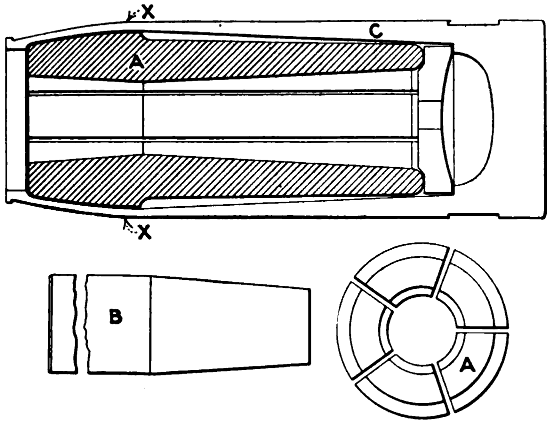
Be It Resolved, That we, the members of the American Drop Forgers Association, hold ourselves in constant readiness at all times to serve this country with our trade, knowledge, our equipment and our men for any necessary military defensive action that our Government may require from us. We also declare that we are in favor of all unselfish efforts toward such military and industrial preparedness as will serve to provide an adequate safeguard against attack by any enemy.

Expander for Reclaiming Undersize Shrapnel

By H. Watts

The device shown is an expander used in shrapnel making for increasing the diameter of rejected shells where the diameter of the nose has been ground too small. A concern making shrapnel had thousands rejected on account of the nose diameter being under minimum size. This device was used and all the rejected shells expanded and reclaimed. This device has been in service every day for the past six months. It can be used under a press or by a man with a 10-lb. sledge hammer.

The sectional drawing shows the expander *A* in position in the shell *C* ready to have the taper pin *B* inserted. The expander is made from 90- to 100-point carbon tool steel,



EXPANDER FOR UNDERSIZE SHRAPNEL

hardened, and tempered to a brown color. After turning, it is cut into five sections with a $\frac{1}{8}$-in. wide saw in the miller. This permits the sections to pass in and out freely at the small opening where the fuse socket screws in. The bottom of the expander rests on the top of the disk. The taper in the expander is $1\frac{5}{16}$ in. per ft. and on the pin 2 in. per ft. This steep taper was given so that the pin would not stick in the expander and cause loss of time. It takes about 1 min. 20 sec. to expand a shell. The expanding takes place at *X*. Heavy grease should be put on the tapers in use.

Fuels for the Oil Engines

By John F. Wentworth

When Diesel began his work, he was not content with the idea of using liquid fuel, but proposed to use pulverized coal as well. This proved inadvisable because of the ash, which must have a bad effect upon the cylinder even if a valve could be made that would handle the coal. There seems to be no good reason, however, why all liquid fuels cannot be used in the oil engine.

One thing for consideration is the ignition points of the different fuels. There is good reason to believe that this point is practically constant for all fuels. If this be true, the only limitation to the fuel for use in the oil engine is that placed by high viscosity, and this seems to be overcome when the fuel is heated and fed through a valve that does not require a water jacket.

The first reason for believing that all fuels have practically a constant point of ignition is in the fact that the chemical composition of all hydrocarbons is practically constant. The carbon content varies from 80 to 90 per cent. and the hydrogen content from 8 to 15 per cent. Even the solid residues from fuel of an asphaltum base come within this range. The only reason for questioning this statement of ignition point would lie in the fact that these fuels have the carbon and hydrogen united in different series of hydrocarbons.

By ignition point is meant the point which, if the fuel be brought in contact with air of the same temperature, ignition will take place spontaneously. This should not be confused with the flashpoint, which is simply the point at which a vapor is given off that readily forms an explosive mixture.

The best practical proof of this common ignition point lies in the fact that the oil engine has shown that heavy fuels will ignite at around 1,000 deg. F., and the condition at which a vapor engine will continue to run even if the ignition means be discontinued is clearly over 800 deg. This can be determined by a calculation of the amount and temperature of the products of combustion remaining at the end of the discharge stroke and by an approximation of the temperature of the charge when it has been drawn into the cylinder over the hot head.

A Universal Fuel Valve

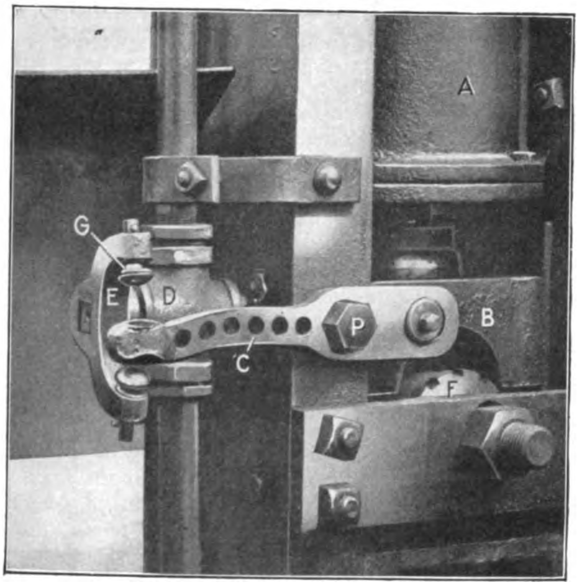
If the ignition points of all hydrocarbons be practically constant, the problem narrows to one of physical properties. The fuel must be reduced to a liquid condition by the addition of heat, and the fuel valve must be so designed that it will not depend upon the size of the passage for producing a perfect spray; for if it does, a valve that will use a heavy fuel with good results will deliver a lighter fuel into the cylinder in the form of a slug of oil. On the other hand, a differently proportioned valve will use the lighter fuel with good results and fail on the heavy fuel. Consequently the use of all grades of fuels in the same engine simply depends upon the design of a fuel valve in which the fuel is positively presented to a current of fast-moving air. It should be easily possible to design such a universal fuel valve, the point being, is it worth while to produce such a fuel-feeding arrangement?

In the description of a marine oil engine of the Werkspoor type, the statement was made that heavy fuel can be used, but the difference in cost between this oil and a lighter oil is so slight that there is but little use in taking the trouble with the heavier fuel. This is a confession of unreliability with the heavy oil. In engines of large power, which are coming to the front rapidly, 0.10 of a cent a gallon will amply repay the trouble of designing a positive and reliable means for using the lowest grades of fuel. Those engines that can use the poorer grades of fuel with absolute reliability will drive out the engines using the lighter and more expensive fuels. In fact the chief advantage of the heavy-oil engine lies in the hope of using all grades of liquid fuels. Purchasers of oil engines should look into this point very carefully before buying. It may be that owing to transportation costs the better oil will be as cheap as the poorer oils in some localities, but this is a condition that will be overcome to a degree at least as soon as the engine is produced which shows a broad market for the lower grades of oil.—*Power.*

Letters from Practical Men

Automatic Valve for Flue Swager

Herewith is shown a simple arrangement of valve control for a flue swager, which is used for swaging the ends of locomotive superheater flues after new ends have been welded on. As originally designed it was necessary for two operators to step on a foot treadle for every stroke of the piston. With the new arrangement the air valve is



AUTOMATIC VALVE FOR FLUE SWAGER

held open by a foot treadle and the machine operates at about 300 strokes per minute.

The illustration shows the back side of the machine. *A* is a 6x12-in. single-acting air cylinder; *B* is the upper swage block fastened on the piston rod. Each of the swage blocks is about 8 in. square by 4 in. thick. The two swage blocks are forced apart by four stiff spiral (or coil) springs, one on each corner of the block. *D* is a $1\frac{1}{2}$-in. threeway cock that is operated from the swage block *B* by the valve lever *C* pivoted at *P*. The lever *C* acts on the valve *D* through the fork *E*, which is provided with bottom head pins and springs, shown at *G*, to cushion the blows from the lever *C*. *F* is the mandrel for centering the flues. This device has been in operation for $2\frac{1}{2}$ years without giving trouble.

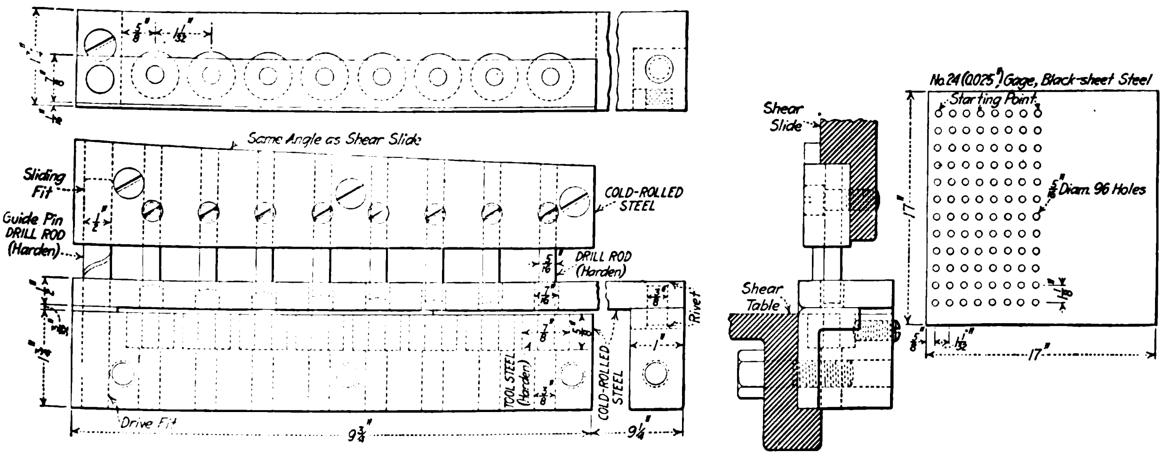
Minneapolis, Minn. WILLIAM SEELERT.

Converting a Squaring Shear into a Gang Punch Press

The illustration, Fig. 1, shows a gang punch used successfully in a common squaring shear. A lot of 4,000 pieces of sheet metal, 17x17 in. by 0.025 in. thick, had to be punched with ninety-six $\frac{5}{16}$-in. holes, as shown in Fig. 2. There was no power press large enough for this job, so a few pieces were first made by using a templet and punching one hole at a time in a hand punch. On account of the large number of holes in each piece this was slow work, so I tried another solution of the problem.

The upper and the lower knife and the front and rear gages were removed from a 32-in. squaring shear. The tools shown in Fig. 1 were made to fit in the same position as the knives, and the same screw holes were used for attaching them. The spacing of the holes between each row on the work was done by placing a piece of $\frac{1}{2}$x$\frac{1}{2}$-in. cold-rolled steel 17 in. long in the screw slot on the table. This piece had graduations $1\frac{1}{8}$ in. apart, and the work was simply moved forward one mark after each stroke of the punch.

The die block is a piece of cold-rolled steel $1\frac{3}{4}$x$1\frac{3}{4}$x$9\frac{3}{4}$ in., with inserted tool-steel dies that are held by $\frac{3}{8}$-in. setscrews. The stripper plate is also made of cold-rolled steel $\frac{1}{2}$x$1\frac{3}{4}$x$18\frac{3}{4}$ in. and is fastened to the die



FIGS. 1 AND 2. CENTERING A SQUARING SHEAR INTO A GANG PUNCH PRESS

block at one end by a fillister-head screw. The other end is attached to the table of the shear. The punch holder is made of $\frac{7}{8}$x$1\frac{7}{8}$x$9\frac{3}{4}$-in. cold-rolled steel, with the upper side planed to the same angle as the shear slide. The punches are made of $\frac{5}{16}$-in. drill rod $2\frac{9}{16}$ in. long. The lower ends of the punches are ground to an angle, to make them shear through the metal more easily.

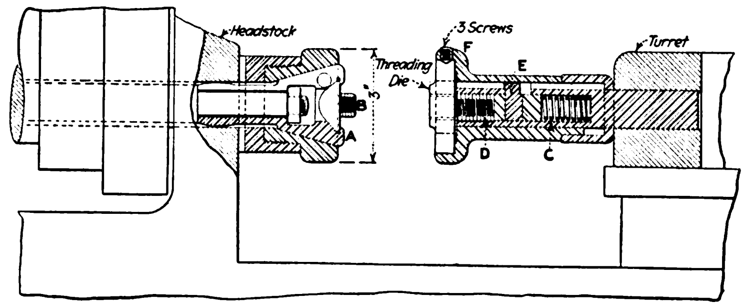
If the punches are oiled frequently, it requires little effort to force them through the work. We also punched $\frac{1}{32}$-in. sheet metal with equal success. G. B. OLSON.

Bridgeport, Conn.

Thread-Chasing Fixture for Small Parts

A quick and efficient method of chasing fine threads that lead up to a shouldered part is here shown as applied to a hand screw machine.

A three-jawed draw-in chuck A is made to fit the machine used for centering and driving the part B to be threaded. A die holder or sleeve of sufficient length to insure the necessary bearing and allow for the amount of travel required for clearance while placing the work in the chuck and threading it is made to slide on a post secured in the turret head. The post should be of the same diameter as the hole in the turret head and should be bored to receive a spring C, which keeps the locking bolt D pressed forward.



THREAD-CHASING FIXTURE FOR SMALL PARTS

The bolt is projected through an elongated hole E in the post and is a sliding fit in the slot or keyway cut the entire length of the die holder to prevent it from turning while it is being pushed forward to the work.

The end of the sleeve F is turned down to receive a shell that fits the post and allows clearance for the locking bolt when the die is threaded up against the shoulder of the work, allowing the die to revolve with the work and preventing the sleeve from coming off the post.

The end of the sleeve is cut on a spiral, beginning on one side of the keyway and ending at the opposite side. The purpose of the spiral is to form a lock when the power is reversed, caused by the spring in the post pressing the locking bolt against the shoulder on the end of the sleeve, which is in line with the slot, thereby backing the die from the thread.

The die holder is turned down to remove weight and to make a good grip for the hand. The die, which should be ground down on the face to clear the jaws of the chuck, is held in place by three screws. A very slight amount of clearance should be allowed in the holder for a float. The sleeve should be a good sliding fit on the post, to prevent sagging.

In operation the turret head is set so that when the die holder is screwed up against the shoulder of the work the holder will revolve with the work, as the locking bolt must then be out of the slot in the sleeve. The turret is then locked in this position, and the die holder is operated by hand, which makes it more sensitive for catching the thread and producing good work.

Allston, Mass. JOHN J. EYRE.

Camshaft-Grinding Fixture

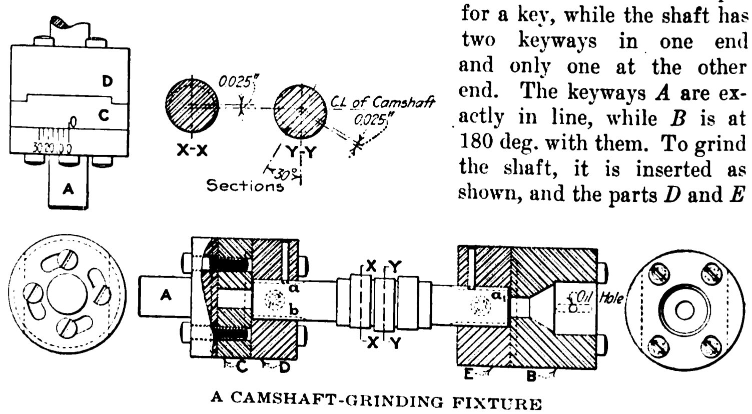
In order to grind shafts with eccentric cams of sections XX and YY, having an eccentricity of 0.025 in., 0.050 in. and 0.075 in., the fixture shown was designed. These cams had to be within 0.001-in. limit, and no trouble was experienced in keeping within that limit with this fixture.

The part A is clamped in the spring collet of a 16-in. engine lathe, while the part B is running on the ground center in the tailstock; C is graduated and fitted to A with a $\frac{1}{8}$-in. register and by four $\frac{1}{4}$-in. screws. A hole runs concentric with the register.

The pieces D and E are fitted to C and B respectively, so that the fixture can be shifted $\frac{1}{8}$ in. out of center and held together by four $\frac{1}{4}$-in. screws. D and E have each a $\frac{3}{4}$-in. reamed hole, while C and B have each a $\frac{3}{8}$-in. reamed hole.

Before setting up a job for grinding, a $\frac{3}{4}$-in. plug with a $\frac{3}{8}$-in. shank is placed in the reamed hole, the parts screwed together and the outside turned concentric with the bearing B and the shank A respectively.

As will be seen, the parts E and D have each a pin for a key, while the shaft has two keyways in one end and only one at the other end. The keyways A are exactly in line, while B is at 180 deg. with them. To grind the shaft, it is inserted as shown, and the parts D and E are clamped with the aid of an indicator to 0.025-in. or whatever eccentricity is required. Having ground the section XX, the shaft is taken out from the part D and



A CAMSHAFT-GRINDING FIXTURE

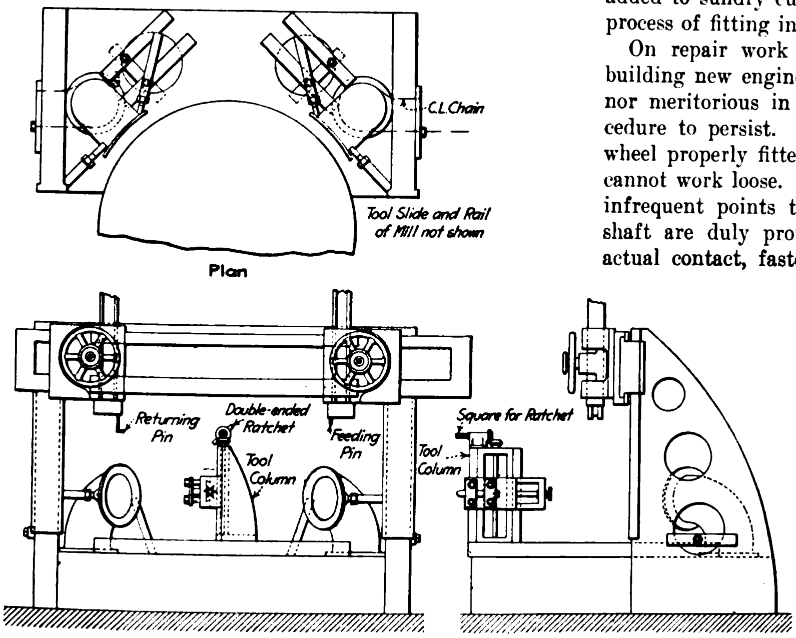
the fixture placed in the keyway *B*. The other end should remain unchanged. After loosening the part *C* and turning it to the required angle, as section *YY*, the other cam can then be ground. A. B. GAMORY.

Detroit, Mich.

Machining 24-In. Elbows

A few months ago at the plant of the Ironton Engine Co. we were making some castings for a blast furnace, among them two 24-in. elbows with 30-in. flanges. They were flat on one face and had a 54-in. radius on the other. Owing to some changes on the pipe line after these castings were finished, this radius had to be changed or new castings made.

Our superintendent suggested that we clamp the castings on the bedplate of our 10-ft. boring mill, fasten to the table an old head that was lying around the shop of the mill and change the radius face of these castings to suit the new condition.



MACHINING 24-IN. ELBOWS

The screw of the head was driven by a pair of bevel gears and a ratchet, which is plainly shown in the sketch. By using a kick pin in each head we were able to get a continuous feed.

These castings, weighing from 1,150 to 1,200 lb., were put on the mill, and one good heavy cut was taken down this face in 10 hr. F. J. HENDERSON.

Ironton, Ohio.

Fitting Flywheel Keys

In spite of modern machine-shop methods and recent advances the matter of fitting and keying a flywheel is in too many instances today an operation of the primitive and muscular type. Why this should be so is a little difficult to understand. Engine shops do such work on a time-limit basis, but by methods that seem to the onlooker archaic. The resources of modern grinding seem not to have penetrated to any depth in the conservative practice of many engine shops.

Shaft and bore are machined and assembled, the surface left in the bore of the wheel is of a friable nature, and the tooled surface gives too readily to the compression exerted in keying up. Considering the accuracy and economy of modern grinding, it is rather peculiar that methods have not been revised. Where such work is of reasonable size and in quantities, there seems no valid reason why keyways and keys should not also be procured.

Taking by no means a methodical view of the subject, a small surface grinder and magnetic chuck at the disposal of the erector would prove of valuable assistance and eliminate much wasted labor. Instances are plentiful where three men, two sledge hammers, a couple of 6-ft. pinch bars, splintered wood packing, hard breathing, added to sundry curses, are required to remove a key in process of fitting in a job of some size.

On repair work such methods are necessary, but in building new engines it is neither creditable to the shop nor meritorious in the management to allow such procedure to persist. It may broadly be stated that a flywheel properly fitted and keyed with intelligence simply cannot work loose. The fact that the phenomenon is not infrequent points to irrational methods. If wheel and shaft are duly proportioned with adequate surfaces in actual contact, fastened by keys of similar qualification properly driven home, there can be no question of the undesired slacking back.

For obvious reasons the assembler or erector will always have the last word on the subject of keys, but more refinement in method and less muscle would seem beneficial all round. It is perfectly possible by simple hydraulic or screw means to withdraw a jib-head key in process of fitting by the unaided effort of one man. Simple easing with a file is permissible, but the need for $\frac{1}{8}$-in. reduction at the vise by hand is not unknown in repetition work of the character under discussion. The ancient method utilized a piece of wood to fit the key space; the smith then forged a key thicker by a paper all over. Such a key would require little time to make a first-rate job. Under modern conditions of making for stock, insufficient attention is paid to the waste of time in erection due to cumulative errors in the machine shop or divergence in size of blank keys.

The contention advanced is not that making up for stock is wrong; but that with standard sizes for keys, broaching methods and grinding, the fitting of a key should be a matter of minutes only. The modern divorce of the machine shop from erection and the making up for stock are not without drawbacks. The former is mainly concerned with cheap removal of metal, the latter with the purpose of the finished job.

The internal broaching machine gave us a cheap means of keyseating bores, the traversing slot miller a corresponding means with regard to shafts; yet unless the point is closely watched, there is apt to be a want of correspondence between the two parts.

In a well-designed engine the portion of the shaft carrying the flywheel is for reasons of strength frequently enlarged. There seems therefore no reason why the broaching operation for final size should not be carried out with the wheel mounted. If such a system is in vogue, it is certainly not universal practice and might even in the case of large work be more generally employed. Under such conditions keys might be carried in stock surface-ground to fine limits and comparative interchangeability assumed. The erector under such methods could fix and fit a flywheel in a fraction of the time often needed.

It is, after all, simply a revision of method required, for which standard and commercial means are already available, giving easier work to the erector, cutting time out of an expensive operation and benefiting incidentally the finished fit. A. L. HAAS.

Tooting, England.

[There are several manufacturers of finished machine keys in the United States. These keys are ground within a limit of 0.001 in.—Editor.]

Bevel-Gear Grinding Chuck

Quite a number of gear-grinding chucks have already been illustrated in the *American Machinist,* but this article describes how a simple form of bevel-gear grinding device can be easily made.

Most gear chucks have carefully shaped tooth forms, in order to hold the gear while the bore is being ground. This takes time to secure sufficient precision so that accurate gears can be ground.

As may be seen in Fig. 2, by using a straight cylindrical rod *A* no tooth-shape filing and fitting will

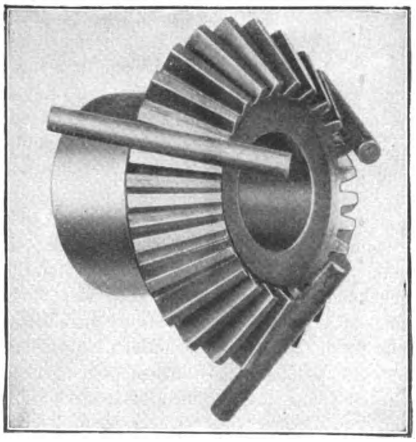


FIG. 1. BEVEL-GEAR GRINDING CHUCK

be necessary, and a simple reliable grinding fixture can be made in a short time. Actual experience proves that it is not necessary to have a tooth shape in order to grind bevel gears exactly.

Fig. 1 illustrates three cylindrical rods placed in position. The gear is clamped down on the rods *A* in the chuck, as in Fig. 2. The pitch line of the gear does not rest on the rods *A*, but simply rests along the tooth space, regardless of the pitch angle.

Fig. 2 shows how the gear is held in the chuck while being ground. *A* is a cylindrical tool-steel rod hardened and ground. Only one rod is shown, but three are used in this case. More should be employed on larger gears. *B* is the chuck body, made of cold-rolled steel. For larger sizes cast iron will do. *C* is a T-bolt and pivots on a pin. *D* is the clamp screw, which also pivots in the same way as *C*. *F* is a knurled locknut and is countersunk in the strap, as at *M,* so that, in case the nut loosens, the strap *G* would not open by itself. The strap rests on the gear at the center, shown only at *H;*

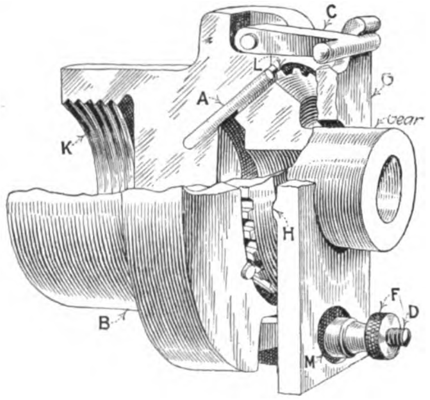


FIG. 2. CHUCKING THE GEAR

K is the thread, which usually fits on the grinder spindle. The chuck is made so that the gear has about $\frac{1}{16}$-in. clearance from the face angle of the gear, as *L.*

In making the chuck, the body *B* is first machined in the usual manner. Before the nest for the gear is turned out, the holes for the rods *A*, Fig. 2, are bored, and then the required amount of stock is removed. The size of the pins should be so selected that, when the nest is bored, with the necessary clearance for the gear, there should be about one-quarter of the hole left to keep the pin in proper position to rest in. No screws are necessary. The pin should have a drive fit.

To set up for drilling and boring the holes for the rods, the best way is to screw the pins *A* on the gear and set the machine up according to the natural position the pin would take, as in Fig. 1 (screws not shown). No dividing head should be used. CHARLES EISLER.

Bloomfield, N. J.

Crowning a Wooden Pulley

The top of a drawing table frequently becomes rough with the innumerable holes made by thumb-tacks. These holes can very readily and satisfactorily be filled by sprinkling some fine sawdust over the top of the table, brushing it well into the holes and then applying shellac.

A wooden pulley, which did not have enough crown to hold the belt, was just a little too large to swing in the largest of the ordinary manufacturing lathes and have a crown turned on it. It was finally concluded to try building a crown on the pulley by the method just described. After shutting down one evening, a crown was built on the pulley with some sawdust and glue (instead of shellac, as in the other case) and allowed to stand overnight. The next morning the pulley was smoothed up with a piece of sandpaper, the belt put on and started up. This pulley was repaired over a year ago and is still in good running order.

Middletown, Ohio. W. E. SHARKEY.

Discussion of Previous Question

Machine-Shop Oil Cans

The article by A. D. Vance, on page 325, is of more than passing interest, because it shows clearly that finality has not yet been reached regarding rational design of machine-shop oil cans. As in many other matters, this condition is possibly due to lack of study and consideration on the part of manufacturers or in the blind following of precedent.

About two years ago I designed some spring-bottom oil cans for our machine shop. They differed somewhat from those referred to, although they were made with a view to achieving one of the same results—namely, to prevent the much too frequent annoyance due to the oil cans rolling off the machines, benches, etc.

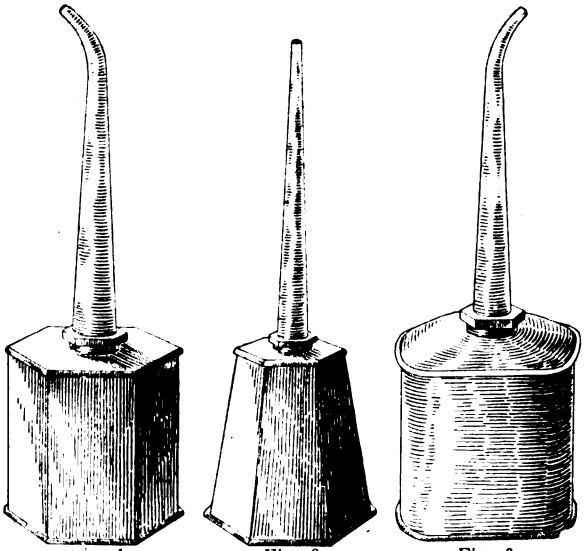


Fig. 1 Fig. 2 Fig. 3

MACHINE-SHOP OIL CANS

Every well-regulated machine shop should contain a supply of efficient oil cans; suitable places should also be provided in which to keep them when not actually in use. This enables the mechanic to put his hand on a can at once instead of roving around the shop, as is often the case. Figs. 1, 2 and 3 show spring-bottom oil cans that vary from the type usually made by oil-can manufacturers. These cans are easily made by hand with a few tools and at little cost of material. Should large quantities be required, seamless bodies could readily be produced in modern drawing and forming dies.

An oil can of hexagonal shape, with straight sides, is shown in Fig. 1. Fig. 2 represents a similar can with taper sides. This style is preferred by the machine men. The can illustrated in Fig. 3 is also very serviceable and can be made with taper sides if desired.

Rectangular or square-shaped oil-can bodies of suitable sizes, having square or round corners, will be found to have an advantage over the usual cylindrical form. The square bodies could be strengthened by corrugations if necessary. Thin hard-rolled sheet brass is a suitable material for the bottoms. The springiness, or diaphragm action, is readily obtained by careful hammering after the edge has been bent up to fit the body. The bottom should be struck about a dozen blows with a smooth-faced hammer on a bright anvil, just round the center, to cause a slight buckle. It is then soldered to the body, care being taken that the soldering iron is not too hot. The bottom must not be pressed until thoroughly cold.

Manchester, England. A. EYLES.

Wanted--Data on Cylinder and Piston Grinding

In reply to the inquiry on page 860 by A. D. Marcotte, regarding the grinding of cylinders, I submit my experience. Some years ago I was with one of the big motor companies and had a lot of trouble trying to get production on cylinders. We had two grinders which should have given an output of 35 to 40 cylinders per machine per day. We were getting only about 25 per day off both machines.

The trouble was that the cylinder nose was finished before boring, to fit a fixture for holding it on the boring machine, and the strains of the boring operation were such that the nose was out of alignment when the cylinder came to the grinder. It was impossible to grind without adjusting for every piece.

During the process of carrying the job through the different operations in the factory the back of the flange was faced off to make a smooth seat for the nuts holding the cylinder to the crank case, and 0.010 in. was left on the cylinder nose. The back of the flange was then turned off and the nose also finished in size. This was done on an expanding arbor in a lathe, which enabled us to reduce the grinding limit to 0.010 in. for the bore of the cylinder, thus doing away with the adjusting on the grinder and increasing our output up to 100 cylinders per day of 10 hr. JOSEPH A. DALTON.

Brooklyn, N. Y.

Take Warning!

With much interest I have watched the results of the warning given in these columns regarding the proposed change of our standards of measures to the metric system. Owing to the fact that my work requires very little use of the metric system, I have heretofore given it but scant attention. From those with whom I have discussed the question I have failed to learn any material advantage to be derived from the use of the metric system over the English standard.

There is nothing done in measuring or figuring measurements by the metric system that cannot be done just as well and sometimes better by the English standard. Expressing a measurement in metric units entails more work than giving it in English units.

To say a bar of metal is eleven millimeters in diameter takes longer than to say it is half-inch, quarter, three-quarters or inch, and one grasps more readily the meaning of the latter. Speaking in metric terms requires the expression of the "unit" (millimeter) to convey the meaning, whereas in the usual shop parlance of the English standard it is just sixty-two and a half (0.0625 in.), or one-sixteenth, one twenty-fifth (0.125 in.) or one-eighth, for measurements less than an inch.

Units of the English standard expressed in decimals automatically divide inches, feet, yards, etc., into tenths, hundredths, thousandths, etc., which gives the same method of computation as does the metric system.

The idea of changing an old, tried and adopted method for something "just as good" is very much like adopting the vertical system of writing in place of the Spencerian system. No doubt its sponsors thought it was the "upright" thing to do, but it eventually "fell down," and the prettier style exists to prove its worth.

In spite of the fact that the units comprising the English sysem are not tens and divisors of ten, it is a system that makes measurements easily computable. While some may have trouble in learning fractions, the decimal system as applied to the English standard gives a simple and easily learned method of computation. The 2-ft. carpenter's rule is a splendid example of a way to become familiar with fractions, and our dollar and cents coinage gives a clear understanding of decimals.

Rochester, Minn. GEORGE G. LITTLE.

Taper-Shank Drills

There appeared on page 554 an article regarding taper-shank drills, which ought not to go unchallenged. Mr. Spence says that the taper should change from No. 2 to No. 3 at ¾ in. diameter instead of $^{59}/_{64}$ in., and from No. 3 to No. 4 at 1 in. diameter instead of $1\,^{17}/_{64}$ in. I think this would be an expensive and unnecessary change. In each of these cases it would require about twice as much steel, with most of it simply turned to waste. The result would be that the cost of a drill would become more nearly prohibitive than ever, and I should say the difference is more than your correspondent has allowed for.

Regarding the necessity for a change owing to broken tangs, my experience has proved to me that it is very often improper use that causes a tang to twist or break. Badly worn sockets, whereby the tang takes all the strain instead of the shank taking its share by being a perfect fit, is a frequent cause. In proof of this I have seen a $\frac{11}{16}$-in. drill with a No. 3 shank, with the tang twisted badly, and yet I drilled through the work with a standard drill (No. 2 shank) simply by making a properly fitting socket. I have never yet seen anything to warrant a change from the Morse standard. A. P. MOORE.

Sheffield, England.

Standard Product Inspection

The article by J. A. DeTurk and S. H. Radabaugh, page 591, is full of interest to me and should be to all chief inspectors. Of course, we all know there are chief inspectors who have been "pitchforked" into their berths because of their mathematical training and others who have been "through the hoop" in the workshops. Of the two, give me the latter. He is the man who knows. The former is the man who first "assumes" and then deducts from his assumptions.

I quite agree with the authors of the article when they say that only limit gages should be used in the shops and not micrometers, which are so liable to wear and which always have the uncertain errors of judgment in "feel." Their last remarks are also true, that chief inspectors should be responsible to the general management and that a good inspector will "work with the production department, not against it; he must be a good mechanic, and must be decisive in character, even-tempered, firm, fair-minded and—a gentleman."

I have in mind a large ordnance firm in Great Britain where the chief inspectors of each department were controlled by that department chief, with the result that either the inspectors resigned or remained dissatisfied and consequently got a bad name all round. In one large concern manufacturing munitions, the chief tool inspector was, to my intimate knowledge, told by an imported refugee organizer from a large Continental electric firm to try out screw-machine form tools on parraffin wax. The result was that the chief inspector left, having no one to appeal to. The refugee organizer was not far behind him.

Yes! A chief inspector should be well paid, well selected and have the backing of the management. He should have access to all departments for consultation, have great determination, excellent logic and be prepared to stake his job on his decision. R. L. HASELGROVE.

Buckshire, England.

Grinding Die-Setting Pins

I notice with interest the answer from Mr. Remacle, on page 915, to my article on die-setting or guide pins. I must take issue with him, however, on the superiority of hardened and ground pins and bushings over the method that I am using. Mr. Remacle, I am sure, has not tried using unhardened, natural, surface drill rod running in cast iron, or he would not think that the more expensive way would give the best results.

As I said in the previous article, I have followed the one method for five years on several hundred dies, many of them serving hundreds of thousands of times. A large portion of my work was on 90-lb. tin plate 0.009 in. thick, where the punch and die have to fit as close as it is possible to make them. I used very little metal over 0.035 in. thick.

As I had uniformly good results, I cannot see how any other method can be any better. I do not remember a single instance where the pins wore enough to shear the punches, even on the thinnest metal. In a number of cases I used the same shoe, punch, holder and pins for a second die and punch after the first had been broken or worn out.

Of course, Mr. Remacle is right about the method of drilling and reaming, inasmuch as a good miller is certainly more accurate than a drilling machine. We had no miller, however, and succeeded in getting good results with the drill. It was not very old and had been well taken care of. We made many small dies, which could be separated without the aid of jacks, although we did not always do it, by any means. W. B. GREENLEAF.

Plymouth, Mich.

Editorials

Theory and the Engineer

Hardly a day passes in these busy times without the announcement of some new scientific principle that is to revolutionize some industry. It may be a new process for obtaining gasoline or even a substitute for this fuel; it may be a new mode of propelling submarines or a method for making aniline dies; it may be a machine tool or a shop process; but always there is a large proportion of the public and frequently not a few men of considerable scientific attainment who are ready to believe that the step is only a short one between the principle or invention and its successful industrial application.

We who spend much of our time describing the work of other men's hands and brains know what a long road there is between the laboratory and the workshop and how many are the obstructions in the way. It is the prime function, if not indeed the life work, of the engineer to remove these obstructions and to span the gulf that lies between what has been called "raw" science and industrial science. We look upon the present-day perfection of the electric motor, the loom and the printing press or even the simpler marvels of the dictaphone, the camera or the oil motor, but how few of us appreciate the enormous number of practical difficulties encountered or the prodigious amount of thought and work expended before the original principle could be converted into a practical remunerative enterprise.

Even after the original conception has graduated from the "raw" science stage and has been tested out under so-called commercial conditions, it is always exceedingly difficult for the combined efforts of inventor and engineer to find a financier with the courage to stand behind the venture and the patience to wait for a return that is hardly ever immediate.

Bacteria in Cutting Oils

Of late these questions have been frequently asked: What information have you in regard to the presence of dangerous bacteria in cutting oils? What do you know about the need and methods of oil sterilization? But few data have been published that might answer these queries, although observation in shops leads to the belief that infection frequently comes to screw-machine operators from the oils with which their hands are constantly covered and that careful shop management calls for the sterilization of all cutting oils. Some light is thrown on this matter by a few facts submitted by the Richardson-Phenix Co.

This firm has made examinations of many samples of cutting oils used in different machine shops, and it reports that bacteria are invariably found. Recently a sample was taken from a plant where the sanitary conditions are above the average, and submitted to careful study. The general results are these:

Before treatment the bacteria count was 24 per cubic centimeter of oil. After heating for 20 min. at a temperature of 80 deg. F. the bacteria count was 22 per cubic centimeter; heated for 20 min. at 100 deg. F. the count was 15; heated for 20 min. at 120 deg. F., the count was 8; heated for 20 min. at 140 deg. F., the count was 0.

In each case the counts were made after incubation for 48 hr. at 37 deg. C. (98 deg. F.). As there was no growth in the portion of oil heated at 140 deg. F., after incubating for 48 hr. at 37 deg. C., another portion of the oil was heated at 140 deg. F. for 20 min. and incubated for 24, 48, 72, 96 and 120 hr. At the end of every 24-hr. period of incubation the oil was examined for the growth of bacteria. At each of these examinations and at the expiration of the 120 hr. no growth had appeared.

In kind these bacteria are tuberculosis and ordinary dirt bacteria. The conclusion reached from the study mentioned is that heating oil to a temperature of 140 deg. F. for 20 min. is enough to kill most of the common bacterial growths. Experience has also shown that if the shop is in a thoroughly satisfactory sanitary state the sterilization of the oil is necessary only about once in two weeks. Of course, frequent examinations should be made to determine its conditions and sterilization performed when necessary.

At the same time it should be observed that the bacteria count in none of the cases cited is very high; in fact, compared with the bacteria present in ordinary drinking water, it is low. Yet the fact that dangerous bacteria may and do exist in cutting oils is sufficient warrant for shop managers to study their own factory conditions and determine for themselves whether or not they should provide means for cutting-oil sterilization.

The Business Man and the Technical Journal

Not long ago we heard a "captain of industry" and a scientist lamenting because the reading of technical periodicals has become so universal and complaining that it absorbs much of the time of the readers. Because of these two facts, they went on to say, the quiet and thorough study of well-written books has been forsaken, and readers nowadays get only a superficial and desultory knowledge of the things they study.

We think the conclusions are hardly sustained by the large array of facts relating to them. We doubt if good technical books ever found a more ready market than now. It would be well-nigh impossible to collect reliable statistics on the subject, but our impression is that through the universal diffusion of current technical literature and the knowledge of books conveyed and advertised by it the book trade has been rather helped than harmed. We do know that 133,000 copies of technical books written from material that originally appeared in the *American Machinist* have been sold. Very many technical books would never reach the world but for the introduction and commendation of the periodical.

Librarians are busier than they ever were; scholars are no less studious than formerly; science was never more active in its investigations; discovery was never pushed more efficiently and enthusiastically. Truly, the facts hardly sustain the conclusions of those who decry the technical periodical.

To the man absorbed in business and practical affairs who can spare more time than that demanded by his daily paper the technical journal brings every week or month the latest investigations and their application and enables him to keep pace with his contemporaries. If the work of the various active scientists of the day were embodied only in elaborate books, he would seldom see or read one of them. In the periodicals all the scientific men of the world meet. They learn there what each man is doing, while all the interested world studies them and keeps in touch with their work. Indeed, we do not know of any class of men who would be more affected by a suspension of periodical technical literature than those same business men and scientists who sometimes speak so harhly of it.

The First Years After College

About this time every year thousands of young men are leaving college to enter upon active life. They are ambitious, confident of their ability, hopeful; and yet in the great majority of cases the prospect is most perplexing, to say the least. They look along the avenue of prosperity and see all the posts occupied, the offices filled, the paths crowded, and they wonder where they can find room. If they will but gaze over the heads of the crowd, however, a little farther along the avenue they will see great open spaces where the occupants are never crowded. Messrs. Schwab, Corey and Frick are never troubled for space at their elbows. Professions are never crowded near the top. There is always room to spare where the experts are.

It is in the order and nature of things that the first few years of every man's business or professional life are years of education. It is these years that teach him what is in him, drill into him a patient and persistent habit of work and give him the strength to hold all the ground gained. Doors seldom open to the man who has not prepared himself to enter them. By the same token, when a man has thoroughly prepared himself for a higher place, the door to that place usually swings back of itself.

It is true that only a few can reach the top, but it is also true that the farther from the bottom the fewer the company. It is as if each calling were pyramidal in its human constituency; and while only one man is at the top, there are several tiers of men below him who have ample space. It is only at the base that men are so numerous that they crowd and jostle each other out of the fairway into the bypaths. If a man does not develop the ability to lift himself out of this crowd at the base, it seems reasonably certain that he is not adapted to his chosen calling.

It is in those first few years that young men know the only leisure they will ever know. They are golden years that should be filled with systematic reading, social intercourse and ceaseless observation. Afterward they will become absorbed in too many business and family cares to find time to pursue such habits, and when they look back at the lost years it will be too late.

The work of the world seeks the hands best fitted to do it, just as naturally as water runs down hill; and the question whether a man is to rise above the rabble at the base of the pyramid will be decided by the way he improves those first few years after college in acquiring the thorough knowledge of his profession always possessed by those at the top.

The Value of Praising

There seems to be an indefinable something about all engineering plants, particularly the metal-working shop, that after a while prevents those occupying supervising positions from praising where praise is due. Whether it is because the supervisor becomes more or less influenced by his constant association with so much mechanism that he unconsciously treats men as part of it or whether it is that the workmen seem for the most part lacking in those finer, more delicate sensibilities that appear to respond appreciably to an occasional word of praise is unimportant; but it is certain that even the occasional word is seldom spoken. Hereby a great mistake is being made.

Many shops are full of men unhappy in their work and producing but a fraction of their possible output for want of a little judicious praise. They have little faith in themselves and need assurance of their capabilities from others, especially their supervisors. It is a popular notion that much self-esteem is a common weakness and that men do not require others to comment favorably upon their efforts. We are confident, however, that a large part of what appears to be vanity or egotism is the very opposite. It is only an uneasy or frantic attempt to win from others an assurance of what one himself sorely doubts. How unfortunate then that supervisors in their various dealings with the men under them are so sparing of praise!

How often have some of the best workmen left a plant for a few cents more a day at some other shop, when a word or two of praise would have held them. It is true that praise is sometimes dangerous, but so is blame. So are firearms and locomotives and flywheels; so is everything useful. But would one banish sunshine because it sometimes causes forest fires? No doubt "it is poison to a human soul to breathe the incense of praise habitually," but praise and overpraise are two different things. The former, when justly bestowed, always stimulates.

The higher the class of labor the less grudging should we be with our praise. This is so because it has been truly said that sensitiveness to merited praise may be almost regarded as an exact measure of the delicacy of the civilization. The civilized nature is sensitive all over, and therefore the more highly developed the workman the better the result that may be expected from honest commendation.

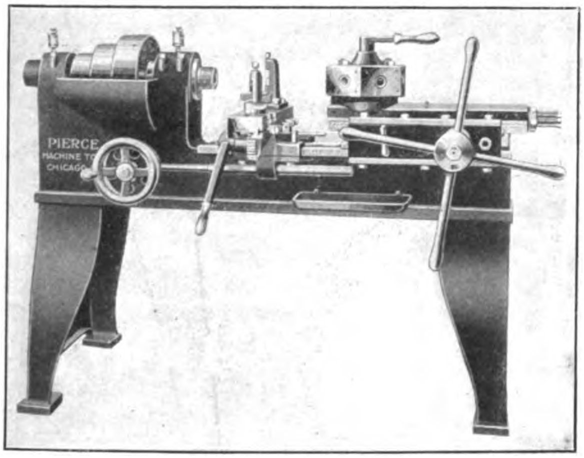
Like many other good things where a little goes a long way, that little must be of the purest kind and free and full. A French moralist has gone so far as to say that "it is a great sign of mediocrity always to praise moderately." We have heard from our childhood the expression "to damn with faint praise." Habitually to withhold commendation where it is deserved, to praise faintly where there is signal merit, to be always afraid of committing oneself and of being asked for a raise in wage argue a narrow head, to say the least.

Shop Equipment News

Hand Screw Machine

The illustration shows a 1-in. hand turret screw machine, with plain head, recently developed by the Pierce Machine Tool Co., Chicago, Ill. In both the design and construction the chief aim has been to provide a machine of sufficiently heavy proportions to insure rigidity in operation.

The headstock is of bowl-type construction, cast in one piece with the bed. The automatic chuck is forged solid on the end of the spindle with external thread. The small amount of overhang from the front spindle bearing is designed to abolish the tendency to vibrate. The machine is arranged so that the plain round solid collets can be used, or a master collet can be furnished adapted to hardened bushings.



HAND SCREW MACHINE

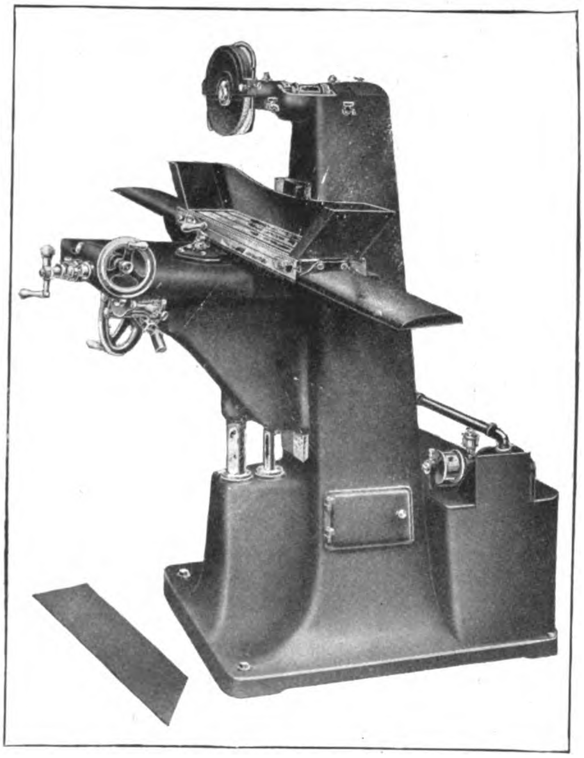
Capacity, automatic chuck, round, $1\frac{1}{16}$ in.; capacity, threaded work on soft steel, $\frac{5}{8}$ in. U.S.S.; capacity, pipe threads in brass up to $1\frac{1}{16}$ in.; capacity, drilling in soft steel, $\frac{3}{4}$ in.; hole in automatic chuck plunger, $1\frac{3}{32}$ in.; hole through spindle, $1\frac{5}{16}$ in.; length that can be turned, 8 in.; greatest distance, end of spindle to face of turret, saddle flush, $16\frac{1}{2}$ in.; diameter of turret across flats, hex. $7\frac{1}{2}$ in.; distance, center of turret holes to top of slide, $2\frac{3}{8}$ in.; travel of cutoff, longitudinal, $8\frac{1}{2}$ in.; width of driving belt, $2\frac{1}{2}$ in.; extension of bar feed rod, 3 ft. 4 in.; width of countershaft belt, 3 in.; cross face, 2 ft. 2 in. by 5 ft.; weight, 1,350 lb.

The cutoff rest has a good bearing on the bed, is provided with hand longitudinal screw-feed adjustment, arranged with micrometer dial and observation stops.

The turret, hexagonal in form, is fitted with six tool holes with binder bushings and also provided with bolt holes for securing the tools to the face of the turret, as well as counterbored to receive a boss on the back of the tool. The turret holes are arranged with holes through the turret stems, allowing the stock to pass through up to the full diameter of the hole. The locking bolt for the turret is fitted at the front end of the slide, directly under the cutting tool, and works in hardened and ground taper bushings let into the solid turret, as near the periphery as practicable. Independent adjustable stops for each position of the turret face operate automatically.

Wet or Dry Surface Grinder

A single-wheel machine on the same lines as the double grinder illustrated on page 617, has been brought out by the Grayson Tool and Manufacturing Co., Indianapolis, Ind. In fact, this machine may be considered as one-half of the Duplex machine there shown. It has the same spindle construction, similar feeding mechanism and the same size of table. It is equipped with a three-speed countershaft, so as to drive wheels from 2 to 8 in. in diameter at their proper cutting speed.



WET OR DRY SURFACE GRINDER
Table, $6\frac{7}{8}$x20 in.; cross-movement, 7 in.; travel, 20 in.; wheels, 2 to 8 in.

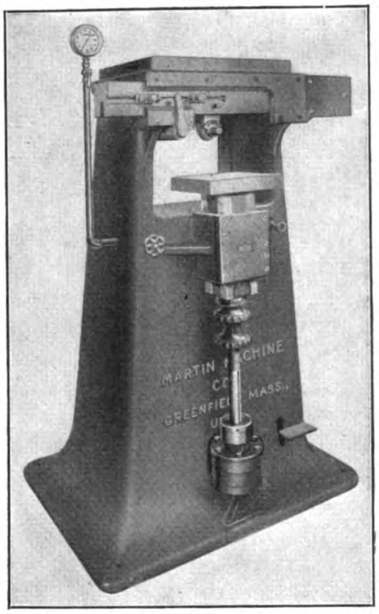
The guard for wet grinding is shown in place on the table, the front piece being on the floor by the base of the machine. This guard can be easily removed, when desired, for dry grinding.

Two of the new features are the inclosing of the vertical screw and the drive shaft in telescoping tubes to protect them from grit and dust, and the use of cushion springs in the table dogs for eliminating shock and noise during reversal. The sliding ways on the face of the column are cast in a chill to close the pores against the entrance of dust. Felt wipers, top and bottom, aid in keeping the wearing surfaces free from foreign particles of any kind.

Hydraulic Marking Machine

The marking machine shown was designed for marking round or flat surfaces and incorporates as a special feature hydraulic control.

The adjustment of the table is provided with a set of ball-bearing thrust collars which relieve the locknuts of the pressure, therefore allowing them to be free and easy to move by a slight turn of the hand. Both table and slide are provided with gibs. Regardless of what part of the table the work may be placed, the stroke of the slide may be varied by two adjustable stops and set to a position desired. The entire drive depends upon a small pulley at the rear attached to a pump driven by a $1\frac{1}{2}$-in. belt.



HYDRAULIC MARKING MACHINE
Travel of slide, 8 in.; adjustment of table, 6 in.; floor space required, 30x24 in.; weight of machine, 950 lb.

All adjustments of the machine are within easy reach of the operator when standing before the machine, where the work is plainly in view.

The working operations are placing the work to be marked in position and starting the machine by pressure on the foot treadle at the right, which opens a valve, allowing the pressure of the oil to raise the table. The die then traverses the work and at completion of the forward stroke the table drops, the work is released, the die returns to its first position and the machine stops, unless continuous operation is desired, which may be had by keeping the foot on the treadle.

An oil tank in the base supplies the oil to the hydraulic cylinders. The oil is pumped by a small rotary geared pump at the rear of the machine through a relief valve set to give any pressure desired, indicated on the gage at the left of the machine.

The oil, being held back under pressure, goes to the operating valve. In one position the oil passes through the pipes to the cylinders, raising the table to the working position and flowing through the hollow piston rod to the slide cylinder, which forces the slide on its outward stroke. The exhaust flowing back through the valve into the tank, until the operating valve is shifted automatically by the stop on the slide, reverses the flow of oil into the opposite ends of cylinders, forcing the table down and the slide back to the starting point.

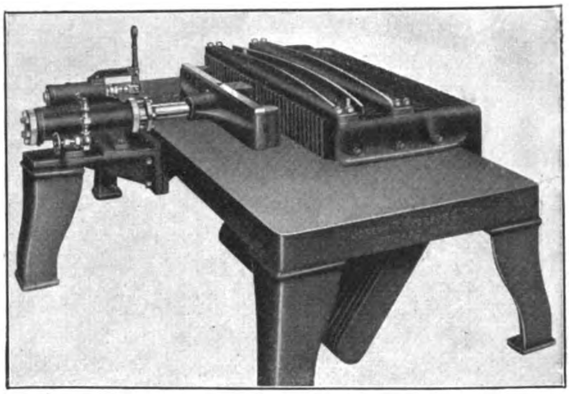
The speed by which the slide is traversed is governed by the supply valve at the left, which controls the amount of oil passing through the cylinder. Any speed between 0 and 225 ft. per min. with a pressure of 75 lb. may be obtained.

The type of machine shown represents a recent development of the Martin Machine Co., Greenfield, Mass.

Elliptic-Spring Former

The spring-forming machine shown was designed primarily for railroad-spring shop use. It will form elliptic-spring leaves of any size and curvature common in ordinary practice without changing dies.

The machine requires only one man for its operation, but may be used by two fitters working on different kinds of leaves at the same time. In the operation of the machine the hot spring leaf is formed next to the cold plate against which it fits in the spring, thus giving an accurate camber to the hot leaf. A second heat is not required for tempering, as the leaf is taken directly from the former to the oil bath.



UNIVERSAL ELLIPTIC-SPRING FORMER
Maximum stroke, 9 in.; table, 7x4¼ ft.; length of crosshead, 36 in.; height of dies or keys, 6 in.; floor space, 7½x6¾ ft.

The machine consists of a heavily designed horizontal table supported by five legs. The bank of keys which make up the female die is arranged at one end of this table, together with the male die, behind which is the pressure cylinder. The keys rest on edge, side by side, and are held in a forward position by a series of counterweight levers, which furnish the necessary pressure to set the hot plates. On the front end of the piston rod a crosshead is provided, which, coöperating with three blocks, act as a male die and offers the backing for the cold plate or templet.

The valve for controlling the movement of the plunger or piston is placed immediately on top of the piston when compressed-air operation is desired and immediately at the side of the piston, where operation is by hydraulic means. The cylinder itself is mounted on an extension of the table.

This machine is a recent addition to the line made by Joseph T. Ryerson & Son, Chicago, Ill.

Plain Cylindrical Grinder

The self-contained grinder shown in the illustration represents a recent product of the Perkins Grinder Co., Cleveland, Ohio. The control is designed to be centralized and automatic, and hand feeds are provided.

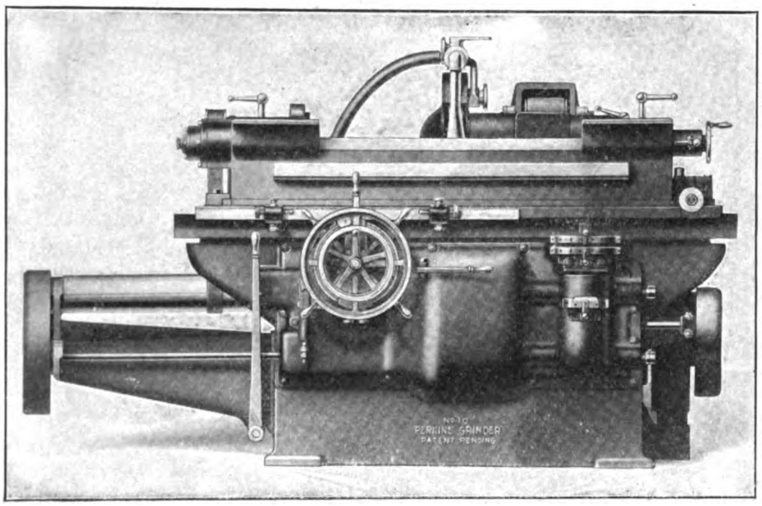
The main-drive shaft runs at a constant speed of 575 r.p.m. The power is applied from the lineshaft to a single-belt clutch pulley, or a motor may be connected direct to the main-drive shaft.

The control box is a separate unit. The work speeds and table feeds may be engaged or disengaged independently or simultaneously while the machine is running. The transmission and automatic table mechanism are two independent units, positioned in front of the machine and completely covered.

The transmission has 10 speeds for both work speed and table feed; no gears run over 80 r.p.m. All of the transmissions are always in mesh. The work speed, driven by a link belt, has 10 progressive speed changes—30, 60, 90, 120, 150, 180, 210, 240, 270, 300 r.p.m. The table traverse has 10 progressive speed changes—12, 24, 36, 48, 60, 72, 84, 96, 108, 120 in. per min.

The automatic crossfeed may be set to feed at either or both ends of the table traverse. A variable tarry device is arranged to tarry at each end of the stroke and can be regulated. The table traverse can also be stopped and started with the tarry lever.

For taper grinding, the table swivels and has two scales, graduated in degrees and thousandths of an inch. The work spindle is arranged for live and dead centers; the footstock spindle has a variable spring tension controlled by a handwheel and quick-acting lever. The backrest has both vertical and horizontal movement. Ball bearings are provided for the high speeds; the other bearings are lined with phosphor bronze. The ways and bearings are thoroughly protected.



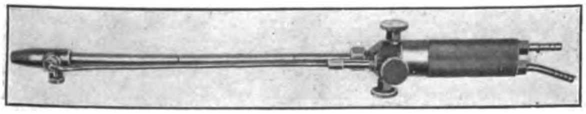
PLAIN SELF-CONTAINED CYLINDRICAL GRINDER

Maximum swing, 11 in.; maximum grinding length, 40 in.; diameter of grinding-wheel spindle, 3½ in.; width of grinding-wheel driving belt, 5 in.; diameter of grinding wheels, 18 in.; least reduction of automatic crossfeed, 0.0005; greatest reduction of automatic crossfeed, 0.005; diameter of driving clutch pulley, 12 in.; width of main-drive belt, 6 in.; power required, 15 hp.; net weight, 6,500 lb.

Welding and Cutting Torch

The form of torch shown was designed for a wide range of work and to be readily changed from welding to cutting.

The head is cast *en bloc,* to eliminate leakage. The cutting head can be adjusted to two different positions—a right-angled torch or a straight-ahead cutting torch—as shown.



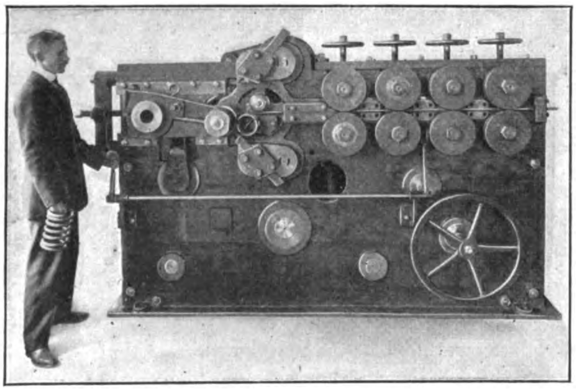
WELDING AND CUTTING TORCH

This torch is known as the "Hoover" and represents a recent product of the Oxy-Acetylene Products Co., Chicago, Ill.

Heavy Spring-Winding Machine

The illustration shows a spring-coiling machine built by Sleeper & Hartley, Inc., Worcester, Mass. It is adapted to make either extension or compression springs, and it is possible to feed 100 ft. into a single spring.

The spring is not produced by being coiled around an arbor, but by being fed forward by feed rolls against a coiling point or deflector, the machine putting a predetermined amount of wire into each spring. The machine is automatic, coiling and cutting alternately, the coiling mechanism being stopped while the spring is being cut off.



HEAVY SPRING-WINDING MACHINE

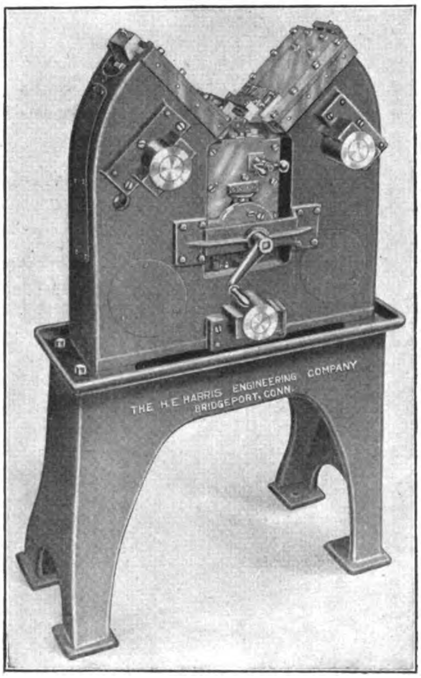
Capacity, ⅝-in. oil-tempered wire, cold; length of wire, 100 ft.; speed of wire feed, 50 ft. per min.; floor space, 6x8 ft.; weight, 16,000 lb.

The only function of the arbor is to provide a cutting edge against which the exterior cutter may carry the wire for the purpose of shearing it off after each coil.

In all these machines adjustments are provided for the feed or amount of wire which can be fed into any one spring; and of course the diameter and pitch, as well as the contour of the spring, may be changed instantly by means of adjustments provided.

Special Rifle-Sight Leaf-Notching Machine

The illustration shows a machine for notching simultaneously both edges of a Russian rifle sight. The machine has two diagonally disposed slides that carry 10 notching tools each. The slides are crank-actuated at an average speed of about 6 ft. per min. The tools



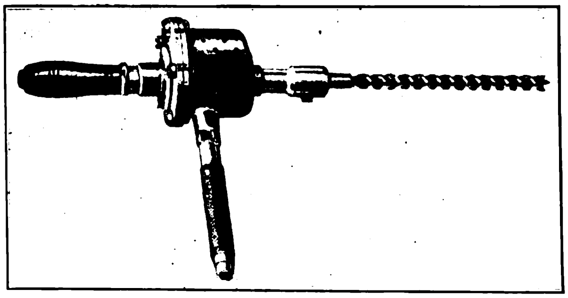
RIFLE-SIGHT LEAF-NOTCHING MACHINE

are held in accurately made tool holders. When individual tools become worn or break, they are replaced by others, as with the accurately shaped tools and tool holders the relationship between tools can be readily maintained without replacing the whole set-up.

This machine is built by the H. E. Harris Engineering Co., Bridgeport, Conn.

Pneumatic Wood-Boring Machine

This machine was originally designed for boring holes in railroad-car work, ship frames and wood-frame structures of all kinds. It weighs but 6 lb. and will

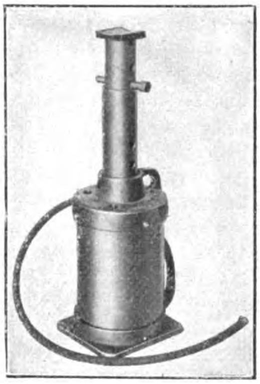


PNEUMATIC WOOD-BORING MACHINE

bore holes up to ¾ in. in diameter through oak or pine sills at the rate of 1 in. per sec., with 90 lb. air pressure, The bit runs at 2,200 r.p.m. It is not likely to get out of order, as there are only five principal parts in it, including the operating handle. It is made by the Baird Pneumatic Tool Co., Topeka, Kan.

Pneumatic Lifting Jack for General Service

This lifting jack may be used for raising an automobile or for various jobs around the shop. It may be operated by an ordinary automobile tire pump or from shop air connections. It has a minimum height of 10½ in. When the piston is extended, it reaches to a height of 16 in. A central telescoping piece can be raised two additional inches, making a total height of 18 in. when desired. The piston will stay in any position in which it is placed until the air is released; but for additional safety, holes are drilled crosswise through both the piston and the telescoping piece. The latter, of course, must be locked with a pin in any case when raised, but with the piston itself it is optional with the operator. The jack weighs 10½ lb. and is made by the Baird Pneumatic Tool Co., Topeka, Kan.



PNEUMATIC LIFTING JACK

European Women and Our Labor-Saving Machinery

A study of the economic and financial conditions immediately following the great wars of modern history—the Napoleonic wars, the Crimean, our Civil War, the Franco-Prussian, the Boer and the Russo-Japanese wars—in comparison with the vast struggle now raging in Europe has convinced a number of writers and speakers on business subjects that, far from being threatened with acute depression, Europe will be more likely to see, when peace is concluded, a period of commercial activity and prosperity. It is pretty generally agreed that, whatever the economic readjustment, there will be a much increased use and invention of labor-saving machinery all over the war-torn lands of Europe.

The substitution of the labor of women and girls for the more muscular toil of men on the older continent, we are told, will necessitate a great deal of labor-saving machinery. We Americans, by general admission, produce the best of such machines. Will the vastly increased employment of women in Europe have a deep and lasting effect on American business? This is but one of the searching questions put to us as far-sighted business men by the great war. It seems apparent that the readjustment that will take place in Europe will have a marked industrial influence in America.

Panama National Exposition

By Frank A. Stanley

SYNOPSIS—This exposition, opened at Panama City a short time ago, will retain two of its buildings—namely, those of Spain and Cuba—as permanent structures, and most of the exhibits in them will also be kept as of lasting interest. There is little shown in the way of machinery, but plenty of interesting objects reveal the natural resources of the republic. It is said that the United States Government exhibit is the greatest one ever shown abroad by this Government.

The national exposition that opened at Panama in February occupies a site above the beach along the Bay of Panama on the shore road to old Panama City. This exposition, which has as its Director General an American, James Zetek, of Chicago, was undertaken with the object of celebrating the opening of the Panama Canal and commemorating the discovery of the South Sea by the Spanish explorer Balboa. Its principal structures, seven in number, arranged in squares about a central plaza, are the Hall of Fine Arts, the Administration, Commerce, Agricultural and Horticultural Buildings, the Education Building and the permanent buildings of Spain and Cuba. The latter two after the expositon closes are to be utilized as the homes of the legations of the two countries mentioned. It is probable that most of the exhibits in them will remain as articles likely to be of lasting interest.

An interesting feature of this exposition is the fact that the exhibit of the United States Government is the most complete and comprehensive one that this Government has ever sent to a foreign country. The entire Government display was transferred bodily from the Panama-Pacific Exposition at San Francisco and, as most of our readers are aware, includes exhibits from every governmental department, the most noteworthy being those of the army and navy, the Geological Survey, the Bureau of Standards, the Panama Canal, Public Roads offices, Bureau of Mines, Bureau of Fisheries, Bureau of Education. Among the items that are most likely to attract attention are the army and navy collections, particularly the latter, in which models of all kinds of ships from the earliest times are shown, including the most primitive and the most uptodate warships, among them battleships, cruisers, destroyers, colliers, submarines, etc. Similarly the showing of the United States Army is of importance from a contemporary as well as a historical point of view, as it represents a complete record of arms from the old arquebus to the modern high-velocity military rifle and the rapid-fire gun.

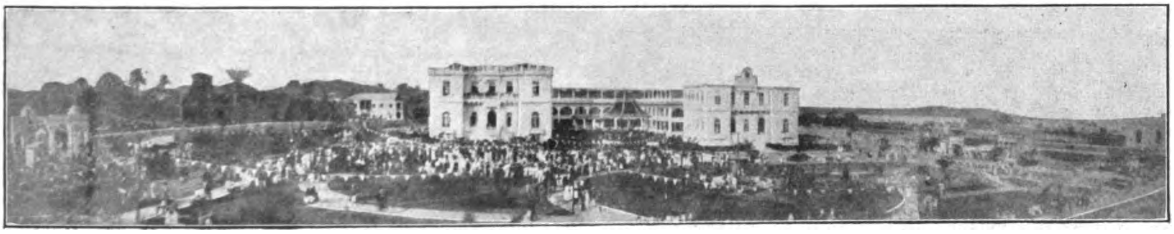


FIG. 1. PANORAMA OF PANAMA NATIONAL EXPOSITION

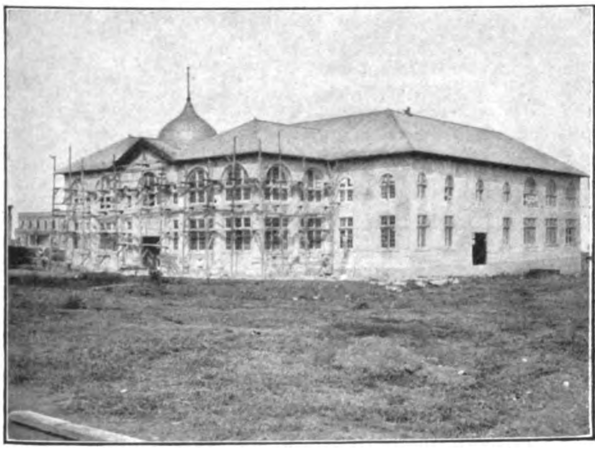


FIG. 2. EDUCATION BUILDING

FIG. 3. AGRICULTURAL BUILDING

An important characteristic of most expositions nowadays is the statistical chart, calling attention to various stages of progress in human activity. One in the Bureau of Education will probably be a surprise even to widely traveled Americans, who little realize the number of schools in this country. This summary points out that there are 20 great universities in the United States and about 800 of less importance; when it comes to the country—that is, the rural schools, say those having one teacher each—there are 212,000. Other exhibits of inter-

est in this connection come from the public schools of Denver, Chicago, Los Angeles and other widely separated cities of the United States, each showing something distinctive in character and well worked out in application.

While taken as a whole the exposition has comparatively little from the strictly engineering viewpoint; there are some things of immediate interest to readers of a mechanical turn of mind and quite a good many features worth while to visitors with a broad point of view.

In the panoramic view of the exposition grounds, Fig. 1, the Commerce Building will be seen in the foreground in the center of the picture, the Fine Arts Building at the right and the Panama Government Building at the left. The Education Building as it appeared shortly before completion is seen in Fig. 2 and the Agricultural Building in Fig. 3, these illustrations giving a good idea of the architecture of the principal structures.

Visitors to Panama for the first time undoubtedly have found the most important feature of the exposition to be the exhibits of the natural resources of that republic. Great pains have evidently been taken by the directors to gather as complete a line of natural objects as possible,

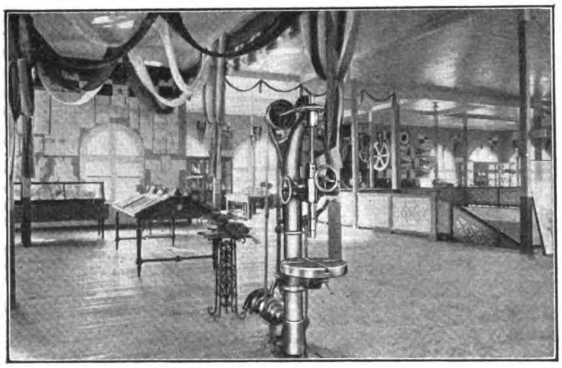


FIG. 4. DRILLING MACHINE AND TOOL MADE BY STUDENTS

and this is demonstrated by the hundreds of varieties of high-grade cabinet woods and timber woods exhibited. Travelers through Panama state that there are millions of acres of tropical forests densely grown with most valuable woods that yet remain practically virgin timber. The diversity of woods here is well suggested by the fact that among the samples shown are some that are lighter than cork and others heavier than water.

There is no great number of machine shops and foundries in the Republic of Panama; and as had been expected, the exhibits of mechanical objects are few and far between. There are, however, a few such appliances from local establishments and from schools for teaching trades, arts and crafts. Among these may be mentioned the exhibit of the Panama School of Arts and Crafts, which occupies a considerable area and shows most commendable work. Among the exhibits are a number of electrical supplies, such as wall lamps, heaters, etc., and a vertical drilling machine, illustrated in the foreground of Fig. 4, the background of the view representing a number of castings and forgings of various kinds produced at the school. These include metal-cutting machines, brass and copper tools, brazed shells, decorative objects and a variety of other articles. Also a good many examples of high-grade woodwork are exhibited and many mechanical and architectural drawings.

Naturally no exposition at Panama would be complete without a representation of the strides made in general sanitation and the elimination of diseases, such as yellow fever and the plague. It is possible here to follow the history of the yellow-fever mosquito, as the insect develops in a glass cage and remains under observation from the larva stage to the adult. Similarly a tank shows the process by which mosquitoes breed and the method of destroying the larva by pouring oil upon the water's surface.

It has been pointed out as a curious circumstance that a big panoramic relief map of the Panama Canal should be shown at this exposition. This map is about 50 ft. long and gives complete details and data for a clear comprehension of this undertaking. Doubtless many people have seen this who never have seen the original canal, although living fairly close by. Possibly some of these people know little of the canal itself, and they may perhaps never see it.

NEW PUBLICATIONS

THE CALLENDAR STEAM TABLES—By H. L. Callendar. Thirty-nine 5½x8½-in. pages; cloth bound. Published by Longmans, Green & Co., New York. Price, 80c.

This little book contains seven tables relating to the properties of saturated and superheated steam. In the pressure table volume and total heats are given for both Centigrade and Fahrenheit temperatures. The properties in terms of temperature are given in separate tables for values from 0 to 259 deg. C. The properties of superheated steam are similarly presented, total heat being given only in mean calories Centigrade, and volume and entropy in separate tables in terms of Centigrade degrees. The book will no doubt be useful to physicists and experimenters working with the metric system of units.

MODERN STARTING, LIGHTING AND IGNITION SYSTEMS—By Victor W. Page. Five hundred and nine 5½x8 in. pages; 295 illustrations. Published by the Norman W. Henley Publishing Co., New York City. Price, $1.50.

This book should help anyone interested in the subject to understand the important electrical features of automobiles. It is a concise and comprehensive treatise of the latest practice and is written in such a way that the reader need not be an electrical engineer in order to comprehend the text.

The book is copiously illustrated, so that the repairman can understand the construction of the systems. The following are the titles of the well written and illustrated chapters: Elementary Electricity; Battery and Coil Ignition Methods; Magneto Ignition Systems; Elementary Electric-Starter Principles; Typical Starting and Lighting Systems; Starting-System Faults and Their Systematic Location; Miscellaneous Electrical Devices.

Chapter V is of particular advantage, as every practical system is fully treated both by illustration and descriptive matter. In the following chapter the various troubles that may arise in the use of starting, lighting or ignition systems are mentioned, and the measures to be taken to remedy or avoid them are explained.

PRINCIPLES AND PRACTICE OF COST ACCOUNTING—By Frederick H. Baugh. One hundred and ninety-four 6x9-in. pages; indexed; cloth bound. F. H. Baugh, Baltimore, Md. Price, $3.

Reviewed by DEXTER S. KIMBALL*

This book, to use the words of the author, "has for its object a comprehensive and practical presentation of the general principles upon which cost accounting for manufactured articles is based, the application of these principles in a general manner to the most common types of manufacture and the illustration of the details." The table of contents is as follows: Chapter I, Synopsis of the Financial Accounting; Chapter II, Principles of Cost Accounting; Chapter III, Specific Job Cost; Chapter IV, Department Cost (Man-Hour); Chapter V, Departmental Cost (Machine- and Man-Hour); Chapter VI,

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Process Cost (Simple Type); Chapter VII, Process Cost (Complex Type); Chapter VIII, Illustration of Departmental Cost Accounts; Chapter IX, Illustration of Process Cost (Simple Type).

The book differs from many others on this subject in that it is written from the viewpoint of the accountant rather than from that of the factory cost-keeper. The treatment, therefore, gives a fairly full discussion of the relation between the general-accounts and the detail-cost ledgers; in fact, it is assumed that the cost accounts are an integral part of the general accounting system. The introduction and Chapter I are mainly discussions of the principles of cost finding as usually presented and include brief arguments regarding the place and value of such items as interest, taxes, rent, depreciation, etc., which go to make up the burden, or expense. The remaining chapters give examples of the several ways in which the costs of production are found and summarized. Thus, Chapter III treats of cost finding by the production-order method, under the name of specific job cost. Other chapters treat of departmental costs and process costs, each chapter giving complete instructions as to the methods to be pursued and the books and accounts that are necessary. The discussion is largely theoretical, very few forms being presented.

The book will be of most interest to general accountants and to cost accountants who wish to study the relation of cost accounts to the general accounts. The discussion in Chapter II on the fundamentals of cost finding, while sufficient for this book, is not comprehensive enough for a beginner who wishes to obtain a clear conception of the nature of expense and the logical methods of allocating it. The brief treatment accorded many other items in other chapters might be similarly criticized so far as beginners are concerned, this briefness being so marked as sometimes to make the text a little disjointed. This is of course not so serious a matter for an experienced man, and to those who know something of accounting and cost-finding methods the book will be of service. In some respects it is written along the line of probable progress. Cost-finding methods will in all probability become more and more a factor in general accounting as the importance of cost-finding is more fully appreciated.

PERSONALS

Thomas Grant, formerly superintendent of the Hall Button Co., Jersey City, N. J., has accepted the position of mechanical superintendent with the Morgan Manufacturing Co., Newport, R. I.

Raymond Henry, until recently superintendent of the Frost Gear and Forge Co., Jackson, Mich., has become assistant works manager of the Ingalls & Shephard Forging Co., Harvey, Ill.

Isaac H. Levin, for some time past chief engineer and chemist of the International Oxygen Co. has resigned to establish a consulting practice in chemical research in Newark, N. J.

F. R. Blair, formerly secretary, treasurer and sales manager of the S. K. F. Ball Bearing Co., has resigned to organize and become president of F. R. Blair & Co., Inc., 50 Church St., New York City.

W. Wetsel, for several years associated with the Baush Machine Tool Co., Springfield, Mass., in various executive capacities, has been placed in charge of the company's recently established Detroit branch in the Dime Bank Building.

BUSINESS ITEMS

The Boos Machine Co. announces its purchase of the St. Marys Machine Works, St. Marys, Ohio. Operation of the plant is under way in the manufacture of oil and gas engines.

The Service Supply and Equipment Co., Fulton Building, Pittsburgh, Penn., has been organized by D. A. Casey as a sales agency for machinery and supplies. Mr. Casey, who will be general manager, was for the past six years machinery salesman with the Westinghouse Electric and Manufacturing Co.

The Canton Foundry and Machine Co., Canton, Ohio, contemplates the erection of a number of new buildings, including a new and much larger foundry and an annex to the machine shop, in addition to a new shop now under construction for the manufacture of its portable cranes. The additional buildings are calculated to provide about a 75 per cent. increase in manufacturing facilities.

CATALOGS WANTED

Ferdinando Bigotti, Turin, Italy, would be glade to receive catalogs and other literature from manufacturers of machine tools.

The Sheffield Machine and Tool Co., 35 S. St. Clair St., Dayton, Ohio, would like to receive catalogs from manufacturers of equipment used in making dies, jigs, fixtures, etc.

The Everett Mfg. & Supply Co., 97 Tileston St., Everett, Mass., organized to manufacture and trade in metal parts and supplies of all kinds, would be glad to receive catalogs and price lists from manufacturers of machinery and metal goods.

TRADE CATALOGS

Beaver Easy-Working Die Stocks and Square-End Pipe Cutters. The Borden Co., Warren, Ohio. Booklet. Pp. 16. 3½x6 in.

Engine Lathes, Turret Lathes, Cutting-Off Machines, Shapers, Etc. Davis Machine Tool Co., Inc., Rochester, N. Y. Pp. 40. 8x11 in. Illustrated.

The Grayson Triplex. The Grayson Tool and Manufacturing Co., Indianapolis, Ind. Bulletin. Pp. 8. 8½x11 in.

This illustrates and describes the toolroom miller and shaper built by this company.

Fine Mechanical Tools. The L. S. Starrett Co., Athol, Mass. Catalog No. 21. Pp. 336. 5x7½ in.

This contains illustraions and descriptions of the extensive line of small tools made by this company and some recent additions to the line, a new price list is included.

Sprague Electric Works, 527-531 W. 34th St., New York. Bulletin No. 48907. 500-lb. electric hoists. Illustrated, 8 pp., 8x10½ in. Bulletin No. 49600. Flexible steel armored conductors, flexible steel conduit, stamped steel boxes, fittings and tools. Illustrated, 24 pp., 8x10½ in. Bulletin No. 48706. A. C. 2- and 3-phase motors and controllers for flat-bed and small rotary printing presses. Illustrated, 12 pp., 8x10½ in.

Grinding Wheels and Machinery. Norton Co., Worcester, Mass. Catalog. Pp 162. 6x9 in. Illustrated.

In addition to a comprehensive list of the proper grades and shapes of wheels for a wide variety of work and machines this catalog contains considerable engineering data on the subject of grinding, including a table for the selection of grades, methods of mounting wheels, and rules for calculating surface and pulley speeds.

FORTHCOMING MEETINGS

American Society for Testing Materials. Annual meeting June 27 to July 1, 1916, Hotel Traymore, Atlantic City, N. J. Edgar Warburg, secretary, University of Pennsylvania, Philadelphia, Penn.

American Foundrymen's Association and American Institute of Metals. Annual meeting, September 11-16, Cleveland, Ohio, A. O. Backert, secretary, American Foundrymen's Association, Cleveland, Ohio.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Wednesday each month. J. A. Brooks, secretary, Brown University, Providence, R. I.

New England Foundrymen's Association. Regular meeting second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. J. H. Warder, secretary, 1785 Monadnock Block, Chicago, Ill.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Technical League of America. Regular meeting second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York, N. Y.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	June 16, 1916	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$14.50	$15.00	$9.50
No. 2 X Northern Foundry, New York	19.75	20.50	14.00
No. 2 Northern Foundry, Chicago	19.00	19.00	13.00
Bessemer, Pittsburgh	21.95	21.95	14.70
Basic, Pittsburgh	18.95	18.95	13.65
No. 2 X, Philadelphia	20.00	20.50	14.25
No. 2, Valley	18.00	18.50	12.75
No. 2, Southern Cincinnati	17.40	17.90	12.40
Basic, Eastern Pennsylvania	19.75	20.50	13.50
Gray forge, Pittsburgh	18.70	18.70	13.35

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger and plates ¼ in. and heavier from jobbers' warehouse at the places named:

	New York June 16, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Steel angles, base	3.50	3.50	1.85	3.25	3.10
Steel T's, base	3.55	3.55	1.90	3.25	3.10
Machinery steel (bessemer)	3.50	3.25	1.80	3.25	3.10
Plates	4.00	4.25	...	3.65	3.50

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse at the places named:

	New York June 16, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
No. 28 black	3.65	3.65	2.60	3.20	3.20
No. 26 black	3.55	3.55	2.50	3.10	3.10
Nos. 22 and 24 black	3.50	3.50	2.45	3.05	3.05
Nos. 18 and 20 black	3.45	3.45	2.40	3.00	3.00
No. 16 blue annealed	4.45	4.70	2.35	3.70	3.60
No. 14 blue annealed	4.35	4.60	2.25	3.60	3.50
No. 12 blue annealed	4.30	4.55	2.20	3.50	3.45
No. 10 blue annealed	4.25	4.50	...	3.55	3.40
No. 28 galvanized	5.65	5.65	6.00	5.00	5.50
No. 26 galvanized	5.35	5.35	5.70	4.70	5.20
No. 24 galvanized	5.20	5.20	5.55	4.55	5.05

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot for carload lots f.o.b. mill:

	Black June 16, 1916	Black One Yr. Ago	Galvanized June 16, 1916	Galvanized One Yr. Ago
¾ to 2 in. steel butt welded	70%	81%	50½%	72½%
2½ to 6 in. steel lap welded	68%	80%	48½%	72½%
Diameter, In.				
¾	3.45	2.19	5.69	3.16
1	5.10	3.23	8.42	4.68
1¼	6.90	4.37	11.39	6.33
1½	8.25	5.23	13.61	10.18
2	11.10	7.03	18.32	10.18
2½	18.72	11.70	30.13	16.09
3	24.48	15.30	39.40	21.04
4	34.88	21.80	56.14	29.98
5	47.36	29.60	76.22	40.70
6	61.44	38.40	98.88	52.80

From New York stock the following discounts hold:

	Black	Galvanized
3½ to 6 in. steel lap welded	61%	36%
¾ to 3 in. steel butt welded	64%	42%

Malleable fittings, Class B and C, from New York stock sell at 30 and 5% from list price. Cast iron, standard sizes, 55%.

Bar Iron—Prices are as follows in cents per pound at the places named:

	June 16, 1916	Three Months Ago
Pittsburgh, mill	2.60	2.40
Warehouse, New York	3.25	2.90
Warehouse, Cleveland	3.25	2.95
Warehouse, Chicago	3.10	2.90

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-size lots, the following quotations hold:

	June 16, 1916	Three Months Ago
New York	List price plus 20%	List price
Cleveland	List price plus 20%	List price
Chicago	List price plus 10%	List price

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York Today	New York One Year Ago	Cleveland	Chicago
$6.00	$3.75@4.00	$6.30	$5.25

In coils an advance of 50c. is usually charged.

Drill Rod—Discounts from list price in New York are as follows: Standard, 65%; extra, 60%; special, 55%.

High Speed Tool Steel containing from 10 to 18% tungsten sells as follows per pound in New York:

Billets ....$2.40 Bars $3.25

METALS

Miscellaneous Metals—The present quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	New York June 16, 1916	One Month Ago	One Year Ago
Copper, electrolytic (carload lots)	28.50	30.50	20.50
Tin	42.00	49.50	41.50
Lead	7.00	7.50	6.25
Spelter	13.12½	16.37½	21.00
ST. LOUIS			
Lead	6.85	7.37½	....
Spelter	13.00	16.50	....

At the places named, the following prices in cents per pound prevail:

	New York June 16, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Copper sheets, base	37.50	37.50	28.50	37.50	37.50
Copper wire (carload lots)	37.50	37.50	26.75	33.00	38.00
Brass rods, base	44.50	45.50	26.62½	42.00	38.00
Brass pipe, base	46.50	46.00	23.50	45.00	46.00
Brass sheets	44.50	44.50	26.75	42.00	38.00
Solder ½ and ½ (case lots)	27.37½	30.50	29.50	30.50	28.00

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York June 16, 1916	New York One Year Ago	Cleveland June 16, 1916	Cleveland Three Months Ago
Copper, heavy and crucible	22.50	17.00	22.00	24.00
Copper, heavy and wire	22.00	....	21.50	23.00
Copper, light and bottoms	18.00	14.00	18.00	20.00
Lead, heavy	5.50	5.50	5.75	7.00
Lea, tea	5.00	5.50	4.25	5.25
Brass, heavy	12.75	8.50	13.00	19.00
Brass, light	10.00	10.00	10.50	12.00
No. 1 yellow rod brass turnings	14.00	....	12.00	14.50
Zinc	9.00	17.00	8.00	15.00

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	35.50	36.00	36.50	37.00	38.00
¼ to 5/16	35.25	35.75	36.25	36.75	37.75
⅜ to 1⅞	35.00	35.50	36.00	36.50	37.50
1 15/16 to 2⅞	35.75	36.25	36.75	37.25	38.25
Rounds					
3 to 3 7/16	36.50	37.00	37.50	38.00	39.00
Squares					
3	36.50	37.00	37.50	38.00	39.00
Rounds					
3½ to 3 15/16	36.25	36.75	37.25	37.75	38.75
Squares					
3 1/16 to 3 15/16	36.25	36.75	37.25	37.75	38.75
Rounds—Squares					
4 to 4 15/16	37.00	37.50	38.00	38.50	39.50
5 to 6 15/16	38.00	38.50	39.00	39.50	40.50
7	38.50	39.00	39.50	40.00	41.00
Flats	36.50	37.00	37.50	38.00	39.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.

Hexagon bars 2c. per lb. over corresponding size of round rods.

For cutting to any specified length not shorter than 1 ft. add 1c. per lb.

The scrap allowance is 18c. per lb. delivered at works.

Antimony—Chinese and Japanese brands are quoted in cents per pound for spot delivery, duty paid:

	June 16, 1916	Three Months Ago
New York	21.00	44.00
Chicago	25.00	44.75

Zinc Sheets—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 20.00

	In Casks June 16, 1916	In Casks Three Months Ago	Broken Lots June 16, 1916	Broken Lots Three Months Ago
New York	24.00	26.00	24.50	26.50
Cleveland	22.75	26.25	23.25	26.50
Chicago	25.00	30.00	25.50	34.00

Copper Bars from warehouse sell as follows in cents per pound:

	June 16, 1916	Three Months Ago
New York	43.00	39.50
Cleveland	40.25	....
Chicago	40.25	37.25

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places named:

	New York	Cleveland	Chica[go]
Best grade	60.00@65.00	51.25	60.00
Commercial	30.00@35.00	18.50	25.00@28.00

SHOP SUPPLIES

Nuts—From warehouses at the places named, on fair sized orders the following amount is deducted from list:

	New York June 16, 1916	New York Three Months Ago	Cleveland June 16, 1916	Cleveland Three Months Ago	Chicago June 16, 1916	Chicago Three Months Ago
Hot pressed square	$2.50	$3.00	$3.25	$3.70	$3.25	$4.00
Hot pressed hexagon	2.50	3.20	3.25	3.80	3.25	4.20
Hot pressed square	2.00	3.00	3.00	3.50	3.00	4.00
Cold punched square	2.00	3.00	3.00	3.50	3.00	4.00
Cold punched hexagon	2.50	3.75	3.25	4.25	3.50	5.25

Semifinished nuts sell at the following discounts from list price:

New York... 50-10% Cleveland.... 65% Chicago.... 65%

Carriage Bolts—From warehouses at the places named the following discounts from list price are in effect:

	New York	Cleveland	Chicago
⅜ by 6 in.	45—5%	50—10—5%	60—5%
Larger and longer	35%	40—15%	50%

At this rate the net prices are as follows:

Length, In.	New York ¼	New York ½	New York ¾	Cleveland ¼	Cleveland ½	Cleveland ¾	Chicago ¼	Chicago ½	Chicago ¾
1½	$0.53	...	...	$0.43	...	...	$0.38	...	...
2	.58	...	...	.48	...	...	.42	...	...
2½	.63	$2.12	$5.53	.51	$1.39	$3.63	.46	$1.63	$4.25
3	.68	2.30	5.85	.55	1.51	3.85	.50	1.77	4.50
3½	.73	2.48	6.18	.60	1.64	4.06	.54	1.91	4.75

Machine Bolts—From warehouses at the places named the following discounts hold:

	New York	Cleveland	Chicago
⅜ by 4 in. and smaller...	50%	60 and 10%	60 and 10%
Larger and longer up to 1 in. by 30 in.	40%	50 and 5%	50 and 10%

At this rate the net prices per 100 follow:

Length In.	New York ¼	New York ½	New York 1	Cleveland ¼	Cleveland ½	Cleveland 1	Chicago ¼	Chicago ⅝	Chicago 1
2	$0.83	$2.32	$9.60	$0.67	$1.46	$6.08	$0.64	$1.74	$7.20
2½ ...	.89	2.84	10.14	.70	1.57	6.32	.67	1.85	7.60
3	.97	2.63	10.68	.73	1.66	6.86	.70	1.97	8.00
3½	1.01	2.79	11.22	.77	1.77	7.48	.73	2.08	8.40

Wrought Washers—From warehouses at the places named the following amount is deducted from list price:

New York.... $4.00 Cleveland.... $6.00 Chicago.... $6.00

At this rate, the net prices follows:

Diameter, In.	New York	Cleveland	Chicago
3/16	$10.00	$8.00	$8.00
¼	8.20	6.20	6.20
5/16	7.40	5.40	5.40
⅜	6.50	4.50	4.50
7/16	5.80	3.80	3.80
½	5.40	3.40	3.40
9/16	5.30	3.30	3.30
⅝	5.20	3.20	3.20
¾	5.10	3.10	3.10
⅞, 1, 1⅛	5.00	3.00	3.00
1¼, 1⅜, 1½	5.20	3.20	3.20
1⅝, 1¾, 1⅞, 2	5.50	3.50	3.50
2¼, 2½	6.50	4.50	4.50

For cast-iron washers the base price per 100 lb. is as follows:

New York.... $2.50 Cleveland.... $2.00 Chicago.... $2.10

Rivets—The following quotations are allowed for fair sized orders from warehouse:

	New York	Cleveland	Chicago
Steel 7/16 and smaller	45%	45—10%	50%
Tinned	45%	45—10%	50%

Button heads ¾, ⅞, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.:

New York.... $5.25 Cleveland.... $3.85 Chicago.... $3.50

Cone heads, same sizes:

New York.... $5.35 Cleveland.... $3.95 Chicago.... $3.60

For the following sizes, the extras over the above prices in cents per 100 lb. are as follows:

1¼ to 1¾ in. long, all diameters	$0.25
⅝ in. diameter	0.15
½ in. diameter	0.50
1 in. long and shorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

Nails—Wire nails f.o.b. Pittsburgh sell at $2.50@2.60; galvanized 1 in. and longer, $4.50@4.60, and shorter, $5@5.10. These prices are to regular customers and delivery is made at the mill's convenience. From warehouse wire and cut nails sell as follows:

	Wire June 16, 1916	Wire Three Months Ago	Cut June 16, 1916	Cut Three Months Ago
New York	$3.15	$2.90	$3.15	$2.90
Cleveland	3.05	2.85	2.95	2.85
Chicago	2.85	2.60	2.85	2.60

Copper Rivets and Burs sell at the following rate from warehouse:

	Rivets June 16, 1916	Rivets Three Months Ago	Burs June 16, 1916
Cleveland.	List price	List price	List price
Chicago...	List price 10%	from list	List price
New York	10-2½% from list	25% from list	10-2½% from list

MISCELLANEOUS

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire

⅜, 11/32, 5/16, ¼, 7/32, 3/16	10.00
No. 8, 5/32 and No. 10	11.00
⅛	12.50
No. 12	13.50
3/32, No. 14 and 1/16	15.00
No. 18	16.50
No. 20	17.50

Special Welding Steel

⅛	33.00
5/32	30.00
3/16	28.00

Cast-Iron Welding Rods

¼ by 19 in. long	22.00
3/16 by 12 in. long	26.00
⅜ by 19 in. long	20.00
½ by 21 in. long	20.00

Vanadium Wire in Coils or Sticks

1/16	15.50
3/32	15.00
⅛	14.00
5/32	12.00
3/16 and larger	11.00

Tin Plates—The following prices are in effect from warehouses at the places named:

			New York June 16, 1916	New York One Month Ago	Cleveland June 16, 1916	Cleveland One Month Ago	Chicago June 16, 1916	Chicago One Month Ago
Coke tin plate, 14x20:								
100 lb.			$6.50	$5.00	$5.40	$4.87½	$5.60	$4.65
I. C. 107 lb.			6.65	5.15	5.55	5.05	5.75	4.80
Terne plate, 20x28:								
Base Wgt.	Net Wgt.	Coating						
100 lb.	200	8	$10.50	$9.00	$9.10	$8.60	$8.90	$8.30
I. C.	214	8	10.80	9.30	9.35	8.90	9.25	8.80
I. X.	270	8	12.80	11.30	11.60	11.10	11.50	13.10
I. C.	218	12	12.00	12.00	10.50	10.10	10.75	10.30
I. C.	221	15	13.00	13.00	10.50	10.90	11.60	11.25
I. C.	226	20	13.50	13.50	12.50	12.20	12.50	12.20
I. C.	231	25	14.25	14.25	13.50	13.40	13.75	15.30
I. C.	236	30	15.50	15.50	14.50	12.40	14.75	15.30
I. C.	241	35	17.00	17.00	15.75	15.60	15.85	16.00
I. C.	246	40	19.00	19.00	16.75	16.60	17.10	16.55

Seamless Drawn Tubing—The base price per pound from warehouse is as follows:

	New York	Cleveland	Chicago
Brass	43.50	46.00	43.00
Copper	48.00	48.00	45.00

For immediate stock shipment the following quotations prevail:

Diameter, In.	Copper New York June 16, 1916	Copper New York One Year Ago	Copper Cleveland	Copper Chicago	Brass New York June 16, 1916	Brass New York One Year Ago	Brass Cleveland	Brass Chicago
¾ to 2½	51.50	34.50	48.00	45.00	46.60	31.50	46.00	43.00
3	51.50	34.50	48.00	45.00	46.60	31.50	46.00	43.00
3½	52.50	35.50	48.00	46.00	47.50	32.50	46.60	44.00
4	53.50	38.50	51.00	49.00	50.50	35.50	49.00	47.00
4½	55.50	38.50	51.00	49.00	50.50	35.50	49.00	47.00
5	57.50	40.50	53.00	51.00	52.50	37.50	51.00	49.00
6	58.50	43.50	55.00	52.00	53.50	38.50	53.00	50.00
7	60.00	43.50	55.00	54.00	55.50	40.50	53.00	52.00
8	62.50	45.50	59.00	56.00	57.50	42.60	57.00	54.00

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	May 27	June 3	June 10	June 17
Prompt furnace	$2.25@2.40	$2.50@2.75	$2.50@2.75	$2.75
Prompt foundry	3.50@3.75	3.25@3.50	3.25@3.50	3.25@3.50

Cotton Waste—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	11.00@13.00	11.00@14.00	11.00@13.50
Colored mixed	8.00@10.00	7.50@11.00	8.00@10.50

Sal Soda sells as follows per 100 lb.:

New York	$2.05	Cleveland	$2.25
Philadelphia	1.80	Chicago	1.90

Roll Sulphur in 360-lb. bbl. sells as follows per 100 lb.

New York.... $2.75 Cleveland.... $2.75 Chicago.... $2.75

Foundry Clay in Cleveland sells at $3.25 per ton for carload lots.

Sponge Cloths (Wiping Towels) in New York sell as follows: 16x18 in., 35c.; 18x20 in., 40c.; 18x22 in., 43c. In Chicago prices are $24 to $28 per 1,000. In Cleveland, per 1,000, 13¼ x 13¼ sell at $29.50 and 13¼x20½ at $35.

Foundry Supplies—In New York, the following quotations prevail:

Foundry blacking	1½c. per lb.
Foundry flour (best grade)	$4.75 per bbl.
Foundry rosin	12c. per lb.
Core oil	40c. per gal.
Core wash	1½c. per lb.

Linseed Oil—These prices are per gallon:

	New York June 16, 1916	New York Three Months Ago	Cleveland June 16, 1916	Cleveland Three Months Ago	Chicago June 16, 1916	Chicago Three Months Ago
Raw in barrels	$0.69	$0.81	$0.73	$0.84	$0.72	$0.81
5-gal. cans...	.79	.91	.83	.94	.73	.86

Boiled, it is 1c. per gal. higher.

White and Red Lead, in cents per pound, sell as follows:

	Red Dry	Red In Oil	White Dry and In Oil
100-lb. keg	10.50	11.00	10.50
25- and 50-lb. kegs	10.75	11.25	10.75
12½-lb. keg	11.00	11.50	11.00
1- to 5-lb. cans	12.50	12.50	12.50

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

Corrigan Bros. plans to construct a machine shop at Millinocket, Maine.

Bids will soon be received by Bureau of Supplies and Accounts, Navy Dept., Washington, D. C., for furnishing and delivering under Schedule 9807 at Navy Yard, Portsmouth, N. H., one ½-in. sensitive drill, one 6-spindle drill press, 2 buffing lathes and one 21-in. upright drill press.

Plans are being prepared for the reconstruction of the plant of the Patch Manufacturing Co., manufacturer of shrapnel, at Rutland, Vt.

Plans are being prepared by E. C. and G. C. Gardner, 33 Lyman St., Boston, Mass., for the construction of a 1-story garage for A. A. Geisel, 293 Bridge St., Boston. Estimated cost, $20,000.

Bids will be received by Bureau of Supplies and Accounts, Navy Dept., Wishington, D. C., until June 27, for furnishing and delivering under Schedule 9788 at Navy Yard, Boston, Mass., one 2,000,000-lb. chain testing machine.

Bids will soon be received for the construction of an addition to the plant of Gilbert & Barker Co., manufacturer of plumbers supplies, at Springfield, Mass. Estimated cost, $300,000.

Plans are being prepared by Miner & Kalman, Arch., 43 Tremont St., Boston, Mass., for the construction of a garage at Waltham, Mass., for the West End Garage Co. Estimated cost, $30,000.

Bide are being received for the construction of a 1-story garage for David Shapiro, 122 Green St., Worcester, Mass. Estimated cost, $20,000. Noted June 1.

Bids will be received until June 27 by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for two ⅛- to 1⅛-in. full automatics, 1 portable floor crane and hoist, 2 sensitive assembly drills, 2 ball-bearing bench turret drills, one 20- to 23-in. sliding head drill, 2 turret drills with 10 spindles, 1 oil extractor, 1 hole chuck grinder, 1 universal cutter and tool grinder, 1 drill grinder, 1 tool grinder, eight 7-in. swing bench lathes, 18 engine lathes, 10 turret lathes, 1 machine for filing, sawing and lapping, 1 surface grinding machine, 1 polishing or buffing machine, 1 vertical riveting machine, 2 universal grinding machines, 14 milling machines, 6 polishing and finishing machines, two 2-spindle profiling machines, 8 screw machines, 2 horizontal tapping machines, 2 turret machines, 1 inclinable open back power press, 1 hand screw press, 7 sensitive drill presses, 6 straightening shaft presses, 1 double automatic saw sharpener and 1 semiautomatic screw slotter under Schedule 9740 for Newport, R. I.

The American Emery Wheel Works plan to construct a 3-story addition to its plant at Providence, R. I.

The Bead Chain Co. plans to construct a 2-story, 60x100-ft. factory at State and Mountain Grove St., Bridgeport, Conn.

The contract has been awarded for the construction of a plant on Barnum Ave., Bridgeport, Conn., for the Remington Arms-Union Metallic Cartridge Co. Noted Jan. 6.

The contract has been awarded for the construction of an addition to the plant of the Wallace Barnes Co., manufacturer of springs, at Bristol, Conn.

The Philbrick-Booth Foundry Co., 26 State St., Hartford, Conn., has awarded the contract for the construction of a foundry on Homestead Ave., Hartford.

Bids are being received for the construction of a 1-story, 98x170-ft. factory at Waterbury, Conn., for the Metal Specialty Co. Noted June 8.

MIDDLE ATLANTIC STATES

The Buffalo & Lake Erie Traction Co., Buffalo, N. Y., has awarded the contract for the construction of car shops at Lackawanna.

The Atlantic Smelting and Refining Co., 749 Hicks St., New York, N. Y. (Borough of Brooklyn) will build a 2-story addition to its plant. William J. Conway, 400 Union St., Brooklyn, is Arch.

The Chevrolet Motor Co., 816 11th Ave., New York, N. Y. (Borough of Manhattan), plans to construct a 6-story, 200x 200-ft. automobile factory.

Bids will soon be received by Bureau of Supplies and Accounts, Navy Dept., Washington, D. C., for furnishing and delivering at Navy Yard, New York, under Schedule 9779 forty eight ¼-in. portable electric drills and 12 electric bench grinders.

Bids will be received by Bureau of Supplies and Accounts, Navy Dept., Washington, D. C., until June 27, for furnishing and delivering under Schedule 9787, one pipe threading machine, at Navy Yard, New York, N. Y.

Plans are being prepared by M. L. Loney, Arch., 447 West 14th St., New York, N. Y. (Borough of Manhattan), for the construction of a 6-story factory for the American Can Co. at Brooklyn, N. Y.

The Ludlum Steel Co., Watervliet, N. Y., has awarded the contract for the construction of a 1-story rolling mill. Noted Mar. 16.

Plans are being considered by the Ulster Iron Works, Dover, N. J., for the construction of an addition to its plant. John Mulligan is Vice-Pres.

Burack Bros., New York, N. Y., manufacturer of jewelry plans to establish a manufacturing plant on Beecher St., Newark, N. J.

W. H. Connolly Co., Newark, N. J., will construct a commercial garage on 12th Ave.

The Foster Engineering Co., Newark, N. J., manufacturer of valve specialties, will construct 1-story addition to its plant on Monroe St.

The J. E. Mergott Co., Newark, N. J., manufacturer of pocket book frames, has awarded the contract for the construction of a 3-story addition to its plant. L. F. Mergott, 316 Jeliff Ave., is Pres.

Plans are being prepared by William F. Lehman, Arch., for the construction of a commercial garage on Mt. Pleasant Ave., Newark, N. J., for Clarence Miller.

The Paige-Detroit Motor Car Co., Newark, N. J., will establish a garage and service station on Halsey St.

Louis Sacks, Newark, N. J., operating a foundry on Hamburg Pl., has had plans prepared for a 1-story addition.

The Splitdorf Electric Co., Newark, N. J., manufacturer of auto ignition apparatus, plans to construct a 4-story concrete addition to its plant on High St.

The Simplex Automobile Co., New Brunswick, N. J., manufacturer of automobiles, is enlarging its plant.

W. R. Phillips & Son is constructing a plant for the manufacture of iron frames for conservatories at Stillwater near Newton, N. J.

The American Motor Co., Plainfield, N. J., has awarded the contract for the construction of a plant to cost, $100,000.

The United States Metals Refining Co., Rosevelt, N. J. (Eatontown post office), will enlarge its plant. Estimated cost, $500,000.

The Lebanon Valley Iron and Steel Co., Lebanon, Penn., plans to construct a new mill at its plant at Hebron, Penn. (Lebanon post office). Estimated cost, $50,000. J. C. Brown, Gen. Mgr.

Bids will be received until June 20 by Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for 3 pipe threading and cutting off machines under Schedule 9,750 for Philadelphia, Penn

The National Umbrella Frame Co., Philadelphia, Penn., will build an addition to its plant on 30th St.

The Shoop Bronze Co., Tarentum, Penn., will construct a plant for the manufacture of bronze goods. Estimated cost, $25,000.

Taylor & Wingert, manufacturer of metal stampings, plans to construct a plant at Hagerstown, Md., to cost, $100,000.

SOUTHERN STATES

Bids will soon be received by Bureau of Supplies and Accounts, Navy Dept., Washington, D. C., for furnishing and delivering at Navy Yard, Norfolk, Va., under Schedule 9,782, 16 valve reseating machines.

Bids will soon be received by Bureau of Supplies and Accounts, Navy Dept., Washington, D. C., for furnishing and delivering under Schedule 9,800 at Navy Yard, Charleston, S. C., 1 core drill and accessories.

Bids will soon be received by Bureau of Supplies and Accounts, Navy Dept., Washington, D. C., for furnishing and delivering under Schedule 9,801 at Navy Yard, Charleston, S. C., one 4-in. radial drilling machine.

MIDDLE WEST

The Akron Machine and Repair Factory, Akron, Ohio, plans to construct a factory at Barberton, Ohio.

The Bucyrus Steel Co., Bucyrus, Ohio, is enlarging its plant.

The contract has been awarded for the construction of a plant for the American Sheet and Tin Plate Co., Canton, Ohio, manufacturer of hardware.

The Triumph Manufacturing Co., Cincinnati, Ohio, manufacturer of mixing machinery, plans to remodel its plant.

The American Steel and Wire Co., Western Reserve Bldg., Cleveland, Ohio, manufacturer of machinery, etc., is having plans prepared for a 1-story, 100x125-ft. addition to its plant on Aetna Rd. Estimated cost, $32,000.

Plans are being prepared by W. J. Carter, Arch., 1423 Illuminating Bldg., Cleveland, Ohio, for the construction of a factory for the American Stove Co., Cleveland. Estimated cost, $25 000. D. E. Dangler, 5017 Perkins Ave. Noted Mar. 2.

The Cleveland City Forge and Iron Co., Cleveland, Ohio, plans to construct a 1-story addition to its plant. R. A. Herman, Lakeside Ave. and East 45th St., Pres.

The McLaren Iron Works Co., 1276 East 55th St., Cleveland, Ohio, plans to construct a new factory at Urbana Rd. and Nickel Plate R.R. Estimated cost, $15,000.

Preliminary plans prepared by Mead & Hamilton, Arch., 1002 Garfield Bldg., Cleveland, Ohio, for the construction of a garage for William H. Taylor Son & Co., 630 Euclid Ave.

The Ford Motor Co., Detroit, Mich., plans to construct an assembling plant at Columbus, Ohio.

The Ohio Malleable Iron Co., Columbus, Ohio, is building an addition to its plant. Estimated cost, $60,000.

Plans are being prepared for an addition to the plant of the Defiance Screw Machine Products Co., Defiance, Ohio, manufacturer of machinery, etc.

Renick & Rice, Findlay, Ohio, plans to construct a brick and concrete garage at 124 East Main Cross St. Estimated cost, $11,000.

The Fremont Stove Co. is constructing an addition to its plant at Fremont, Ohio.

The Wasser & Zimmer Job Machine Works, Marion, Ohio, plans to establish a machine repair shop on South Main St.

The Willys-Overland Co. contemplates constructing an assembling plant at Toledo, Ohio.

Bids are being received by the Packard Electric Co., Warren, Ohio, manufacturer of machinery, for the construction of a 3-story, 64x140-ft. factory. Estimated cost, $75,000. J. W. Packard is Pres. Noted June 15.

The Briar Hill Steel Co., Youngstown, Ohio, plans to construct a benzol plant.

The Youngstown Sheet and Tube Co., Youngstown, Ohio, contemplates an expenditure of $100,000 for improving its blast furnaces at Hubbard, Ohio.

The Dockray Brass and Iron Co., Zanesville, Ohio, has awarded the contract for the construction of a 2-story addition to its plant. Noted June 15.

A factory is being constructed in Else Gundo, Calif., by the Lambert Manufacturing Co., Anderson, Ind., to be used for the manufacture of tractors.

The Lavellet Foundry Co., Anderson, Ind., is constructing an addition to its plant.

The Indiana Brass Works has awarded the contract for the construction of a 43x105-ft. melting room at Frankfort, Ind., and is in the market for equipment.

The contract has been awarded for the construction of an addition to the plant of the Oakes Co., Roosevelt Ave. and Wheeler St., Indianapolis, Ind., manufacturer of steel parts for automobiles. Estimated cost, $25,000. Noted Feb. 24.

The Studebaker Corporation, Brush and Piquette St., Detroit, Mich., manufacturer of automobiles, plans to construct a plant at Lafayette, Ind.

The contract has been awarded for the construction of a 1-story, 50x200-ft. foundry for the Laporte Furnace and Foundry Co., Laporte, Ind. Estimated cost, $8,000.

The Studebaker Corporation, Brush and Piquette St., Detroit, Mich., manufacturer of automobiles, plans to construct a plant at South Bend, Ind.

The Detroit Stove Works, Detroit, Mich., has awarded the contract for the construction of a factory at 1320-80 East Jefferson St. Estimated cost, $25,000.

The Grant Iron and Metal Co. plans to construct a plant at Detroit, Mich.

The Motor Products Corporation, 762 Woodward Ave., Detroit, Mich., manufacturer of motor cycles, etc., plans to construct a plant.

The Standard Fuel Appliance Co., 1267 Beaufair Ave., Detroit, Mich., manufacturer of furnaces for treating, hardening and carbonizing steel, is enlarging its plant.

The Studebaker Corporation, Brush and Piquette St., Detroit, Mich., manufacturer of automobiles, plans to construct a plant at Muncie, Ind.

The plant of Johnson Bros. Boiler works, Grand Haven, Mich., recently destroyed by fire with a loss of $50,000, will be rebuilt.

The American Safety Lock Co. plans to construct a plant at Grand Rapids, Mich.

The contract has been awarded for the construction of a factory at Muskegon, Mich., for the L. O. Gordon Manufacturing Co., manufacturer of cam-shafts and other motor specialties. Estimated cost, $15,000. Noted May 25 and June 1.

The Illinois Specialty Manufacturing Co., Bloomington, Ill., recently incorporated, plan to establish a factory for the manufacture of a patented banana ripener. A. L. Frankeberger, Bloomington, is interested.

Joseph M. Fitzgerald, Daniel J. Cahill and Frank M. Flynn, Chicago, Ill., have purchased a site on Emerald Ave. on which they plan to construct a garage.

The contract has been awarded for the construction of a 7-story factory at Franklin and Superior St., Chicago, Ill., to be occupied by the Lawrence Manufacturing Co., manufacturer of machinery, etc. Estimated cost, $60,000.

The Sasgen Derrick Co., 3101 Grand Ave., Chicago, Ill., will build an addition to its machine shop. Estimated cost, $18,000.

The contract has been awarded for the construction of a garage for John K. Shortall, 1664 Prairie Ave., Chicago, Ill. Estimated cost, $15,000.

Plans are being prepared for additions to the plant of the American Carbon and Battery Co., Rock Rd., East St. Louis, Ill., manufacturer of electrical supplies.

The Joseph F. Wangler Boiler and Sheet Iron Works, St. Louis, Mo., plans to establish a factory at Litchfield, Ill.

The Illinois Steel Co., Chicago, Ill., will construct an addition to its plant at South Chicago. Estimated cost, $20,000.

Hugh Agner, of the Raymond C. Agner Co., Burlington, Wis., has purchased a site on Geneva St. on which he plans to construct a 2-story, 60x150-ft. garage.

Wallace Montague, La Crosse, Wis., plans to construct a 2-story garage to be leased by the Overland Motor Car Co. Estimated cost, $50,000.

The Wisconsin Welding and Cutting Co. is constructing an addition to its plant at 315 4th St., Milwaukee, Wis.

A. Pattison, Mondovi, Wis., plans to construct a 1-story, 40x132-ft. garage and repair shop.

Plans are being prepared by Sindahl & Matheson, Arch., Neenah, Wis., for the construction of a public garage for Julius Denhardt. Estimated cost, $10,000.

The contract has been awarded for the construction of a 1-story, 65x250-ft. factory for the Perfe Radiator Co., 15th St., Racine, Wis. Estimated cost, $12,000. Noted May 25.

The Milwaukee Stamping Co., 64th and Pullen Ave., West Allis, Wis., manufacturer of hardware specialties, plans to construct a 72x122-ft. addition to its plant. Estimated cost, $15,000.

WEST OF THE MISSISSIPPI

The contract has been awarded for the construction of a garage for Leonard Everitt, 810 2nd Ave., Council Bluffs, Iowa.

Bids have been received for the construction of a 1-story machine shop and garage at Davenport, Iowa, for the Lee Broom and Duster Co. Estimated cost, $10,000.

Plans are being prepared for the construction of a 2-story factory at Marshalltown, Iowa, for Fisher Governor Co., manufacturer of steam pumps and machinery.

The Western Crucible Steel Castings Co. plans to construct additions to its plant on 29th St. between Grand and Pleasant Ave., Minneapolis, Minn. Estimated cost, $50,000.

The contract has been awarded for the construction of a 2-story garage at 3814 Farnum St., Omaha, Neb., for Thorevald Bronderslav. Estimated cost, $30,000. Noted May 11.

The American Water Heater Co., recently incorporated, plans to equip a factory for the manufacture of water heaters at St. Louis, Mo.

The C. Heinz Stove Co. plans to install new equipment at its factory at St. Louis, Mo.

The Republic Motor Truck Co., recently incorporated, plans to equip a machine shop and garage at St. Louis, Mo.

Bids have been received for the construction of a plant at Valley Park, Mo., for the Barks & Barstow Manufacturing Co., manufacturer of steel roofing and specialties. Noted June 1.

The Texas Iron and Metal Co. plans to construct a foundry at Dallas, Tex. Estimated cost, $15,000.

H. W. Hartsaw and associates, Bristow, Okla., have organized a company to construct a factory at Bristow for the manufacture of a patented lightning arrester.

L. Conway has been granted a permit for the construction of a garage at 617 South Main St., Tulsa, Okla.

WESTERN STATES

The contract has been awarded for the construction of a 2-story reinforced-concrete garage at Seattle, Wash., for the Winton Motor Car Co. Estimated cost, $65,000. Noted June 15.

M. G. Thorsen plans to construct a 2-story garage at Washington and Lownsdale St., Portland, Ore. Estimated cost, $25,000.

Bids will be received until July 11 by Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for 1 set of large plate bending rolls under Schedule 9752 for Mare Island, Calif.

The Aluminum Products Co., La Grande, Ill., has awarded the contract for the construction of a factory at 2nd Ave. and East 11th St., Oakland, Calif. Noted May 25.

The contract has been awarded for the construction of a garage at Oakland, Calif., for A. Stark. Estimated cost, $20,000.

J. P. Gardner, 22 California Ave., Santa Monica, Calif., plans to construct a garage and machine shop on Ocean Ave., Santa Monica. Estimated cost, $10,000.

CANADA

Armstrong-Whitworth of Canada, Ltd., plans to construct an addition to its plant at Longueuil, Que., for the manufacture of steel tires for locomotives and passenger rolling stock. Estimated cost, $750,000. M. J. Butler is Mgr.

The Dominion Sheet Metal Co. is constructing additions to its plant on Burlington St., Hamilton, Ont. Noted May 11.

We have been advised that the Renfrew Electric Manufacturing Co., Ltd., Renfrew, Ont., is in the market for zoggle and drawing presses. Noted June 8.

Press reports state that the Canadian Sprayer Co. plans to construct a factory at Trenton, Ont., for the manufacture of sprayers and gasoline engines.

GENERAL MANUFACTURING

NEW ENGLAND STATES

The Magnet Knitting Mill has awarded the contract for the construction of a 2-story, 75x250-ft. addition to its mill at Clinton, Maine.

Burrill & Clark is constructing an addition to its weave shed at Corinna, Maine, and is in the market for machinery.

Plans are being prepared for the construction of an addition to the plant of the Home Scale Co. at Rutland, Vt.

Bids are being received for the construction of a 4-story, 65x322-ft. factory for the Boston Woven Hose and Rubber Co., Cambridge, Mass.

Fire, June 7, destroyed the plant of the Kress Carriage Co. at Lawrence, Mass.

Fire, June 11, damaged the paper plant of T. E. Chase & Son Co. on Howe St., Lowell, Mass. Loss, $8,000.

The Kinney Worsted Yarn Co., recently incorporated, plans to construct a factory at Pittsfield, Mass.

Plans are being prepared by Cutting, Carleton & Cutting, Arch., 44 Front St., Worcester, Mass., for the construction of a 4-story addition to the factory of the Graton & Knight Manufacturing Co., 344 Franklin St., Worcester, manufacturer of boots and shoes.

The International Braid Co. plans to construct a 4-story factory at its Elmwood mills at Daboll and Mawney St., Providence, R. I.

The contract has been awarded for the construction of a 4-story, 60x150-ft. mill at Norwich, Conn., for the Winchester Woolen Co. Estimated cost, $75,000. Noted June 8.

The contract has been awarded for the construction of a 83x163-ft. mill at Thomasville, Conn., for the Winchester Woolen Co. Estimated cost, $50,000. Noted Apr. 20 and May 18.

MIDDLE ATLANTIC STATES

The contract has been awarded for the construction of a 3-story factory for the Chautauqua Worsted Mills, Falconer, N. Y. Estimated cost, $45,000.

The contract has been awarded for the construction of a mill at West 2nd and Schuyler St., Oswego, N. Y., for the Hayes Knitting Co. Estimated cost, $50,000. Noted Feb. 17.

Bids are being received by the Utica Spinning Co., Utica, N. Y., for the construction of a 3-story, 50x100-ft. spinning mill. Estimated cost, $25,000. R. Hatfield, Whitesboro St., is Pres.

The Aronsohn Bloom Silk Mills, Bayonne, N. J., plans to construct a new addition to its plant at the foot of West 23rd St.

The B. F. Boyer Co., Camden, N. J., manufacturer of worsted yarns, will construct a new addition to its plant and improve and enlarge its present plant.

The Magnetic Pigment Co., manufacturer of coloring matter, Camden, N. J., will construct an addition to its plant.

Plans are being prepared for a 2-story addition to the plant of the Stumpf Leather Co., Harrison, N. J.

The American Hair Felt Co., Newark, N. J., has awarded the contract for the construction of a new plant on Lockwood St. Estimated cost, $50,000.

The Beckton Chemical Co., Newark, N. J., will construct a 1-story addition to its plant on Vanderpool St.

The Consolidated Color and Chemical Co., Brown St., Newark, N. J., will construct an addition to its plant to be used as a chemical laboratory.

E. Kaufman & Co., Newark, N. J., manufacturer of traveling bags, will construct a new factory on Murray St.

The Empire Rubber Co., Trenton, N. J., manufacturer of automobile tires and mechanical rubber goods, will build a 2-story addition to its plant on North Clinton Ave.

The American Bronze Powder Manufacturing Co., Verona, N. J., will build an addition to its plant on Grove St.

Plans are being prepared for a bleaching plant at Covington, Penn., for the West Virginia Pulp and Paper Co., 200 5th Ave., New York, N. Y.

The Rosell Silk Mill Co., Hazleton, Penn., will construct a large addition to its plant on McKinley Ave.

Fire recently damaged the factory of the William Wolstencroft Felt Manufacturing Co., Mulberry and Bridge St., Frankford, Philadelphia, Penn. Loss, $10,000.

J. D. Arthur and A. Donald, Philadelphia, Penn., have purchased a site at Monmouth, Janney and Weikel St. on which they plant to construct a factory for the manufacture of shoes.

SOUTHERN STATES

The Charles Boldt Glass Co., Huntington, W. Va., plans to construct an addition to its plant in West Hamilton. Estimated cost, $7,500.

The Reaugh Chemical Co., Wheeling, W. Va., recently incorporated with $250,000 capital stock, plans to equip a plant for the manufacture of chemical dyes.

The G. H. Y. Hosiery Co., Concord, N. C., recently incorporated with $100,000 capital stock, plans to construct a hosiery mill at Concord. A. J. York is interested.

The Magnet Knitting Mills, Clinton, Tenn., has awarded the contract for the construction of a 2-story factory. Estimated cost, $100,000. Noted Apr. 27.

The Tennessee Mills, Knoxville, Tenn., recently incorporated with $100,000 capital stock, plans to construct a factory for the manufacture of knit underwear. Estimated cost, $30,000. L. D. Tyson, Pres.

The contract has been awarded for the construction of a plant for the Buckeye Cotton Oil Co., Memphis, Tenn. Estimated cost, $100,000. Noted June 15.

MIDDLE WEST

The Punctureless Auto Tire Co., Akron, Ohio, plans to construct a factory at Barberton, Ohio.

The Federal Foundry Supply Co., 2639 East 79th St., Cleveland, Ohio, manufacturer of foundry flour, etc., plans to construct a 2-story addition to its plant. Estimated cost, $25,000.

The Fitzsimons Co., Youngstown, Ohio, manufacturer of shafting, plans to construct a factory on Wilson Ave. Estimated cost, $5,760.

The Armour Packing Co., Indianapolis, Ind., plans to remodel its plant at Ray and Cody Ave. Estimated cost, $20,000.

The contract has been awarded for the construction of a 1-story chemical building for the Eli Lilly Co., Indianapolis, Ind., manufacturer of chemicals. C. J. Lynn, 224 East McCarty St., Secy.

The Solvay Process Co., manufacturer of chemicals, Jefferson Ave., Detroit, Mich., plans to construct an addition to its plant. Estimated cost, $36,000.

Fire recently destroyed a portion of the plant of the Valley City Chair Co., Grand Rapids, Mich. Loss, $150,000.

Oliver M. Burton Co., 2024 South Racine Ave., Chicago, Ill., plans to construct a factory for the manufacture of cotton felt hats.

The Dixie Cotton Felt Mattress Co., 2024 South Ravine Ave., Chicago, Ill., plans to construct a factory.

The Great Western Smelting and Refining Co., Chicago, Ill., will construct a 1-story foundry at 600-28 41st St. Estimated cost, $50,000.

The Haysen Manufacturing Co., 13th St. and St. Clair Ave., Sheboygan, Wis., plans to construct a plant for the manufacture of breat wrappers.

We have been informed that the West Bend Woolen Mills, West Bend, Wis., will be in the market for looms, spindles and gages for the new additions which it plans to construct to its factory. Address John Geib, West Bend. Noted Mar. 23 and June 1.

WEST OF THE MISSISSIPPI

The Studebaker Automobile Corporation, Brush and Piquette St., Detroit, Mich., plans to construct a plant at St. Paul, Minn., for the manufacture of tires.

The Kaut-Reith Shoe Co. plans to construct an addition to its plant at Carthage, Mo.

The Allen Mop Co., recently incorporated, plans to equip a factory at Kansas City, Mo., for the manufacture of mops.

The National Security Envelope Co. plans to build factory at Kansas City.

Fire, June 1 destroyed the plant of the Seymour Compress and Ice Co. at Seymour, Tex. Loss, $60,000.

The Tulsa Packing Co. plans to construct a cold-storage plant at Tulsa, Okla. Estimated cost, $65,000.

The Peoples Gin Co. plans to construct a cotton gin at Bristol, Colo. Estimated cost, $8,000.

WESTERN STATES

The Altoona Packing Co. has purchased a site at Astoria, Ore., and plans to construct a cold storage plant.

The Portland Woolen Co. has been granted a permit for the construction of a 2-story addition to its factory at St. Johns, Ore. Estimated cost, $6,500.

The Fresno Fruit Growers plan to construct a packing house at Tulare and 2nd St., Fresno, Calif. Estimated cost, $4,000.

The Benchley Fruit Co. plans to rebuild its plant at Fullerton, Calif., which was recently destroyed by fire with a loss of $35,000. William Benchley is Mgr.

Gilbert F. Stevenson plans to construct a 100x100-ft. addition to its packing plant at Woodlake, Calif.

CANADA

The Royal Paper Box Co. plans to construct a factory at Brantford, Ont. Estimated cost, $12,000.

The Colonial Knitting Co. plans to construct a factory at Elmira, Ont., and install machinery. Estimated cost, $25,000.

The citizens of Simcoe, Ont., voted to loan the Unique Shoe Co. $20,000 for the construction of a factory.

Classified Advertising

The Classified Advertising section appears on pages 166, 167, 168, of this issue and will in future appear in the same relative position in the paper.

American Machinist

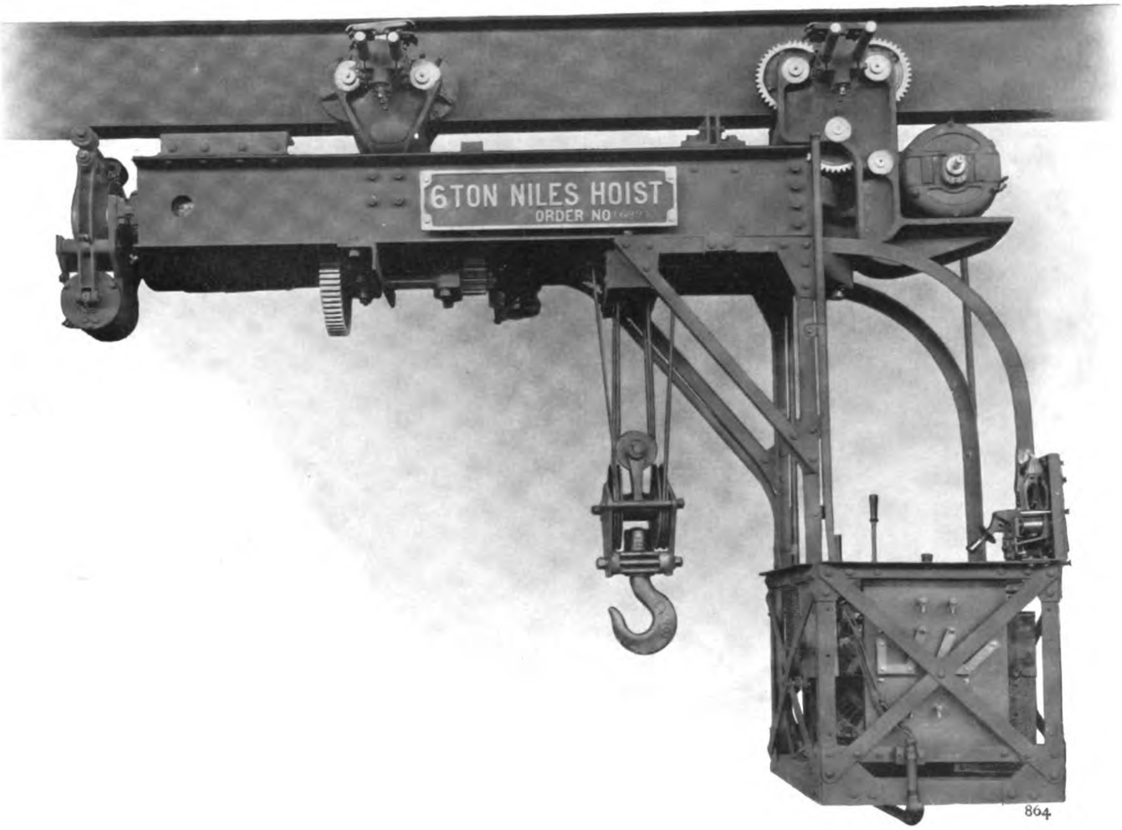
Volume 44, No. 26
Issued Every Thursday
Hill Publishing Company

NEW YORK, JUNE 29, 1916

Price, 15 Cents
Contents, First Page
Advertising Index, Last Page

Mono-Rail Trolley Hoist

Load carried from one point to any other by transfer bridge and I-beam tracks



THE single I-beam track on which the trolley runs can be arranged in an almost endless variety of ways; spur tracks can be run out at intervals over the gallery floor; a track may be curved around to run lengthwise of the gallery floor; tracks may be run off to the various buildings of an extensive plant; tracks may be run either across or lengthwise of railway sidings, for the unloading of cars. The cage for the operator is attached to the trolley so that he is always with the load.

Write for our 90-page Catalog "Niles Electric Traveling Cranes" showing various uses to which the above trolley is being applied.

Niles-Bement-Pond Co.,

111 Broadway, New York City
25 Victoria St., London, S. W.

SALES OFFICES AND AGENCIES—Boston: 93-95 Oliver St. **Philadelphia:** 405 N. 21st St. **Pittsburgh:** Frick Bldg. **Cleveland, O.:** The Niles Tool Works Co., 730 Superior Ave. **Hamilton, O.:** The Niles Tool Works Co. **Cincinnati:** The Niles Tool Works Co., 336 W. Fourth St. **Detroit:** Kerr Machinery Bldg. **Chicago:** W. Washington Blvd. and N. Jefferson St. **St. Louis:** 516 N. Third St. **Birmingham, Ala.:** 2015 First Ave. **San Francisco:** 16 to 18 Fremont St. **For Colorado, Utah, Yyoming and New Mexico:** Hendrie & Bolthoff Manufacturing & Supply Co., Denver. **For Seattle, Wash.:** Halladie Machinery Co. **For Canada:** The John Bertram & Sons Co., Ltd., Dundas, Montreal, Winnipeg, Vancouver. **Japan:** The F. W. Horne Co., 6 Takiyama-cho, Kyo-bashi-ku, Tokio. **Italy:** Ing. Ercole Vaghi, Milan. **France:** Glaenzer & Perreaud, 18 Faubourg du Temple, Paris. **Russia:** S. G. Martin & Co., Ltd., Petrograd and Moscow. **Holland:** R. S. Stokvis & Zonen, Ltd., Rotterdam. **Brazil:** Comptoir-Technique Bresilien, P. O. Box 802, Rio de Janeiro.

American Machinist

L. P. ALFORD, *Editor*

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VOLUME 44 — JUNE 29, 1916 — NUMBER 26

CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

The background perspective and flat-tone perspective illustrations in this issue are made by the Ormay processes, protected by United States patents issued June 22, 1915, and Apr. 18, 1916.

NUMBER OF COPIES PRINTED THIS ISSUE, 24,000

This includes the English Edition. None sent free regularly, no returns from news companies, no back numbers.

The United States Supreme Court Says

"An article alone is not necessarily the inducement and compensation for its purchase. It is in the use to which it may be put, the purpose it may serve and *there is deception and fraud when the article is not of the character or kind represented and hence does not serve the purpose.*"

SO RARELY does the Supreme Court of the United States deliver an opinion dealing directly with advertising ethics that there will be special interest in the decision handed down April 24, wherein the highest court in the land is placed on record as opposed to undue exaggeration in advertising. In view of current activities of the Post Office Department, the Federal Trade Commission, etc., this expression from the Supreme Court may be accounted particularly timely since it deals specifically with dishonest advertising.

In effect, the Supreme Court says that an advertiser is dishonest when he raises false expectations on the part of a customer. Mere exaggeration of the qualities possessed by an article might be condoned, although the court does not expressly say so, but when an advertiser goes farther and invents advantages for his article or assigns to it virtues it does not possess he is distinctly beyond the pale.

Only Reliable Products can be continuously advertised

Special Shop Methods Used in Making Multigraphs

By Fred H. Colvin

SYNOPSIS—The making of the Multigraph involves the use of special milling and drilling methods. A rotary staking device is of interest. Machines are made as convenient as possible. Special testing fixtures of somewhat unusual design suggest applications of similar fixtures to other classes of work.

The making by the American Multigraph Co., Cleveland, Ohio, of the Gammeter Multigraph, that form of condensed printing office for all sorts of commercial letters and similar work, involves the use of many interesting fixtures and methods.

The type segment, which forms half of the printing cylinder, is made from an aluminum casting well braced on the interior, as can be seen in Fig. 1. Here, two of these segments are held together in a fixture, being first surfaced on the flat sides and then clamped into a complete cylinder by means of the ears *AA*.

The fixture locates them in line with the spindles of the two heads mounted on the one lathe, and in this position the end is bored out to receive the end plate of the printing cylinder. The boring tools are carried on the spindle nose, and the lathe carriage is moved first in one direction and then the other. The stops *B* locate the depth of the counterbore at each end. The segments then have the ears cut off and go next to a gear cutter, which cuts the slots for the steel rails that are afterward inserted. The gear cutter also surfaces the outside of the segment, saving the operation of turning. One of the holding mandrels is shown at *C*, Fig. 1.

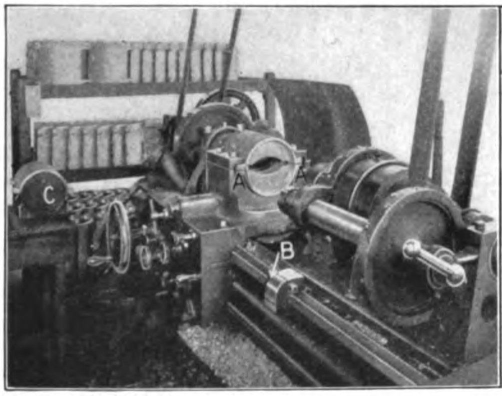

FIG. 1. BORING ENDS OF TYPE SEGMENTS

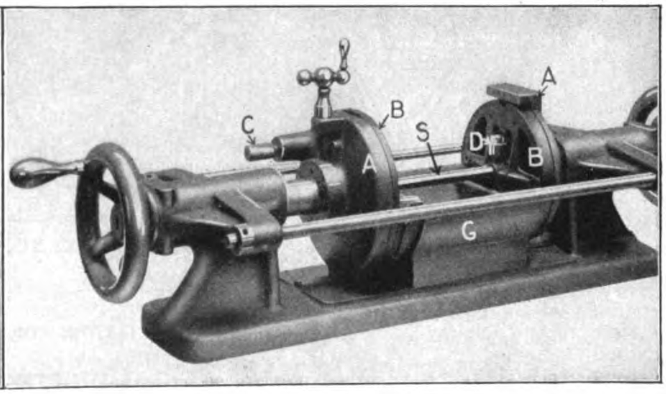

FIG. 2. FIXTURE FOR ASSEMBLING HEADS AND SEGMENTS

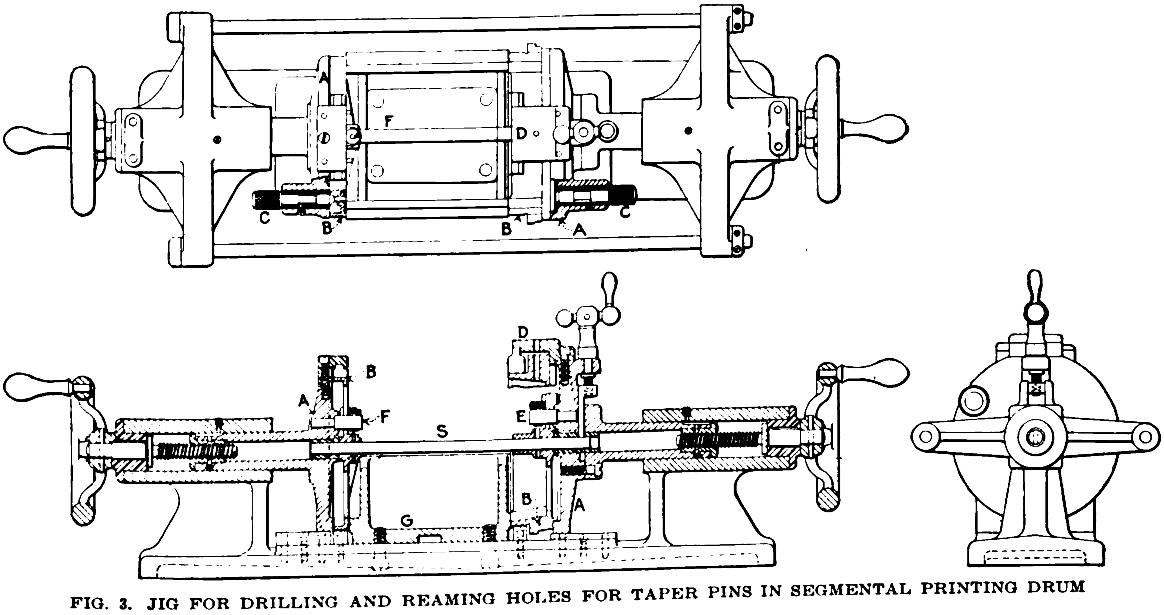

FIG. 3. JIG FOR DRILLING AND REAMING HOLES FOR TAPER PINS IN SEGMENTAL PRINTING DRUM

After the slots are milled, the I-shaped steel rails are put into place and the segments placed in a special fixture mounted on a shaper, as shown in Fig. 5. The ram carries a roll that might be called a rotary staking tool, shown at *A*. It is toothed in the center portion, which runs between the rails and forces the metal down around the lower head of the I-shaped section. The roll is grooved each side of the toothed portion, so as to hold the rails in position and assist in the staking operation.

The indexing arrangement is operated by the stop *B*, the lever *C*, which indexes the drum *E* by means of the latch *D*, operating the double pawls shown below. This operates very satisfactorily, both as to accuracy and rapidity.

Fig. 2 shows the way in which the segments are fitted to the heads of the printing cylinder. The end plates *A* force the two heads *B* into proper relation, the indexing pin *C* holding against rotation, while the locating hole is drilled through the bushing *D*.

The details of this drilling and reaming fixture are shown in Fig. 3, parts being lettered to correspond with Fig. 2. This shows very clearly how the heads *BD* of the printing drum fit into proper position on the shaft *F*. The heads are pressed in until they touch the central stop *G*. Then the holes are drilled and reamed, the jig plate *D* guiding the drill for the outer hole and the bushing *E* for the hole through the shaft. The bushing *F* performs a similar duty at the other end. Index pins *C* locate the heads with relation to each other, so as to be in line when pinned to the shaft.

Another interesting fixture—for milling the center plates—is shown in Fig. 4. The plate *A* is centered over the stud *B* and is held in position by the spider *C*, which carries four hardened-steel points. The spider is also centered on the stud *D* and is fastened by means of the hinged open washer *D* in connection with the setscrew shown. The center plate is indexed in its different positions by the ring pin *E*, located in the hardened bushing *F*. The side location of the plate to be milled is controlled by the screw *H* and the adjustable screw *G*.

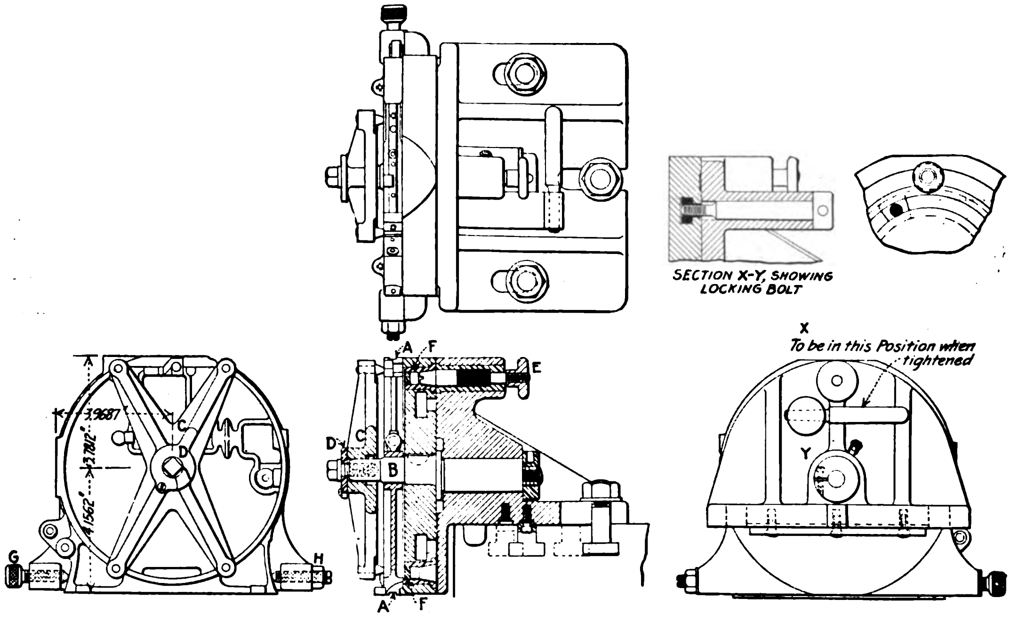

FIG. 4. MILLING FIXTURE FOR CENTER PLATES

Another feature of the Multigraph is the movable cam bands, which act in a similar manner to the throw-off on a rotary printing press. These bands are cut from Shelby steel tubes, as in Fig. 6, a special mandrel being used for this purpose, after the rings have been bored to insure the correct internal diameter. They are cut off by the special tool shown, in a standard engine lathe that is kept for this particular work. It will be noticed that

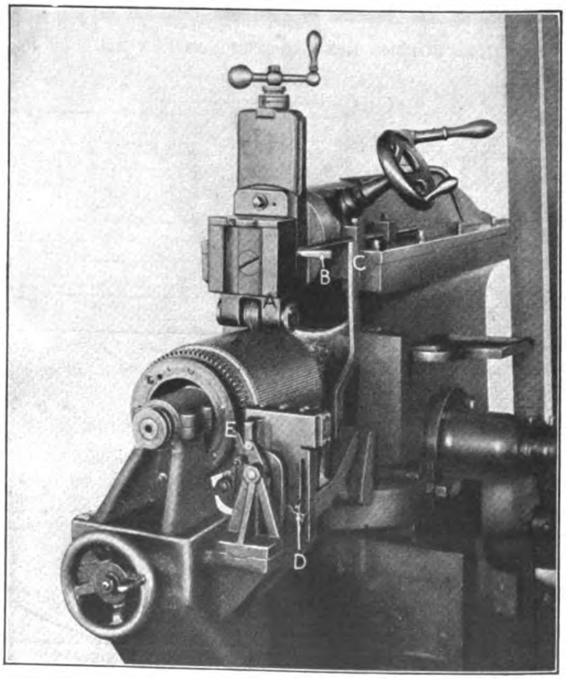

FIG. 5. ROLLING IN THE TYPE RAILS

a hole is drilled at one end of the blank, as at *A*, for driving during the turning and cutting operations. This takes the driving stress off the mandrel and avoids the necessity of gripping the tube, with the danger of springing it.

Cams are milled on this ring by special fixtures, after which it is graduated, as shown in the foreground of Fig. 7. These graduations are made in a punch press with the dies shown. The cam ring fits inside the lower

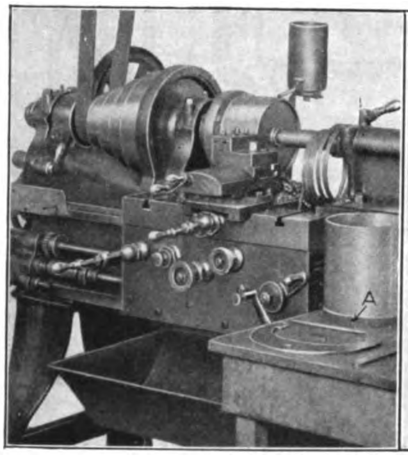

FIG. 6. CUTTING OFF CAM BANDS

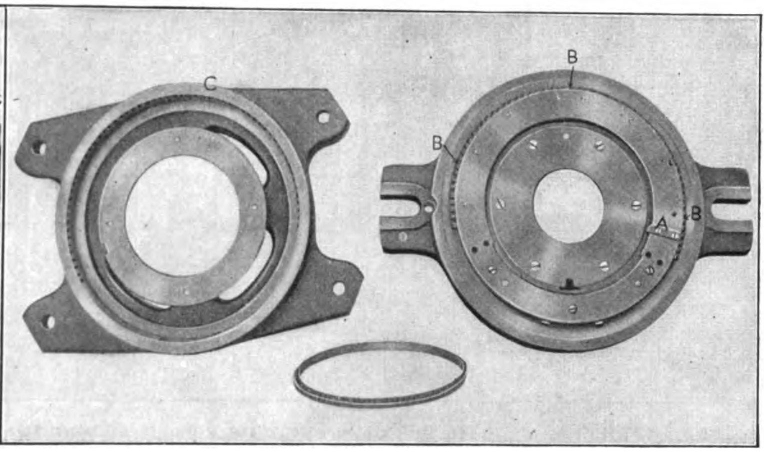

FIG. 7. RADIAL GRADUATING FIXTURE

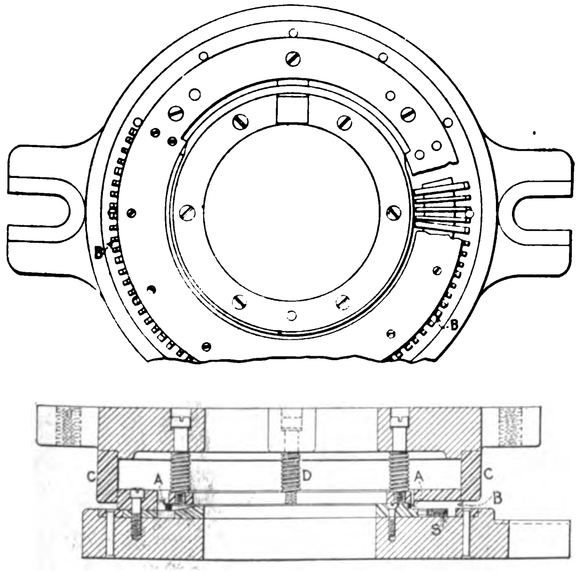

FIG. 8. DETAILS OF GRADUATING DEVICE

die at the right, being located by the finger *A*. The punches, about 60 in number, are shown radially around the die, as at *B*. The left-hand portion bolts to the ram of the press, the outer ring *C* being beveled on the inside to match the outer end of the punches *B*. When the ram descends, this beveled surface comes in contact with the outer end of the punches and forces them all in radially, each punch making its graduation at the proper position on the ring. This method of graduating makes it easy to renew one or more punches independently of all the rest and can probably be adapted for other uses without difficulty.

Details of this graduating device can be seen in Fig. 8, the lower view showing the two parts assembled and ready for operation. This shows the beveled ring *C* ready to force one of the punches *B* into contact with the ring *A*, which is held down in position by the springs *D*. Each punch has a downward projection that acts against the spring *S* and is returned by it as the ring rises.

Fitting the drilling machines to accommodate the work they are to do is not usually performed in the manner shown in Figs. 9 and 10. Here a single- and a double-spindle drilling machine are grouped together and supplied with a common table so as to afford a level platform for moving the drilling fixtures from one to the other. The machine at the left has been raised by the filling block *A*, so that the distance between the spindle and the table has been greatly increased over its original capacity. The first spindle of the next machine has been raised by the block *B*, the third spindle remaining in its original position.

The object of doing this will be clearly seen by a little study of Figs. 9 and 10, which show the great convenience of being able to turn the drilling fixture in any desired position and to have a spindle to accommodate the varying heights, as shown. Fig. 10 illustrates the fixture on end and also the methods of quickly changing tools for the various operations. It will be noticed here that the second spindle is equipped with a tapping chuck and also that the two machines are connected by the shaft *D*.

Three interesting testing fixtures are illustrated in Figs. 11, 12 and 13. The first is to indicate the squareness or levelness of the long base plate, the method of handling this being clearly shown and requiring no particular explanation. The four feet at the corners rest on the lower part of the testing fixtures, while the arms at each end carry indicating buttons to test the upper surfaces.

The fixture seen in Fig. 12 is somewhat unusual. It tests the end casting shown at the right, the center hole slipping over the plug *A* and a turned surface on the inside resting on the three raised points *B*, while the studs *C* form a gage for the lower edge of the casting, to insure its being in the correct position for gaging.

Plungers *D* and *E* actuate the multiplying levers *F* and *G* and so indicate very minute variations in the

squareness of the surfaces being tested. This is a particularly sensitive instrument and one which has been found very useful in this general class of work. by the finger *A* acting on the multiplying lever, the point of which may be seen at *B*. A slight variation shows very plainly with the larger graduations at the top.

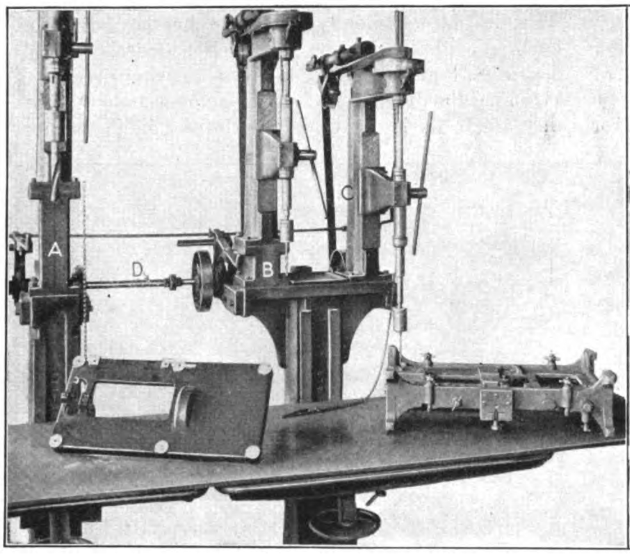

FIG. 9. DRILLING MACHINE SPINDLES BUILT UP FOR DIFFERENT HEIGHTS OF WORK

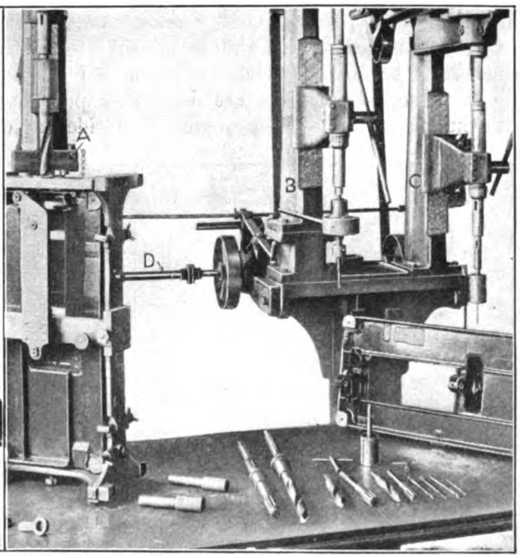

FIG. 10. USING THE DIFFERENT SPINDLES AND TOOLS FOR VARIOUS OPERATIONS

It is important that the end of the drum carrying the type segment be perfectly square with the shaft on which it revolves. In order to be sure that this is the case, the device illustrated in Fig. 13 has been constructed to test this part of the machine. The drum with the two heads in place is mounted vertically between centers, as shown, and the truth of the inside surface of the head is measured

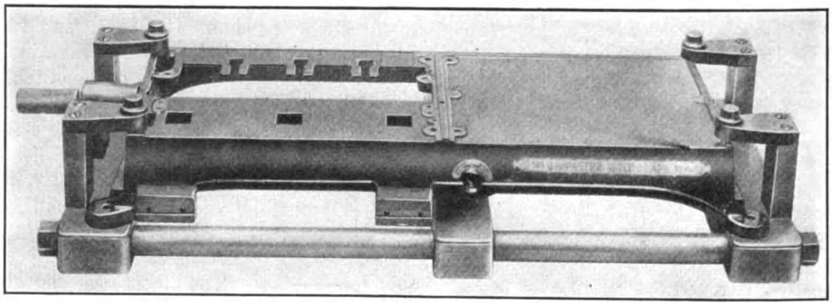

FIG. 11. TESTING SQUARENESS OF LONG BASE PLATE

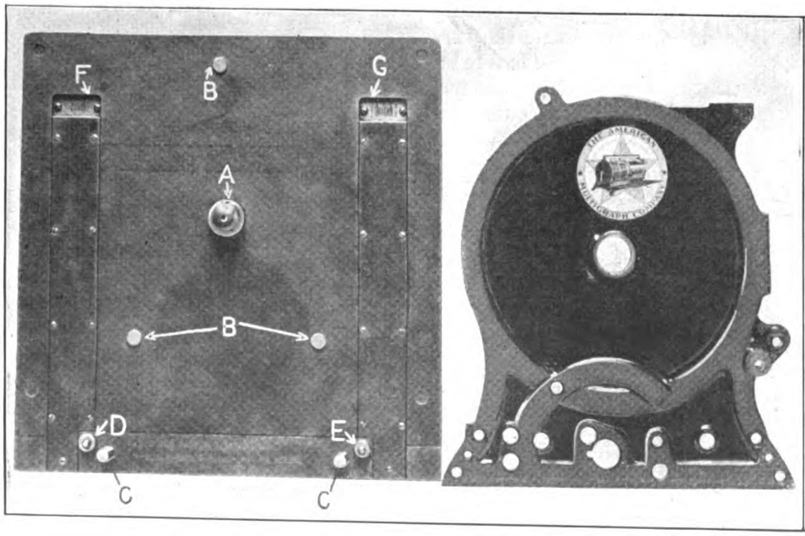

FIG. 12. DOUBLE INDICATING FIXTURE FOR SURFACE OF END PLATE WITH LOCATING AND GAGING STUDS

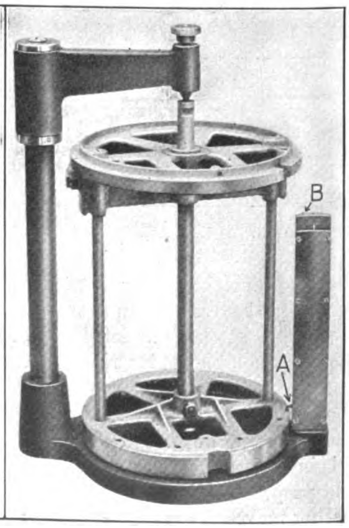

FIG. 13. TESTING SQUARENESS OF HEAD WITH SPINDLE

Small dogs, or chasers, Fig. 14, are used for holding the type in position between the rails on the segment previously shown. These dogs are made from rods of specially drawn steel bar of such a section as will slip between the upper heads of the I-rails, which have been previously staked into position in the segment. The machine shown in Fig. 15 is for cutting off these dogs and at the same time milling a notch in them for receiving the spring that prevents them from sliding too freely between the rails. The specially formed bar is seen feeding in at *A*, the feeding mechanism being shown at *B*, the cutting-off saw at *C* and the specially formed cutter at *D*.

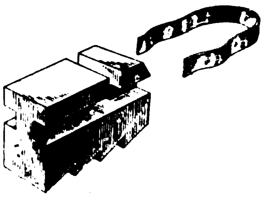

FIG. 14. CHASER BLOCK AND SPRING

The springs are put on these little dogs by an ingenious hand machine, Fig. 16. The spring wire comes in spools; it is about 0.08 in. wide and 0.01 in. thick. This feeds down from the spool, as shown at *A*, while the dogs that are to have the springs put on them are placed in the magazine *B*. The lever and its connections *DC* are so arranged that a throw to the left cuts off a sufficient length of the flat spring wire and forms it around the sides of the dog, the wire itself feeding through a slot milled especially for this purpose. This can be done very rapidly, as the parts are small and the girls become expert at this kind of work after a little experience.

Fig. 17 shows a little device for cutting off small rubber stops that are sometimes used at the ends of the line. These rubbers come in long strips, which are fed by gravity through the side tubes shown on the upright at *A*. Suitable knives arranged at *B* and operated by the lever *C* cut off these rubber plugs at a very rapid rate, allowing them to fall into the box *D*.

A different sort of cutter, Fig. 18, is for stripping the insulation from double wires used in connection with the motor on the Multigraph outfit. This is not only quicker than the old pen-knife method, but also avoids injury to the wires, at the same time leaving them quite clean of insulation. At *A* are upright knives with a stop behind them at the proper distance for the stripping of the insulation. The wire with its covering is forced down between these knives so that the end rests against the stop at the back. Then the lever *B* is moved, which clamps the wires by their insulation and also pulls them toward the operator, drawing the wire out of its insulation and leaving it clean, as can be seen at *C*.

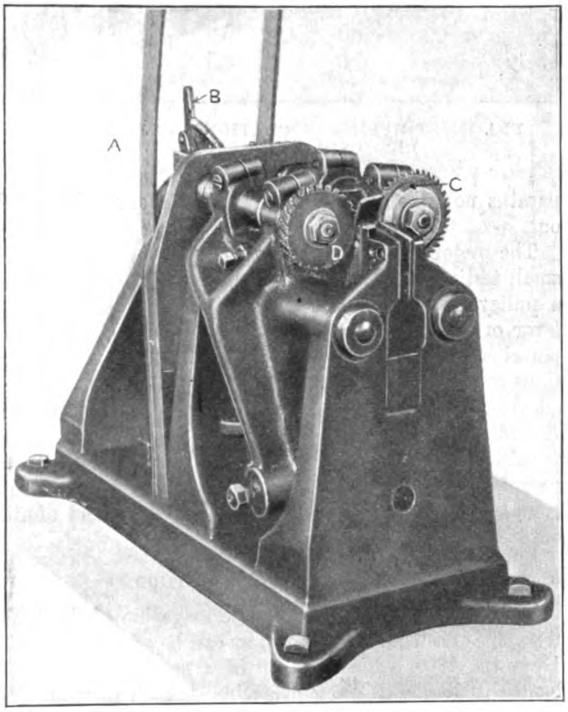

FIG. 15. SPECIAL MILLER FOR SLOTTING CHASER BLOCKS

FIG. 16. PUTTING BANDS ON CHASER BLOCKS

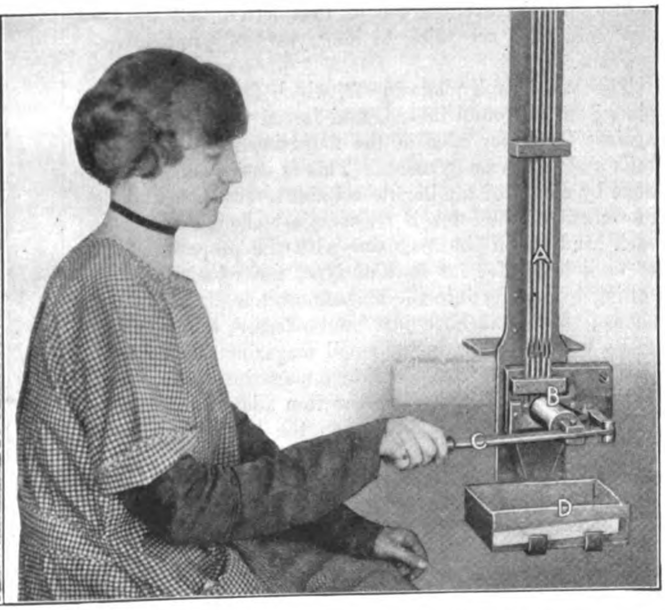

FIG. 17. CUTTING OFF RUBBER STRIPS

In order to make sure that the motor supplied with the Multigraph can deliver the power required, each motor is tested, as shown in Fig. 19. This is a crude arrangement, which will give way to a more complete apparatus now that the device has been thoroughly tested out.

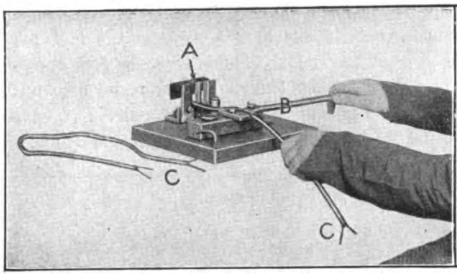

FIG. 18. STRIPPING INSULATION FROM ELECTRIC WIRES

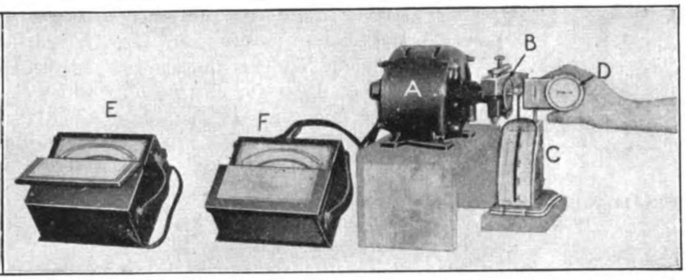

FIG. 19. SIMPLE METHOD OF TESTING MOTORS USED ON MULTIGRAPHS

The motor *A* is mounted on the raised portion of the small testing stand, and the prony brake *B* is applied to a pulley fastened on the end of the motor shaft. The lever of this brake bears on the platform of the small postal scale *C*, while the tachometer *D* shows the revolutions of the armature shaft. At the same time the electrical readings are taken from the wattmeter and voltmeter *E* and *F*, so that all necessary data are easily obtained for finding the exact performance of each motor. This record is kept for each machine and motor, so that any complaint or inquiry in regard to the power end of the outfit can be easily taken care of.

Magazine-Loading Method

The method of loading the type magazine of the Multigraph is decidedly ingenious, as can be seen in Fig. 20. Here the type, which is cast in a special machine, is loaded in the long filling magazine *A*, each row containing a different letter. As in all printing establishments, however, the number of letters in the font varies according to the average use of that letter, "E" always predominating, according to long years of printing experience.

The Multigraph magazine *B*, which is to be filled, is placed on the round table *C* and forced up into position against the lower edge of the magazine *A*, so that the rails and slots exactly mesh. This is easily and quickly done by means of the handwheel and screw *D*. A single movement of the lever *E* releases just enough letters of each kind to fill the magazine with the proper number of each letter for its font of type, the released letters falling by gravity into the magazine below, as at *B*. As shown, the letters have just been released, and one can easily trace the type in the small magazine by its corresponding absence from the larger magazine above. Moving the lever *D* in the other direction allows all the type in the main magazine to fall to the bottom, so as to present a uniform body at the lower end.

The next movement of the lever throws out small separating fingers or wedges, which automatically force themselves between the type in the main magazine at the proper distance to allow a sufficient number to fall into the small magazine, effectually holding in place all those above until the lever is again moved and the type falls to the bottom, ready for the next filling operation. This saves an immense amount of time and insures an accurate count of type in the lower magazine in each case. The fixtures and methods shown will give some idea of the careful attention that has been given to the problem of accurate and economic manufacturing by the American Multigraph Co., Cleveland, Ohio. A great deal of the work falls well within that rather vague limit which bounds the confines of the manufacture of precision-machine parts.

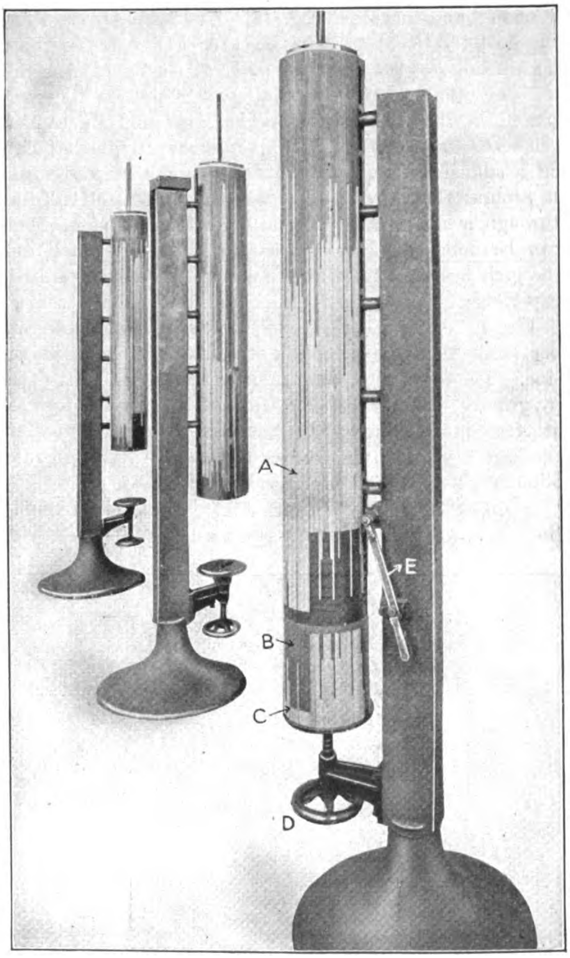

FIG. 20. SIMPLY OPERATED MAGAZINES FOR LOADING THE TYPE SEGMENTS

The Applicant's Difficulty*

By R. Fleming

It may be inferred that the writer of a letter making application for a position will express himself at his best. An analysis of 493 letters written during the years 1914 and 1915, applying for engineering positions, gives some interesting results. Of these letters 217 were from college men, either graduates or members of graduating classes. Fifty colleges were represented. Only about one letter in three from these college men could be called "good," and hardly one in twenty would receive special attention. In fact, the applications of two men stating "I am not a college man" and some letters from boys wanting to be tracers made a more favorable impression than those from the majority of college graduates.

What are some faults in their letters? In the first place, 95 out of the 217 were on notepaper. A favorite-sized page was 5x6 in. There is a semblance of authority for the use of notepaper in at least one handbook, but the advice of a professor to his senior class might well be followed:

> When you write a letter applying for a position, use business paper and not love-letter stationery, for a business letter is not a love letter.

Notepaper is inconvenient for filing. What engineer has not had personal experience with applications "filed for future reference"?

Careless handwriting is another common fault. Fine penmanship is not vouchsafed to many, but the writing of everyone can be at least legible. A consulting engineer writes in such a slovenly manner that his letter is hard to read. He may have thought that his letterhead would do away with the necessity of writing distinctly. It is often difficult to read the name at the end of a letter. An associate professor of drawing wants a salary of $40 a week, but one can only guess his name. The same is true of a candidate "for a responsible position."

A graduate of an institution like . . . should not be a "beginer," nor should a graduate of . . . be "thankfull." Perhaps the man who writes "weather," "imaterial" and "having had ample technical education to warrant a drauftsman's position" is not a college graduate.

Many applications give too little definite information. Such statements as "I am a college man," "I am a graduate from an engineering school," "have a fine technical education, being a college graduate," "am technically educated," could be better expressed by giving the name of the college and the year of graduation.

Serious Faults of Style

A flippant tone in a letter is not conducive to its favorable reception. One man writes:

> However, it is not my intention in submitting same, that it be placed on file for some future manager to cast into the wicker morgue, because sir I graduate from the Civil Engineering Course of . . . the coming June, and the position for which I am making application can be filled at that time.

A bombastic or too confident tone is not to be commended. The man who writes:

> Have had 13 years' experience in structural drafting. . . . Have never made an expensive error in any work I have turned out. . . .

may never have had much responsibility thrown upon him.

The following letter is unclassified:

> I am a young man (19). I have received a 4 year Civil Engineering Education and a year of Field Experience I am fully versed in designing and constructing steel structures, Reinforced Concrete, also numerous other things in the Engineering line.

An irreverent hand had written in pencil, "Some boy!"

Sypherd, in his "Handbook of English for Engineers," summarizes weak points in letters of application under: Poor Beginning, Faulty Sentence Structure, Excessive Use of the First Person, Excessive Modesty and Miscellaneous Errors. He gives the advice:

> Begin at once without any preliminary explanation with a statement of what you desire; say briefly, straightforwardly and without assuming too great knowledge or skill, whatever you think your future employer ought to know about what you have done or can do; refer him to men who can speak definitely and without reservations as to your ability and moral worth; then stop.

It should be noticed that no letter of application, however well written, will secure a position unless there is one to be had. For the last two or three years the bread line of engineers has been a long one. That the supply still exceeds the demand becomes evident by comparing the "Positions Wanted" with the "Positions Vacant" in the advertising columns of the technical papers. There are applicants by the score for every position vacant. The importance of the letter of application is apparent. This, however, is but one phase of a larger subject—the use of better English by engineers.

Schools Trying To Meet the Difficulty

In his preliminary analysis[1] of the replies received from 23,000 circular letters to engineers regarding the needs of the profession Professor Mann, of the Carnegie Foundation for the Advancement of Teaching, writes:

> In questioning the efficiency of the engineering schools at the present time there are four conspicuous things in which the professional men show a fair degree of unanimity. The first and most important is English. A large majority of the letters received mention the absolute necessity for higher efficiency in the training in English.

Some colleges are trying to meet this need. The Stevens Institute of Technology in its catalog for 1916-17 states: "No effort is spared to impress upon the students that their success as engineers will depend largely upon their knowledge and use of language." Attention is given to English and Logic throughout the college course. This seems more rational than to neglect them, claiming that these particular branches belong to the grammar and high schools. Where English is neglected because the course is already overcrowded with other subjects, something might be done by way of substitution. Often out-of-term and supplemental-reading courses could profitably be introduced.

In conclusion attention is called to the following books on the subject:

"Handbook of Composition," Wooley.

"Handbook of English for Engineers," Sypherd.

"The Theory and Practice of Technical Writing," Earle, and "Good Engineering Literature," Frost, are of value to the engineer given to writing for the technical press.

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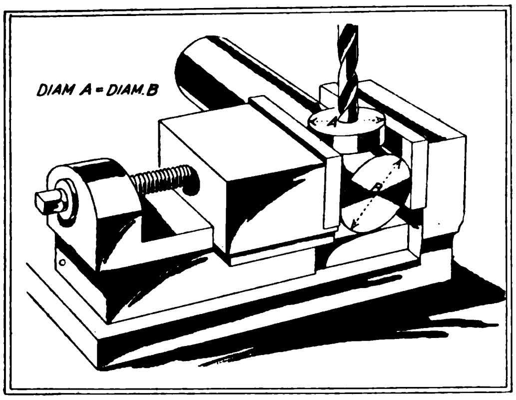
*Reprinted from "Engineering News."

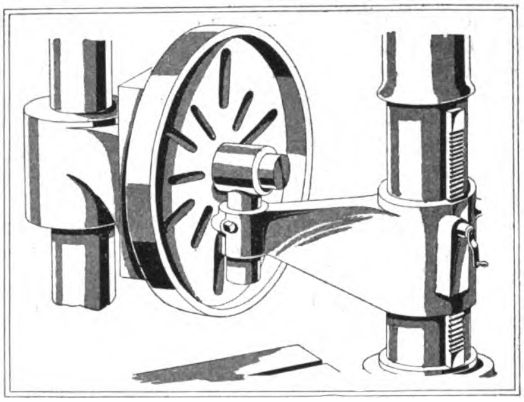
[1]Bulletin of the Society for the Promotion of Engineering Education, Vol. VI, p. 100 (October, 1915).

From a Small-Shop Notebook

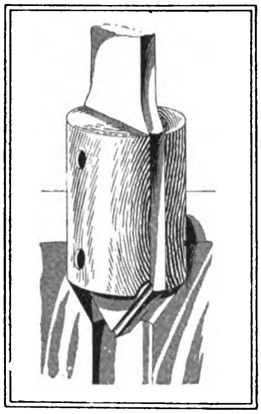
By John H. Van Deventer



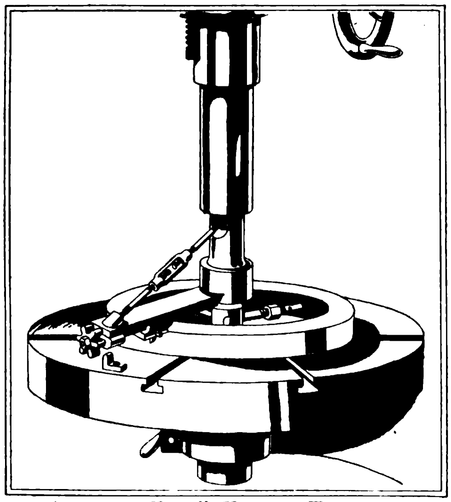
Both the Stock and the Bushing Are Held by the Jaws



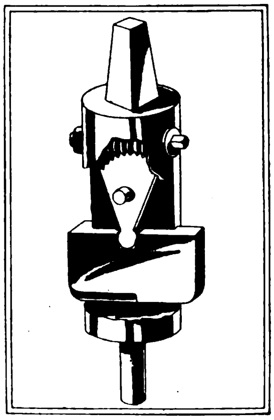
This Scheme Converts a "Drill Press" Into a Boring Machine



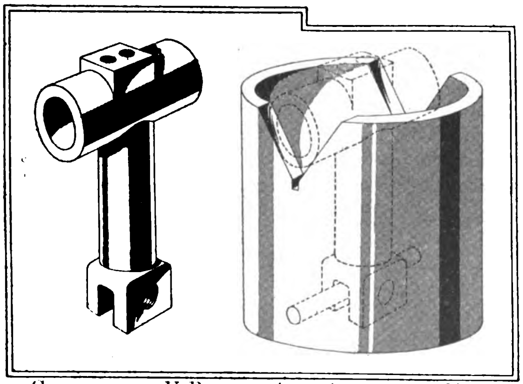
A Simple Flat Reamer with Wood Packing



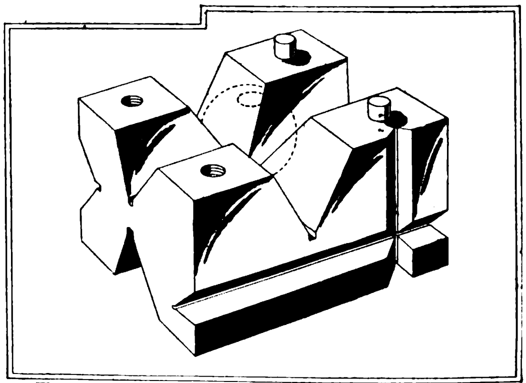
A "Star Feed" Facing Tool for the Drilling Machine



Adjustable Boring Cutter for Finishing Holes

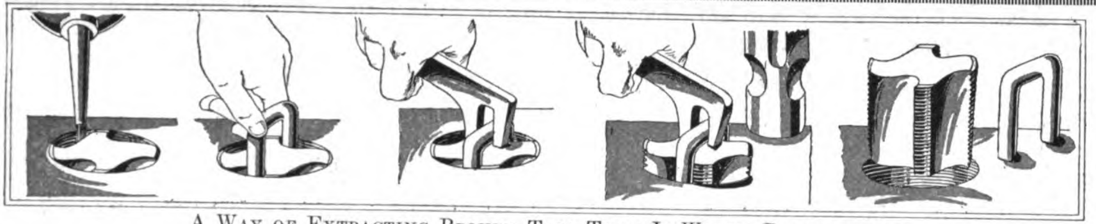


Convenient V-Blocks Are Sometimes Made from Round Pipe

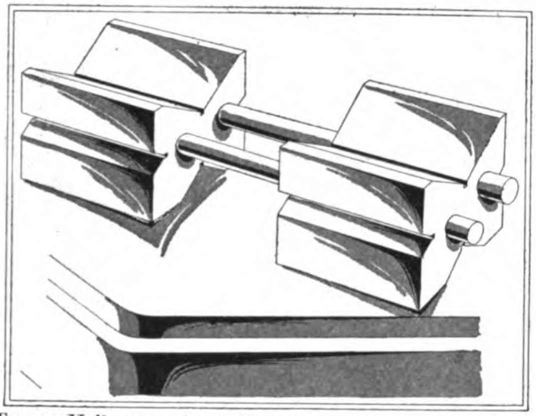


This Universal V-Block Will Hold Round Stock and Spheres

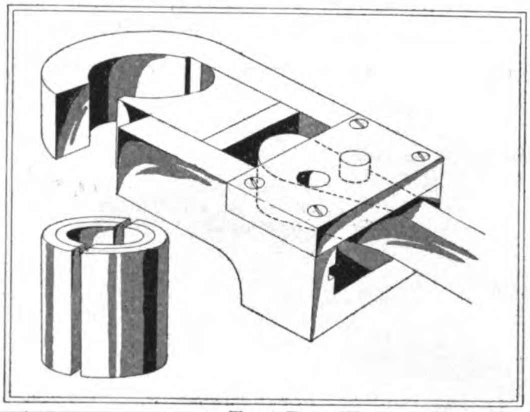
HELPING THE DRILLING MACHINE TO EARN A PROFIT



A WAY OF EXTRACTING BROKEN TAPS THAT IS WORTH REMEMBERING

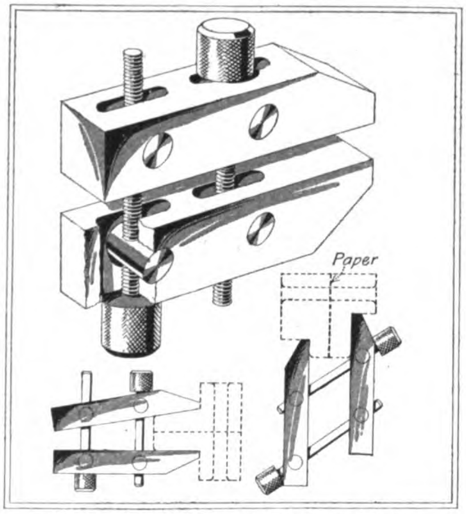


THESE V-BLOCKS ARE GUIDED BY TWO ROUND BARS

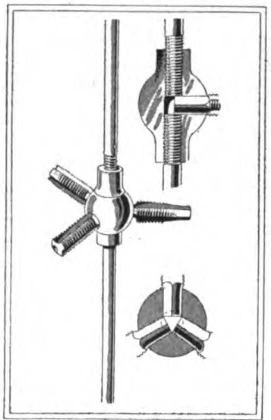


THIS PIPE WRENCH WILL NOT INJURE FINISHED WORK

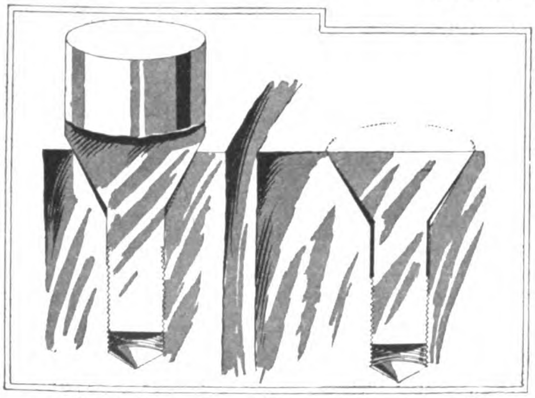
A FIREPROOF RECEPTACLE FOR WELDING AND BRAZING TORCHES



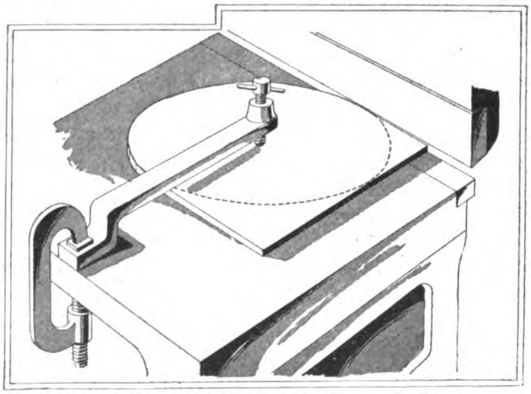
EVERY TOOL MAKER SHOULD HAVE A SET OF THESE CLAMPS



THIS TRIPLE TAP WRENCH BELIEVES IN PREPAREDNESS



WHEN YOU MUST USE A "DUTCHMAN," PUT IT IN RIGHT



THIN DISKS MAY BE "TURNED" ROUND, ON A SQUARE SHEAR

Jig for Lapping Special Precision Gages

By E. V. Allen

The Grayson Tool and Manufacturing Co., Indianapolis, Ind., which makes all kinds of fine tools and gages, recently had an order for a number of special comb gages. These gages had 29 teeth, or 30 spaces, the center to center distances of the teeth being 0.125 in., with the spaces, 0.0675 in. in width. Only an over-all limit of 0.0002 in. was allowable. The gages were machined and the teeth milled. They were next ground all over with enough left between the teeth for final lapping. This was done in the jig illustrated in Fig. 1. One of the comb gages is shown at *A* and another at *B*. The latter has a test piece *C* in place between the teeth. Two of these test pieces were used, and they were first carefully ground and lapped to exact size.

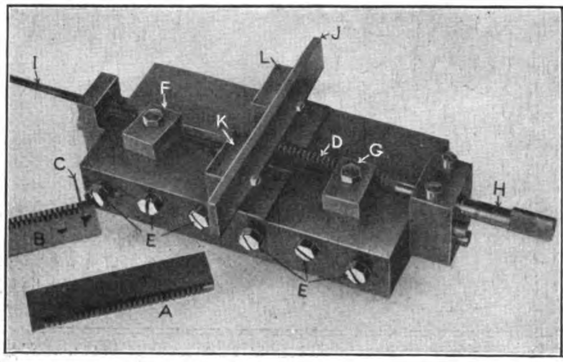


FIG. 1. GRINDING JIG FOR COMB GAGES

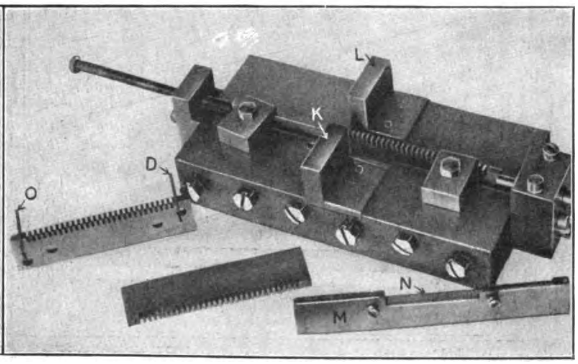


FIG. 2. LAPPING JIG FOR COMB GAGES

The gage to be lapped was placed in the slot of the jig at *D*, all side movement being carefully taken up by the adjusting screws *E*. Two clamps *F* and *G* held the work firmly to the bottom of the slot. Spacing was determined by means of the micrometer head *H*, against which one end of the gage was butted. Firm contact with the micrometer end was obtained by carefully adjusting the screw *I*. The lapping was done with a diamond lap carried in the holder *J*, which was guided by the two blocks *K* and *L*.

This will be better understood by reference to Fig. 2. Here the holder is shown at *M* and the diamond-charged lap at *N*. It will be seen that the guiding blocks *K* and *L* are made so as to afford sliding contact for the holder on both the bottom and one side. These blocks are set into the jig body and are doweled and screwed into place. With the gage set in place, the teeth are first all lapped on one side enough to clean up properly. The gage is then reversed and the other sides of the teeth lapped enough to admit the test pieces. By placing the two test pieces, as shown, at *O* and *D*, or in intermediate positions, the pieces may not only be used as individual test pieces for each space or slot, but they may be checked up with an outside micrometer.

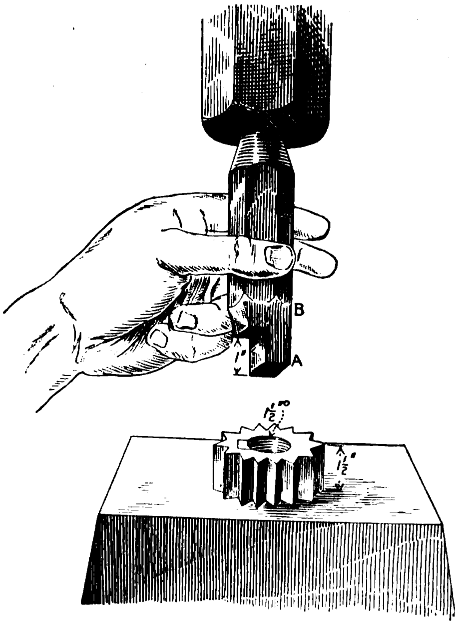
Of course, in work of this kind great care and patience must be exercised, and all tendency to accumulative error must be avoided. However, the main idea of the method of using a jig of this sort will be grasped at once and give an idea of the fine work done in this shop.

Tool for Marking Keyways in Ratchet Wheels

By Thomas Underwood

I recently had to cut keyseats in 100 ratchet wheels, as shown in the accompanying illustration. These had to be cut on a shaper; and in order to lay the keyways off easily, I made the tool shown.

The front portion *A* was curved to suit the bore of the ratchet wheels, while the part *B* was filed to the size of the keyway desired. The face of this offset was relieved in the center, and the whole point was hardened. By placing the front part *A* through the hole in the gear until *B* rested on the face and then striking the end of the tool with a fairly heavy hammer, the notch *B* left an impression on the face of the ratchet wheel of exactly the size desired for the keyway.



TOOL FOR MARKING KEYWAY

This method saves considerable time in laying off and might perhaps be used in other instances to advantage.

Improvement of the Lubricating System Increases Production

By Ethan Viall

SYNOPSIS—This article calls attention to the frequent loss of shop efficiency through improper methods of handling oil or soap-water mixtures. When handled correctly, not only is the increase in production notable, but the appearance of the shop is greatly improved.

The ordinary idea in using oil or soap water as a lubricant or coolant seems to be that, as long as the liquid is poured on the work in more or less sufficient quantities, it makes little difference how much slops over on the floor, drains from the work or accumulates in any convenient hollow or cavity. The inevitable result is a slippery, sloppy, smelly place that is not conducive to safety, efficiency or comfort. In first placing the machines in its plant the Boss Nut Co., Chicago, followed the plan of using a gravity feeding tank for each machine. The machines are a battery of 2- to 20-ton punch presses and a battery of an equal number of six-spindle nut tappers. The product consists of square and hexagon nuts stamped out of $\frac{5}{16}$- to ½-in. metal, with tapped holes from ⅜ to 2 in. in diameter. The stock comes in long bars and is known as standard cold-punching nut steel. As common with this class of stock, there is considerable scale to contend with.

On the punch presses, the soap-water mixture was fed to the dies through a ¼-in. pipe, from which it found its way into a pan underneath the machine. Small individual rotary pumps forced the mixture from the drip pans to the gravity tanks above.

The stampings from the presses fell into iron kegs or pails with perforated bottoms, which were set in the drip pans. These receptacles, after standing in the drip pans for a while, were lifted out, the drippings being supposed to remain in the pans. However, in lifting the cans out a considerable amount of the mixture ran off them, causing a large area of slippery, sloppy floor around each machine. While this loss was not great when calculated in dollars' and cents' worth of mixture, the cost of keeping the floor clean enough so that the men could work at all took the time of two men about two hours a day. It also required two to three men to lift the cans of punchings from the drip pans.

As the lubricant was used over and over without treatment, it soon became full of dirt and scale, which was poured over the dies. Two men consumed at least two hours per day mixing and delivering fresh lubricant to the various machines. When the mixture in a machine became so dirty as to render it unfit for use, it was thrown away. In adding or renewing the mixture the time of the operator and the machine itself was lost, reducing the average efficiency. As the operators were on piecework, any delay cut seriously into their wages. Finally, the management decided that a change of some kind was necessary and began to look into the matter of finding a way to better conditions.

After the subject was looked into to some extent, it was decided to have the Richardson-Phenix Co., Milwaukee, Wis., put in a Peterson filtering system. In the concrete floor under the presses, trenches were cut of sufficient size and pitch so that the mixture would drip from the machines and easily run to a centrally located filter tank set under the floor. The trenches under the machines were covered with gratings of ⅛x⅜ flat iron spaced ¼ in. apart. The gratings were made remov-

FIG. 1. METHOD OF PLACING GRATING AND WORK KEYS

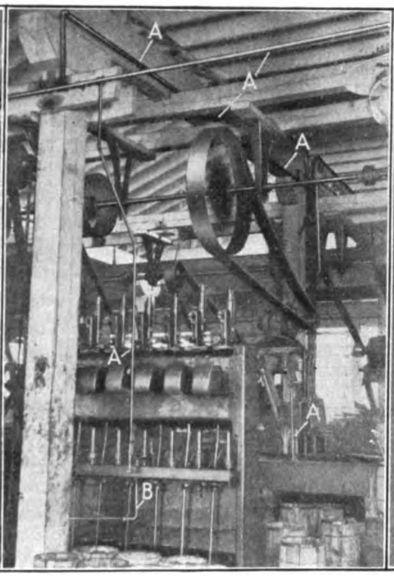


FIG. 2. PIPING TO A TAPPING MACHINE

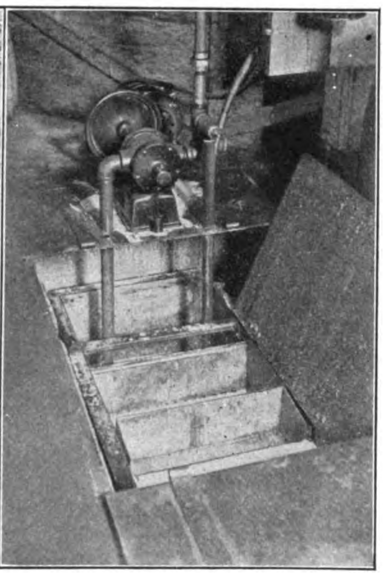


FIG. 3. VIEW OF PUMP AND TANK

able for the purpose of cleaning or repair at any time. The kegs in which the product was caught were placed on these gratings, so that all drippings would flow back to the filter tank. One of the presses so equipped is shown in Fig. 1. These perforated-bottom kegs can be easily and quickly slid out from under the work chute and allowed to drain on a part of the grating as another keg is slipped in place to catch the punchings. This is such a simple operation that one man easily does it where two were formerly required.

As the soap-water mixture finds its way back to the central tank, it is filtered and pumped up through a series of pipes and again poured out to the work and tools at the various machines. This method eliminates the troublesome small gear pumps on the individual machines and saves the men from filling the gravity tanks formerly used—a cause for frequent slops. As the soap water is strained and filtered before entering the feed pipes, the operator never has to worry over dirt- or grease-clogged outlets, but can center his full attention on getting out his work. The even mixture caused by the churning action of the pump is also an advantage.

The tapping machines formerly experienced practically the same trouble as the punch presses and were similarly equipped. The present method of piping a tapping machine is illustrated in Fig. 2. A grating takes care of the drippings from the work in kegs. The feed pipes from the pump are indicated by A. A drain pipe is shown at B. Nozzles are placed so as to pour the mixture over the taps and work as required.

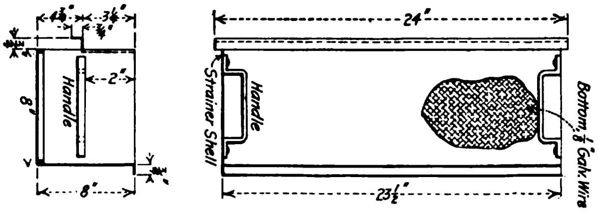


FIG. 4. DETAILS OF STRAINER BASKET

Other Details of the System

As previously stated, the filter tank is placed under the floor, as seen in Fig. 3. The tank itself is covered by a hinged iron cover, shown thrown back at the right. A heavy hinged floor plate is also used. This has been taken off and drawn into the foreground, for photographing. The pipe leading to the pump from the left is the suction pipe. The one at the right is a return pipe fitted with an automatic pressure valve, so that any excess pressure in the overhead pipe will find an outlet and return to the tank. This method keeps an even liquid pressure in the pipes at all times, regardless of the number of nozzles. The pump is a Gould rotary, driven by a 2-hp. General Electric motor running at 1,200 r.p.m. and connected to the pump by back gears. The main discharge pipe is 1¼ in., and the outlets or nozzles are of ⅜- or ¼-in. pipe, reduced at the ends where needed. The drain pipes leading from the trenches are 2 in., leading into 2½ in. and finally into a short piece of 3 in. leading into the tank itself. The quantity furnished at each nozzle varies some, but will average close to 2 gal. per min., one such pump and tank as shown giving about 3,000 gal. per hr.

The arrangement of the filter is shown in Fig. 5. The returning mixture enters at the side into the settling chamber. A deflecting plate diverts its flow downward to facilitate the precipitation of the heavier particles and to prevent short circuiting to the chip or strainer

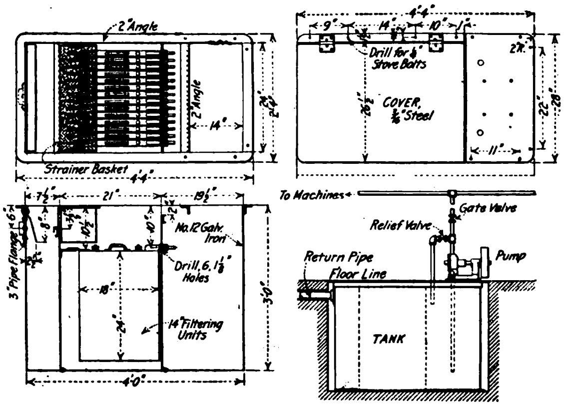


FIG. 5. DETAILS OF FILTER AND TANK

basket through which it drains into the filtering compartment. The latter contains fourteen individual filtering units made of heavy galvanized wire screens held one inch apart in a metal frame over which a cloth filtering bag is easily drawn and held smoothly in place by bringing it over the top and screwing down a cover plate with two thumb nuts. These filtering units, set vertically, filter from the outside to the inside over the entire cloth area under a uniform head. This will be made clear by studying Fig. 6 which illustrates the U-tube principle employed. The head at any point such as X always remains equal to A because the columns of oil on the inside and the outside of the units up to the point of outlet are always in balance. The vertical position automatically tends to keep the filtering surface clean. When necessary any unit can be removed, cleaned or provided with a new bag and

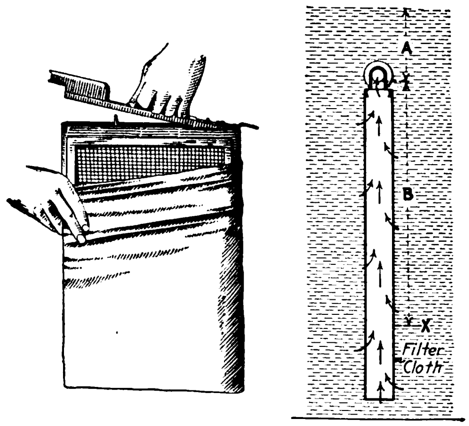


FIG. 6. DETAILS OF FILTER CELL AND ACTION

replaced without interfering with the operation of the filter.

The advantage of having a dirt-free, well-mixed compound is apparent. So also is the advantage of a dry floor and well-drained product. The other advantages accruing from the change in the system are that a large

shown in Fig. 5. The
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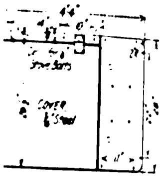

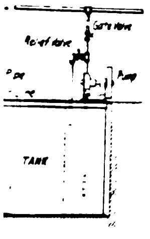

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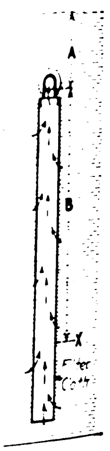

AND ACTION

operation of the

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other advantages
are that a large

amount of unproductive work was eliminated. The men formerly employed to do cleaning, lifting and the like are now transferred to production work, and the machine operators are enabled to keep their minds constantly on their work.

The present system was installed in working order about Jan. 1, 1916. Taking figures from office-record cards, one experienced operator on Dec. 3, 1915, ran out 30,425 nuts in 9½ hr. Sometimes his production was as low as 23,000 per day. On the same size of nuts and the same machine, this operator on Apr. 3, 1916, ran out 44,660 in 9½ hr. His daily average is close to 42,000 per day and is never lower than 35,000. Some of the daily records are worse than this and some better, but the figures in this case seem to be a fair average, everything considered. A conservative estimate is that general shop production has been increased at least 25 per cent. Another thing is that previously the men were paid 10c. per 1,000 pieces on certain sizes of nuts. The present rate is 8c. per 1,000 pieces, and the men make more than they did before the system was installed.

Cam-Milling Fixture

By E. A. Thanton

A special fixture used in milling a double-rise cam on a handled lever and a collar is illustrated in Fig. 1. These cam parts are used on its turret lathes by the W. K. Millholland Machine Co., Indianapolis, Ind. A collar is shown in the fixture, held in by clamps, and a lever is shown in the foreground. The fixture is used in a plain miller and is bolted to the table. A narrow cutter on the arbor is fed across the cut. The cut for the cam rises is made in a series of steps. After each cut across, the handle *A* is pulled, causing the dog *B* to engage the next notch in the segment *C*. This not only moves the work around a little, but also raises it, so that the cutter cuts deeper each time.

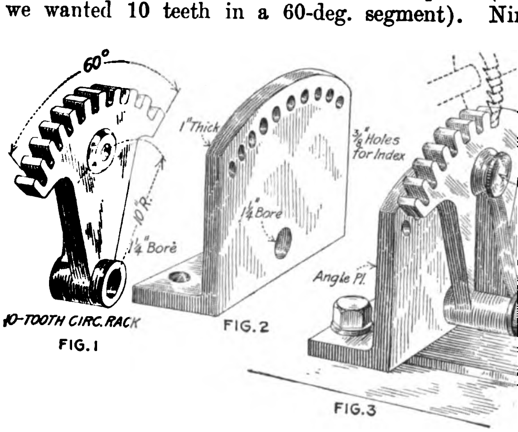
This action will be better understood by reference to Fig. 2, where the fixture is shown disassembled. A roller on the end of screw *D*, where it projects through into the inside of the bore of the base, works in the spiral slot *E*, so that as the center part is rotated it is either raised or lowered. The parts are locked solid during the cut by means of the clamping screw at *F*. After the cams are milled in this way, they are smoothed up with a file.

Cutting a Circular Rack on the Miller

By J. Limbrunner

Several circular racks had to be cut on the m
but it was found that they were too large to be s
between the centers of the index head. It the
became necessary to devise some other means for fa
ing and dividing the blank, and the following m
was successful:

A ⅝-in. diameter hole was drilled in the cent
the casting, Fig. 1, on a 10-in. radius. Next, a
with a 10-in. radius, drawn on a piece of paper
divided as accurately as possible into 60 parts (be
we wanted 10 teeth in a 60-deg. segment). Ni



ARRANGEMENT OF ANGLE PLATE FOR CUTTING CIRCULAR RACK ON A MILLER

these divisions were carried over to the angle plat
Fig. 2, and ⅜-in. holes were drilled and reame
these points of division for the index pin. The ma
of setting up the job is illustrated in Fig. 3.
1¼-in. bolt has to be loosened after finishing each t
the index pin withdrawn and the blank turned to
left, until the index pin can be pushed into the
hole in the angle plate.

If the angle plate is made heavy enough, no tro
will be experienced from chattering. It is apparent
the holes for the index pin must be accurately loc
in the angle plate to obtain correct spacing of the t

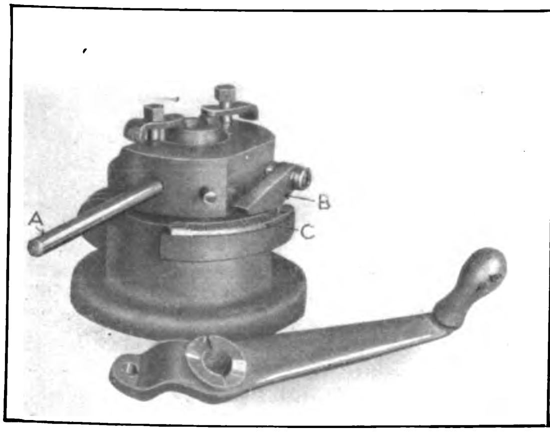


FIG. 1. CAM-MILLING FIXTURE

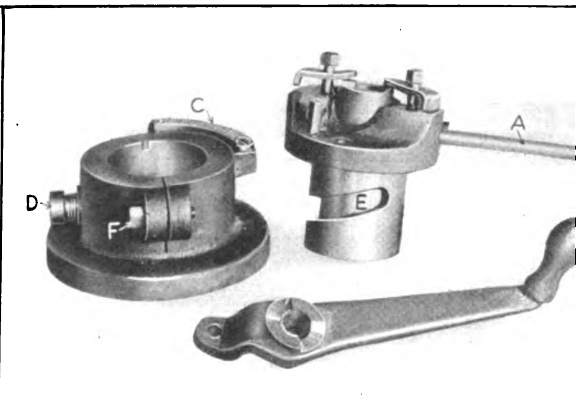


FIG. 2. FIXTURE DISASSEMLLED

Punches and Dies for Making an Embossed Ball

By Robert Mawson

SYNOPSIS—In this article are shown tools for making an ornamental ball used on jewelry. This element is made from flat stock and is first pierced, then embossed and finally blanked into a star-shaped piece, which is then placed in a die. A punch is fed down on it, forming it into a cup-shaped part, which is put into another die. A ball-shaped punch is used on the closing operation.

The Metal Products Corporation, Providence, R. I., makes a variety of sheet-metal parts for the jewelry and similar trades. Some of these parts are plated and polished into finished products. Others are supplied to the trade in the condition in which they come from the press. The tools here described are for making an embossed ball.

This piece is manufactured from flat stock. A strip of brass is fed under the stripper of the die and the holes pierced. It then passes along to the next position, and the surface is embossed by another punch. The strip is fed along to the third position and the part blanked out into a star-shaped element. These three operations are performed in one tool, which is fitted up with the three punches mentioned. It will be seen that, with a tool designed as described, one stroke of the press performs a piercing, embossing and blanking operation.

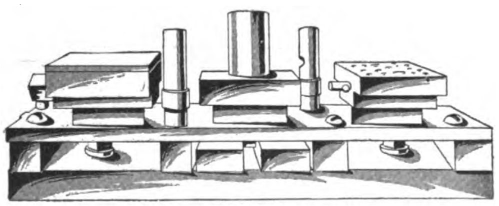
The die has two dowel pins set into reamed holes of the machine to keep the tool square. After the piece has been blanked, it is placed in a circular depression in another die held on another punch press. A punch located in the machine is then forced down on the ball element, making it cup-shaped. The die is fitted with location stops, so that the flat may be placed in a central position on the tool.

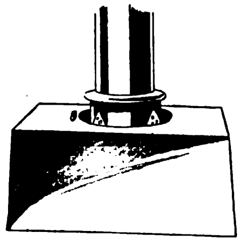
The next operation is the final punch and die work—namely, closing in. The element is placed in a cup-shaped die held on the punch press, and a ball-shaped punch is fed down. As the punch is forced down, the die further closes in the piece, giving it a spherical form. It is then an easy matter to close in the ends into a ball, which is ready for plating and polishing as desired.

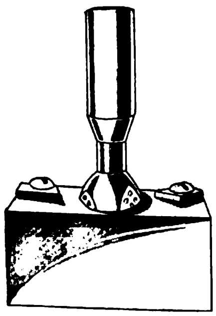
The interesting feature of these tools is the punch and die used for the first three operations. On this tool it will be observed that the stop, which has been cut to the correct width, is pierced, embossed and blanked to the shape shown in Fig. 1. The punches are set at the correct distance apart and held to the punch holder on the press.

The die elments are made of separate tool-steel hardened blocks with the correct contour for piercing, embossing and blanking. These elements are then attached to the die bed at the proper distance apart. The stripper plate, which is made of machinery steel, is fastened to the die bed with screws and dowels. The part as received from these tools is shown, and it will be seen that the impressions and the embossing work have been performed completely on a star-shaped piece. This part is then formed into a cup shape as the next operation.

The element is placed over the die and is located by pins that fit into notches of the star shaper. The punch, which is made with a slightly conical end, is forced down onto the blank and forces it into the circular contour of the die. This operation pushes up the ends of the blank and forms it into a cup-shaped blank. As the punch has a ball end, the blank is made to proper shape.







PUNCHES AND DIES FOR MAKING AN EMBOSSED BALL

FIGS. 2 AND 2-A

Operation—Piercing the blank. The stock, which has been cut to the correct width, is fed under the stripper. As the punch X descends, the brass strip is pierced, and the blank is then ready for the embossing operation.

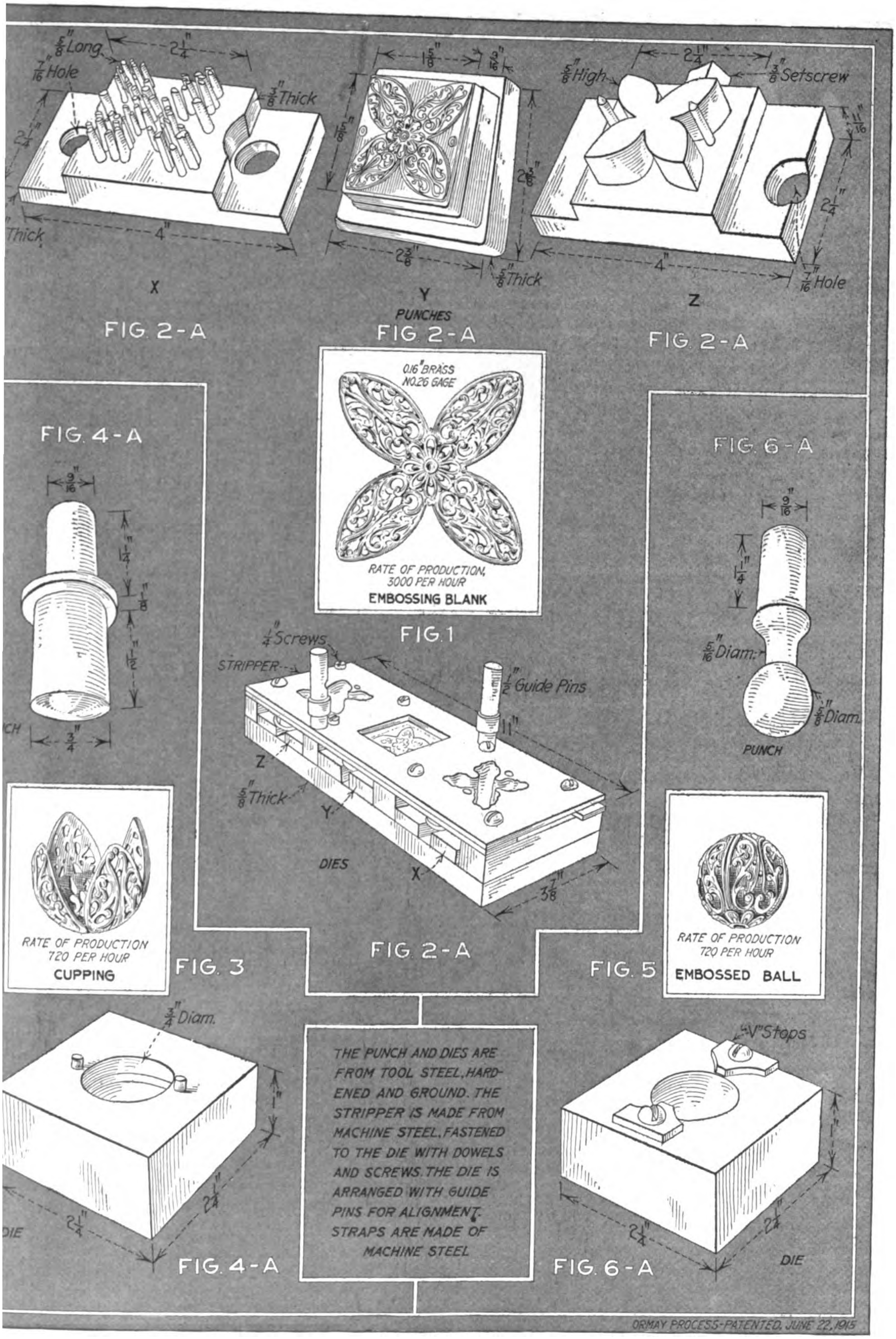
Operation—Embossing the blank. The pierced stock is fed along the die to the second position, and the punch Y being forced down by the machine, the pattern carried on the punch is produced on the brass element. The stock is then fed along to the third position, and the punch Z, being fed down, blanks out the part. The embossed ball at the end of this operation is shown in Fig. 1.

FIGS. 4 AND 4-A

Operation—First cupping to the shape shown in Fig. 3. The star-shaped element is placed over the die, being located by two steel stops. The punch is fed onto the part and forces it down into the circular contour of the die.

FIGS. 6 AND 6-A

Operation—Further closing-in of the cup-shaped element, which is finally given the shape shown in Fig. 5. The piece is placed over the die and is again located by two steel V-shaped stops. The points of these stops fit between points of the star-shaped element. The ball-shaped punch, then fed down, closes in the piece to a ball form.

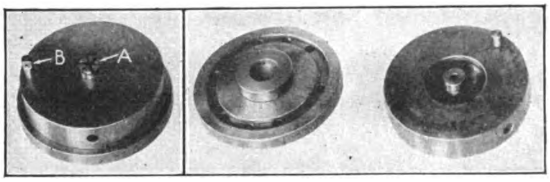


DETAILS OF PUNCH AND DIES FOR MAKING AN EMBOSSED BALL

Close Indexing for Gage Work

Not long ago the Grayson Tool and Manufacturing Co., Indianapolis, Ind., had an order for a special gage made from round stock, to be exactly 0.719 in. in diameter and with six equidistant slots in one end 0.098 in. in width. In order to obtain accurate spacing of the slots a special indexing fixture was made, as shown in Fig. 1. The gage, with the slots roughed out approximately, was set into the center at *A*. The spacing was done by means of the pin *B*, which fitted into grounds and lapped holes in the base. As the work was indexed, the slots were ground to size.

The idea will be better understood by reference to Fig. 2, where the two parts are shown separated. The base is



FIGS. 1 AND 2. INDEXING FIXTURE FOR SPECIAL GAGE

at the left, which is grooved. Buttons 0.40 in. in diameter were used to locate the six holes exactly 2 in. apart. An error of less than 0.0001 in. was allowed, so it can be easily seen that there was small chance for error on the smaller diameter of the gage in the center. The bottom of the upper part, shown at the right, was recessed to fit accurately over the hub of the base. Holes were drilled in the rim of the upper plate for the insertion of a rod to assist in turning it, as the fit was very close.

Station-Type Opening and Closing Drill Jig

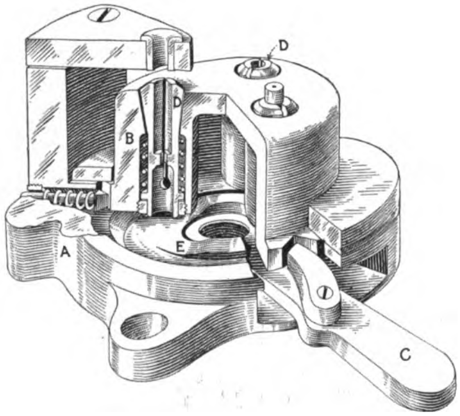
By John J. Eyre

The illustration shows a simple but efficient fixture for drilling small parts used in munitions and other work where the stock is round and large production is required. When work of this nature is drilled in the ordinary box type of jig, held and placed in position for drilling by the operator, the greater part of the time is spent in locking and unlocking the jig, cleaning out the seat for the work and locating the jig in place for drilling.

The fixture shown consists of a bottom plate *A*, which is bored out to receive a circular member, or turntable, *B*, actuated by the hand lever *C* and a pawl. The turntable is bored to receive three or more spring chucks *D*, which are a little larger than the work to be drilled, the action of the spring drawing the chuck into its seat and holding the work firmly while it is drilled. The turntable has at the bottom a flange that is notched directly opposite the center of the chucks, to receive the pawl on the hand lever and a spring locking pin which is on the center line of the bushing that locates the table in the correct position for drilling.

In the bottom plate, on the circle described by the chucks, is bolted a hardened-steel sector *E*, tapered off at both ends so that when the table is moved ahead by the hand lever the bottom end of the chuck will ride up on the hardened surface, thereby compressing the spring and automatically releasing the chuck. While a treadle feeds the drill into the work in the chuck under the drill spindle, the operator removes and inserts the work in the open chuck in front. The sector *E* should be secured to the bottom plate directly opposite the drill bushing, so that the chucks will be opened in front of, and conveniently for, the operator.

When two or more holes are to be drilled in a piece, more chucks can be placed in the turntable and a multi-



STATION-TYPE OPENING AND CLOSING DRILL JIG

drill head used, one drill located over each chuck to drill a different hole. As the work passes along, all holes are drilled. It will be seen that by this method one complete piece is drilled at each movement of the drill head, with the advantage of not being obliged to make the drill head too small for practical work and constant use. Where two holes are to be drilled, a two-spindle head can be purchased and the pitch of the chucks in the turntable designed to fit its centers.

The fixture shown was devised for drilling the spring chamber in percussion pellets for the No. 100 British detonator fuse. The cross-section shows the construction of the chuck and the locating pin in the back of the fixture.

Jigs of this type were also designed for the two holes in the percussion detonator plug and for the four holes in the percussion needle plug, using multidrill heads for both, which meant from four to six times the production and better work.

Taper Boring Arrangement for Making Dies

By E. B. Barker

The following may be of interest to people engaged in making punches and dies for shells. Having a number of dies to make for 18-lb. shrapnel shell and no lathe with a taper attachment available, I rigged up a combination lathe. After the die had been rough-bored and turned, I took a compound slide rest off an old lathe and put it in place of the square-tool post on the saddle. By putting a stud in the center, after the correct taper had been obtained by placing a stop on the saddle to come up against the end of the slide, the taper could be obtained without setting the tool each time.

To get a feed, I took out the screw, put a stud in the top slide and one in a tool box on the hexagon turret. A connecting-rod of suitable length was then placed on the two studs and completed a satisfactory job.

Roll Pressures in Cold-Rolling Steel

By William K. Shepard* and George C. Gerner†

SYNOPSIS—An investigation into the pressures required to cold-roll both annealed hot-rolled steel and unannealed steel that had been partly cold-rolled. Charts and tables give the results for different thicknesses and percentages of reduction. Most of the tests were made on strips 1 in. wide.

Inquiries were made a few years ago of the Sheffield Scientific School of Yale University by Connecticut manufacturing concerns in regard to the roll pressure in cold-rolling brass and steel. As no information could be found concerning this subject, an investigation on the roll pressure in cold-rolling brass was made by the authors of this article and published in the *American Machinist*, Vol. 42, p. 461. The present paper is the report of a similar investigation on steel made in the Mason Laboratory of Mechanical Engineering at the Sheffield Scientific School of Yale University.

The steel was rolled in an experimental rolling mill and the pressure on the rolls measured directly by means of a testing machine.

One grade of steel—carbon, 0.10 per cent. and under; phosphorus, 0.02 per cent. and under; manganese, 0.30 to 0.45 per cent.; sulphur, 0.04 per cent. and under—

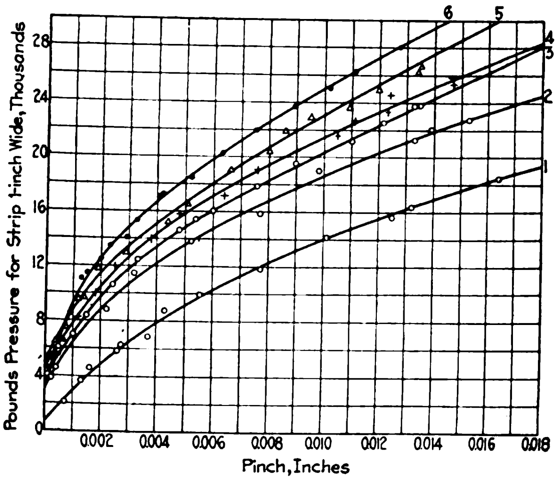


FIG. 1. PRESSURE EXERTED ON 5-IN. ROLLS WHEN COLD-ROLLING HOT- AND COLD-ROLLED STEEL

was used in all of the tests. This steel was kindly furnished by the Stanley Works, New Britain, Conn.

Strips of hot-rolled steel, of steel which had been cold-rolled and then annealed, and of steel which had been cold-rolled various amounts at the Stanley Works and unannealed were all rolled in the experimental mill to determine the roll pressure for these different conditions.

Methods of Conducting Tests

The experimental rolling mill was placed on the weighing table of a 100,000-lb. testing machine. The pinch screws of the mill were held in place by a plate that pressed against the movable head of the testing machine, and the rolls were then adjusted to any desired pinch by moving the head of the testing machine with the hand speed. The diameter of the rolls in the experimental mill was 5 in., and the mill was driven by a motor that gave a speed of 16 ft. per min. for the face of the rolls.

As the steel passed through the rolls, the pressure was transmitted through the pinch screws and plate to the testing machine. The poise of the testing machine was

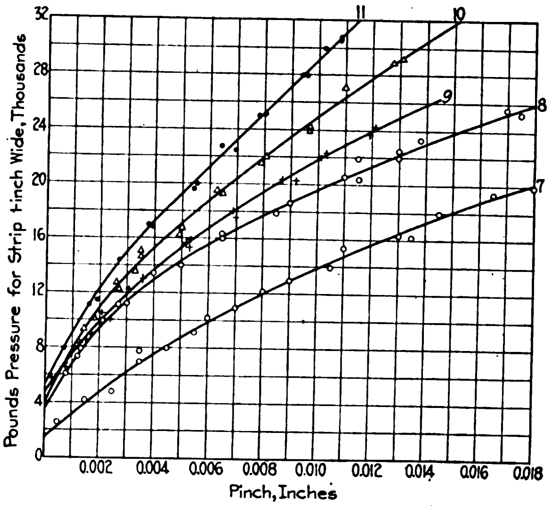


FIG. 2. PRESSURE EXERTED ON 5-IN. ROLLS WHEN COLD-ROLLING HOT- AND COLD-ROLLED STEEL

moved to the proper position to balance this, and the readings from the beam then gave the pressure on the rolls.

In nearly all the tests a strip of steel 1 in. wide was rolled. However, a few tests were made with strips of different widths to determine the effect of width of strip on the pressure.

General Results of Tests

Strips of hot-rolled steel 0.096 in. thick were rolled in the mill. The results of these tests are shown by curve 1 in Fig. 1, and the pressure on the rolls as taken from these curves is given in Tables 1A and 1B.

Strips of unannealed steel that had been reduced from the hot-rolled steel (0.096 in. thick) by a number of passes through the rolling mill of the Stanley Works were also rolled in the experimental mill. The results of these tests are shown by curves 2 to 6 in Fig. 1 and in Tables 2A and 2B. The history of the steel for each group is as follows:

2. Starting with hot-rolled steel 0.096 in. thick, cold-rolled in one pass to 0.081 in. thick unannealed.
3. Starting with hot-rolled steel 0.096 in. thick, cold-rolled in two passes to 0.071 in. thick unannealed.
4. Starting with hot-rolled steel 0.096 in. thick, cold-rolled in three passes to 0.065 in. thick unannealed.
5. Starting with hot-rolled steel 0.096 in. thick, cold-rolled in four passes to 0.0585 in. thick unannealed.
6. Starting with hot-rolled steel 0.096 in. thick, cold-rolled in five passes to 0.051 in. thick unannealed.

*Assistant professor, Sheffield Scientific School.
†Instructor, Sheffield Scientific School.

Strips of hot-rolled steel 0.073 in. thick were rolled in the mill, and the results of these tests are shown by curve 7 in Fig. 2 and in Tables 1A and 1B.

Strips of unannealed steel that had been reduced from the hot-rolled steel (0.073 in. thick) by a number of passes through the rolling mill of the Stanley Works were

8. Starting with hot-rolled steel 0.073 in. thick, cold-rolled in three passes to 0.060 in. thick unannealed.

9. Starting with hot-rolled steel 0.073 in. thick, cold-rolled in six passes to 0.049 in. thick unannealed.

10. Starting with hot-rolled steel 0.073 in. thick, cold-rolled in nine passes to 0.040 in. thick unannealed.

TABLE 1A. PRESSURE EXERTED ON 5-IN. ROLLS FOR A STRIP 1 IN. WIDE WHEN COLD-ROLLING HOT-ROLLED AND ANNEALED STEEL

		Pressure on Rolls (Pounds) for a Pinch in Inches of									
No.	Material	0.002	0.003	0.004	0.005	0.006	0.008	0.010	0.012	0.016	0.020
1	0.096 in. thick hot-rolled	4,950	6,550	7,950	9,150	10,350	12,350	14,050	15,600	18,250	20,600
7	0.073 in. thick hot-rolled	4,700	6,100	7,450	8,600	9,800	11,850	13,800	15,600	18,750	21,200
12	0.036 in. thick annealed	4,900	6,850	8,550	10,100	11,500	14,100	16,550	18,800	.....	.....

TABLE 2A. PRESSURE EXERTED ON 5-IN. ROLLS FOR A STRIP 1 IN. WIDE WHEN COLD-ROLLING UNANNEALED COLD-ROLLED STEEL

	Material	Amount Reduced		Pressure on Rolls (Pounds) for a Pinch in Inches of								
No.	Reduced to	In.	Per Cent.	0.002	0.003	0.004	0.005	0.006	0.008	0.010	0.012	0.016
2	0.081 in. thick	0.0150	15.60	8,800	10,600	12,200	13,550	14,800	16,900	18,650	20,300	23,300
3	0.071 in. thick	0.0250	26.05	9,800	11,950	13,550	14,950	16,200	18,400	20,400	22,400	26,200
4	0.065 in. thick	0.0310	32.30	10,600	12,700	14,450	15,900	17,200	19,450	21,550	23,450	26,850
5	0.0585 in. thick	0.0375	39.10	11,500	13,400	15,100	16,650	18,050	20,700	23,200	25,400	29,700
6	0.051 in. thick	0.0450	46.90	12,650	14,850	16,700	18,350	19,800	22,600	25,050	27,300	31,550

TABLE 3A. PRESSURE EXERTED ON 5-IN. ROLLS FOR A STRIP 1 IN. WIDE WHEN COLD-ROLLING UNANNEALED COLD-ROLLED STEEL

		Amount Reduced		Pressure on Rolls (Pounds) for a Pinch in Inches of								
No.	Material	In.	Per Cent.	0.002	0.003	0.004	0.005	0.006	0.008	0.010	0.012	0.016
8	0.060 in. thick	0.013	17.8	9,350	11,400	13,000	14,400	15,550	17,650	19,550	21,300	24,450
9	0.049 in. thick	0.024	32.9	9,750	11,800	13,600	15,200	16,700	19,350	21,800	23,900	.....
10	0.040 in. thick	0.033	45.2	10,950	13,300	15,300	17,100	18,750	21,900	24,900	27,700	.....
11	0.0345 in. thick	0.0385	52.7	12,350	15,000	17,300	19,300	21,300	25,250	29,200	33,100	.....

TABLE 4A. PRESSURE EXERTED ON 5-IN. ROLLS FOR A STRIP 1 IN. WIDE WHEN COLD-ROLLING UNANNEALED COLD-ROLLED STEEL

		Amount Reduced		Pressure on Rolls (Pounds) for a Pinch in Inches of							
No.	Material	In.	Per Cent.	0.002	0.003	0.004	0.005	0.006	0.008	0.010	0.012
13	0.029 in. thick	0.007	19.5	9,500	11,700	13,750	15,800	17,800	21,800	25,700	29,400
14	0.027 in. thick	0.009	25.0	10,100	12,950	15,700	18,400	21,000	26,000	31,000	36,000
15	0.023 in. thick	0.013	36.1	12,000	14,950	17,850	20,850	24,000	30,750	38,300	.....
16	0.0215 in. thick	0.0145	40.3	12,750	16,100	19,500	22,950	26,100	32,700	.....	.....

TABLE 1B. PRESSURE EXERTED ON 5-IN. ROLLS FOR A STRIP 1 IN. WIDE WHEN COLD-ROLLING HOT-ROLLED AND ANNEALED STEEL

		Pressure on Rolls (Pounds) for a Per Cent. of Rolling of								
No.	Material	4	8	10	12	16	20	24	28	30
1	0.096 in. thick hot-rolled	7,800	12,000	13,700	15,200	17,800	20,100	22,300	24,400	25,400
7	0.073 in. thick hot-rolled	5,900	9,600	11,200	12,650	15,300	17,700	19,700	21,500	22,300
12	0.036 in. thick annealed	3,600	6,450	7,700	8,850	11,000	12,800	14,600	16,250	17,100

TABLE 2B. PRESSURE EXERTED ON 5-IN. ROLLS FOR A STRIP 1 IN. WIDE WHEN COLD-ROLLING UNANNEALED COLD-ROLLED STEEL

	Material	Amount Reduced		Pressure on Rolls (Pounds) for a Per Cent. of Rolling of								
No.	Reduced to	In.	Per Cent.	4	8	10	12	16	20	24	28	30
2	0.081 in. thick	0.015	15.6	11,050	15,300	16,950	18,400	21,000	23,400	25,400	27,200	28,000
3	0.071 in. thick	0.025	26.05	11,650	15,750	17,400	18,900	21,700	24,500	27,200	.....	.....
4	0.065 in. thick	0.031	32.3	11,900	16,150	17,800	19,200	21,900	24,300	26,500	.....	.....
5	0.0585 in. thick	0.0375	39.1	12,200	15,600	17,850	19,450	22,400	25,000	27,600	.....	.....
6	0.051 in. thick	0.045	46.9	12,600	16,800	18,450	20,000	22,800	25,250	27,500	.....	.....

TABLE 3B. PRESSURE EXERTED ON 5-IN. ROLLS FOR A STRIP 1 IN. WIDE WHEN COLD-ROLLING UNANNEALED COLD-ROLLED STEEL

		Amount Reduced		Pressure on Rolls (Pounds) for a Per Cent. of Rolling of								
No.	Material	In.	Per Cent.	4	8	10	12	16	20	24	28	30
8	0.060 in. thick	0.013	17.8	10,250	14,150	15,550	16,850	19,200	21,300	23,300	25,000	25,800
9	0.049 in. thick	0.024	32.9	9,600	13,450	15,050	16,500	19,100	21,550	23,650	25,500	.....
10	0.040 in. thick	0.033	45.2	9,800	13,700	15,300	16,750	19,400	21,850	24,350	26,600	27,700
11	0.0345 in. thick	0.0385	52.7	10,400	14,400	16,050	17,600	20,300	23,050	25,750	28,500	29,900

TABLE 4B. PRESSURE EXERTED ON 5-IN. ROLLS FOR A STRIP 1 IN. WIDE WHEN COLD-ROLLING UNANNEALED COLD-ROLLED STEEL

		Amount Reduced		Pressure on Rolls (Pounds) for a Per Cent. of Rolling of								
No.	Material	In.	Per Cent.	4	8	10	12	16	20	30	35	40
13	0.029 in. thick	0.007	19.5	7,400	10,250	11,500	12,650	15,050	17,400	23,200	25,950	28,700
14	0.027 in. thick	0.009	25.0	7,150	10,600	12,100	13,650	16,600	19,450	26,200	29,700	33,000
15	0.023 in. thick	0.013	36.1	8,450	11,500	12,900	14,300	16,900	19,600	26,950	30,900	35,100
16	0.0215 in. thick	0.0145	40.3	8,200	11,750	13,300	14,700	17,650	20,400	27,600	31,200	.....

TABLE 8. PRESSURE EXERTED ON 20-IN. ROLLS FOR A STRIP 1 IN. WIDE WHEN COLD-ROLLING HOT-ROLLED AND UNANNEALED STEEL

	Pressure on Rolls (Pounds) for a Pinch in Inches of									
Material	0.002	0.003	0.004	0.005	0.006	0.008	0.010	0.012	0.016	0.020
0.096 in. thick hot-rolled	9,900	13,100	15,900	18,300	20,700	24,700	28,100	31,200	36,500	41,200
0.081 in. thick unannealed	17,600	21,200	24,400	27,100	29,600	33,800	37,300	40,600	46,600	51,500
0.071 in. thick unannealed	19,600	23,900	27,100	29,900	32,400	36,800	40,800	44,800	52,400	.....
0.065 in. thick unannealed	21,200	25,400	28,900	31,800	34,400	38,900	43,100	46,900	53,700	.....
0.0585 in. thick unannealed	23,000	26,800	30,200	33,300	36,100	41,400	46,400	50,800	59,400	.....
0.051 in. thick unannealed	25,300	29,700	33,400	36,700	39,600	45,200	50,100	54,600	63,100	.....

also rolled in the experimental mill. The results of these rollings are shown by curves 8 to 11 in Fig. 2 and in Tables 3A and 3B. The history of the steel for each group is as follows:

11. Starting with hot-rolled steel 0.073 in. thick, cold-rolled in eleven passes to 0.0345 in. thick unannealed.

Strips of steel 0.036 in. thick that had been cold-rolled from hot-rolled pickled steel (0.072 in. thick) in the

rolling mill of the Stanley Works and then annealed 11 hr. were rolled in the experimental mill, and the results of these tests are shown by curve 12 in Fig. 3 and in Tables 1A and 1B.

Strips of unannealed steel that had been reduced from the annealed steel (0.036 in. thick) by a number of passes through the rolling mill of the Stanley Works were also rolled in the experimental mill. The results of these tests

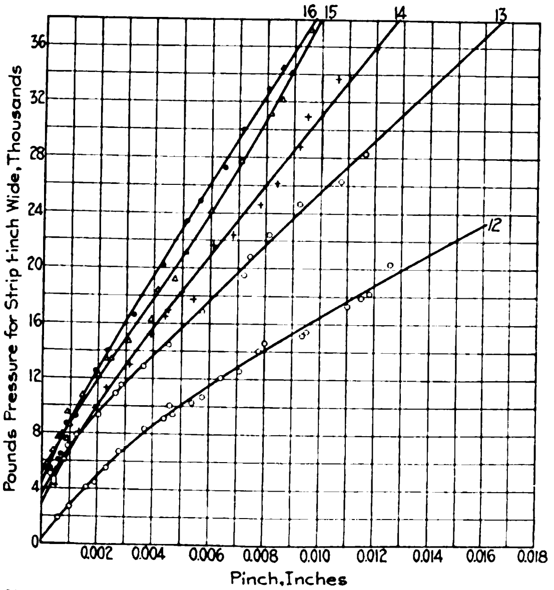


FIG. 3. PRESSURE EXERTED WHEN COLD-ROLLING ANNEALED AND COLD-ROLLED UNANNEALED STEEL

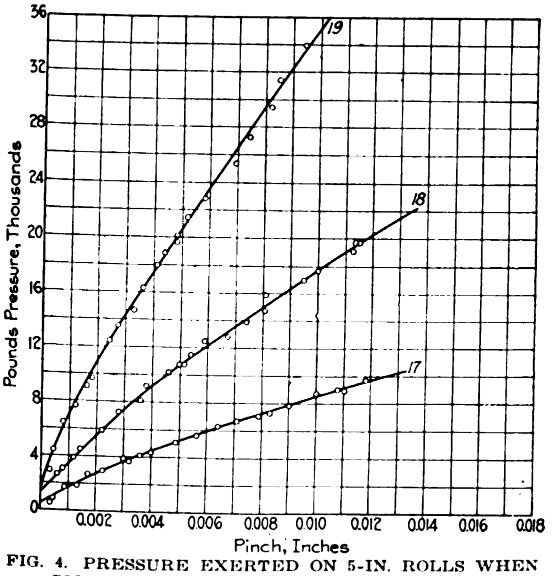


FIG. 4. PRESSURE EXERTED ON 5-IN. ROLLS WHEN COLD-ROLLING ½-IN., 1-IN. AND 2-IN. STEEL

are shown by curves 13 to 16 in Fig. 3 and in Tables 4A and 4B. The history of the steel for this group is as follows:

13. Starting with annealed steel 0.036 in. thick, cold-rolled in one pass to 0.029 in. thick unannealed.

14. Starting with annealed steel 0.036 in. thick, cold-rolled in two passes to 0.027 in. thick unannealed.

15. Starting with annealed steel 0.036 in. thick, cold-rolled in three passes to 0.023 in. thick unannealed.

16. Starting with annealed steel 0.036 in. thick, cold-rolled in four passes to 0.0215 in. thick unannealed.

The effect of width of strip was investigated with annealed steel 0.035 in. thick. Strips of this steel ½, 1 and 2 in. wide were rolled in the mill. The results of these tests are shown by curves 17, 18, 19 in Fig. 4, and the pressures on the rolls as taken from these curves are given in Table 5.

TABLE 5. EFFECT OF WIDTH OF STRIP UPON PRESSURE EXERTED ON 5-IN. ROLLS WHEN COLD-ROLLING ANNEALED STEEL 0.035 IN. THICK

Pinch, In.	Pressure on Rolls (Pounds) for a Strip of Width 2 In.	1 In.	½ In.	Pressure Ratio for Strips 2 In. to 1 In.	2 In. to ½ In.	1 In. to ½ In.
0.001	7,100	3,500	1,720	2.03	4.13	2.04
0.002	10,950	5,500	2,780	1.99	3.94	1.98
0.003	14,300	7,500	3,650	1.91	3.92	2.06
0.004	17,500	9,200	4,450	1.90	3.94	2.07
0.005	20,550	10,750	5,200	1.91	3.96	2.07
0.006	23,600	12,200	5,910	1.93	4.00	2.06
0.007	26,600	13,600	6,600	1.96	4.03	2.06
0.008	29,600	15,000	7,280	1.97	4.07	2.06
0.009	32,450	16,350	7,900	1.99	4.11	2.07
0.010	35,300	17,800	8,540	1.98	4.13	2.08
0.011	38,100	19,050	9,150	2.00	4.17	2.08

When rolls of different diameters are used, the pressure will, it is believed, depend on the projected areas of the rolls in contact with the metal. The meaning of the term "projected area of the rolls acting on the metal" will be understood by referring to Fig. 5.

When a piece of metal 1 in. wide is being rolled between the rolls A and B from a thickness t to t_1 inch, the projected area of the rolls acting on the metal will be equal to b, the sectioned area in the top view.

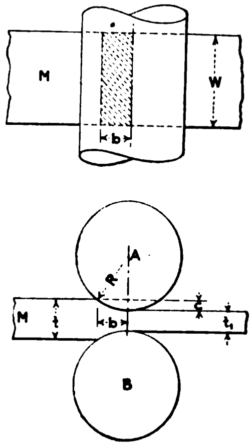


FIG. 5. DIAGRAM OF ROLLS ACTING ON METAL

For a strip of metal w inches wide the projected area will be w times that for a 1-in. width. The per cent. rolling will equal $\frac{t - t_1}{t}$. From Fig. 5 it is seen that the projected area b for any pinch $t - t_1$ on a 1-in. strip can be found from the relation

$$b = \sqrt{R^2 - (R - C)^2}$$

where

R = Radius of the rolls;

$C = \frac{t - t_1}{2}$, or one-half the pinch.

The values of the projected areas of 5-, 8-, 12-, 14-, 16-, 18- and 20-in. rolls acting on a strip of metal 1 in. wide, for different amounts of pinch, have been calculated by the foregoing formula and are given in Table 6.

TABLE 6. PROJECTED AREAS FOR ROLLS OF DIFFERENT DIAMETERS FOR A STRIP 1 IN. WIDE

Pinch, In.	Projected Area (Sq.In.) for Rolls of Diameter 5 In.	8 In.	12 In.	14 In.	16 In.	18 In.	20 In.
0.002	0.0707	0.0894	0.1095	0.1183	0.1265	0.1341	0.1413
0.010	0.1580	0.1999	0.2449	0.2645	0.2828	0.2999	0.3162
0.020	0.2234	0.2827	0.3463	0.3740	0.3989	0.4241	0.4471
0.030	0.2734	0.3461	0.4240	0.4580	0.4897	0.5194	0.5475

When these values are plotted on logarithmic cross-section paper, Fig. 6, it is seen that there is a straight-line relation between the projected areas and the different pinches for each size of rolls. As these lines are nearly parallel, it follows that there is a nearly constant ratio for all pinches between the projected areas of each size of rolls and the projected areas of the 5-in. rolls. The ratios of these

projected areas of different-sized rolls to the projected areas of 5-in. rolls for three pinches are given in Table 7.

If now we wish to obtain the pressure on the rolls for a certain-sized roll, when steel of the composition used in our rolling-mill tests is rolled, we must multiply our values in Tables 1A, 1B, 4A and 4B by the ratio of the projected areas in Table 7 for this size of rolls. For example, the values thus found for the pressure on 20-in. rolls for the hot-rolled steel having an original thickness of 0.096 in. and the steel cold-rolled from this thickness are given in Table 8.

TABLE 7. RATIOS OF PROJECTED AREAS OF DIFFERENT-SIZED ROLLS TO PROJECTED AREAS OF 5-IN. ROLLS

Pinch, In.	Ratios of Projected Areas of Rolls to Projected Areas of 5-In. Rolls, for Rolls of Diameter						
	5 In.	8 In.	12 In.	14 In.	16 In.	18 In.	20 In.
0.002	1.000	1.265	1.549	1.674	1.789	1.897	1.999
0.010	1.000	1.265	1.550	1.674	1.790	1.898	2.001
0.020	1.000	1.265	1.550	1.674	1.790	1.898	2.001
0.030	1.000	1.266	1.551	1.675	1.791	1.900	2.003

Discussion of Results

The speed of 16 ft. per min. for the face of the rolls was chosen for these tests, as similar experiments on brass[1] made by the authors of this article showed that higher speeds than this had no decided effect on the roll pressure. The values given in Table 5 show that the pressure on the rolls approximately increases directly with the breadth of the strip rolled.

In Table 1A it can be seen that a pressure of 21,200 lb. was developed on the 5-in. rolls in rolling 0.073-in. thick

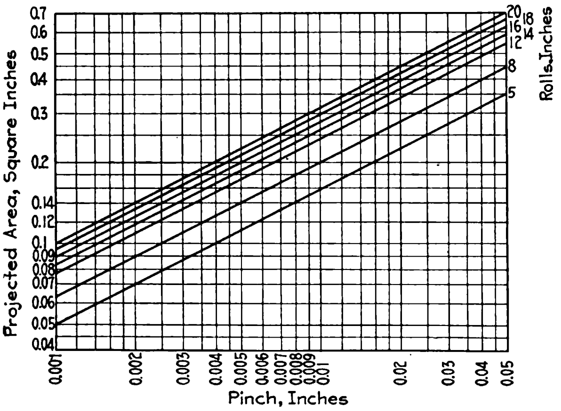


FIG. 6. PROJECTED AREAS OF VARIOUS-SIZED ROLLS

hot-rolled steel, No. 7—a pinch of 0.020 in. In Table 3A it will be seen that about the same pressure was developed on the rolls in rolling the cold-rolled steel, No. 11—a pinch of 0.006 in.

Again in Table 1A it will be seen that a pressure of 9,800 lb. was developed on the 5-in. rolls in rolling 0.073-in. thick hot-rolled steel, No. 7—a pinch of 0.006. In Table 3A it is found that a pressure of 21,300 lb., or more than twice as much, was developed on the 5-in. rolls in rolling the cold-rolled steel, No. 11—the same pinch. A number of similar comparisons may be made by further examination of Tables 1 to 4.

The safe roll pressure for a rolling mill being known from its design, for the grade of steel used in this investigation, it will be possible from the results given here to determine the maximum safe pinch for any initial condition of the steel or properly to design a mill when the amount of rolling required is known.

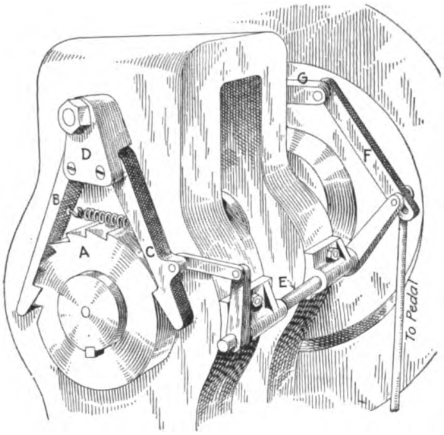
[1] "Roll Pressure in Cold-Rolling Brass." "American Machinist," Vol. 42, p. 461.

Punch-Press Accidents

By W. Alton

In regard to the different causes of press accidents that have been mentioned, I believe they are occasionally caused by the ram's dropping back after it has nearly reached the top of its stroke. This is not such a rare occurrence when the press is equipped with a friction brake that bears all the time, for it is only a question of time when the brake wears so much that it no longer holds.

To overcome this difficulty the following stop was applied to a press after the ram had dropped and only just missed catching the operator: A ratchet wheel *A* was keyed on the end of the crankshaft. The casting *D* was hung on a stud that was available, and to this the two pawls *B* and *C* were attached. *B* rides on the ratchet all the time and prevents the press from falling back. The shaft *E* was mounted across the front of the press and connected by suitable links and levers to the operating pedal.



THE ALTERATION TO THE PRESS

The clutch lever *G* was attached to the lever on the shaft *E* by the link *F*, having a slotted end so that the first thing done when the pedal is depressed is to withdraw the pawl *C*, and then the press is set in motion. This pawl prevents the press ram from dropping forward if the crank happens to be carried a little past the center.

After applying the above device, we slacked up the brake and ran the press to test it. It worked as certainly as if the brake was on; but if we held off the pawl *B*, it would drop back about once in four times.

Exports of Ammunition, explosives and firearms for the period beginning Aug. 1, 1914, and ending May 1, 1916, according to figures made available by the Department of Commerce, run up to the enormous figure of $480,000,000. It is significant to observe that of this aggregate $188,475,063 was shipped during January, February, March and April of 1916. In classifying these exports the following figures are given: Cartridges, $44,271,750; gunpowder, $127,767,170; other explosives, $195,649,764; firearms, $22,473,934. These figures do not include unloaded shells, of which it is calculated by the department's experts $90,000,000 were exported during the period covered. The unloaded shells are included in the export statements under the general classification of miscellaneous iron and steel products. Prior to the war the total of the exports of ammunition, explosives and firearms amounted to $300,000 per month, which by April, 1916, had risen to the stupendous monthly value of more than $58,000,000.

The Manufacturer's Interest in Vocational Education

By Max B. Robinson*

SYNOPSIS—No one is more vitally interested in the future of vocational education than the builders of machinery, yet in too many cases they are paying little or no attention to it. Changing conditions have made the old apprenticeship a thing of the past, and there is little organized effort to get a practical substitute. The present crisis has shown the scarcity of skilled men. Will the proposed Congressional aid solve the problem, and how can it be best applied?

The vocational-education bill now before Congress contemplates giving to the states an annual sum in excess of $7,000,000 to aid in advancing industrial and agricultural education. As our manufacturers have long sought Federal aid for training workers, it is but natural to assume that they have more than passing interest in this prospective legislation. Unfortunately, however, their active support has been rather meager, and it has been difficult to draw from them any adequate and definite expression of opinion. Industrial production is said to be a feast or a famine, and the feast of today seems to have brought indifference as to the morrow. Should this bill, called the Hughes bill and the Smith bill in the House and Senate respectively, pass the present Congress, the representatives of agriculture and education, and not the manufacturers, may claim the credit for the constructive work.

In the light of facts it seems as though our manufacturers are surely, if unintentionally, pursuing a most shortsighted policy. They rush representatives to Washington to combat dangers that may threaten the tariff, but appear indifferent toward the millions that may or may not be spent for their future workers. They anticipate coming demands for their products and create new designs accordingly, but fail to anticipate their future supply of brains, skill and brawn. They fight inefficiency in most elusive forms in their own organizations, but seem unready to fight a policy leading to future inefficiency or to support actively a policy making for the opposite.

Contrast the attitudes shown toward vocational education by the other interests most affected. Industry has concerned itself with present conditions, expecting others to solve the problems of the future. Agriculture, on the other hand, has recognized the development and benefits that can result from Federal aid. Agriculture has already sought and received Federal aid, as evidenced by the Government researches, by the experiment stations and by the agricultural instruction now given in many rural schools and in our state universities. The agricultural interests are receiving what industry has long desired, but what it has made little effort to obtain. Other interests will be intelligently represented in the administration of any educational bills that may become law.

There are in our public schools today over 19,000,000 children. Approximately 10,000,000 of these will never go beyond the fourth grade; 14,000,000 never reach the eighth grade, and over 17,000,000 never see a day of high school. As soon as the state laws permit, these 17,000,000 children drop out of school and enter agricultural, commercial and industrial life.

As Dean Schneider explains the size of the problem: "If these millions of children were stretched across the country in a straight line, giving one linear foot of space to each child, the line would reach from the upper end of Maine to the lower end of California. That portion which goes through the high schools would reach across the state of California. The rest of the line from Maine to the eastern border of California is drawn into commercial, industrial and agricultural life at about the age of 15 years, with no industrial training prior to going to work and practically no schooling thereafter. This proportion holds in any industrial town or city."[1]

Most of these remain under parental guidance, and many will learn to till the soil as did their fathers. As a group, they cause little anxiety. It is for industry to advance the welfare of the children who are to become its workers and without whom it could not exist. It is confronted by two separate and distinct problems: (1) The securing of workers with general training at least equal to and preferably better than that of our grade schools; (2) the training of workers in jobs for which they have demonstrated talent.

The fact that these problems exist should not be taken as an indictment of our public schools nor of our public-school systems. Although our schools have not provided the instruction that these children over 14 need and desire, industry gave no warning that it could no longer train its own. It outgrew its apprenticeships without notice. Industry, therefore, has helped create the conditions of which we speak, and industry must help apply the remedy. The part which the public schools must play is what we call "vocational education."

The Proposed Legislation

In the light of our problems as stated, it is generally admitted that a comprehensive system of vocational education is a growing necessity. It is also recognized that only Federal aid can make such a system possible in many states. So much has been written on this that argument seems unnecessary. The present emphasis is that the attention, consideration and forethought of all interests concerned are required in the final molding of the prospective legislation and that active effort may be required to secure its passage after its final form is agreed upon.

While the possible success of the present issue cannot immediately nor completely solve all problems, it is expected to stimulate greatly the interest and activity in the separate states. The preamble of the bill before the House of Representatives, the Hughes bill, reads: "To

*Shop coördinator, University of Akron.

[1]From "Industrial Efficiency," presented before the American Institute of Electrical Engineers, April, 1909.

provide for the promotion of vocational education; to provide for coöperation with the states in the promotion of such education in agriculture, the trades, industries and home economics; to provide for coöperation with the states in the preparation of teachers of vocational subjects; and to authorize the appropriation of money and to regulate its expenditure."

Under this bill the appropriations commence in 1917 and increase annually in amount until 1925, after which they remain constant. Appropriations for agricultural education are divided among the states in proportion to their rural population, appropriations for industrial education are divided according to urban population, and appropriations for the training of teachers are divided according to total population. All appropriations are based on the condition that the states themselves appropriate like amounts for the same purposes. No part of the appropriations may be spent for lands, buildings, repairs or rentals, and no part may be used to benefit any religious or privately owned schools. Separate state boards appointed in each state are responsible for all money received by the states, while the administration of the bill itself is to lie with a Federal Board for Vocational Education, consisting of the United States Commissioner of Education and four associate members to be appointed by the President, these to receive a yearly salary of $5,000 each.

Provisions of the Bills

The bill stipulates in broad terms the kinds of schools that may be established, but leaves the details to be formulated according to local needs. Most important among the conditions imposed are that the education shall be of less than college grade; that it shall be designed to meet the needs of persons over 14 who are preparing for farm work, a trade or an industrial pursuit, or who have already entered upon such work; that at least half the time of instruction for persons not employed shall be given to practical work on a useful or productive basis; that at least one-third of the appropriation to any state be applied to part-time classes for workers already employed; that the minimum age limit for evening industrial schools be 16 years and that the instruction therein be confined to that which is supplemental to the daily employment. Certain modifications of these conditions may be made in towns of less than 25,000.

Almost identical in form with the Hughes bill is the Smith bill of the Senate, reported favorably by the Committee on Education and Labor on Jan. 31, 1916, and now on the calendar awaiting consideration. In two most important respects, however, does it differ: First, it provides no money toward the salaries of teachers of home economics; and, second, it provides that the Federal Board for Vocational Education shall consist of the Postmaster General, the Secretary of the Interior, the Secretary of Agriculture, the Secretary of Commerce and the Secretary of Labor, these officials to shoulder the entire administration of the work in addition to their other duties. It also "appropriates" money instead of "authorizing" such appropriations.

At the present time there are differences of opinion regarding certain provisions of the Hughes bill and of the Smith bill as outlined. The committee of the United States Chamber of Commerce appointed to consider the question of vocational education has reported strongly in favor of the principle of Federal aid and of most of the provisions of the bills. It believes, however, that the Federal board of administration should not be constituted as outlined in either bill, but should be representative of all the interests concerned—namely, industry, commerce, labor, agriculture and education. It feels that the importance of the work will demand the entire attention of the board—men unfettered with other duties—and that its members should be paid $10,000 per year instead of the $5,000 provided by the Hughes bill, in order to command the great ability needed. This committee also believes that it should be mandatory that the board appoint advisory committees to represent industry, commerce, labor, agriculture, home making and education and that the appropriations should not necessarily be denied to private or religious schools.

These recommendations are embodied in a new draft of a bill submitted with the report and based, as is the Hughes bill, on the bill originally recommended by the Federal Commission on National Aid to Vocational Education in 1914. The principal recommendations have been submitted, under date of Apr. 1, 1916, for a referendum vote to all members of the Chamber of Commerce. The returns on this vote were due on May 16, 1916.

The total annual sum spent for vocational education under the full operation of the educational bill would be more than double the amount of the Federal appropriation, or in excess of $14,000,000. A goodly share of this would be spent for industrial workers. Whether this would meet the problems or fail to meet them depends upon the present provisions of the bill and upon their future execution. In proportion to the effectiveness with which the manufacturers would have their problems tackled, in that proportion must they share their responsibility in passing the right kind of legislation and in securing proper representation in its administration.

The Responsibility of Manufacturers

What, then, shall be the attitude of manufacturers, as businessmen, toward the framing and the passing of this legislation? Shall the bill be scrutinized carefully for features that may seem objectionable? Shall it be searched for omissions that might lower its maximum usefulness to industry and industrial workers? Shall the importance of the influence of industry in the future development of the education proposed be realized? Or will manufacturers sit with folded hands and silent voices and expect the legislators and pedagogues to do these things for them?

It cannot be hoped that the vocational bill will receive undivided support. There is undoubtedly a type of producer, well known to most of us, who will oppose it most bitterly. This man thrives on the youth of his workers, for his specialized work is mastered by mere children. When their increasing age brings responsibilities that demand commensurate wages, his regard for them has left. They are discharged to make room for younger brothers and sisters and are returned to the world without an education and without a trade. With his short sight, such an employer will oppose anything that savors of even slight inconvenience or expense. He is as great a menace to industrial progress as he is to society at large. Who knows but that the dissatisfaction expressed with the recently enacted vocational legislation in Pennsylvania has come largely from this type?

As stated before, it is not expected that the passage of the Hughes bill will bring a millennium. It is but a step in the right direction. Since its help is indirect, public opinion alone can determine the time and extent of its maximum effectiveness. Like most legislation in a new field, the bill undoubtedly contains both strong points and weak points. But on the whole, it looks sane and reasonable and holds promise.

If the solution of the problem of training young workers is to be permanent, it must ultimately be profitable to both the employer and the worker. It must not exploit the latter and seek to lower wages by increasing the supply of skilled labor; neither must it so educate our youth that they will look down upon work. This is a fit problem for employers and educators, working hand in hand. It is too large for either alone.

Variation of Cost with Volume of Work

By Dexter S. Kimball*

All managers who have cost systems have been confronted with the trying problem of rising costs as the volume of work in the factory diminished. Though much has been written on the general theory of cost finding, this particular feature has not been clearly explained and is not in general well understood. A former article (see page 932) dealt with the rise and fall of costs due to variation in volume of work as affected by the cost of tools or cost of preparation. The present article has to do with the rise and fall of costs with the volume of business as affected by expense or burden.

It should be mentioned that the volume of product passing through a factory may vary in several ways. There may be a uniform increase or decrease in every line manufactured; or some lines may increase or decrease in volume while others do not change; or some lines may increase while others decrease. All these changes may be in any relative proportion whatsoever. The arguments presented will be clearer if only the first two of these varying conditions are considered—namely, when the volumes of all lines rise and fall together, or where some lines fall markedly while others remain normal.

Now if expense varied directly with the volume of work, there would be no change in cost so far as expense is concerned with either of the methods of variation of volume under discussion. Such, however, is not the case. An examination of the expense factors of any enterprise will show that, while some are fairly constant in amount, others rise and fall with increase or decrease in the volume of the business, though not according to the same laws. Thus many expenses that are incident to the very existence of the business regardless of productive operations, such as rent, taxes, insurance and depreciation of buildings, do not vary materially whether the business is active or not. Other factors of expense, such as indirect labor and operating supplies, vary with the volume of business, though not in general in direct proportion to such variations in volume. Thus it requires a minimum amount of oil to lubricate the machinery of transmission when no work is being done, and any more oil is obviously dependent upon the volume of work. Many other expenses have similar characteristics. It is difficult to express these relations in terms of any fixed factor of production, but the general law may be expressed by the equation

$$E = c + fv,$$

where E is the expense, c the minimum constant amount and fv some function of the volume, which function in general is a complex quantity and difficult to express mathematically.

If then the volume of all lines of product decreases, it is obvious that, no matter what method of expense distribution is in use, a rise in productive costs must inevitably result, since the characteristics of expense are alike for all lines of product. If the decrease in volume is great enough, all lines will cease to be profitable because of the irreducible minimum expense. The conditions are analogous to those pertaining to special tools or preparation costs discussed on page 932. If no product is produced, this minimum expense still persists and constitutes an irrecoverable loss.

When Some Lines Are Normal and Others Decrease

If, however, the volume of some lines remains normal while that of some others is markedly decreased, the case is different. Under all averaging methods of expense distribution, such as percentage on labor or percentage on man-hours and where all expense is charged off over current product as fast as such expense accrues, the active lines must necessarily carry not only their own expense, but the expense due to idle tools that may not have been used in producing these active lines. If the volume of the active lines should decrease even a moderate amount, it is obvious that this over-burdening might cause these active lines to be a source of loss, though the efficiency of production was not materially changed. If an accurate machine rate could be made that would distribute all expense in proportion to the use that is made of each and every facility, this over-burdening would not occur and each line would bear only its own just share of expense. Such a machine rate is difficult, if not impossible, to obtain. It will be noticed that the production-center method aims to do the very thing; and in so far as the machine rate of the production-center method is concerned, it is in accord with the theory of proportional distribution of expense. The supplementary rate, however, which grows out of the inherent defects of the machine rate, is illogical in so far as it distributes expenses belonging to one class of work against the cost of another class.

It would seem logical that any product should bear only the expense incident to its fabrication. There would seem to be no reason why one line of product should bear the burden of another any more than that one factory should bear the burden of another factory, simply because they both belong to the same man. It is very difficult, however, in most factories to segregate the expense so as to make proportional allocation of expense with any degree of accuracy, and the assumed necessity of distributing all expense as fast as it accrues is the justification usually put forward for such methods as do sometimes burden one line of product with what really belongs to another. Many accountants and managers insist, however, that the expense distributed against any product should be strictly proportional to the use it has made of the facilities of the factory, and any other expense belonging to any other product should be disposed of in some other way.

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One of the methods suggested for solving this problem is to carry all expenses due to idleness directly to the profit and loss account and charge them off as a loss against the business. The error in the reasoning back of this plan is that it assumes that all machines should be in operation constantly and that, therefore, all expense due to idleness is irrecoverable—an assumption that is not necessarily true. A machine may be indispensable and yet be idle a considerable portion of the time, and the expense charge for such a machine should be set so as to discharge the total yearly expense over the production for that period.

This solution of the problem, furthermore, might often result in carrying to profit and loss an expense that could be included in costs and thus recovered. Aside from any logical principles of expense distribution, expediency would dictate that as much expense as possible should be buried in the sales prices, regardless of the origin of these expenses, provided, however, that this does not destroy the possibility of making sales by over-burdening product that normally would produce a profit.

Distributing by Averaging Over a Year or Longer

Another method of solving this difficulty is to carry all expense to an expense account in the usual manner and distribute it by one of the averaging methods already referred to, but adjusting the rate of distribution on the experience of a year, at least, instead of on the records of the preceding month. The expense account, therefore, will act as a reservoir discharging more of the expenses in busy times and less in dull times. It would of course also equalize periodic expenditures, such as taxes, etc. If the rate of discharge be accurately set, the entire expense should be discharged at the end of the period for which the rate of discharge has been computed. Should there be an undistributed balance in the account at the end of the fiscal year, it can be carried to profit and loss or it can be carried forward into the next period and the rate adjusted so as to distribute it over this period. While this method provides for distributing all the expense without great danger of unduly over-burdening production during dull times, it is of course open to the objections that are urged against all averaging methods of expense distribution.

H. L. Gantt, discussing this problem in an interesting paper presented before the American Society of Mechanical Engineers,[1] argues that "the indirect expense chargeable to the output of a factory bears the same ratio to the indirect expense necessary to run the factory at normal capacity as the output in question bears to the normal output of the factory." That is, if the production falls to, say, one-third the normal volume, this production should be burdened with only one-third the normal expense, so that, everything else remaining the same, the manufacturing costs would not change with volume of product.

Granting that proportional distribution of expense is logical and desirable, Mr. Gantt's contention is true only when the decrease in volume of product is brought about by the complete suspension of production in some lines while the remaining lines are continued at normal volume. His contention will be approximately true also for small decreases in all lines of product. But if a great decrease takes place in all lines of product, a rise in productive costs must surely result from causes that lie in the very nature of expense itself. As has been explained, expense does not in general vary proportionally with volume of product, but there is always an irreducible minimum that must be cared for no matter how small or how great the volume of product may be. If all lines of product continue to decrease in volume, there surely comes a time when all manufacturing will be conducted at a loss; and no method of expense distribution can obviate this result. It will appear from the preliminary discussion in this article of the characteristics of expense that the relation between expense and volume of product cannot be expressed in this simple manner.

[1]See "Journal" of the American Society of Mechanical Engineers, August, 1915, p. 466.

Possibilities of an Intelligently Computed Machine Rate

It would appear that an intelligently computed machine rate in connection with a supplementary rate based on the experience of a long period of time would do much to solve this perplexing problem. Such a machine rate would distribute all expenses that are attached to machines or processes in proportion to the use that is made of them, regardless of the volume of product. The bulk of the expenses would therefore be proportionately distributed even in times of moderate depression. The supplementary account containing the expense due to idleness would be equalized not only over processes, but over periods of good times and depressions, thus minimizing to some degree at least the danger of illogical over-burdening and at the same time distributing all expense into the shop costs. I am not aware that this method has been tried, but it would seem to have some merit.

It should be remembered, however, that all these methods of equalizing expense distribution are helpless against extreme depressions. There is no account to which expense can be carried and disposed of by some trick of accounting any more than it can be safely forgotten. Any expense that is not included in the costs and recovered in the sales is a loss. Furthermore, the entire question of variation in expense burden with change in volume of product is complex. Sweeping generalizations regarding it, or in fact regarding any phase of cost finding, are usually unwise, and the particular phase of cost finding discussed in the foregoing paragraphs will bear close inspection in each case before drawing definite conclusions.

Shop Transportation

By Gustave Remacle

Recently, what at first sight appeared to be a rather laughable method of transportation proved upon reflection to be the best under the existing circumstances. The shop was so crowded with misplaced machines that it was impossible to walk more than four or five paces without dodging or ducking around obstacles. The floor was so wrinkled and full of holes that the use of hand trucks was wisely avoided.

An apprentice was given the task of moving about a hundred large milling cutters from one department to another, care being exercised that they did not become nicked at the cutting edges. He accomplished this by placing ten cutters at a time upon the handle of a broom, dragging the broom along the floor. Transported in this manner the cutters came in contact only at the sides, thus avoiding nicking at the cutting edges. I don't think this method could have been improved upon.

Fixtures Used for Machining Automobile Parts

EDITORIAL CORRESPONDENCE

SYNOPSIS—In this article are shown tools and methods employed in machining automobile parts. The fixture for forming the rounded contour on internal levers is unusually simple in construction. An indexing fixture serves for milling the serrations on brake-lever nuts. The brake-lever milling fixture is made in two parts, which may be placed in different positions on the table to suit various lengths of levers. A fixture for milling the slots in screws is also worth noticing.

The International Motor Co., Mack Plant, Allentown, Penn., is using some interesting methods in manufacturing automobile parts. In Fig. 1 is shown the tool for machining the circular contour of the internal levers. The forging has been previously turned to the correct dimensions. It is then placed in the fixture, as shown, and located and securely held in a machined recess.

The fixture is fastened to the table of the miller. The pin of the lever is dropped into a hole of the arm *A*, which is fastened by a nut to the arbor supporting arm of the machine. Thus when the table is fed along with the 8-in. cutter *C* revolving, the internal lever is swung on an arc and the rounded surface of the part is produced. The cutter operates at 19 r.p.m. with a feed of 0.016 in. per revolution.

In Fig. 2 is shown the fixture for machining the rounded surface around the shaft. The forging is placed in a hole of the fixture *A*, which is fastened to the machine table with the 8-in. cutter *B* revolving at 59 r.p.m. The handle *C*, which fits on the machined square of the part, is swung around. In this manner the surface is given a rounded contour.

The fixture for milling the serrations on the brake-lever nut is illustrated in Fig. 3. The nut is placed in a bushing of the fixture, and by drawing back the handle *A* the part is securely tightened down by friction.

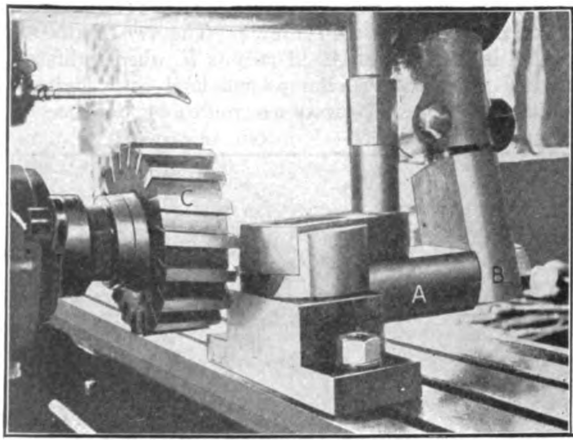


FIG. 1. MACHINING INTERNAL LEVERS

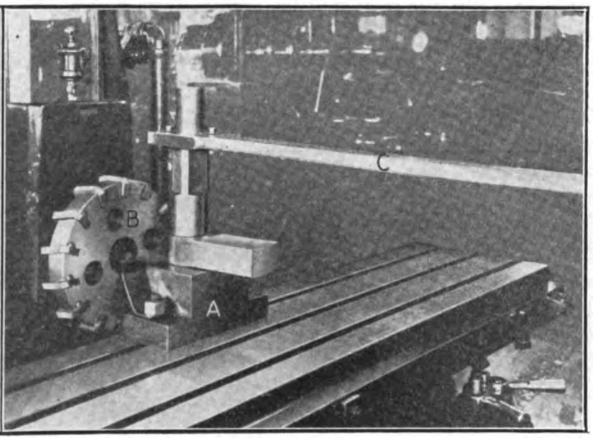


FIG. 2. MACHINING SURFACE OF LEVER

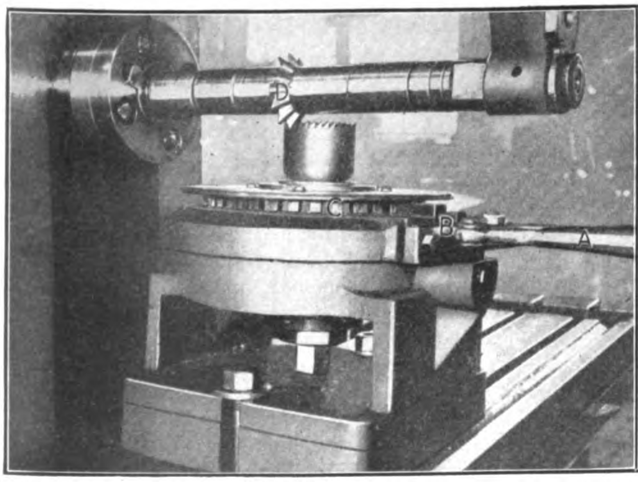


FIG. 3. MILLING BRAKE-LEVER NUT

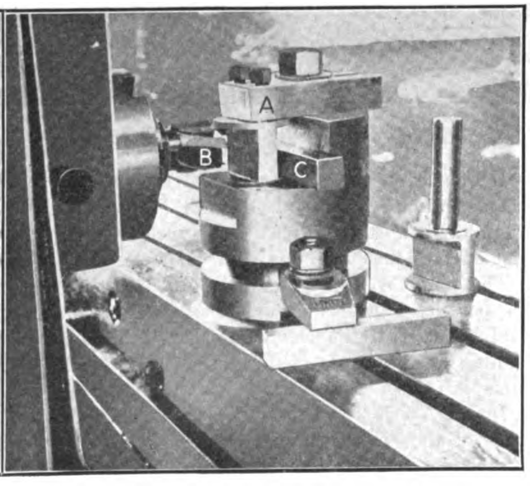


FIG. 4. MILLING THE BRAKE CAM

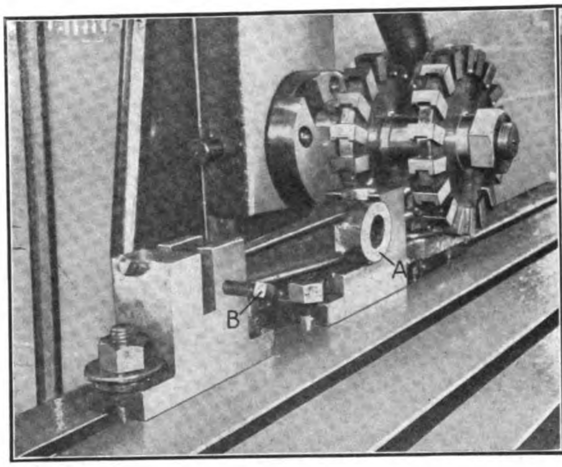


FIG. 5. MILLING BRAKE LEVERS

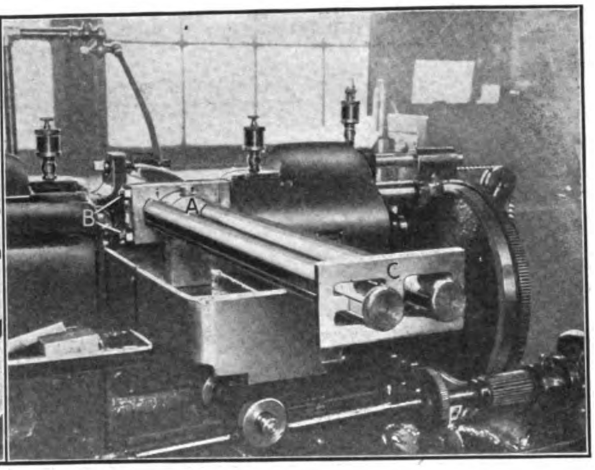


FIG. 6. MILLING SLOTS IN SHAFTS

The various positions are obtained by an index pin at *B*, which drops into the notches of the wheel *C*. After one serration has been machined, the handle is pushed forward, which carries around the chuck holding the part being milled. The handle is then drawn back until the pin indexes, when the lever nut is in position for the next milling operation. The surfaces are machined with the 2½-in. 45-deg. cutter *D*.

The fixture for machining the brake cam may be seen in Fig. 4. The forging is placed in the fixture, the turned shaft fitting into a bored hole. The clamp *A* is tightened on the part to hold it securely. The table is fed against the 1½-in. end mill *B*, operating at 218 r.p.m. with a feed of 0.01 in. per revolution, and the first surface machined until the depth is obtained.

The clamp is then loosened, the cam slid around and the parallel *C* pushed into position. The cam is again held down with the clamp, as described, and the machining operation repeated. One of the machined brake cams is shown at the right of the fixture.

In Fig. 5 is illustrated the method of milling the sides of the emergency-brake levers. The large end is placed in the V-surfaces *A*. The small end of the rod rests on a support and is held rigid by the screw *B*. The fixture is held down to the table with bolts in the usual manner. The surfaces are then straddle-milled with the two 7-in. inserted-tooth cutters operating at 61 r.p.m. with a feed of 0.03 in. per revolution. The advantage of this type of fixture is that the two elements may be placed on the table to suit various lengths.

The fixture for milling the keyways in the service-brake shafts is shown in Fig. 6. The two shafts are located in V-blocks at *A*. The nuts *B*, when tightened, draw together the two clamps and hold both shafts in position. The two keyways are milled by the machine in the usual manner. The shafts are then reversed and the keyways located by the gage *C*, which is made with projections that fit into the machined splines, thus holding them squarely. The other ends of the shafts are located and held in a manner similar to that described. The machining operation is repeated, bringing into alignment the keyways at both ends of the shafts.

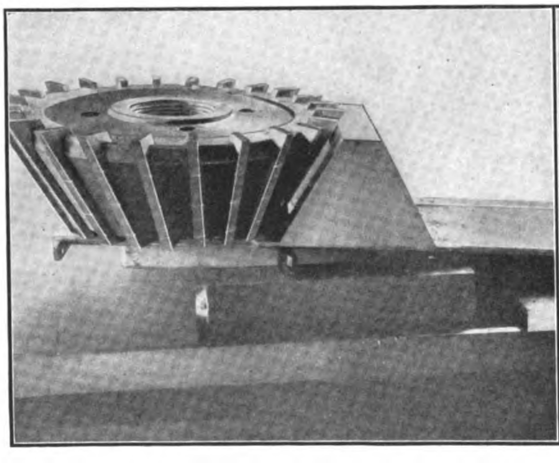


FIG. 7. MILLING BEVEL ON RADIATOR TOP

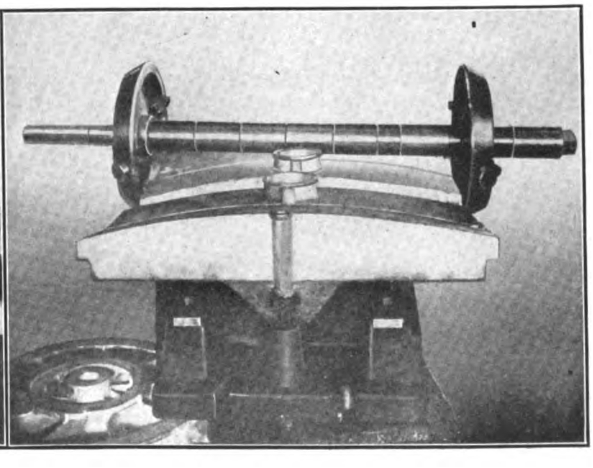


FIG. 8. MILLING SIDES OF TOP

In Fig. 7 is shown the cutter used in machining the beveled surface on the radiator top. This tool is 16 in. at the large end, 5¾ in. high and has an angle of 60 deg. It has 24 inserted high-speed cutter blades.

The cutters and fixture for milling the sides of the radiator top are illustrated in Fig. 8. The cutters,

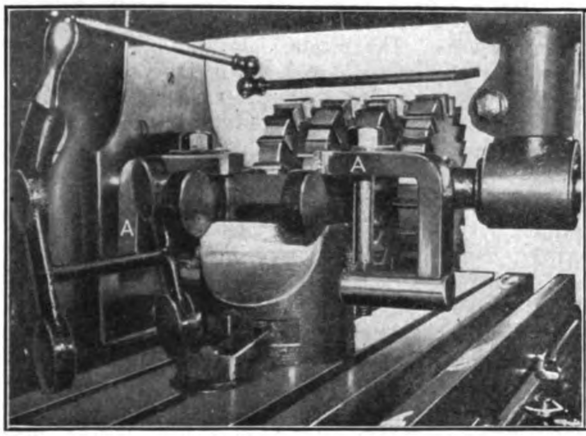


FIG. 9. MACHINING SPRING SHACKLES

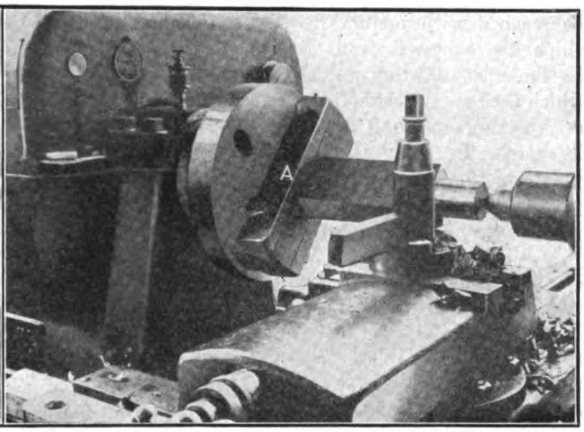


FIG. 10. TURNING BRAKE-SHOE CAM

which are interesting and novel, are 14 in. in diameter. Each has two cutting tools made from 5/8-in. square high-speed steel. They are held in a bushing that is drawn back with a nut, as shown. This type of cutter has proved very successful, producing a good surface. These cutters operate at 163 r.p.m. with a feed of 0.012 in. per revolution.

The fixture for milling the spring shackles may be seen in Fig. 9. The forging is rigidly fastened down with the clamps *A*. The table is then fed against the four 8-in. inserted-tooth cutters operating at 332 r.p.m. After one end has been machined, the table is lowered and fed over. When the fixture is in the proper location, the table is raised and the other end of the shackle machined. In this way the various surfaces are milled in alignment.

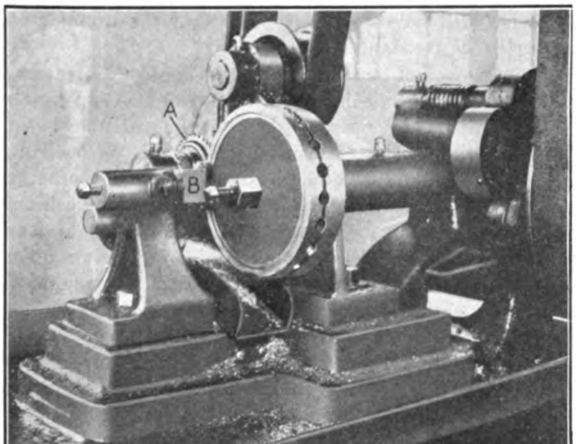


FIG. 11. MILLING SLOTS IN SCREWS

The lathe and method employed for turning the brake-shoe cam are shown in Fig. 10. The rectangular bar is placed on centers and is driven by the sides of the chuck faceplate *A*. These parts are made of 0.20 carbon openhearth steel, and the lathe operates at 160 r.p.m.

In Fig. 11 is illustrated the milling of the slot in headless screws. The parts are placed in the holes shown on the fixture, which carries around the screw against the revolving cutter *A*. When the screw is being slotted, it is held tightly by the adjustable block *B*, which presses against the side of the fixture. As the tool follows around, the pressure caused by the block is removed and the slotted screw drops out. The fixture is thus automatic, the operator simply placing the screws in the holes. The machine will slot on an average of 200 screws per hour.

Disposal of Scrap and Refuse*

By W. Rockwood Conover†

The collection and disposal of scrap merit careful attention. The results obtained from systematic handling of this material in large plants are worthy of consideration. The manufacturer who has given little thought to the subject will find that time or labor expended in conserving and utilizing waste products of the factory is money well invested, and the returns from such labor represent no inconsiderable fraction of his income.

A building devoted to storage and sorting, where these materials can be collected from the several shops, is of advantage. All lots of miscellaneous scrap metals, as well as apparatus to be scrapped, can be sent to this building to be sorted and prepared for shipment to the outside market or for delivery to the home foundries. There is little, if any, material about the factory that has not sufficient value to pay for its handling in this way.

It is often desirable to have borings and turnings of various kinds put into separate barrels or receptacles in the shop and properly weighed and marked, in order to give each department credit for its scrap product when received at the central scrap building. This work can be done by the regular force of floor sweepers or laborers. A practical method of handling steel and iron borings and turnings in large machine shops is to place at several points on the floor sheet-iron boxes or receptacles of convenient size, capable of holding from one-half to one ton and with handles attached to each end for lifting and carrying with the shop cranes to open cars that may be run into the shop. These receptacles should be placed in localities as convenient as possible to several machine tools and where they can

*Prepared for the author's forthcoming book on "Industrial Economics." Copyright, 1916, Hill Publishing Co.

†Factory economist, General Electric Co.

be reached with facility by the overhead cranes. The chips are removed from the machines and deposited in these boxes with practically the same facility with which they are deposited in wheelbarrows, and the expense of wheeling out long distances to platforms or sidings is saved. In manufacturing plants where there is no provision for running cars into the shops permanent platforms with inclined approaches should be erected near the sidings in as close proximity to the shop doors as is possible without interfering with the ingress or egress of production materials, so that the chips can be wheeled and dumped into the cars with one handling.

Collecting Chips from Machines

Too much care cannot be taken in the collection from the machines of such materials as steel and iron borings and turnings, which represent a large proportion of the waste products in many manufacturing plants. The difference in price between mixed and clean borings and turnings is such as to warrant the employment in most cases of sufficient labor to remove the different classes of metals separately, when machines are run on more than one kind of metal. In shops where a large number of machines are in operation it is often desirable to place the collection of chips or turnings under the control and supervision of one person. A man of sufficient intelligence can be selected from the floor-sweeping gang for this purpose without interfering in any great degree with his regular work. The duties of the foreman or assistant foreman in large departments usually prevent either from giving to this subject, except in a general way, the attention that it merits.

The same careful supervision should be given to the separation of brass, composition, copper and other turnings from automatic screw machines and all classes of machines operating on these metals.. A considerable portion of this material can be used at the home plant in making the various alloys for composition castings produced in the brass foundry. Copper and brass turnings that have become mixed with iron, steel or other metals through frequent change of work should be run through a metal separator before shipment to dealers. The difference in price between mixed turnings and pure copper or brass scrap is so great as to render unnecessary any discussion of the subject from the viewpoint of economy and profit. The chips from screw machines or other machines using oil as a lubricant should be run through an oil extractor and the oil separated. This oil is valuable and can again be used for cutting purposes. The net result of reclamation shows a good profit over the expense of operating the separator and of other labor connected with handling the chips.

Collection and Disposal of Refuse

The collection and disposal of refuse is commonly looked upon as an item of dead expense, but even this material has a limited percentage of value which redeems it from total loss. In the erection of manufacturing plants the layout commonly provides for the convenient and systematic handling of productive materials. On the contrary, the economical disposal of refuse or of waste products possessed of greater or less value usually receives but a limited degree of attention. Small dump-cars should be stationed at convenient points alongside raised platforms, so that the material can be wheeled from the adjacent shops or yard and delivered directly into these vehicles. The practice of clearing refuse from shops and depositing it in heaps in the yard and open areas, to be rehandled, is most expensive and is such bad economy as hardly to admit of discussion. The space occupied by these heaps of refuse is frequently wanted for temporary storage of castings or other productive materials, and the cost of removal, especially during the winter months when the mass becomes frozen, is necessarily excessively large. A trial of the system suggested will give results in reduced handling expense that will convince the manufacturer still pursuing the old method. In most establishments the cost of necessary equipment of cars and platforms will be, within a limited period, offset by the economy effected.

A considerable percentage of refuse in many manufacturing plants is adaptable for fuel under steam boilers. Where its consumption in the power house is not deemed practicable or desirable, the erection of a refuse-burning plant of suitable size will permit its being converted into steam for power or heating purposes. In factories where the production materials consist largely of metals the refuse should be inspected before it is fed to the boiler in the burning plant, as the cans or receptacles used for its collection in the several shops will frequently be found to contain pieces of scrap metal that have been thrown in by the careless or unthinking operative. Where no burning plant exists and the refuse from the shops is consigned to one common dumping ground, it is of equal importance that such refuse be carefully inspected and all material of value, such as copper, brass, and other metals, removed and saved. As high an average as 100 lb. or more daily of copper or other valuable metals may thus be recovered. The manufacturer who has not tried this plan will be surprised to find that the dump heap is worthy of constant inspection.

The removal of ashes from power houses and of slag and other refuse materials from foundries also constitutes a large item of expense. Many modern plants are equipped with mechanical conveyors for this purpose. In a large percentage of others, however, the old practice still prevails of wheeling out in barrows to storage heaps and of periodically rehandling these materials to load them into cars. If the accumulation of ashes or other waste products is sufficiently rapid, it is more economical to transfer them directly to cars by means of mechanical conveyors. Even where refuse is used to fill some natural depression, a conveyor system, either alone or in connection with narrow-gage dump-cars, is undoubtedly the most economical and most satisfactory method of disposal. Foundry slag should be carefully looked over and run through tumbling barrels where practicable, in order to reclaim all the metal possible before consigning to the dump or fill.

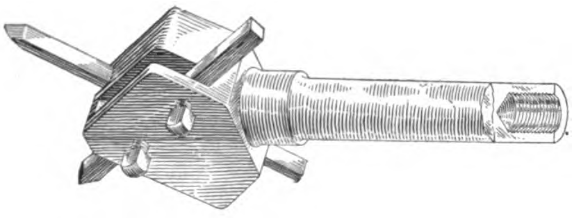
Reducing Glare of Light Bulbs

If prussian blue be applied to the light bulb as far down as necessary to prevent the direct glare of the light from shining in the eyes, it will be found much more comfortable for the workman. It is pointed out by Fred Fruhner. This will throw a bluish light to the eyes, but the direct rays of the light are thrown on the work. The blue should be evenly laid on.

Letters from Practical Men

Adjustable Tool-Milling Cutter

The illustration shows a milling cutter that has given good satisfaction. The holder is of machine steel, with the shank fitted to the miller spindle. The cutting



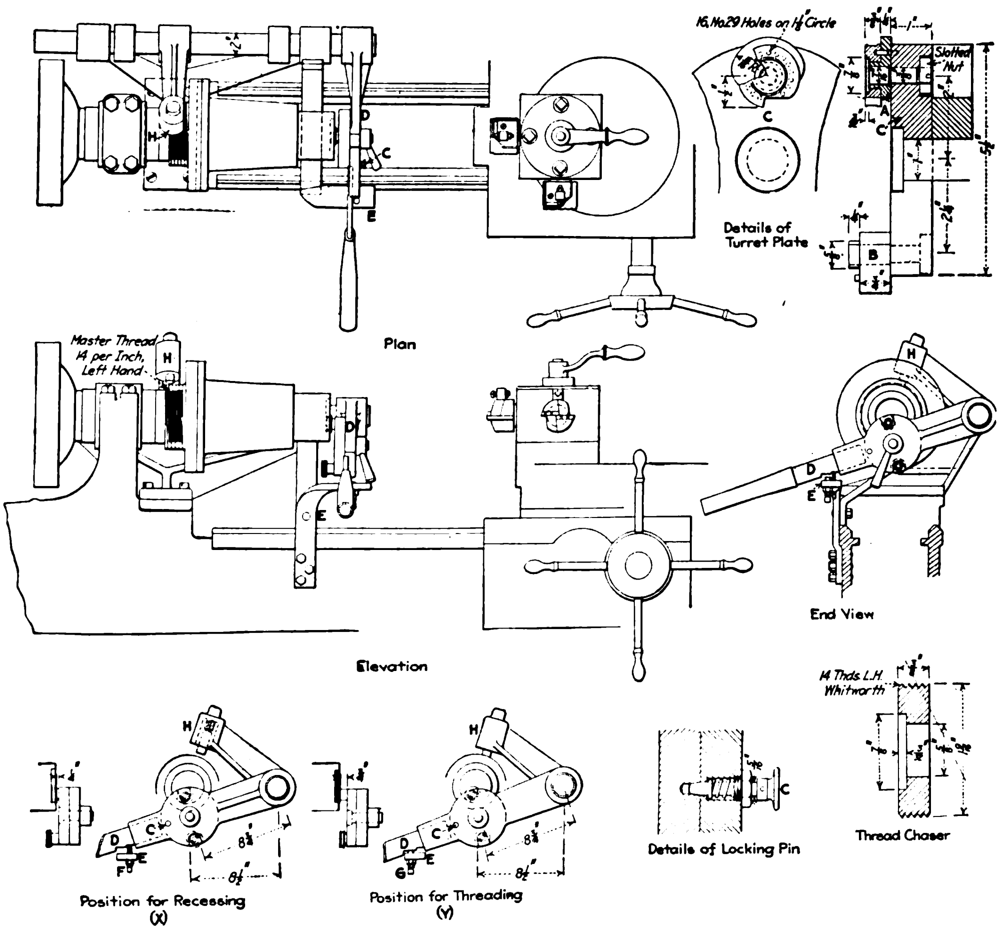
ADJUSTABLE TOOL-MILLING CUTTER

tools are of high-speed steel, square section, and are adjusted to mill various diameters by being arranged at an angle to the center line of the holder. For ordinary setting of the cutters the holder is placed in the miller. Each cutter in turn is allowed just to touch a small surface piece resting on the platen and is then clamped.

Bridgeport, Conn. CHARLES P. BALL.

Chasing Bar Attachment for Threading Shells

The drawing shows an attachment which may be adapted to any turret machine for recessing, counterboring and threading the base of high-explosive shells for the gas plug. The output on 4.5-in. shells is twelve per hour, and the attachment does a superior job when compared with the work of the high-priced thread-milling machines. No rut is left where the cutter starts and stops, but the thread is perfectly clean and continuous throughout. The process is known as chasing with a multiple thread cutter. There is, in addition to the general views of the attachment, an illustration at X of the hand lever for counterboring.



CHASING BAR ATTACHMENT FOR COUNTERBORING AND THREADING SHELLS

Its position in chasing the thread is shown by another view at Y. Details of the turret plate C are also given.

The shell is placed in the chuck; and the recess, which had been previously roughed out on a heavy drill press, is finished with the flat cutters held in the main turret. The turret is run back, and the hand lever with the counterboring cutter in position is brought down as shown in the three general views. The brass follower in H is so disposed that it does not engage the master thread while counterboring the recess. In the details of the turret plate the counterboring cutter holder A is ½ in. thinner than the threading cutter holder B, causing the lever to come in contact with the proper stop screw in the plate E, the one at F being for depth of counterbore and the other at G for depth of thread.

To chase a thread, the operator turns the turret plate to the position shown at Y, moves the cutter up to the bottom of the recess in the shell and bears down. This brings the brass thread follower at H into engagement with the master thread on the hub of the chuck plate, causing the multiple thread chaser to advance the proper number of threads per inch. Several cuts are necessary to finish the thread. When the hand lever comes down on the stop screw G, which determines the size, the thread is finished.

With this arrangement it is impossible for the operator to use the wrong stop, as turning the turret plate determines all the rest. H. P. HOAG.

Brantford, Canada.

Two Handy Planer Tools

In many shops where a variety of planer work is handled, the machinist is often up against it for tools.

The universal tool holder shown in Figs. 1 to 3 takes the place of single-sided tools and tool holders, as it can be used to advantage anywhere they can be used.

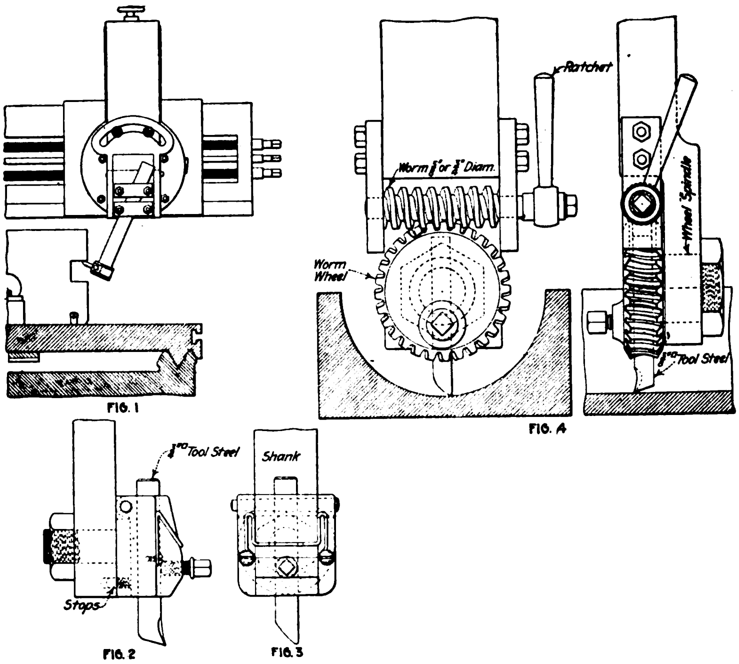
It can be made cheaply, three forgings only being necessary. The shank of the tool should be rather long, and it need only be finished at the bottom, faced on both sides and bored for the swivel-box spindle.

The swivel box and the tool block are machined as shown. The taper-pin hole is drilled with the two parts together. Any kind of spring can be used, but the one shown has proved satisfactory and is of a form quite easy to make.

In use, the apron on the head is blocked to keep it from swinging. The beauty of the lower apron, or clapper box, is that it cannot be set wrong by an ignorant mechanic—when a tool is set to cut one way, the apron must be right.

Cutting out a circle to gage, with a common round-nose tool, is about the most tedious job a planer hand can get. My dislike for such jobs caused me to make the tool shown in Fig. 4. It not only makes the work more agreeable, but does a better job in much less time.

The tool block and its spindle are solid and consist of a wormwheel with a tool slot, a setscrew and a setscrew boss, and a spindle with a nut which should tighten against a shoulder. Meshing in the wormwheel is the



DETAILS OF TWO HANDY PLANER TOOLS

worm shown, held by two plates, cap-screwed to the bar. One end of the worm shaft is squared and fitted with a ratchet handle.

In operation the head is clamped to the rail and the apron set central. The ratchet can be mechanically operated, if so desired, by clamping a stop to the table, high enough to clear the job and move the handle the necessary amount, but owing to the variation in stroke, the hand-operation of this ratchet feed is best and safest in most cases. JOE V. ROMIG.

Allentown, Penn.

Bolt-Threading Machine

Fig. 1 shows a special bolt threader. This machine is of the single-purpose type and was designed for turning and threading the taper thread under the button head of radial stay-bolts. It has a reversible gear drive, mounted on a steel-plate superstructure.

The die heads are arranged so as to be opened by hand by the lever at the side of the head. The top end of the stay-bolt is guided by an interchangeable sleeve in the spindle. Four of these guide sleeves are provided, to take care of all sizes of stay-bolts from 1⅛ to 1⅜ in. inclusive in diameter and of any length. One end of the sleeves has a plain hole and the other end a threaded hole of the respective size of the stay-bolt to be guided. The left-hand die head is furnished with plain cutters, converting it practically into a box tool. The right-hand head has the threading dies. The automatic knock-off for opening the die is not used, because the recess under the head of the bolt is cup shaped and would not permit opening the dies before the bolt is

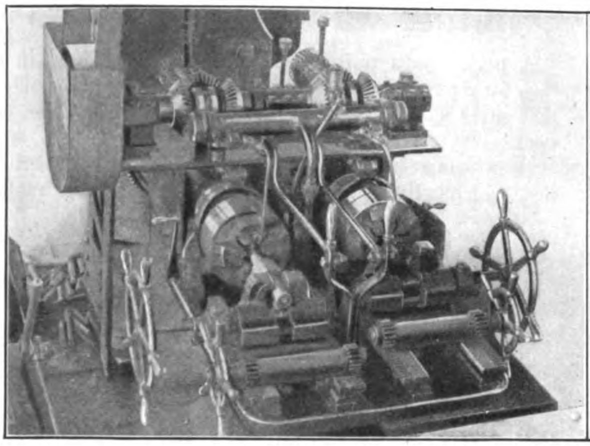


FIG. 1. BOLT-THREADING MACHINE

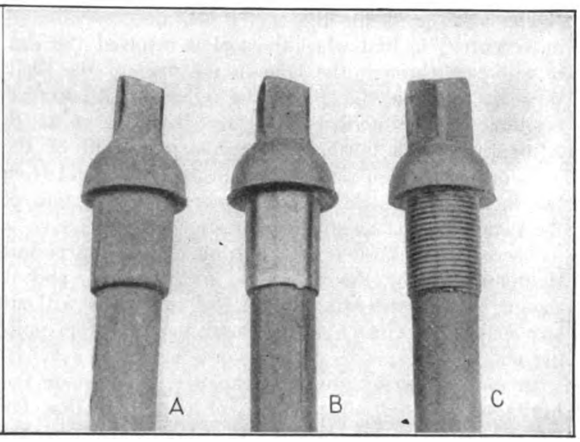


FIG. 2. SEQUENCE OF MACHINING OPERATIONS

backed out a little distance, which is the reason for the reversible drive.

In operating the machine the bolt is placed in the floating holder shown in the left-hand vise. The top end of the rough bolt *A* is entered in the guide sleeve in the spindle, the die head is closed and the bolt fed in by hand. After this operation the bolt looks like *B*, Fig. 2. Next, the bolt is placed in the right-hand head in the same manner. The guide sleeve in this spindle is threaded and can be adjusted so as to bring the threads at both ends of the stay-bolt in correct lead.

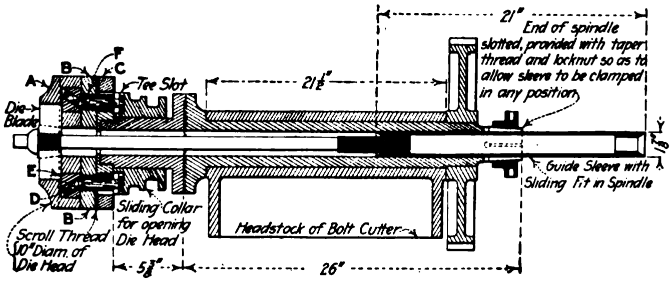


FIG. 3. DETAIL OF SPINDLE AND HEAD

The clutch on the right-hand head is adjusted to slip before any damage is done to the dies, in case the operator should run the die up against the shoulder of the bolt. Before opening the die the machine is reversed about ¼ in., so the dies clear the cupped shoulder of the bolt. After this operation the bolt appears as at *C*. Originally these bolts were turned and threaded on centers in the engine lathe at a cost of over 15c. per piece. With this remodeled bolt cutter the cost per piece has been reduced to 2c. for the finished bolt. This machine has been in service for over a year. It is convenient to operate and gives excellent results.

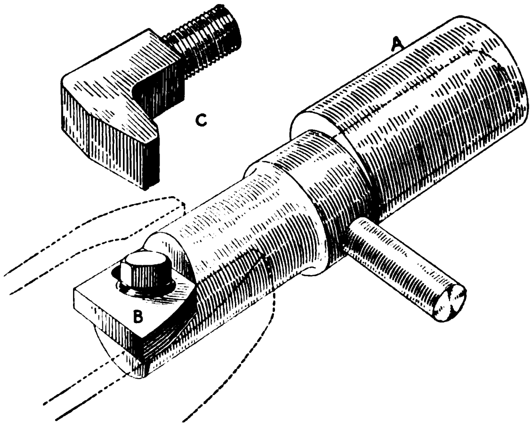
A detailed drawing of the spindle and die head is given in Fig. 3. The die head is shown in the closed position. To open it, the sliding collar is moved backward. The jaws for holding the die blades are made in two halves, *A* and *B*. Fine adjustment is provided by the scroll-thread adjusting ring *C*. The angular T-head pins *D*, which open up the front parts of the jaws, are guided in hardened-steel bushings *E* and *F*, which in turn are tightly pressed into *A* and *B*.

Minneapolis, Minn. WILLIAM SEELERT.

Forming Tool for Adjusting Shells for Weight

The illustration shows a forming tool for removing the surplus length of thread in the nose of the shells, so that the inside of the wall of the shell will match with the end of the nose socket when it is assembled. The amount of metal to be removed is very small, for if the form of the shell before nosing and the shape of the nosing are carefully watched, the length of the thread can be brought quite close to the required dimension, leaving only a shaving to come off to bring it exactly to size.

Some manufacturers are using a collapsible tool that will pass through the hole in the nose of the shell and can then be expanded. My experience with this type is that the chips will get into it and prevent it from collapsing and so give considerable trouble getting the tool out of the shell again. Another method is to make this a separate operation on a lathe, with a forming attachment actuating the slide rest of the machine.



ECCENTRIC FORMING TOOL

The tool shown herewith has no moving parts that can be clogged by chips, and it can be used on the same turret lathe that faces the shell to length and bores and taps the nose.

The bushing *A* fits the turret hole and is bored ¼ in. eccentric, so that when the tool is revolved 180 deg. it will pass through the hole in the nose of the shell. When it is inside, simply turning it back to its original position makes the tool ready for business, as at *B*. After the cut is finished, a reverse movement of the lever brings the tool into a position for withdrawal from the shell. The catches *C* are screwed into the face of the turret and act as supports or stops for the lever.

The eccentric bush is cut open on one side to permit tightening up by the setscrews in the turret, and it should be adjusted to allow the tool to revolve without any shake. The catch will prevent the tool from pulling out.

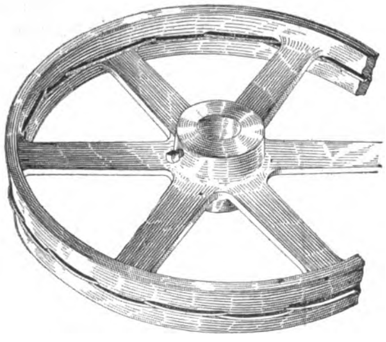
In manufacturing any high-explosive shell where the limits of thickness of the base of the shell allow for metal being removed from the base to bring the weight of the shell within the required limits, a wrinkle is as follows:

After weighing, the shell is marked either O. K. or else so many ounces to be removed. In the latter case the shell is put in a lathe on which the slide-rest screw has a dial that is usually graduated to read in thousandths of an inch. This dial should be removed and a new one put on having divisions so graduated that by advancing the screw one division after the tool touches the shell the tool will remove one ounce of metal from the base of the shell. This amount is usually taken as $^1/_{64}$ in. on the British 4.5-in. shell. With a screw of ¼-in. lead there would be 16 divisions on the dial, each division representing $^1/_{64}$-in. advance of the tool.

New Glasgow, N. S. JOHN S. WATTS.

An Improvised Crown on a Flat Pulley

This simple and effective method was devised for keeping a high-speed belt on a large-diameter iron split pulley driven from a motor. Owing to both pulleys being flat, considerable difficulty was experienced in



AN IMPROVISED CROWN ON A FLAT PULLEY

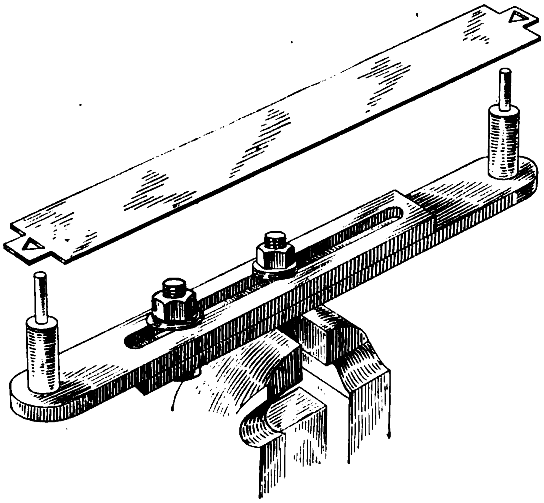
keeping the belt in the center of the pulleys. In the large pulley ½-in. holes were drilled between each pair of spokes and in the center of the face of the pulley. Two belt laces were then threaded on alternate sides of the rim, forming a false crown, as shown in the accompanying illustration. Several methods were tried before this, but without success. I do not remember seeing this arrangement before, but consider it may be a useful kink for any of your readers who have a similar difficulty.

Harehills, Leeds, England. ARTHUR BINGHAM.

Holder for Plated Patterns

A plated pattern is a very hard thing to hold in a vise, for repairing or finishing, so I have devised a holder that saves a great amount of time on these classes of work.

It is composed of two pieces of hard wood, with a slot, which will allow adjusting for any size of plate.



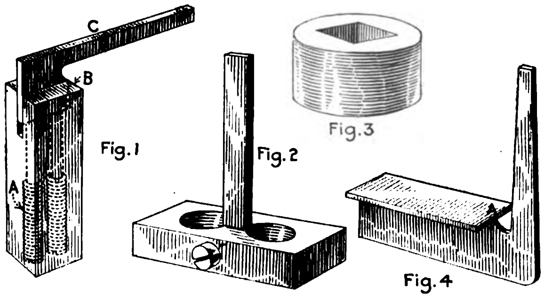
HOLDER FOR PLATED PATTERNS

There is an iron pin at each end to engage the holes in the plate, and the whole fixture is held in the vise by the shank beneath. A. E. HOLADAY.

Naugatuck, Conn.

Some Die Makers' Squares

The square shown in Fig. 1 is valuable for testing when filing out dies. The blade swings on a pin and by means of the screws *A* can be adjusted and held at any desired angle for die work. It should be noticed



FORMS OF DIE MAKER'S SQUARES

that the part of the beam *B* is lower than the blade *C*, thus allowing the operator to see the blade from both ends of the die.

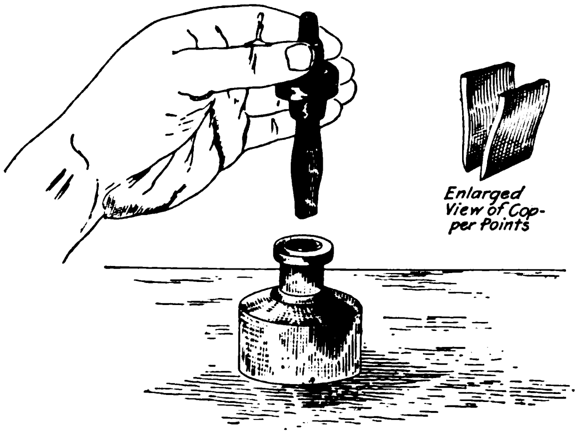
The square in Fig. 2 is particularly helpful in making die bushings, Fig. 3. Bushings of this sort do not present enough plane surface to allow testing with the other squares. Therefore this tool, which spans the opening, is useful for the purpose. In Fig. 4 is shown a handy square that can be made quickly. It consists of two pieces of sheet steel soldered together at *A*.

Newark, N. J. GUSTAVE A. REMACLE.

Discussion of Previous Question

Helpful Drafting-Room Kink

The illustration of my drafting-room kink, on page 188, does not agree with my idea of the quill shape. There is no attempt at pointing the quill pen-shaped in my sketch, but it should be made with a broad pen, such as is used



HELPFUL DRAFTING-ROOM KINK

in sign writing. My description states for what it is used—for quickly changing blueprints by making any inked-in or changed dimension or note more prominent, so that when the blueprint gets into the shop and is handled by oily or greasy hands the important change will still be noticeable. W. J. Gaffke.

Buffalo, N. Y.

Making Patterns and Castings for the Small Shop

On page 667 Mr. Van Deventer points out some of the many troubles the small shop may run up against, especially in pattern work and the foundry. Now I do not mean to criticize any of those statements, but I wish to call attention to certain facts based on experience with a few similar-sized plants with and without foundries and pattern shops. The shop that bought all its castings we will call Mr. Rush. Mr. Rush was a man of the old school, with modern cost ideas, and figured that it would be cheaper to buy his castings, as it would cost him nothing to scrap a defective casting. Therefore the foundry equipment was sold.

The castings in this factory ranged from 1 to 600 lb. in weight. Castings were now bought on contract, but the troubles also began. Different foundries used different mixtures and methods. Hence, some castings would not finish to drawing dimensions; in others the stock was excessive. The best joke on Rush was it did not cost anything to reject a casting. Of course, defective ones were replaced, but not very promptly. I have seen as many as 31 defective castings out of 40 pieces. Now when you figure the delay and the canceled orders resulting from late deliveries, the foundry in a small shop is not such a luxury after all

The other shop, which we will call Mr. Quick, also manufactures a standard article. Mr. Quick began with eight men and bought his castings, but soon found out that he must know what went into his product, which is exactly the same as that made by Mr. Rush.

What I have said regarding the foundry applies equally to patterns made on contract. Of course, I do not mean that all jobbing foundries or pattern makers do poor work; but good work costs more money, and it is always or nearly always the lowest bidder that gets the contract. G. Strom.

Brooklyn, N. Y.

Taper-Shank Drills

On page 554 of the *American Machinist* a writer calls attention to the proportion of drill sizes in relation to standard Morse taper shanks. He says: "The No. 1 taper on the shank does not change over to No. 2 until $^{37}/_{64}$ in. is reached. This leaves too weak a tang for the $\frac{9}{16}$-in. drill, * * * * being out of all proportion to the stresses to which such a drill is ordinarily subjected."

This would no doubt be the result if the drill were to be pushed to the limit of its endurance in hard material on a machine fitted with powerful automatic or power-feed drive.

The writer of the article presumes that it would be just as difficult to have manufacturers of drills adopt changes in the various sizes of taper shanks as it would be to have them all adopt a single standard taper on all tapered machine parts. It may therefore be of interest to call attention to the fact that these changes have already been effected by some makers. For instance, the Birmingham Small Arms Co., in England, has for some time standardized and put on the market small-sized drills with larger taper shanks than the usual older-style standard adopted by the Morse Co. The No. 2 taper takes in drills from ½ to $^{55}/_{64}$ in., No. 3 taper ⅞ to $1\frac{3}{16}$ in., No. 4 taper $1^{13}/_{64}$ to $1\frac{23}{32}$ in. These dimensions approach the changes suggested in the previously mentioned article.

It would be interesting to obtain more information with regard to the Morse Co.'s data, as the sizes may after all have been sound policy from a commercial point of view both in manufacturing and selling, as this company manufactures standard twist drills with taper shanks larger than regular as follows:

Taper Shank No.	Diam. of Drill, In.	Taper Shank No.	Diam. of Drill, In.
2	$\frac{5}{16}$ to $\frac{9}{16}$	4	1⅛ to 1¼
3	$^{37}/_{64}$ to $\frac{29}{32}$	5	$1^{47}/_{64}$ to 2

The same company also manufactures high-speed steel twist drills without tangs, the taper shanks being designed to fit steel sleeves with clutch drive, the drill being entirely driven by the clutch—that is, two flats on the

larger diameter of taper shank—for use where a strong positive drive is absolutely necessary.

Regarding what I have mentioned concerning the data adopted by the Morse Co.'s standard for small drills, consideration must be given to another side of the matter under discussion. Many concerns engaged in producing small work on a manufacturing basis find the No. 1 taper shank a distinct advantage in some respects. Take a case in which much small work is drilled to jigs in multiple-spindle machines, or light work of a delicate construction is drilled in single-spindle machines. The size of the taper hole in the machine spindle is usually taken as a basis for selling or purchasing purposes. As conditions exist, a machine with a larger-sized taper hole in the spindle would obviously mean an increase in price for the plant, and again the advantage of a wide range of drills with No. 1 taper shanks is well known to those who use quick-change turrets or interchangeable collets for single-spindle drilling, reaming and tapping operations.

In conclusion it seems that the safest policy regarding drills, as with numerous other small tools, is "the right tool for the job." If tangs are broken through using improper sizes of shanks for heavy work, resort can always be had to various devices that it pays to stock in any well-equipped toolroom—"Use-'em-up sockets," for instance, which drive the drill by a flat ground on the shank in much the same way as the clutch drives on larger drills; or "Cleveland" double tang and drill sockets, both types of which are shown in the sketches.

Pratt & Whitney, of America, and Vickers, of England, have coöperated in the production of vanadium high-power drills twisted from flat bars with taper shanks formed by an increased twist. Their contention is that with these taper shanks there is no strain on the tang and that it is impossible to break it under any condition of drilling. The No. 3 taper starts at $^{51}/_{64}$ in., No. 4 at $1^{7}/_{64}$ in. and No. 5 at $1^{43}/_{64}$ in. I understand the smallest shank is No. 2. With this size of shank, drills are made from $5/8$ in. diameter.

The writer's experience with this type of drill has been confined to the 1-in. diameter. It can certainly take an enormous power feed without the least sign of destroying the tang. J. H. HORNER.

Glasgow, Scotland.

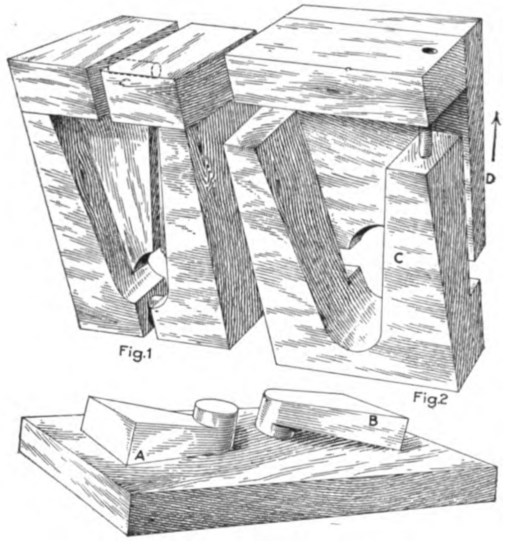
The Best Way to Make Cores and Prints

On page 640 is an article on the making of core boxes for what are known as tail-print cores, showing an "improved" way of making the core box, Fig. 2, over the old and time-honored way, Fig. 1. In making patterns and core boxes, the pattern maker must at all times bear in mind the fact that his labor and its products are not the end, but only a means to an end—namely, producing castings. Anything in the pattern or core box that would entail extra labor on the part of molder or core maker is not the best practice.

In the core box, Fig 2, it would be necessary to lift off the side of the box having the circular hole or holes and then turn over the box with the same side down before lifting off the other half. The core would be left in the position B on the drying plate, resting on the inner edge of the circle and the inside edge of the tail core, causing sag in the long tail cores and bruising the sand on the sharp edges, thus making an imperfect core.

In the old way, where the box is split on an even center, one can give all the draft required on both sides and face. When the core is rammed up, the box can be turned over with the tail side down on the flat side. The box can be taken off either side, leaving the core in the correct position on the drying plate—namely, on a flat surface, as shown at A—fully supporting the core till baked.

Personally, I should hate to suggest to any practical core maker that he make cores in the box Mr. Eyre speaks



TWO WAYS OF MAKING TAIL-PRINT CORES

of, in preference to the old-style box. As far as expense of core boxes is concerned, one could make two of the split-in-center type to one of the kind suggested on page 640. JOHN PARKER.

Boston, Mass.

[There is no reason why the core box, Fig. 2, should not be laid with the face C on the core-drying plate and rapped lightly while the part D is drawn in the direction of the arrow, after which the part C is either drawn in the opposite direction or lifted vertically.—Editor.]

Wasted Intervals in the Small Shop

With all the talk about rapid production and cost-reducing methods in the large munition factories and other manufacturing plants, it has often occurred to me that a great many of the methods used could, with modifications, be applied to the numerous small shops scattered throughout the country. Obviously, many of the developments could be used only where there is mass production, but others are broader and in some degree could be applied to almost any shop employing more than two or three men.

The division of labor can be used as an example, for I believe from personal observation that here is where the most glaring examples of small-shop inefficiency are to be found. It is a common sight in hundreds of small shops to see a first-class machinist start a piece of work and follow it through the different operations, often at-

tending to the most simple processes on it. This is unnecessary, for in almost any shop where there are two or more machinists there are, or ought to be, one or more helpers who could do some of the simpler parts of the work, such as centering shafts, almost all drilling, etc., as well as the skilled worker. This is not efficiency that requires long study or working out with a stop watch, but just a little foresight and tact on the part of the foreman. It would be surprising to some to know how many shops there are, employing a few men, in which all the workers are rated as machinists, with the possible exception of a boy who, for convenience, is known as an apprentice.

This practice of following a job seems to be the traditional way of doing the work and for that reason might appear hard to change in some localities, but it seems to me that any reasonable man ought to see that it is unsound to have a 40c. man doing 20c. work. If a man is capable of earning 40c. or more an hour, he should see the reasonableness of keeping him on 40c. work as much as possible. The very fact that he is able to earn these wages shows that he can reason at least that far.

Right here I should like to say a word for the foreman, who is supposed to plan all this. In many of the very small shops, besides supervising all the work and planning the next job, he is expected by the owner to turn out a certain amount of actual work himself. And in the slightly larger shops, say those employing from 20 to 50 men, the tradition seems still to linger in the minds of the owners that there is no limit to the power of expansion of a foreman. I personally know of shops doing a jobbing and repairing business where the foreman has charge of 50 men. He has a few so-called "strawbosses," who are supposed to be of great assistance to him; but as they usually have no real authority, they seldom accomplish much beyond seeing that the younger workers do not actually sit down. Of course, there are superintendents and others in authority; but the actual details of operation are left to the foreman, who attends to as many as he is able and of necessity lets the rest go.

Another thing quite noticeable around small shops is the care of drills—or rather the lack of care. Some drill-press boys handle the drills and reamers in the same way that they handle the clamps and rough bolts. The drills are all piled together on a bench or table and dropped on the floor and the shanks dented, until I sometimes wonder how they are able to produce holes at all.

I have found it a good plan to acquaint the drillers with the value of drills, reamers and similar tools. Very few seem to have any idea of the cost of such tools and are usually quite astonished when told the actual price. This information generally results in much more gentle handling of the drills thereafter, for very few willfully maul tools when it is known that the price runs into a considerable amount of money.

I wonder how many owners, unless they are around the shop most of the time, know that in the majority of cases the drills are returned to the toolroom and put in the racks without being sharpened, with the result that the next man who wants to use one has to wait for it to be ground, even though he is the highest-paid worker in the shop.

In this connection a simple plan for shops too small to have a more complete system is to have a boy—apprentice or otherwise—whose duty it is to make the rounds of the machines at regular intervals, return to the toolroom all drills and other tools that have been used and bring to the machine such ones as will be necessary for the next job. The boy might not be at the machine every time a change was being made, but he would save the machinist a great many trips and the group of men waiting at the tool window would be noticeably smaller.

Another thing that many owners neglect is to provide plenty of tool steel. I have often seen a lathe hand roughing down a big shaft and using just one tool. When this became dull, he stopped the machine and went to the emery wheel. This is surely false economy, especially since most small shops use tool holders and bits and the additional outlay for tool steel would be over-balanced many times by the minutes gained, remembering that no matter how many tools are used the actual steel consumed will be the same.

There is another tradition that I believe small-shop machinists ought to have outgrown by this time, but it is prevalent to a surprising degree in repair and the smaller marine and jobbing shops. It is the idea that a first-class machinist should not be told too minutely how to do a piece of work given him. The man receives the rough material and a drawing, and any information as to the details of doing the work is usually resented as reflecting on the ability of a first-class mechanic. Many times the work is not done in the most economical way; but if the method used is at all reasonable, the foreman, to keep peace in the family, says nothing, This is something that the owner is not apt to notice, unless he is an expert mechanic himself or has an elaborate cost system, which last is rather rare in the types of shops mentioned. By this time the mechanics should realize that the machinist's trade has grown too big to be entirely learned by any one man and that suggestions as to methods can be given to the best of them.

Of course, all of this seems out of place and unnecessary to the large-shop workers, who are used to the subdividing of the foreman's duties and the instruction card with exact directions; but it should be remembered that there are hundreds of machine-shop workers who never even saw an instruction card or heard of a speed boss. The only effort most of the owners of these shops seem to be making to cut production costs is to experiment with higher speeds and bigger feeds, overlooking the leaks that are much more important, for in most shops the amount that cuts can be speeded up is very little without an almost complete change of equipment.

I believe that if many owners would give more time to some of these things and to what John H. Van Deventer calls "intervals" and less to speeding up the cuts, they would soon have the means to buy modern equipment, which they could speed up to the limit without any experimenting. E. W. WRIGLEY.

Seattle, Wash.

Compulsory Adoption of Metric System

In these days when Mr. McAdoo is being asked by the Bureau of Standards to push along the compulsory adoption of the metric system into this country by advocating it at the conference in Argentina, it is interesting to have a little side light on Argentine conditions as regards the use of the metric system.

The following excerpt from the May number of *The Americas,* published by the National City Bank of New York, is from an article on "How to Translate Argentine Prices." It will be noticed that while the metric system is by law made compulsory in Argentina, they still continue, according to this article, to measure great estates in square leagues and the square league varies in different provinces.

Also, according to this article, occasionally old Argentine measurements and weights come up and puzzle the country, and the list shows that there are a good many of them. Evidently there would be as little success in this country in abolishing our own present measurements as there would be in any other country, and this article merely confirms the mass of other evidence offered by Mr. Halsey and Mr. Dale to the effect that a compulsory metric system merely adds another system and does not replace the old units. The extract referred to is given herewith:

Great estates in Argentina are often measured in square leagues. The square league is measured differently in different parts of the country, being equal to 10.4255 sq.mi. (6,671.66 acres) in Buenos Aires, Santa Fé and Entre Rios provinces and to 9.6529 sq.mi. (6,177.85 acres) in the National Territories, with varying sizes in other provinces. In San Luis, Mendoza, San Juan and Catamarca the square league equals 2,615.627 hectares; in Cordoba, 2,709.827; in Corrientes, 2,701.088; in Tucuman, 2,662.560; in Santiago del Estero, 1,880.485.

These are the metric measurements. Occasionally the persistent "old Argentine" measurements come up and puzzle the reader. A few of them are:

Onza = 1.012803 oz. = 28.7125 grams
Libra = 1.012803 lb. = 0.4594 kilos
Arroba = 25.32 lb. = 11.485 kilos
*Quintal = 101.28 lb. = 45.94 kilos
Tonelada = 0.904288 English tons = 0.9818 metric tons
Pulgada = 0.947 in. = 2.4055 cm.
Pie = 0.947 ft. = 0.2886 m.
Vara = 0.947 yd. =0.866 m.
Cuadra = 4.17 acres = 1.6871 hectares
†Cuartilla = 7.549188 gal. = 34.2992 liters
†Fanega = 3.774594 bushels = 1.3719 hectoliters
Cuarta = 1.0455 pt. = 0.5937 liters
Frasco = 2.091 qt. = 2.375 liters
Galon = 3.345 qt. = 3.800 liters
Barril = 16.728 gal. = 7.6 decaliters
Pipa = 100.37 gal. = 4.56 hectoliters
Pesada of dry hides = 35.448 lb. = 16.079 kilos
Pesada of salted hides = 60.768 lb. = 27.564 kilos
Pesada of washed sheepskins = 30.384 lb. = 13.782 kilos

*The international quintal is a metric measurement equaling 100 kilos.

†These have also other values as variously stated.

Cincinnati, Ohio. E. F. DuBrul.

Your editorial on page 563 and also Charles M. Muchnic's article on page 692 again open a discussion which comes up from time to time and which is of especial interest to the American mechanic. Some years ago a crusade was put on foot to change the existing English standard of measurements to the metric system. This crusade was short lived, as the bulk of the manufacturers of this country could not see the need nor the advisability for such a step.

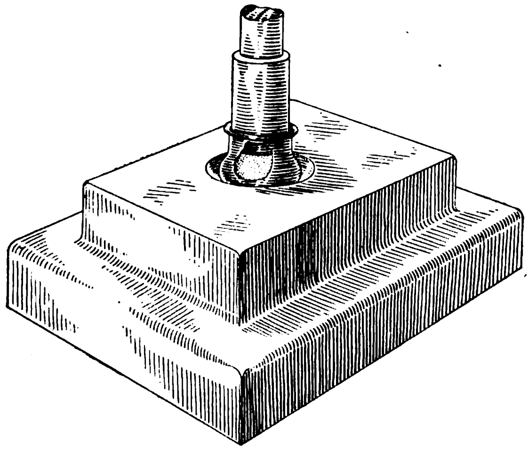
Personally I have worked about eight years using the metric system and can say that it is the simpler of the two; but let the men who are advocating the metric system stop and consider the enormous loss in discarding small tools and instruments that the change will bring to the machinists, carpenters and all trades using linear measurements. This loss will be great even if the change comes gradually, to say nothing of the expense to manufacturers in altering equipment to meet the new conditions. That the metric system must come gradually—and very gradually—if at all, is a foregone conclusion. Any attempt to rush matters will surely end in failure, because of the vast amount of labor and money it will involve.

Speaking of the Latin-American and European countries using the metric system and our export business with them, let the American manufacturers who deal with those countries adopt the metric system as a factory standard, as many have already done. This action would clear the horizon as far as foreign trade is concerned. I for one think that this country is not ready at this time to adopt the metric system. It may come eventually, but for the present the English system is good enough.

New Britain, Conn. W. C. Betz.

Punches and Dies for Making Pepper and Salt Tops

I was much interested in Mr. Mawson's article on page 805. Having had experience on this same job years ago in a small silver shop, I found it interesting to compare the methods, which, with but a few exceptions, were identical. In spite of the fact that these tops were made in very large quantities the high-production compound die was not used. A compound die for a simple round cup is



A SIMPLE BULGING DIE

made almost entirely in a lathe and can be produced as cheaply as the two single-operation dies required. Therefore there seems to be no good excuse for not using a compound die for a job of this sort.

A very important difference in methods was that of bulging the tops. The simple tool shown in the accompanying sketch is much cheaper than the one illustrated in Fig. 9-A, page 805. In operating the die 9-A the halves must be held rigidly while bulging and then be separated to remove the top. The die shown is made of cast iron, machined to the radius desired on the shaker. A piece of rubber is secured to the punch, and the shape of the top is regulated by the amount of rubber used and the force with which it is bulged.

The thread is rolled in a manner similar to that shown, except that the roll is mounted on a hand tool and operated on a T-rest by hand.

A floral design is stamped around the tops, in the space outside the perforations. The design is stamped with five successive blows in a foot press, the operator turning the tops by hand for each stamp. Owing to the stamping of the design, it is necessary to perforate the tops after the stamping and bulging have been done.

Newark, N. J. Gustave A. Remacle.

Editorials

Machinists Must Not Enlist!

Only a few days of the mobilization of the National Guard have passed yet some facts have already been driven home. Among the guardsmen are many machinists, skilled mechanics. In the aggregate there are several thousand such men who are now under arms. Not a few shops have been more or less seriously crippled through their loss.

It has been the custom in many communities to recruit machinists for batteries and machine-gun platoons. Their mechanical knowledge and training were of especial value in such military units.

In allowing these skilled men to leave the shop for the camp we are making the same mistake that England and France and Germany made at the outbreak of the present European War. In their cases thousands of mechanics were sacrificed in the early days of the struggle, and later on as many such men as possible were withdrawn from the army and sent back to the factories. But the effect of the mistake could not be completely wiped out. Today, in spite of all this experience that stares us in the face, we are making the same mistake.

It is possible that no central authority can interfere in the case of the enlisted guardsmen. But something must be done in connection with new enlistments, particularly if there is a call for 500,000 volunteers. We are short of good mechanics in our shops today, and this situation will grow progressively worse if munition orders are placed and pressure brought to bear to hurry production. A tremendous strain will be put on the machine shops under these conditions, and every mechanic will be needed.

President Wilson or Congress should take immediate action to keep skilled mechanics out of the army. They are more needed elsewhere.

Machinists must not be permitted to enlist!

Courtesy Toward Visitors

There is a lot of room for improvement in the methods of receiving visitors in many shops. Nor is this confined to the smaller places. Some of the larger institutions, with ushers and other appendages, do not leave a good impression with visitors.

Many of the heads of reception rooms are gems of the first water. They are pleasant, diplomatic and thoughtful in the extreme. If the man you want to see is engaged, they make it as pleasant for you as possible and report progress from time to time. Such men are worth more to any concern than they ever get and are a decided addition to that great asset known as good will.

In other cases the reception official is pompous and far from pleasing in any way. He irritates the visitor and increases rather than softens any grouch that may be lurking in the visitor's system. And unfortunately these two types of men seem to reflect the character of those in charge of the business in many cases.

The most annoying characteristic of these men is that they suddenly create an aversion to telling them the life history they demand, before your name goes in to the party you want to see. Perhaps the most exasperating experience is to go to such an office, armed with a perfectly good letter of introduction to the president of the company from one of his friends, and then have the usher open and read it before he decides even to present it. If this is his duty, he should at least be provided with a booth into which he might retire from the gaze of the irate individual who presents the letter.

There are few things that pay better in any business than courtesy and consideration in the treatment of visitors, whether they be ordinary mortals or angels unawares.

Standard-Size Holes--Why?

It is accepted practice in manufacturing machinery to make all holes of standard size and produce variations in fit between these holes and the parts that enter them by varying the sizes of the latter. This is a method of standard-size holes. It has a strong grip in machine-shop practice, but one that is not too strong to question and challenge.

It is difficult to point out the reasons that led to the establishing of this general policy. It may go back to the days when fits were made by actually trying one piece with its mate instead of using standard or limit gages. Be that as it may, today we have these conditions: An enormous and continual expense in buying, making and keeping up reamers, boring cutters and standard arbors because of standard holes; easy methods in changing the dimensions of shafts, studs, pins and spindles throughout the range from driving to running fits.

The disadvantages in these conditions surround the first item. Reamers are among the most expensive of machine-shop small tools—in fact, they are the most expensive, considering the work that they are called upon to do. A standard-size reamer lasts but a very short time, or, put a little differently, will hold its size for only a few holes. Then it must go back to the toolroom for setting up and resharpening. It is this fact that has brought about the popularity of adjustable reamers.

But even these expenses and disadvantages might not seem so serious if the final result—standard holes—actually became a part of the finished machines. However, a standard hole seldom remains standard after it reaches the erecting floor. There come the operations of line reaming, scraping and fitting, which are very apt to change considerably the size of the hole originally produced at a great deal of trouble and expense by using standard reamers.

Along with this comes another feature of design, which is brought about by this practice of making standard holes and varying the size of the fitting members. Very often bearings must be made with caps, because one of the

series is a drive fit and a shaft with a drive-fit section cannot be passed through a standard-size hole. On the other hand, if the holes were varied and the shafts standard in diameter, the shaft could be passed through the running-fit holes to the drive-fit hole and do away with the objection of designing and manufacturing split bearings.

These reasons seem to make out a case for standard-size shafts and varying-size holes which is worthy of serious consideration. The advantages as regards the cost and upkeep of reamers are at once apparent. Reamers of a size to give running fits can be started in use; and, as they wear, they can be reground and stoned to give other variations down to holes small enough for drive fits. This feature should mean the saving of thousands of dollars in the machine shops of this country. Certain disadvantages in design will disappear by the adoption of such a method. Standard arbors will have to be abandoned, of course, with these varying-size holes; but the expansion arbor has come to stay and is a far less delicate tool than the expansion reamer. There is no possible disadvantage in the manufacture of shafts, pins, studs and spindles with varying diameters. Our methods of production lend themselves easily to such a design.

Although this is not a new subject, let us have a free discussion of it.

Some of the Troubles of a Small-Shop Foreman

The letter on page 860 discussing the troubles of a small-shop foreman was printed to call attention to a condition that is as deplorable as it is real. We all know that the problems and tools of the small-shop proprietor are many, but the foreman has his own troubles as well, as indicated in the letter. We also know that success is not to be had by saving five dollars on a clock and wasting twenty-five by not having one; that the foreman is right in saying that you cannot get good men to begin work at 6 a.m. when other shops start at 7 or even later.

No matter how many problems the small-shop proprietor has, and they are many, he must consider the general trade conditions and meet them, if he expects to keep good men in the shop. Good men who can be retained are more of an asset to even a small shop than many seem to realize.

The incident of the brass castings indicates the necessity for some responsible person's being in charge of work, to prevent such occurrences. Here again the cost of error foots up to many times the saving supposed to be effected by letting things run themselves. If the "old man" cannot look after such things, the foreman should be given authority and time to do it. Expensive economy is all too prevalent in small shops as well as in large ones.

Many American employers are showing the truest loyalty by making provision for the welfare of the dependents of such of their employees as are now enlisting or have been mobilized in the National Guard. In some cases wages are being guaranteed for the duration of military service, in other wages and salaries are being guaranteed for a specified number of months or until a certain date. In still others, life-insurance policies are being taken out on the lives of the employees who have gone with their regiments. With hardly an exception, announcement has been made that the positions will be held open until the men return.

Firms who have made these patriotic provisions include almost every kind of business and industry. The American people are duly grateful. Machinery-building firms have not been mentioned in this connection for the very good reason that their employees should not only be discouraged from enlisting, but even prevented from so doing. Every mechanic will be needed in our shops if conditions grow any worse than they are today.

It is reported that one large manufacturer has announced to his employees that the men who are mobilized with or enlist in the National Guard or Army can consider themselves discharged, as their places will not be held open for them and no preference will be given to them should they apply for reëmployment. If this report is true, his act seems to border dangerously on the edge of treason. The announcement itself is like the proverbial fly that buzzes into the ointment.

Machine-Tool Shipments from Port of New York

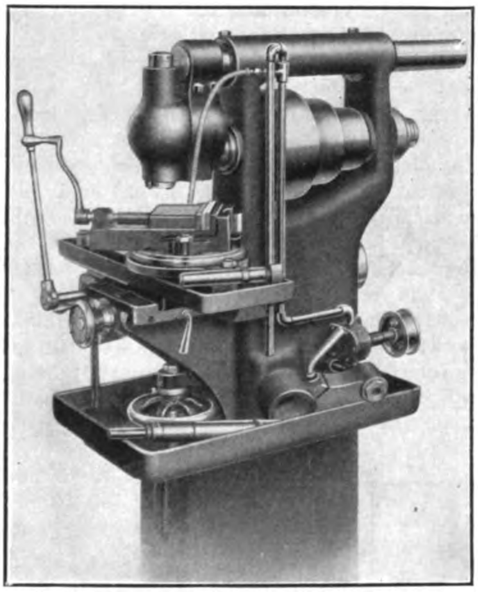
	1916	
	First Quarter	April
Argentina	$36,527	$10,103
Australia	131,290	54,365
Australia and Tasmania	213,891	......
Barbados	26	......
Bermuda	64	......
Bolivia	......	......
Brazil	6,389	212
British East Africa	61	......
British South Africa	19,564	......
British West Africa	3,894	......
British Honduras	......	......
British East Indies, other	......	......
British West Indies, other	4	......
British India	10,013	11,941
British Guiana	6	......
Canada	......	......
Chile	5,542	13,313
China	2,729	2,787
Colombia	832	1,135
Costa Rica	1,395	711
Cuba	20,284	18,962
Danish West Indies	8	......
Denmark	26,254	1,604
Dutch East Indies	2,769	......
Dutch West Indies	2,702	......
Dutch Guiana	......	......
Ecuador	591	202
Egypt	178	......
England	4,471,340	1,482,903
Finland	11,133	2,442
France	3,108,251	1,699,746
French Azores	......	55
French China	......	......
French Oceania	3,061	......
French West Indies	......	......
Gibraltar	1,015	......
Guatemala	425	64
Greece	544	580
Haiti	......	24
Honduras	729	1
Hongkong	47	......
Italy	1,539,410	605,291
Jamaica	72	......
Japan	98,839	5,617
Mexico	12,117	58,485
Newfoundland and Labrador	3,196	125
Netherlands	65,146	30,428
New Zealand	39,804	1,711
Nicaragua	36	......
Norway	89,898	19,170
Panama	20,211	15,688
Peru	7,130	289
Philippine Islands	934	47
Portugal	482	267
Portuguese Africa	1,397	......
Russia in Asia	30,174	23,636
Russia in Europe	671,986	81,177
Salvador	71	1,072
Santo Domingo	749	129
Scotland	108,558	51,446
Spain	337,155	17,851
Straits Settlements	1,787	......
Sweden	29,852	452
Switzerland	9,938	......
Trinidad and Tobago	500	......
Uruguay	1,434	144
Venezuela	3,083	446
Total	$11,156,916	$4,214,621

Shop Equipment News

Miller with Vertical and Horizontal Attachment

The hand miller shown represents a combined horizontal and vertical type recently developed by the Bickford Machine Co., Greenfield, Mass.

The rack for the table feed is a quarter-section of a screw and is driven by a worm gear that is designed to reduce backlash and chatter to a minimum. A weight returns the table when the feed is stopped and thereby prevents the cutter from marking the work at the end



MILLER WITH VERTICAL ATTACHMENT

Feed of table (hand or power), 15 in.; crossfeed of saddle, 4½ in.; vertical range of knee, 8 in.; full size of table, 8x23½ in.; greatest distance table to spindle, 8½ in.; largest diameter of cone, 9½ in.; width of driving belt, 3¼ in.; capacity of vise jaw 1¼x5 in., opens 3 in.; floor space, 30x36 in.; weight of machine, 920 lb.; size of box, 21x37x58 in., 26 cu.ft.

of the cut. The feedshaft is extended to take a lever for hand feed. Lever clamping screws are provided, also adjustable graduated collars on both elevating and crossfeed screws.

The vertical attachment, which is readily shipped in place on the machine, has a crucible-steel spindle running in phosphor-bronze bearings and bored for No. 9 Brown & Sharpe taper. The spindle is driven through steel gears by a driveshaft that enters the main spindle of the machine. As will be observed, the attachment when in place becomes a part of the machine, its spindle receiving all the power of the main driving belt.

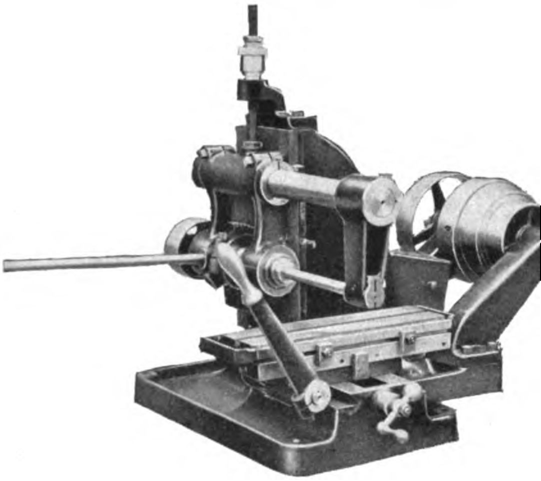
The swivel vise is of simple design, being in reality the addition of a circular plate and ring to the plain vise. For keeping the cutters cool a geared pump is attached to the rear of the machine, the supply tank being in the machine base.

Bench Miller with Adjustabl Head and Overarm

The illustration shows a bench miller of the adju able-head type recently developed by the Morris Mach Tool Co., Cincinnati, Ohio. The machine is also ava able in the column form.

The head slides up and down the column by means o rack and segment operated by a lever that can be pla in two positions to suit the convenience of the operat and is also arranged with micrometer depth gage. It counterbalanced by a weight that is adjustable to ta care of different sizes of cutters or arbors.

The spindle runs in bronze bearings, the front beari being taper and adjustable for wear. The back shaft a runs in bronze bearings. All bearings are arranged



BENCH MILLER

Size of table, 4x15 in.; table feed, 6 in.; vertical travel head, 5 in.; spindle speeds withthree-step cone, 120, 180, 480, 720 and 1,080 r.p.m.; countershaft speed, 360 r.p.m.

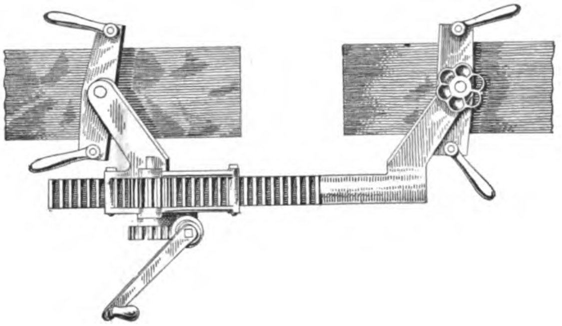
lubrication by the capillary oiling system. Six speeds obtained through the three-step cone and by reversi the pulleys on the end of the spindle and the end of back shaft. The table traverse is operated by a le through rack and pinion. The saddle is fed by a squa thread screw that has a micrometer attachment.

Safety Belt Clamp

In addition to the safety feature of the belt cla shown it is calculated to save time in taking up slack and lacing belts.

The operation of the clamp is made apparent by the lustration. Each side has a swing bolt that enables operator to quickly put the clamps over a slack belt insert the ends of a broken belt; then apply the sw bolts, tighten the clamps and turn the crank until

desired tension is secured. The adjustment is thereby made while the belt is on the pulleys, eliminating all guesswork as to the amount of slack to be taken up. The rack pinion is worm driven to eliminate slippage.



SAFETY BELT CLAMP
Four sizes for belts ranging in width from 1 to 6, 1 to 8, 1 to 10 and 1 to 12 in.

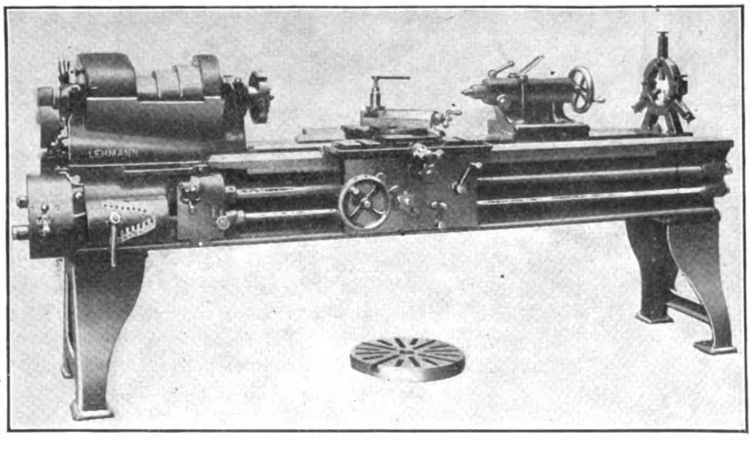
The clamp may be readily separated into two sections, making it easy to carry about and apply to inaccessible drives.

This form of clamp is a recent product of the Cleveland Fabric Belting Co., Cleveland, Ohio.

Quick-Change Engine Lathe

The illustration shows a quick-change engine lathe built by the Lehmann Machine Co., St. Louis, Mo.

The headstock is provided with a three-step cone of a wide face and double back gears that give nine spindle speeds in geometrical progression. The spindle is made of high-carbon steel and ground. Bearings are of phosphor bronze and positively lubricated. They are securely held in place, but may be renewed. End thrust is taken by fiber in contact with steel washers hardened and ground.



QUICK-CHANGE ENGINE LATHE
Swings over shear, 18¼ in.; swings over carriage, 12 in.; takes between centers, 5 ft.; hole through spindle, 1$\frac{5}{16}$ in.; diameter of spindle nose, 2½ in.; number of threads on spindle nose, 6 U.S.S.; cone-pulley diameters, 6$\frac{3}{8}$ in., 8$\frac{1}{3}$ in., 10 in.; width of belt, 3 in.; weight, 3,120 lb.

The bed has chilled ways, is deep and wide and is braced by large crossribs. All bearings fastened to the bed are doweled into position on planed bosses. The carriage is provided with an oil trough that returns cutting lubricant inside of the V's. Shear wipers fastened to the carriage keep the V's lubricated and clean. The apron gives double support for studs and a double bearing for running shafts. The lead screw and feed rod have bearings in the apron. All gears and pinions except friction gears are of steel, and the studs are hardened and ground. A safety device prevents engagement of the feed rod and the lead screw at the same time.

The tailstock is clamped to the bed by bolts brought up to the top of the barrel convenient for the operator. The spindle is large and is provided with an improved device for locking. The lead screw is of high-carbon steel with a four-pitch Acme thread. It is provided with a ball thrust.

New Cutting-Tool Alloy

A new alloy for cutting-tool purposes is being introduced by Darwin & Milner, Ltd., Sheffield, England. With this alloy no heat-treatment is needed, the material being ready for use after grinding. It is cast in bars of any section, those that were used in a recent demonstration being from 2 in. square down to ¼x$\frac{5}{16}$ in.

The same firm is said to be making experiments with a view to the direct casting of such things as milling cutters. Another application of the material proposed is for motor valves. The alloy is put forward as a substitute for the best high-speed steel, and its composition includes no vanadium, tungsten, molybdenum or cobalt. It is cast in iron or sand molds, iron giving slightly better results. It is said to be much tougher than stellite.

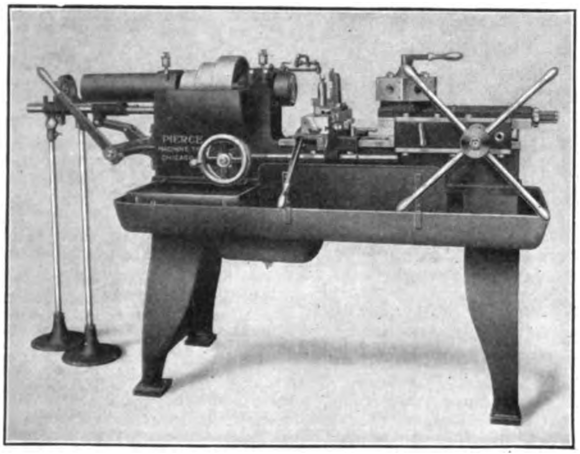
To demonstrate the material a bar of chrome-nickel steel was turned in a 24-in. lathe, the bar turned containing, according to the analysis given: Carbon, 0.32 per cent.; manganese, 0.63 per cent.; chromium, 1.17 per cent.; nickel, 3.28 per cent. A tool of this material 1¼ in. square ran for 8 min. against a well-known high-speed steel tool, which ran for 3 min., the cutting speed being 100 ft. per min. and the cut $\frac{3}{32}$ in. deep by $\frac{1}{32}$ in. feed. In subsequent demonstrations the cuts were at 45 ft. per min., $\frac{1}{16}$ in. deep by ¼ in. feed, the tool running for 7⅓ min. and remaining in good condition at the end. A 2-in. square tool was run at 35 ft. per min., $\frac{3}{16}$ in. deep by ⅛ in. feed; a ½-in. square tool at 45 ft. per min. with a cut $\frac{3}{32}$ in. deep by $\frac{1}{16}$ in. feed; and a tool ¼x$\frac{5}{16}$ in., without tool holder, was used at 50 ft. per min. with a cut about $\frac{1}{32}$ in. deep by $\frac{1}{16}$ in. feed.

The demonstration altogether took about two hours, during which time two 1¼-in. square section bars of the new material were cast in iron molds. When fairly cool one bar was at once ground to shape on an emery wheel, finishing on an ordinary grindstone. It was then for a time cooled in an air blast, so that the workmen could handle it, after which it was placed in the lathe and run for about 13 min. at 47 ft. per min. on the chrome-nickel steel bar mentioned, the cut being $\frac{3}{16}$ in. deep by $\frac{1}{16}$ in. feed, altered at about halfway to $\frac{1}{32}$ in. deep by $\frac{1}{32}$ in. feed. The tool was in good condition at end of test.

Hand Screw Machine with Wire Feed

The hand screw machine shown is of similar type to that illustrated on page 1093, with the addition of wire feed and automatic chuck.

The machine is made by the Pierce Machine Tool Co., Chicago, Ill., and requires no further description as to



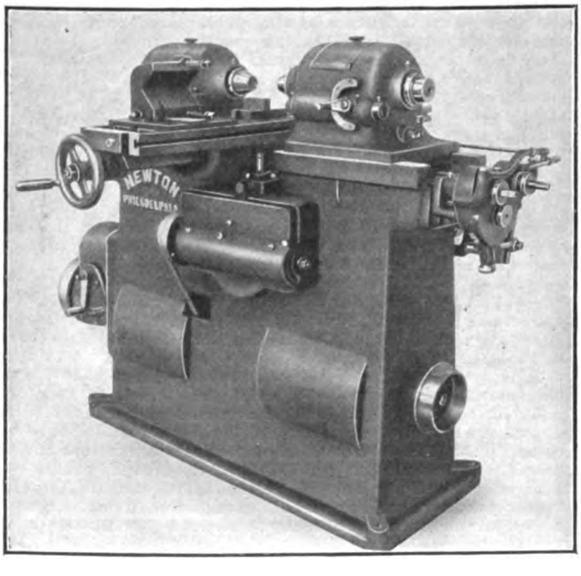
HAND SCREW MACHINE WITH WIRE FEED

Capacity automatic chuck, round, $1\frac{1}{16}$ in.; capacity automatic chuck, square, $\frac{3}{4}$ in.; capacity automatic chuck, hexagon, $\frac{15}{16}$ in.; capacity threaded work on soft steel, $\frac{5}{8}$ in. U.S.S.; capacity pipe threads in brass, up to $1\frac{1}{16}$ in.; capacity drilling in soft steel, $\frac{3}{4}$ in..

design and construction than that given in the previously mentioned article.

Duplex Slot Miller

The illustration shows a double-spindle slot miller built by the Newton Machine Tool Works, Inc., Philadelphia, Penn., and designed for a wide range of work.



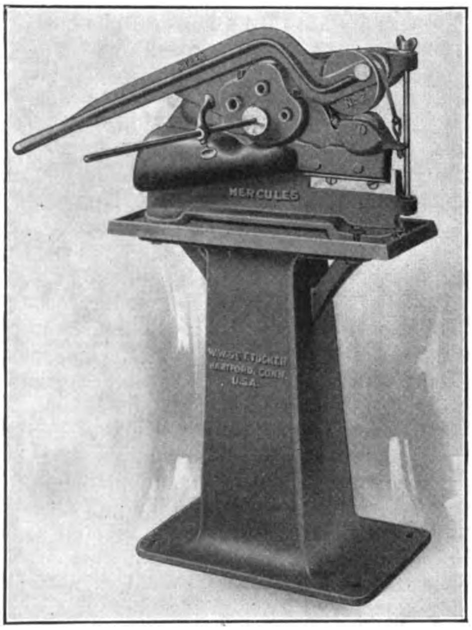
DUPLEX SLOT MILLER

Table feed, per stroke, $\frac{1}{16}$ in. maximum; work table, 44x9 in.; maximum capacity, 4-in. shafts; keyseat capacity, $\frac{1}{8}$ to $\frac{1}{4}$ in.; maximum distance between spindles, 10 in.; driving pulley, 10 in. in diameter; countershaft, 20 in. in diameter, weight, 3,000 lb.

The spindles are provided with double taper bearings fitted with draw-in collets for holding the slot-milling cutters. The spindle heads have automatic feed with safety release when milling cotter holes. Four changes of geared spindle speeds are available without changing gears. High spindle speeds are obtained by open belt and slow speeds through the back gears. The feeds for the work table are either continuous for long splines or reverse automatically for cottering.

Bar-Iron Cutter and Shear

The illustration shows an iron cutter and shear built by W. A. & C. F. Tucker, Hartford, Conn. This machine is made in six sizes to cut round iron up to $\frac{3}{4}$ in. and to shear flat stock up to $\frac{5}{16}$ in. thick. The cutters



ROD CUTTER AND SHEAR

for the round stock are in the shape of bushings, made of tool steel and held in place by setscrews. The shear blades are of wrought iron, tool-steel faced. The direction of the shear cut tends to draw the stock into the shear. An adjustable length gage is provided for the bar-stock cutters. The machine is also built without the bar-stock cutters, as a flat-stock shear.

Direct-Current Motors of the Lower Horsepowers

To meet the increasing demand for direct-current motors of the smaller horsepowers for direct connection and drive of all kinds of industrial machinery, machine tools and the many motor applications requiring a low-power compact motor, the C. & C. Electric and Mfg. Co., Garwood, N. J., has developed a new line.

The new motors, known as the Type IB, are of bi-polar type, with interpoles, and can be furnished in ratings up to 10 hp. in either the shunt or compound wound. For a general manufacturer's drives, as machine tools and other industrial machinery, the characteristics of the shunt-wound motor are the most desirable.

Master Mechanics' Convention

The annual convention of the American Railway Master Mechanics' Association was held at Atlantic City, N. J., June 19 to 21. While there were more exhibits than in 1915, the number of machine tools and appliances was less and the total fell below that of 1914. The general appearance of all exhibits was more attractive, however, and the attendance was good. Some of the few machine firms represented were new comers at this convention. Among the exhibitors of machine tools or appliances were:

E. C. Atkins & Co., Indianapolis, Ind.; C. H. Besly & Co., Chicago, Ill.; S. F. Bowser & Co., Fort Wayne, Ind.; Carbic Manufacturing Co., Duluth, Minn.; Carborundum Co., Niagara Falls, N. Y.; Chicago Pneumatic Tool Co., Chicago, Ill.; Clipper Belt Lacer Co., Grand Rapids, Mich.; Crucible Steel Co. of America, Pittsburgh, Penn.; Davis Machine Tool Co., Rochester, N. Y.; Dixon Crucible Co., Jersey City, N. J.; Fairbanks, Morse & Co., Chicago, Ill.; General Electric Co.. Schenectady, N. Y.; Gibb Instrument Co., Pittsburgh, Penn.; Gilbert & Barker Co., Springfield, Mass.; Goldschmidt Thermit Co., New York City; Greene, Tweed & Co., New York City; Greenfield Tap and Die Corporation, Greenfield, Mass.; Edwin Harrington Son & Co., Philadelphia, Penn.; Independent Pneumatic Tool Co., Chicago, Ill.; Ingersoll-Rand Co., New York City; Keller Mechanical Engraving Co., Brooklyn, N. Y.; Keller Pneumatic Tool Co., Chicago, Ill.; R. D. Nuttall Co., Pittsburgh, Penn.; Nutter & Barnes Co., Hinsdale, N. H.; Oxweld Railroad Service Co., New York City; Quigley Furnace Specialties Co., New York City; Reliance Electric and Engineering Co., Cleveland, Ohio; Wm. Sellers & Co., Philadelphia, Penn.; Simonds Manufacturing Co., Fitchburg, Mass.; United Engineering and Foundry Co., Pittsburgh, Penn.; Warner & Swasey Co., Cleveland, Ohio; Watson-Stillman Co., New York City; Westinghouse Electric and Manufacturing Co., Pittsburgh, Penn.; Wilson Welder and Metals Co., New York City; Yale & Towne Manufacturing Co., New York City.

A gratifying feature of the meetings was the interest shown in the paper by F. O. Wells on the "Standardization of Screw Threads." This association, it will be remembered, was one of the pioneers in the adoption of standards of various kinds, and the screw-thread question is likely to receive careful consideration at the hands of its members. Mr. Wells pointed out the sources of error, the necessity for tolerances that are commercial yet sufficiently accurate for the work in hand, as well as the means for measuring the threads properly—that is, at the pitch diameter.

NEW PUBLICATIONS

FORGING OF IRON AND STEEL—By William A. Richards. Two hundred and thirteen 5x8-in. pages; 237 illustrations; appendix; indexed; cloth bound. D. Van Nostrand Co., New York City. Price, $1.50.

This textbook is intended for use in colleges, secondary schools and the shop. Its author has had an extensive experience in teaching forging and smithwork. As a result he has gathered together in this book statements and illustrations of principles rather than specific exercises.

The first chapter is historical in nature and, while interesting, is not pertinent to the purpose of the book and might well have been omitted. The second chapter deals with iron and steel in their different forms, briefly indicating how they are produced. The third chapter shows the equipment needed for forging, and the fourth takes up the matter of fuel and fire.

With Chapter V begin the various forging processes, running through to Chapter X. The headings are: Drawing Down and Upsetting; Bending and Twisting; Splitting, Punching and Riveting; The Use of Blacksmith Tools; Welding. Then follow two chapters that hardly seem to belong in a textbook of this kind. Chapter X deals with electric, autogenous and thermit welding. All three processes are special in character, requiring peculiar, expensive equipment. Furthermore, they are not likely to be met with by the ordinary graduate of a course in forging and smithing. Chapter XI is in the same class, as it deals with brazing, a very specialized process in metal working.

Chapters XII and XIII take up tool steel and high-speed tool steel, giving much helpful information in regard to their treatment and working. Chapter XIV is devoted to art ironwork and Chapter XV to steam and power hammers. The final chapter deals with the calculations of such shapes as are commonly met with in blacksmithing. An appendix of 33 pages gives a course of instruction that the author has used with high-school and college pupils.

Taken all in all, the book seems well thought out and prepared, with the exception of some matter that seems unnecessary. An unfortunate selection of the type of illustrations mars the otherwise pleasing appearance of the pages.

SUCCESS IN THE SMALL SHOP—By John H. Van Deventer. One hundred and thirty-six 9x12-in. pages; illustrated; indexed; cloth bound. Published by the "American Machinist," New York City. Price, with one year's subscription to the "American Machinist," $4.75.

Reviewed by Dexter S. Kimball*

This interesting book presents in collected form fifty articles and a part of the discussion they called forth in the "American Machinist" during the years 1914-16. These articles were the results of a definite idea—namely, showing the place and possibility of the small shop in the manufacturing field. It was their purpose also to analyze the situation regarding small shops, to find out their weaknesses and their strong points and to offer suggestions and criticisms that would be helpful and strengthening.

Included in the collection are discussions on financing, accounting, management, machine equipment, small-tool equipment, selection of work, helpful devices, shop kinks and methods, etc., all with reference primarily to the small shop. The discussion and comments that were evoked throw many interesting and amusing sidelights on life in the small shop. In presenting this material in collected form it is the hope of the editors of the "American Machinist" that the book will be found of service not only to the owner and manager of the small shop, but also to men in larger shops where departments are often so organized as to present problems much the same as those of their little neighbors.

Some of the articles are of peculiar interest. Thus the first one, entitled "The Future of the Small Shop," contains some detailed historical data bearing on the probable future of the small shop. The argument presented that there will always be room for the small shop in spite of the higher efficiency of the large shop is worth reading. It is of interest also to read that 80 per cent. of all American manufacturing plants are small ones and that in the machine-tool using industries there are 15,000 small shops employing less than 20 men to 1,200 large shops employing more than 250 men. One is led to believe that, after all, the complete consolidation of industry is some distance away. There are many other exceptionally good articles and some on the management of small shops that are worth reading even for a man who is managing a large enterprise.

The object of the book is most praiseworthy. All will agree that anything that will foster individual effort, that will assist in retaining and increasing widespread ownership of industry and that will assist the little fellow to retain his foothold in the industrial field is commendable. The small shop is proverbially less efficient than the large shop. But a perusal of this volume will show that much of this difficulty often arises from lack of financial and manufacturing knowledge as much as from inherent and unalterable circumstances. The treatment of specialization, interest and depreciation, manufacturing expense, inventory, profits and kindred subjects as applied to the small shop is therefore highly pertinent and important, though sometimes written in a jocular manner with many anecdotes to illustrate the points presented.

To those who, like the writer, served an apprenticeship in a small shop in the real old-fashioned way the book will awaken memories of many interesting people. There was a

*Professor, Machine Design and Construction, Sibley College, Cornell University.

picturesqueness about the old-fashioned small shop that has been lost in the larger, more modern and specialized factory. The many character sketches scattered throughout the book cannot fail to remind older men very vividly of the days when trades still had "mysteries" and interchangeable systems were unknown. There was some roughness, but also a great deal of kindliness in the old shops, and "boss" and workman were much closer to each other than they ever can be in the larger modern plant and in fact than they are in most small plants of today. True, these old shops were not efficient, and their successors of today may not be so efficient as they should be. But the small shop certainly contains some things that are worth saving. It stands for individuality and independence. This book should be an aid toward the betterment of the chances for success of the small manufacturer.

The book is attractively bound, and the subject matter is fully illustrated as it was in its original appearance in the "American Machinist."

PERSONALS

D. A. Urquart, until recently foreman of the screw-machine department of the Brown & Sharpe Mfg. Co., has become superintendent of the Union Twist Drill Co., succeeding A. N. Goddard, recently resigned.

F. A. Robinson, for several years a member of the executive force of the Becker Milling Machine Co., Hyde Park, Mass., has been appointed advertising manager, succeeding George Y. Young, recently resigned.

Frank O. Wells, president of Wells Bros. & Co., Greenfield, Mass., has also been elected president of the F. E. Wells and Sons Co., succeeding F. E. Wells who has relinquished active control after fifty years' association with the business.

J. F. Tinsley has accepted the position of assistant superintendent of the Crompton & Knowles Loom Works, Worcester, Mass., having resigned the superintendency of the South Works of the American Steel and Wire Co., Worcester, Mass.

OBITUARY

John D. Hughes, superintendent of the Putnam Machine Co., Fitchburg, Mass., and for a number of years connected with the Bullard Machine Tool Co., Bridgeport, Conn., in various capacities, died on June 15 as the result of an automobile accident. Mr. Hughes was a native of Bridgeport and was but 42 years of age.

George Gilmour, well-known in mechanical circles through his constructive work in accident prevention as head of the engineering and inspection department of the Travelers Insurance Co., died at his home in Brooklyn, N. Y., on June 16. Mr. Gilmour was born in Petrograd, Russia, Jan. 5, 1865, of Scotch parents, his father being chief naval constructor for the Russian government. The son learned the trade of mechanical engineer with John Elder & Co., shipbuilders and engineers, of Glasgow, Scotland. After learning his trade he went to South America, where he worked for a time. Returning by way of Panama he was engaged by French engineers to take charge of the mechanical department of the work on the Panama Canal. Following a period of service on the Isthmus, he became an engineer for the Atlas Line of mail steamers and, when the West India Improvements Co. bought the Jamaica Government Ry., he was chosen master mechanic of the system. The Jamaica Light and Power Co. also had his services as superintendent of motive power and later as consulting engineer. After eight years spent in Jamaica, Mr. Gilmour was appointed mechanical engineer for the New York Telephone Co. and he worked in New York eight years, resigning in 1905 to become chief engineer for the Travelers Insurance Co.

BUSINESS ITEMS

Edward G. Brown, 5, 6, 7 Great Hampton St., Birmingham, England, wants agencies in Great Britain for machine-shop equipment.

The Capital Stock of the Cincinnati Screw Co., Twightwee, Ohio, has been increased to $200,000. Additional large orders have been placed for equipment.

The Federal Tool & Stamping Co. has been organized at Zeeland, Mich., to do metal stamping, tool designing and light machine work. The officers are R. B. Somers, president; J. L. De Glopper, vice-president; F. L. Jerome, secretary; J. S. Van Volkenburgh, treasurer and manager.

Joseph H. Roach & Co., Inc., was organized and has purchased a foundry and machine shop in Bridgeport, Penn., formerly engaged in the manufacture of Wilkinson stokers. In addition to the manufacture of stokers the new firm will conduct a general foundry and machine shop business. Joseph H. Roach, president and founder, was Philadelphia manager of the Hoover, Owens, Rentschler Co.

The Vulcan Trading Corporation, a consolidation of the businesses of Archibald J. Wolfe, London and Lancashire Trading Co. and F. Velthardt, has been organized in New York City, to carry on a general exporting business, specializing in iron, steel and machinery. Mr. Wolfe, who will be in charge of the Russian and machinery departments, was for a number of years connected with the United States Department of Commerce, as Commercial Agent, and later Russian representative of the U. S. Steel Products Co.

CATALOGS WANTED

J. B. Giovanoli, Supervisor of Tools, Continental Motors Co., Muskegon, Mich., would like to receive catalogs of machines and tools used in the manufacture of gasoline automobile motors.

TRADE CATALOGS

Herringbone Gears. Fawcus Machine Co., Pittsburgh, Penn. Catalog. Pp. 16, 9x12 in.; illustrated.

Hilo Black Enamels and Japans. Moller & Schumann Co., Marcy and Fushhing Ave., Brooklyn, N. Y. Bulletin No. 1. Pp. 14. 5x8 in.; illustrated.

Engine Lathes. Worcester Lathe Co., 68 Prescott St., Worcester, Mass. Set of circulars illustrating and describing the different sizes of lathes built by this company.

Chain Belt Traveling Water Screens. Chain Belt Co., Milwaukee, Wis. Bulletin No. 64. Pp. 8, 6x9 in.; illustrated. This describes water screens designed primarily to remove refuse and foreign material from water before it enters power and industrial plants, etc., requiring large quantities of clean water.

FORTHCOMING MEETINGS

American Society for Testing Materials. Annual meeting June 27 to July 1, 1916, Hotel Traymore, Atlantic City, N. J. Edgar Warburg, secretary, University of Pennsylvania, Philadelphia, Penn.

American Foundrymen's Association and American Institute of Metals. Annual meeting, September 11-16, Cleveland, Ohio, A. O. Backert, secretary, American Foundrymen's Association, Cleveland, Ohio.

American Society of Mechanical Engineers. Monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Wednesday each month. J. A. Brooks, secretary, Brown University, Providence, R. I.

New England Foundrymen's Association. Regular meeting second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. J. H. Warder, secretary, 1785 Monadnock Block, Chicago, Ill.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Technical League of America. Regular meeting second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York, N. Y.

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	June 23, 1916	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$14.50	$15.00	$9.75
No. 2 X Northern Foundry, New York	19.75	20.75	14.25
No. 2 Northern Foundry, Chicago	19.00	19.00	13.00
Bessemer, Pittsburgh	21.95	21.95	14.65
Basic, Pittsburgh	18.95	18.95	13.60
No. 2 X, Philadelphia	19.75	20.50	14.25
No. 2, Valley	18.25	18.50	12.50
No. 2, Southern Cincinnati	17.40	17.90	12.65
Basic, Eastern Pennsylvania	19.50	20.50	13.75
Gray forge, Pittsburgh	18.70	18.70	13.35

Steel Shapes—The following base prices in cents per pound are for angles 3 in. by ¼ in. and larger and tees 3 in. and larger and plates ¼ in. and heavier from jobbers' warehouse at the places named:

	New York				
	June 23, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Steel angles, base	3.50	3.50	1.85	3.25	3.10
Steel T's, base	3.55	3.55	1.90	3.25	3.10
Machinery steel (bessemer)	3.50	3.25	1.80	3.25	3.10
Plates	4.00	4.50	...	3.65	3.50

Steel Sheets—The following are the prices in cents per pound from jobbers' warehouse at the places named:

	New York				
	June 23, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
No. 28 black	3.65	3.65	2.60	3.20	3.20
No. 26 black	3.55	3.55	2.50	3.10	3.10
Nos. 22 and 24 black	3.50	3.50	2.45	3.05	3.05
Nos. 18 and 20 black	3.45	3.45	2.40	3.00	3.00
No. 16 blue annealed	4.45	4.70	2.35	3.70	3.60
No. 14 blue annealed	4.35	4.60	2.25	3.60	3.50
No. 12 blue annealed	4.30	4.50	2.20	3.55	3.45
No. 10 blue annealed	4.25	4.55	...	3.50	3.40
No. 28 galvanized	5.40	5.65	6.00	5.50	5.50
No. 26 galvanized	5.10	5.35	5.70	5.20	5.20
No. 24 galvanized	4.95	5.20	5.55	5.05	5.05

Standard Pipe—The following table shows the comparison in discounts, together with the net prices in cents per foot for carload lots f.o.b. mill:

	Black		Galvanized	
	June 23, 1916	One Yr. Ago	June 23, 1916	One Yr. Ago
¾ to 2 in. steel butt welded	70%	81%	50½%	72½%
2½ to 6 in. steel lap welded	68%	80%	48½%	72½%
Diameter, In.				
¾	3.45	2.19	5.69	3.16
1	5.10	3.23	8.42	4.68
1¼	6.90	4.37	11.39	6.33
1½	8.25	5.23	13.61	10.18
2	11.10	7.03	18.32	10.18
2½	18.72	11.70	30.13	16.09
3	24.48	15.30	39.40	21.04
4	34.88	21.80	56.14	29.98
5	47.36	29.60	76.22	40.70
6	61.44	38.40	98.88	52.80

From New York stock the following discounts hold:

	Black	Galvanized
3½ to 6 in. steel lap welded	61%	36%
¾ to 3 in. steel butt welded	64%	42%

Malleable fittings, Class B and C, from New York stock sell at 30 and 5% from list price. Cast iron, standard sizes, 55%.

Bar Iron—Prices are as follows in cents per pound at the places named:

	June 23, 1916	Three Months Ago
Pittsburgh, mill	2.60	2.45
Warehouse, New York	3.25	3.10
Warehouse, Cleveland	3.25	3.25
Warehouse, Chicago	3.10	3.10

Swedish (Norway) Iron—This material per 100 lb. sells as follows f.o.b. places named:

New York			
Today	One Year Ago		
$6.00	$3.75@4.00	Cleveland... $6.30	Chicago... $5.25

In coils an advance of 50c. is usually charged.

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-size lots, the following quotations hold:

	June 23, 1916	Three Months Ago
New York	List price plus 20%	5% above list
Cleveland	List price plus 20%	List price
Chicago	List price plus 10%	List price

Drill Rod—Discounts from list price in New York are as follows: Standard, 65%; extra, 60%; special, 55%.

High Speed Tool Steel containing from 10 to 18% tungsten sells as follows per pound in New York:

Billets ....$2.40 Bars $3.25

METALS

Miscellaneous Metals—The present quotations in cents per pound, with a comparison of practically a month and year ago, are as follows:

	New York		
	June 23, 1916	One Month Ago	One Year Ago
Copper, electrolytic (carload lots)	28.00	30.50	20.50
Tin	40.00	49.00	41.50
Lead	7.00	7.50	5.75
Spelter	12.25	13.50	20.00
ST. LOUIS			
Lead	6.85	7.50	....
Spelter	12.25	13.37½	....

At the places named, the following prices in cents per pound prevail:

	New York				
	June 23, 1916	One Month Ago	One Year Ago	Cleveland	Chicago
Copper sheets, base	37.50	37.50	26.00	37.50	37.50
Copper wire (carload lots)	37.50	37.50	26.75	33.00	38.00
Brass rods, base	44.50	44.50	29.00	42.00	38.00
Brass pipe, base	46.50	46.50	33.50	45.00	46.00
Brass sheets	44.50	44.50	29.00	42.00	38.00
Solder ½ and ½ (case lots)	25.62½	30.62½	29.50	28.75	27.00

Old Metals—The following are the dealers' purchasing prices in cents per pound:

	New York		Cleveland	
	June 23, 1916	One Year Ago	June 23, 1916	Three Months Ago
Copper, heavy and crucible	21.75	17.00	21.00	24.00
Copper, heavy and wire	21.25	....	20.50	23.00
Copper, light and bottoms	18.00	14.00	18.00	20.00
Lead, heavy	5.00	4.50	5.75	7.00
Lead, tea	4.50	4.00	4.25	5.25
Brass, heavy	12.25	8.50	13.00	19.00
Brass, light	9.75	10.00	10.50	12.00
No. 1 yellow rod brass turnings	13.00	....	12.00	14.50
Zinc	9.00	15.00	8.00	15.00

Monel Metal—The following are the prices in cents per pound for mill lengths 8 ft. and over:

Size, In.	10,000 Lb. of a Size and Over	6,000 Lb. of a Size and Over	2,000 Lb. of a Size and Over	500 Lb. of a Size and Over	Less Than 500 Lb. of a Size and Over
Rounds—Squares					
3/16 to 7/32	35.50	36.00	36.50	37.00	38.00
¼ to 5/16	35.25	35.75	36.25	36.75	37.75
⅜ to 1⅞	35.00	35.50	36.00	36.50	37.50
1 15/16 to 2⅞	35.75	36.25	36.75	37.25	38.25
Rounds					
3 to 3 7/16	36.50	37.00	37.50	38.00	39.00
Squares					
3	36.50	37.00	37.50	38.00	39.00
Rounds					
3½ to 3 15/16	36.25	36.75	37.25	37.75	38.75
Squares					
3 1/16 to 3 15/16	36.25	36.75	37.25	37.75	38.75
Rounds—Squares					
4 to 4 15/16	37.00	37.50	38.00	38.50	39.50
5 to 6 15/16	38.00	38.50	39.00	39.50	40.50
7	38.50	39.00	39.50	40.00	41.00
Flats	36.50	37.00	37.50	38.00	39.00

Flats not rolled wider than 6 in. or less than ⅛ in. thick.
Hexagon bars 2c. per lb. over corresponding size of round rods.
For cutting to any specified length not shorter than 1 ft. add 1c. per lb.
The scrap allowance is 18c. per lb. delivered at works.

Copper Bars from warehouse sell as follows in cents per pound:

	June 23,1916	Three Months Ago
New York	43.00	39.50
Cleveland	40.25	39.00
Chicago	40.25	37.00

Zinc Sheets—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks		Broken Lots	
	June 23, 1916	Three Months Ago	June 23, 1916	Three Months Ago
New York	21.50	26.00	22.00	26.50
Cleveland	22.75	26.25@26.50	23.25	26.50
Chicago	20.00	27.00	21.00	28.00

Antimony—Chinese and Japanese brands are quoted in cents per pound for spot delivery, duty paid:

	June 23, 1916	Three Months Ago
New York	18.00	45.00
Cleveland	24.00	50.00
Chicago	23.00	45.00

Babbitt Metal—Quotations are as follows in cents per pound from warehouse at the places named:

	New York	Cleveland	Chicago
Best grade	60.00	49.50	60.00
Commercial	30.00	18.25	25.00

SHOP SUPPLIES

Nuts—From warehouses at the places named, on fair sized orders the following amount is deducted from list:

	New York June 23, 1916	New York Three Months Ago	Cleveland June 23, 1916	Cleveland Three Months Ago	Chicago June 23, 1916	Chicago Three Months Ago
Hot pressed square	$2.50	$3.00	$3.00	$3.70	$3.25	$3.70
Hot pressed hexagon	2.50	3.20	3.00	3.80	3.25	3.80
Cold punched square	2.00	3.00	2.65	3.50	3.00	3.75
Cold punched hexagon	2.50	3.75	3.25	4.25	3.50	4.50

Semifinished nuts sell at the following discounts from list price:

	June 23, 1916	Three Months Ago
New York	50—10%	70%
Cleveland	60%	70—10%
Chicago	65%	70—10%

Carriage Bolts—From warehouses at the places named the following discounts from list price are in effect:

	New York	Cleveland	Chicago
⅜ by 6 in.	45—5%	50—10—5%	60—5%
Larger and longer	35%	40—15%	50%

At this rate the net prices are as follows:

Length, In.	New York ¼	New York ½	New York ¾	Cleveland ¼	Cleveland ½	Cleveland ¾	Chicago ¼	Chicago ½	Chicago ¾
1½	$0.53	...	...	$0.43	...	...	$0.38	...	...
2	.58	...	...	.48	...	...	.42	...	...
2½	.63	$2.12	$5.53	.51	$1.39	$3.63	.46	$1.63	$4.25
3	.68	2.30	5.85	.55	1.51	3.85	.50	1.77	4.50
3½	.73	2.48	6.18	.60	1.64	4.06	.54	1.91	4.75

Machine Bolts—From warehouses at the places named the following discounts hold:

	New York	Cleveland	Chicago
⅜ by 4 in. and smaller	50%	60 and 10%	60 and 10%
Larger and longer up to 1 in. by 30 in.	40%	50 and 5%	50 and 10%

At this rate the net prices per 100 follow:

Length In.	New York ¼	New York ½	New York 1	Cleveland ¼	Cleveland ½	Cleveland 1	Chicago ¼	Chicago ⅝	Chicago 1
2	$0.83	$2.32	$9.60	$0.67	$1.46	$6.08	$0.64	$1.74	$7.20
2½	.89	2.84	10.14	.70	1.57	6.32	.67	1.85	7.60
3	.97	2.63	10.68	.73	1.66	6.86	.70	1.97	8.00
3½	1.01	2.79	11.22	.77	1.77	7.48	.73	2.08	8.40

Wrought Washers—From warehouses at the places named the following amount is deducted from list price:
New York.... $4.00 Cleveland.... $6.00 Chicago.... $6.00

At this rate, the net prices follows:

Diameter, In.	New York	Cleveland	Chicago
$\frac{3}{16}$	$10.00	$8.00	$8.00
¼	8.20	6.20	6.20
$\frac{5}{16}$	7.40	5.40	5.40
⅜	6.50	4.50	4.50
$\frac{7}{16}$	5.80	3.80	3.80
½	5.40	3.40	3.40
$\frac{9}{16}$	5.30	3.30	3.30
⅝	5.20	3.20	3.20
¾	5.10	3.10	3.10
⅞, 1, 1⅛	5.00	3.00	3.00
1¼, 1⅜, 1½	5.20	3.20	3.20
1⅝, 1¾, 1⅞, 2	5.50	3.50	3.50
2¼, 2½	6.50	4.50	4.50

For cast-iron washers the base price per 100 lb. is as follows:
New York.... $2.50 Cleveland.... $2.00 Chicago.... $2.10

Rivets—The following quotations are allowed for fair sized orders from warehouse:

	New York	Cleveland	Chicago
Steel $\frac{7}{16}$ and smaller	45%	45—10%	50%
Tinned	45%	45—10%	50%

Button heads ¾, ⅞, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.:
New York.... $5.25 Cleveland.... $4.05 Chicago.... $3.50

Cone heads, same sizes:
New York.... $5.35 Cleveland.... $4.15 Chicago.... $3.60

For the following sizes, the extras over the above prices in cents per 100 lb. are as follows:

1⅛ to 1⅞ in. long, all diameters	$0.25
⅝ in. diameter	0.15
½ in. diameter	0.50
1 in. long and shorter	0.50
Longer than 5 in.	0.25
Less than kegs	0.50
Countersunk heads	0.50

Nails—Wire nails f.o.b. Pittsburgh sell at $2.50@2.60; galvanized 1 in. and longer, $4.50@4.60, and shorter, $5@5.10. These prices are to regular customers and delivery is made at the mill's convenience. From warehouse wire and cut nails sell as follows:

	Wire June 23, 1916	Wire Three Months Ago	Cut June 23, 1916	Cut Three Months Ago
New York	$3.15	$2.90	$3.15	$2.90
Cleveland	3.05	2.90	2.95	2.90
Chicago	2.85	2.70	2.85	2.70

Copper Rivets and Burs sell at the following rate from warehouse:

	Rivets June 23, 1916	Rivets Three Months Ago	Burs June 23, 1916
Cleveland	List price	10% from list	List price
Chicago	List price	10% from list	List price
New York	10-2½% from list	25% from list	10-2½% from list

MISCELLANEOUS

Welding Material (Swedish)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire

⅜, $\frac{11}{32}$, $\frac{5}{16}$, ¼, $\frac{7}{32}$, $\frac{3}{16}$	10.00
No. 8, $\frac{5}{32}$ and No. 10	11.00
⅛	12.50
No. 12	13.50
$\frac{3}{32}$, No. 14 and $\frac{1}{16}$	15.00
No. 18	16.50
No. 20	17.50

Special Welding Steel

⅛	33.00
$\frac{5}{32}$	30.00
$\frac{3}{16}$	28.00

Cast-Iron Welding Rods

¼ by 19 in. long	22.00
$\frac{5}{16}$ by 12 in. long	26.00
⅜ by 19 in. long	20.00
½ by 21 in. long	20.00

Vanadium Wire in Coils or Sticks

$\frac{1}{16}$	15.50
$\frac{3}{32}$	15.00
⅛	14.00
$\frac{5}{32}$	12.00
$\frac{3}{16}$ and larger	11.00

Tin Plates—The following prices are in effect from warehouses at the places named:

			New York June 23, 1916	New York Three Months Ago	Cleveland June 23, 1916	Cleveland Three Months Ago	Chicago June 23, 1916	Chicago Three Months Ago
Coke tin plate, 14x20:								
100 l b.			$6.50	$5.00	$6.00	$4.87½	$6.00	$4.75
I. C. 107 lb.			6.65	5.15	6.15	5.05	6.15	4.90
Terne plate, 20x28:								
Base Wgt.	Net Wgt.	Coating						
100 lb.	200	8	$10.50	$.900	$9.35	$8.60	$8.90	$8.50
I. C.	214	8	10.80	9.30	9.60	8.90	9.25	8.90
I. X.	270	8	12.80	11.30	11.85	11.10	11.50	12.75
I. C.	218	12	12.00	12.00	10.75	10.10	10.75	10.80
I. C.	221	15	13.00	13.00	10.75	10.90	11.60	11.25
I. C.	226	20	13.50	13.50	12.75	12.20	12.50	12.20
I. C.	231	25	14.25	14.25	13.75	13.40	13.75	15.35
I. C.	236	30	15.50	15.50	14.75	12.40	14.75	15.60
I. C.	241	35	17.00	17.00	16.00	15.60	15.85	16.20
I. C.	246	40	19.00	19.00	17.00	16.60	17.10	16.80

Seamless Drawn Tubing—The base price per pound from warehouse is as follows:

	New York	Cleveland	Chicago
Brass	43.50	46.00	42.00
Copper	48.00	48.00	43.00

For immediate stock shipment the following quotations prevail:

Diameter, In.	Copper New York June 23, 1916	Copper New York One Year Ago	Copper Cleveland	Copper Chicago	Brass New York June 23, 1916	Brass New York One Year Ago	Brass Cleveland	Brass Chicago
¾ to 2½	51.50	35.50	48.00	43.00	46.60	32.50	46.00	42.00
3	51.50	35.50	48.00	43.00	46.60	32.50	46.00	42.00
3½	52.50	36.50	48.00	44.00	47.50	33.50	46.60	43.00
4	53.50	37.50	51.00	45.00	50.50	34.50	49.00	44.00
4½	55.50	39.50	51.00	47.00	50.50	36.50	49.00	46.00
5	57.50	41.50	53.00	49.00	52.50	38.50	51.00	48.00
6	58.50	42.50	55.00	50.00	53.50	39.50	53.00	49.00
7	60.00	44.50	55.00	52.00	55.50	41.50	53.00	51.00
8	62.50	46.50	59.00	54.00	57.50	43.60	57.00	53.00

Coke—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	June 3	June 10	June 17	June 24
Prompt furnace	$2.50@2.75	$2.50@2.75	$2.75	$2.40@2.50
Prompt foundry	3.25@3.50	3.25@3.50	3.25@3.50	3.25@3.50

Cotton Waste—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	11.00@13.00	11.00@14.00	11.00@13.50
Colored mixed	8.00@10.00	7.50@11.00	8.00@10.50

Sal Soda sells as follows per 100 lb.:

New York	$2.05	Cleveland	$2.25
Philadelphia	1.80	Chicago	1.90

Roll Sulphur in 360-lb. bbl. sells as follows per 100 lb.
New York.... $2.75 Cleveland.... $2.75 Chicago.... $2.75

Foundry Supplies—In New York, the following quotations prevail:

Foundry blacking	1½c. per lb.
Foundry flour (best grade)	$4.75 per bbl.
Foundry rosin	12c. per lb.
Core oil	40c. per gal.
Core wash	1½c. per lb.

Foundry Clay in Cleveland sells at $3.25 per ton for carload lots.

Linseed Oil—These prices are per gallon:

	New York June 23, 1916	New York Three Months Ago	Cleveland June 23, 1916	Cleveland Three Months Ago	Chicago June 23, 1916	Chicago Three Months Ago
Raw in barrels	$0.69	$0.81	$0.73	$0.84	$0.72	$0.81
5-gal. cans	.79	.91	.83	.94	.82	.86

Boiled, it is 1c. per gal. higher.

White and Red Lead, in cents per pound, sell as follows:

	Red Dry	Red In Oil	White Dry and In Oil
100-lb. keg	10.50	11.00	10.50
25- and 50-lb. kegs	10.75	11.25	10.75
12½-lb. keg	11.00	11.50	11.00
1- to 5-lb. cans	12.50	12.50	12.50

New and Enlarged Shops

If you are in need of machinery or supplies, the first thing to do is to consult the Buying Section. If you cannot find just what you want, send us particulars, and we will be glad to publish it free of cost, thus putting you in touch with reliable manufacturers.

METAL WORKING

NEW ENGLAND STATES

The American Woolen Co. plans to construct an addition to its factory at Foxcroft, Maine.

Plans are being prepared by Minor & Kalman, Arch., 43 Tremont Ave., Boston, Mass., for the construction of a 1-story, 100x100-ft. garage at Waltham, for the West End Garage Co. Estimated cost, $50,000.

The contract will soon be awarded for the construction of an addition to the plant of Gilbert & Barker Co., manufacturer of gas machines, at West Springfield, Mass.

Plans are being prepared for the construction of a 1-story, 60x120-ft. garage for B. H. Quinn, 30 Forest St., Whitinsville, Mass.

The contract has been awarded for the construction of a 1-story garage at Worcester, Mass., for A. Berkowitz, 5 Chapin St., Worcester. Estimated cost, $14,000. Noted Apr. 13 and June 8.

Plans are being prepared for the construction of a 1-story garage for Bernard Press, 1 Granite St., Worcester, Mass.

Plans are being prepared by Morrison & Young, Arch., 297 Bridge St., Worcester, Mass., for the construction of a 1-story plant on Franklin St., Worcester, for the Worcester Lunch Car Co.

The contract has been awarded for the construction of a 2-story plant at Groton, Conn., for the New London Ship and Engine Co. Noted Feb. 17.

The Abbott Ball Co., manufacturer of steel balls, car wheels, etc., plans to construct an addition to its plant at Hartford, Conn.

The Whitney Manufacturing Co., manufacturer of chains, Hartford, Conn., is receiving bids for a 4-story addition to its plant.

The Barnum-Richardson Co., manufacturer of car wheels, plans to construct a 1-story, 50x200-ft. addition to its plant at Lime Rock, Conn.

Work will soon be started on the construction of a plant on Oak St., New London, Conn., for the E. Whiton Machine Co. Noted Mar. 2.

Fire, June 13, destroyed the plant of W. F. Driscoll Co., manufacturer of wire pullers, at Shelton, Conn. Loss, $15,000.

The Eagle Lock Co. is constructing an addition to its plant at Terryville.

Bids are being received by the Standard Co., Torrington, Conn., wheelwright, for the construction of a 4-story factory on Laurel Ave.

The contract has been awarded for the construction of a 5-story, 70x352-ft. addition to the factory of the Scoville Manufacturing Co., manufacturer of brass goods, at Waterbury, Conn.

Plans are being prepared for the construction of a garage at 58 Kellogg St., Waterbury, Conn., for E. S. Hunt.

MIDDLE ATLANTIC STATES

An addition will be constructed to the plant of the King Sewing Machine Co., Rano St. and Lackawanna R.R., Buffalo, N. Y.

The Acme Pattern and Machine Co., Inc., plans to construct a 2-story factory at 1557-63 Niagara St., Buffalo, N. Y.

The contract has been awarded for the construction of an addition to the plant of the Pierce Arrow Motor Car Co., Elmwood Ave., Buffalo, N. Y. Estimated cost, $100,000. Noted May 11.

Press reports state that A. B. Schultz, manufacturer of automobile and marine engines, will construct a factory at West and Forest Ave., Buffalo, N. Y.

The Willys Overland Co., Toledo, Ohio, has awarded the contract for the construction of a 4-story service building at Buffalo, N. Y.

The Cortland Forging and Machine Works, Cortland, N. Y., has awarded the contract for the construction of a foundry and machine shop. Estimated cost, $35,000.

Bids are being received by the Corona Typewriter Co., 141 East 42nd St., New York, N. Y. (Borough of Manhattan), for a 4-story factory at Groton, N. Y.

The contract has been awarded for the construction of a 1-story, 125x128-ft. brick factory on Hopkins Ave., East Jamestown, N. Y., for the International Casement Co., 516 East 6th St., Jamestown, manufacturer of metal casement windows.

The Covert Motor Vehicle Ct., Lockport, N. Y., plans to construct a 3-story, 100x130-ft. addition to its plant. Estimated cost, $40,000.

The Duplex Engine Governor Co., 36 Flatbush Ave. extension, New York, N. Y. (Borough of Brooklyn), manufacturer of automobile engine governors, has increased its capital stock from $125,000 to $200,000. The company plans to enlarge its manufacturing facilities. T. Douglas is Pres.

Plans are being prepared by Francisco & Jacobus, Arch., 200 5th Ave., New York, N. Y. (Borough of Manhattan), for the construction of a 4-story factory at Elmhurst, New York, N. Y. (Borough of Queens), for the Norma Co. of America, manufacturer of roller bearings.

Plans are being prepared by J. P. Crocker, Arch., 2017 5th Ave., New York, N. Y. (Borough of Manhattan), for the construction of a 6-story garage on 55th St. west of 9th Ave., Manhattan, for Daniel Meeman.

The contract will soon be awarded for the construction of 3 additions to the plant of the American Locomotive Co., Schenectady, N. Y. Noted June 1.

Bids are being received by the Habirshaw Wire Co., 10 East 43rd St., New York, N. Y. (Borough of Manhattan), for the construction of a 2- and 3-story, 200x300-ft. addition to its plant at Yonkers, N. Y. Estimated cost, $100,000.

The Bayonne Steel Casting Co., Bayonne, N. J., has awarded the contract for the construction of a 1-story addition to its plant on Ingham Ave.

The Acme Manufacturing Co., Boonton, N. J., manufacturer of automobile specialties, is in the market for turret machines.

Frank DiBerti, Newark, N. J., has had plans prepared for the construction of a garage on 4th St.

The Valley Forge Cutlery Co., Newark, N. J., will build an addition to its plant on South 6th St.

The Benjamin Eastwood Co., Paterson, N. J., manufacturer of machinery, is in the market for turret machines.

The Niles-Bement-Pond Co., Plainfield, N. J., manufacturer of machinery, has awarded the contract for an addition to its plant. Noted May 25.

The Moultrup Steel Products Co. plans to construct several additions to its plant at Beaver Falls, Penn. Estimated cost, $150,000.

The Matthews Gravity Carrier Co., Ellwood City, Penn., has had plans prepared for additions to its plant. Estimated cost, $25,000.

The Benjamin & Butler Machine Works, Hazleton, Penn., is building an addition to its plant. Noted Mar. 23.

According to press reports an addition will be constructed to the plant of the Bond Foundry and Machine Co., Manheim, Penn., manufacturer of power transmission specialties.

The Electric Materials Co., North East, Penn., will build an adition to its plant.

The Baldwin Locomotive Works, Broad and Spring St., Philadelphia, Penn., has awarded the contract for 4 buildings at its Eddystone plant.

The Gomery-Schwarz Motor Car. Co., Philadelphia, Penn., has awarded the contract for the construction of a 10-story building at Broad and Cherry St. Noted May 4.

The Hess Machine Co., 2512 Callowhill St., Philadelphia, Penn., awarded contract for machine shop at 45th and Lancaster Ave., Philadelphia. Noted Apr. 20 and 27.

The Midvale Steel Co., Nicetown, Philadelphia, Penn., is in the market for machinery for finishing shells.

The Philadelphia Steel and Forge Co., Philadelphia, Penn., will construct a 1-story addition to its plant on Milnor St.

The Philadelphia Textile Machinery Co., Hancock and Somerset St., Philadelphia, Penn., has awarded the contract for the construction of a 1-story addition to its plant.

The S-S-E Co., 2300 Chestnut, Philadelphia, Penn., is having plans prepared for the construction of a 1-story, 200x100-ft. brick and concrete automobile factory at Erie Ave. and B St., Philadelphia. V. L. Emerson is Gen. Mgr.

The Sweeten Automobile Co., Philadelphia, Penn., has awarded the contract for the construction of an addition to its service station at 3430 Chestnut St.

The contract has been awarded for the construction of a 2- and 3-story, 100x156-ft. garage for the Albion Hotel, Baltimore, Md.

An automobile repair shop will be established by the Auto Appliance Manufacturing Co., 11-13 East 21st St., Baltimore, Md.

A 1-story addition will be built to the iron and brass foundry of the Caroline Foundry Co., 723 South Caroline St., Baltimore, Md.

The Cityco Realty Co., 2 East Lexington St., Baltimore, Md., plans to build a 45x250-ft. garage.

The contract has been awarded for the construction of a plant at Laney's Lane and Pennsylvania R.R., Baltimore, Md., for the Hess Steel Co. Estimated cost, $100,000.

SOUTHERN STATES

The Slab Fork Coal Co., Slab Fork, W. Va., plans to construct a machine shop and will be in the market for 40-in. engine lathe, shaper and Hyd press.

The Atlanta Plow Co. plans to construct additions to its plant on Howell Mill Rd., Atlanta, Ga.

The Studebaker Corporation, Brush and Piquette St., Detroit, Mich., plans to construct a plant at New Orleans, La.

The Chattanooga Machinery Co., Chattanooga, Tenn., plans to construct a factory.

The Paducah Automobile and Manufacturing Co., Paducah, Ky., recently incorporated with $25,000 capital stock, plans to construct a factory for the manufacture of automobile parts.

MIDDLE WEST

The Corcoran Manufacturing Co., recently incorporated at Cincinnati, Ohio, will establish a factory on Winton Pl., Cincinnati, for the manufacture of automobile bodies, hoods, fenders, etc. L. Corcoran is Pres.

The Hooven-Owens-Rentschler Co., manufacturer of power engines, Hamilton, Ohio, plans to enlarge its iron foundry.

The National Tube Co. has started work on the construction of a blooming mill at Lorain, Ohio. Noted June 8.

The Spicer Manufacturing Co., foundry and machine works, New Philadelphia, Ohio, plans to rebuild its plant, recently destroyed by fire. R. T. Norning is Mgr. Noted May 25.

The Phillips Sheet and Tin Plate Co., Steubenville, Ohio, plans to construct an addition to its plant. Estimated cost, $6,000. D. M. Weir is Vice-Pres.

The Pressed Steel Products Co., Youngstown, Ohio, plans to construct an addition to be used for the manufacture of steel drums.

The contract has been awarded for the construction of a 1-story addition to the plant of the Kuhlman Car Co., East 140th St., Cleveland, Ohio. Noted May 18.

The Sanitary Tinning Co., manufacturer of general hardware, etc., plans to construct a factory on East 93rd St., near Way Ave., Cleveland, Ohio. Estimated cost, $50,000. A. J. Miller is Pres.

The Mark Manufacturing Co. will construct a new steel mill at Indiana Harbor, Ind. Estimated cost, $5,000,000.

The Studebaker Corporation, Brush and Piquette St., Detroit, Mich., contemplates the construction of a plant at La Fayette, Ind.

The Albion Bolt Co., Albion, Mich., recently incorporated with $10,000 capital stock, will establish a factory for the manufacture of nuts and bolts. M. Merriam is Pres.

The Chevrolet Motor Co., has awarded the contract for the construction of a factory at Bay City, Mich.

The Superior Steel Casting Co. will construct a factory at Benton Harbor, Mich.

The Detroit Brass Works, Detroit, Mich., has awarded the contract for the construction of a 2-story factory. Noted June 1.

The Ford Motor Car Co., Detroit, Mich., plans to construct a 4-story factory at 4325 Broadway, Detroit. Estimated cost, $60,000.

The Motor Products Corporation, 762 Woodward Ave., Detroit, Mich., manufacturer of motorcycles, plans to construct a factory.

Plans are being considered by the Alter Motor Car Co., Essexville, Mich., for the construction of a factory. F. M. Woodward is Gen. Sales Mgr.

Fire recently destroyed the main buildings of the Johnston Bros.' Boiler Works, Ferrysburg, Mich. Loss, $150,000.

The Dort Motor Car Co., Flint, Mich., plans to construct a factory. Estimated cost, $60,000.

The Acme Universal Joint Co., Kalamazoo, Mich., plans to construct a plant at Kalamazoo for the manufacture of auto joints.

The Baldwin Manufacturing Co., manufacturer of standing grain thresher, Sparta, Mich., desires catalogs and price lists from manufacturers of machinery and iron and steel. W. H. Hall is Pur. Agt.

The Moore Bros. Stove Works, Joliet, Ill., will build an addition to its factory on Franklin St.

Work has been started on the construction of an addition to the plant of the Lyon Metallic Manufacturing Co., Montgomery, Ill.

The T. A. Cummings Foundry Co., 1354 Cortland St., Chicago, Ill., will build a 1-story addition to its plant.

The Sasgen Derrick Co., 3101 Grand Ave., Chicago, Ill., has awarded the contract for the construction of an addition to its plant. Estimated cost, $18,000. Noted June 22.

The Western Iron Co., 1208 Borland Bldg., Chicago, Ill., granted permit to build a 1-story garage at 4906-08 North Clark St., Chicago. Estimated cost, $10,000. N. Buck, Arch.

The John Obenberger Forge Co. will construct a forge and machine shop at 63rd and Lapham St., Milwaukee, Wis.

The contract has been awarded for the construction of a factory for the George H. Smith Steel Casting Co., Madison St., Milwaukee, Wis.

Plans have been prepared by C. J. Keller, Arch., for the construction of a factory on Oregon St., Milwaukee, Wis., for the General Welding and Manufacturing Co.

The Ward Manufacturing Co., manufacturer of motorcycles and bicycles, plans to construct an addition to its plant at 18th St. and Martin Ave., Sheboygan, Wis.

Hugh E. Jones and Frank Drinolka, Waupaca, Wis., plans to construct a garage at Waupaca.

The Overland-Wisconsin Co., Milwaukee, Wis., plans to construct a distributing and service station at McIndoe and 1st St., Wausau, Wis. Estimated cost, $40,000.

WEST OF THE MISSISSIPPI

A 3-story addition is being built to the plant of the Dexter Co., Fairfield, Iowa, manufacturer of washing machines.

The Consumers Twine and Machinery Co. plans to improve its plant at Sioux City, Iowa. Estimated cost, $50,000.

The Mercantile Warehouse Co. will construct a garage at Waterloo, Iowa. Estimated cost, $35,000.

The Mareen & Johnson Machine Co. is constructing a 1-story machine shop at 700 44th Ave., N., Minneapolis, Minn. Estimated cost, $8,000.

The Smith Novelty and Toy Manufacturing Co. plans to construct a factory in Midway District, St. Paul, Minn.

The Four S Razor Co. plans to construct a factory at Hutchinson, Kan.

The Cooper Foundry Co., Atchison, Kan., recently incorporated, plans to establish a foundry. Charles Cooper, St. Joseph, Mo., is interested.

Armour & Co. plans to construct a machine shop at South Omaha, Neb.

The Missouri Meerschaum Pipe Co. plans to construct an addition to its plant at Owensville, Mo. Estimated cost, $10,-00.

J. E. and Ross Lee and J. F. Greer, Springfield, Mo., plans to construct a foundry and machine shop at Yellville, Ark.

The contract has been awarded for the construction of a garage and salesroom at Abilene, Tex., for David S. Castle, 29 Radford Bldg., Abilene. Estimated cost, $15,000.

W. C. Durant plans to construct an assembling plant at Ft. Worth, Tex. Estimated cost, $690,000.

Charles E. Brown and H. D. Bruce plans to construct a plant at Lawton, Okla., for the manufacture of mining machinery.

WESTERN STATES

The American Coin Register Co., 1706 Broadway, Oakland, Calif., has awarded the contract for the construction of a 2-story factory at Emeryville, Calif.

Plans are being prepared for the construction of a 50x117-ftfl garage on Main St., Los Angeles, Calif., for Gregg & Twiss.

T. J. Wisecarver plans to construct a 2-story garage at Modesto, Calif. Estimated cost, $16,000.

CANADA

The Grand Trunk Ry. plans to construct a roundhouse, machine shop, etc., at Lindsay, Ont. Estimated cost, $20,000. J. D. McMillan, Belleville, Ont., Acting Supt.

The Algoma Steel Co. is constructing a plant at Steelton, Ont. Estimated cost, $12,000.

The Sheet Metal Products Co. of Canada, Ltd., 199 River St., Toronto, Ont., has awarded the contract for the construction of a plant at Toronto. Estimated cost, $6,000.

The Automatic Thresher and Machine Co., Ltd., recently incorporated, plans to construct a plant at Calgary, Alta.

FOREIGN OPPORTUNITIES

William Hall, Ltd., Alma Works, Sheffield, England, is open to purchase continuously large quantities of twist drills, steel jobbers lengths. Price lists, discount and cash terms are desired.

GENERAL MANUFACTURING

NEW ENGLAND STATES

The Sears-Roebuck Co., Chicago, Ill., contemplates constructing a 4-story factory at Portsmouth, N. H., for the manufacture of shoes.

The John T. Slack Corporation, manufacturer of shoddy, plans to construct a 1-story, 20x200-ft. factory at Springfield, Vt.

The Smith Paper Co. has awarded the contract for the construction of an addition to its factory at Lee, Mass.

The Lowell Textile Co. plans to construct a 2-story mill at North Chelmsford, Mass.

The contract has been awarded for the construction of a 2-story addition to the factory of Edwin Bartlett, manufacturer of cotton warps, at North Oxford, Mass.

The contract has been awarded for the construction of a factory on Chandler St., Worcester, Mass., for Bickford & Sweet, 60 King St., manufacturer of slippers. Estimated cost, $25,000. Noted Feb. 17.

The International Braid Co. has awarded the contract for the construction of a 4-story factory at its Elmwood mills at Daboll and Mawney St., Providence, R. I. Estimated cost, $60,000. Noted June 22.

MIDDLE ATLANTIC STATES

The Auburn Button Co., Auburn, N. Y., has awarded the contract for the construction of a 1-story, 45x200-ft. shoe factory.

The contract has been awarded for the construction of a plant for the manufacture of nitric acid for the Contact Process Co., Buffalo, N. Y., manufacturer of chemicals. Estimated cost, $135,000. Noted Feb. 10.

Plans are being prepared for the construction of a 3-story, 80x300-ft. reinforced-concrete factory at Elmwood Ave. and Erie R.R., Buffalo, N. Y., for the Kittinger Furniture Co.

The Chautauqua Worsted Mills, Lisler Ave. and Erie R.R., Falconer, N. Y., has awarded the contract for additions to its plant. Estimated cost, $50,000.

The Little Falls Felt Shoe Co., Little Falls, N. Y., has awarded the contract for the construction of a factory.

The contract has been awarded for the construction of a 4-story, 100x230-ft. factory building at Anabel Ave. and Creek St., Long Island City, N. Y. (Borough of Queens), for the Degnon Realty and Improvement Co., 3 East 42nd St., Manhattan, to be leased by the Kindel Bed Co., Chicago, Ill. Estimated cost, $125,000. Noted June 8.

Plans are being considered by the Burlington Silk Mills, Burlington, N. J., for an addition to its factory.

The contract has been awarded for the construction of a 1-story adition to the plant of the B. F. Boyer Co., Camden, N. J., manufacturer of worsted yarns. Noted June 22.

Press reports state that the Whitney Glass Works, Glassboro, N. J., plans to construct additions to its plant on Sewell St.

Plans are being considered by Betz & Gross, Dillsburg, Penn., for the construction of a hosiery mill at Dillsburg.

Press reports state that a plant will be constructed at Marcus Hook, Penn., by the General Chemical Co., 25 Broad St., New York, N. Y.

The William Cramp and Sons Ship and Engine Building Co., Bench and Ball St., Philadelphia, Penn., contemplates enlarging its plant on Pettys Island.

According to press reports a 5-story addition will be built to the factory of the Ferris Shoe Co., Janney and Weikel St., Philadelphia, Penn. Albert B. Groves, 314 North 4th St., St. Louis, Mo., is Arch.

The contract has been awarded for the construction of a 2-story factory on Bodine St., Philadelphia, Penn., for George C. Mellor, manufacturer of pianos. Estimated cost, $12,000.

Plans have been prepared by Charles W. Denny, Arch., Hale Bldg., Philadelphia, Penn., for the construction of a 4-story addition to the factory of the National Drug Co., 4679 Stenton Ave., Philadelphia.

The contract has been awarded for the construction of an 8-story building on Sandusky St., Pittsburgh, Penn., for the United State Rubber Co. Estimated cost, $125,000.

The contract has been awarded for the construction of an addition to the plant of the Rich Woolen Mills, Woolrich, Penn. Noted May 4 and 18.

The American Manganese Steel Co. plans to construct an addition to its plant at New Castle, Del.

The Baltimore Enamel and Novelty Co., Baltimore, Md., plans to construct a factory on Allen St.

SOUTHERN STATES

A. C. Ernst of the Viscoe Co., Marcus Hook, Penn., plans to construct a silk mill at Roanoke, Va. Estimated cost, $1,000,000.

The Blue Ridge Brokerage Co. plans to construct a cold-storage plant at Greenville, S. C.

T. J. McNamara, formerly superintendent of the Lanett Bleachery and Dye Works, Lanett, Ala., plans to construct a bleachery and dye plant at Atlanta, Ga. Estimated cost between $10,000 and $20,000.

According to press reports Armour & Co. plans to to construct a packing plant near Talleyrand Ave., Jacksonville, Fla. H. B. Minimum is Mgr.

Fire recently destroyed the packing plant of Lee & Edwards, Thonotosassa, Fla.

W. H. Sullivan of the Great Southern Lumber Co., Bogalusa, La., plans to construct a paper mill at Bogalusa. Estimated cost, $1,000,000.

The Mente Bay Co., New Orleans, La., manufacturer of tires, plans to enlarge and improve its plant on Montegut St.

The Compressed Inner Tube Co., manufacturer of a solid rubber device for use inside of automobile tires, plans to construct a factory at Louisville, Ky. S. S. Bush and Samuel A. Culbertson, Columbia Bldg., Louisville, interested.

MIDDLE WEST

Fire, June 14, destroyed the plant of the Goodrich Rubber Co., Akron, Ohio, manufacturer of rubber good. Loss, $5,500.

The Acme Woolen Mills Co., 1294 7th St., Cleveland, Ohio, will build a silk mill on West 70th St., Cleveland.

The Lederer Furniture Co., Rose Bldg., Cleveland, Ohio, has awarded the contract for the construction of a new 4-story building at Euclid Ave. and East 61st St., Cleveland. Estimated cost, $150,000. Noted June 15.

The R. I. Dollings Co., Hamilton, Ohio, plans to erect a paving brick plant at Brazil, Ind. Estimated cost, $500,000.

The Ohio Central Glass Co., Lancaster, Ohio, is improving its plant.

A plant for the manufacture of axe and hammer handles will be established by C. W. Nicholson, Latham, Ohio.

The portion of the plant of the Valley Chair Co., Grand Rapids, Mich., recently destroyed by fire with a loss of $150,000, will be rebuilt. Noted June 22.

Plans are being prepared for a large plant for the Piqua Handle and Manufacturing Co., Marquette, Mich.

Fire, June 11, destroyed the plant of the Colson Novelty Co., Paris, Ill., manufacturer of novelties. Loss, $100,000.

The Jewel Belting Co., manufacturer of belting, has had plans prepared for the construction of a factory at 2831 South La Salle St., Chicago, Ill. Estimated cost, $50,000.

The Federal Rubber Manufacturing Co. has awarded the contract for constructing 3 factory buildings at Cudahy, Wis. Noted May 25.

Plans are being prepared by Washington & Kenhans, Arch., Chicago, Ill., for the construction of a packing plant for the Green Bay Stockyards and Packing Co., Green Bay, Wis. Estimated cost, $150,000. F. C. Greiling is interested. Noted June 1.

The International Shoe Co., Wood River, Ill., plans to construct a tannery. Estimated cost, $1,000,000.

WEST OF THE MISSISSIPPI

The Wyman, Partridge & Co., 1st Ave., N., and 4th St., Minneapolis, Minn., plans to construct a factory and cold-storage plant at 5th St. and 2nd Ave., Minneapolis. Estimated cost, $350,000.

The Carey Salt Co. is constructing a 1-story, 160x200-ft. packing plant at Hutchinson, Kan. Estimated cost, $30,000. Noted Apr. 6.

The Solvay Process Co. is constructing an addition to its soda ash plant at Hutchinson, Kan.

J. J. Johnson plans to install a hay press manufacturing plant at Batesville, Ark.

The Independent Gin Co. plans to construct a cotton gin at Lake City, Ark.

The Farmers and Merchants Gin Co. plans to reconstruct its cotton gin at Irene, Tex. George G. White is Pres.

The Fuller Cotton Oil Co. contemplates construction a cotton gin at Snyder, Tex.

The Western Oklahoma Gin Co. plans to construct a cotton gin at Mountain Park, Okla. Estimated cost, $12,00.

The Cottonwood Oil Mill Co., Ringling, Okla., is in the market for equipment.

The Tatums Gin Co. plans to equip a cotton gin at Tatums, Okla.

The Delta Sugar Co. plans to construct a factory at Delta, Colo.

WESTERN STATES

Fire recently destroyed the plant of the Valley Canning Co. at Newberg, Ore. Estimated cost, $15,00.

An addition is being built to the sugar refinery of the California & Hawaiian Sugar Co., Crockett, Calif.

Fire recently destroyed the packing plant of the Sutherland Fruit Co. at Fullerton, Calif. Loss, $10,000.

Bids will soon be received for the construction of a factory for the Wagner Leather Co., 120 Oak St., Stockton, Calif. Estimated cost, $12,000.

The R. W. Pridham Co., manufacturer of paper boxes, 112-124 North Center St., Los Angeles, Calif., has purchased a site on Pacific Blvd., Vernon, Calif., Grafton post office, and plans to construct a plant. Estimated cost, $100,000.

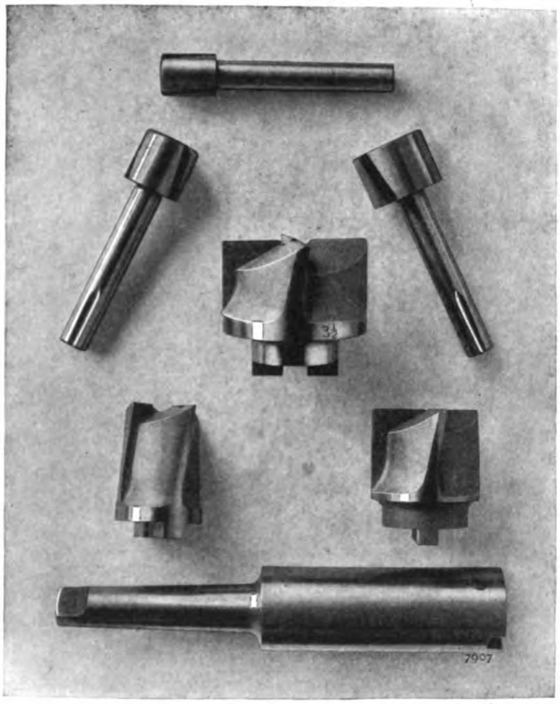
CANADA

The Hamilton Stamp and Stencil Co. has awarded the contract for the construction of a plant at Hamilton, Ont.

Classified Advertising

The Classified Advertising section appears on pages 168 and 169, of this issue and will in future appear in the same relative position in the paper.

The Right Combination At Once



Holder, Cutter and Guide

For every counterboring job you can make immediately the right combination of holder, cutter and guide if your tool room is equipped with

P. & W. Interchangeable Cutter Counterbores

Holders, Cutters and Guides furnished in wide range of sizes.

Holders

End of holder is milled to receive the driving lug of the cutter and there is also a hole and set screw to accommodate the shank of the guides.

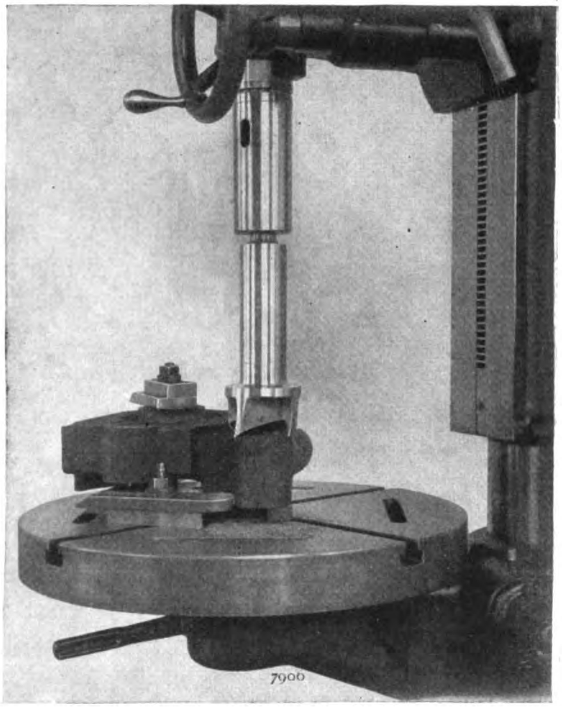
Guides

Are of hardened tool steel. They are held in place by means of a set screw in the holder engaging a V-slot in the shank of the guide.

Cutters

Can be furnished of either carbon or high-speed steel.

The shank of the guide passes through the hole in the cutter and the shoulder between the guide and its shank keeps the cutter in place. Cutters can be sharpened on the face and the guide is simply pushed further in the hole after grinding.



Spot Facing
with a P. & W. Interchangeable Cutter Counterbore.

Place a trial order with our nearest store.

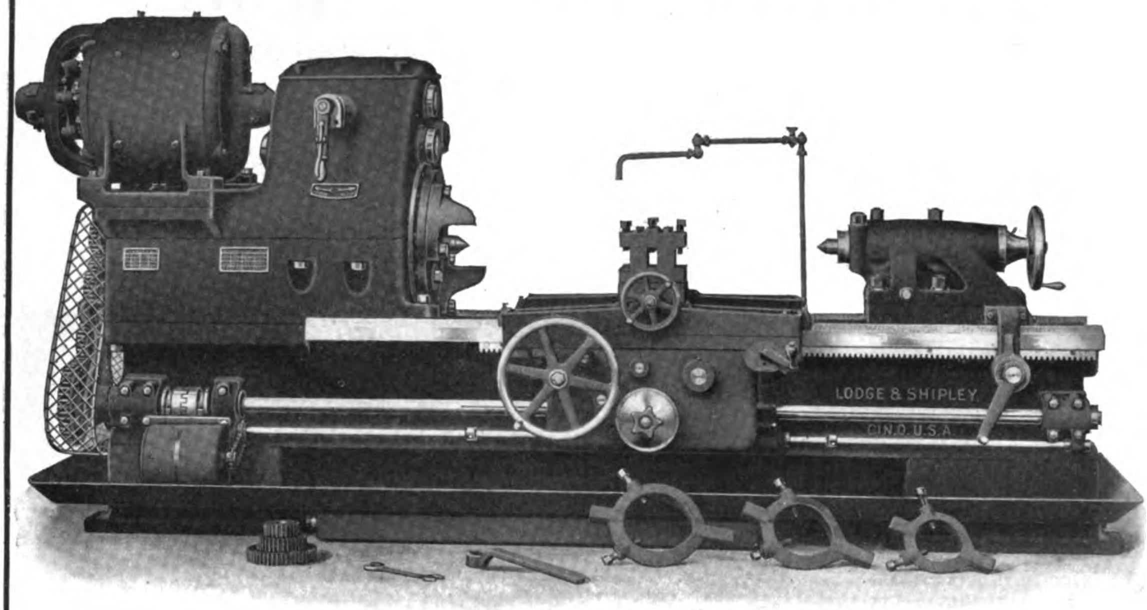
Pratt & Whitney Co., Hartford, Conn.

Offices and Agencies:

NEW YORK .... 326 Hudson St.
BOSTON .... 93-95 Oliver St.
PHILADELPHIA .... 405 N. 21st St.
CLEVELAND .... 530 Superior Ave.
DETROIT .... Kerr Machinery Bldg.
CHICAGO .... W. Washington Blvd. and N. Jefferson St.
ST. LOUIS .... 516 North 3rd St.

CINCINNATI .... 336 W. Fourth St.
BIRMINGHAM, ALA. .... 2015 First Ave.
ST. PAUL, MINN. .... Robinson, Cary & Sands Co.
DENVER, COLO. .... Hendrie & Bolthoff Mfg. & Supply Co.
SAN FRANCISCO .... 16 Fremont St.
SEATTLE, WASH. .... Hallidie Machinery Co.

IT'S UP TO YOU
To Take Advantage of These
EARLY DELIVERIES



There will be a few of these HEAVY FORGE LATHES left after we finish some large contracts. These will soon be ready for delivery.

They swing 15 in. over the carriage. Speeds and feeds are designed for work up to that size. Full swing is 30½ in. The drive is direct from a 3 to 1 motor.

This machine is especially built for cutting large quantities of metal in a short time.

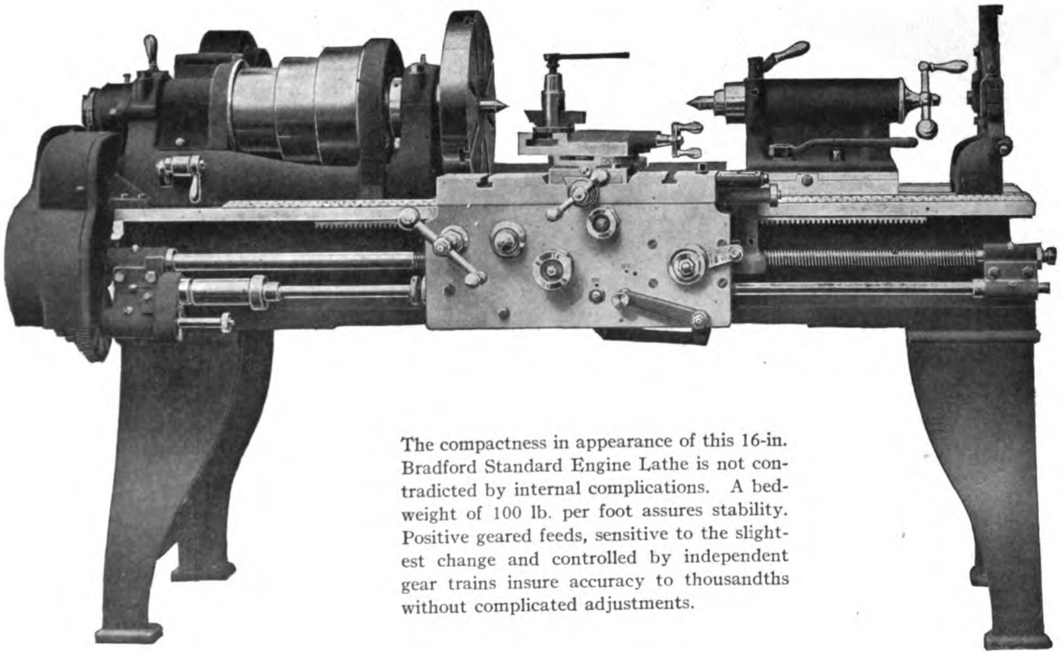
BUILT TO STAND UP UNDER THE HEAVIEST SERVICE

Write us about it now.

The Lodge & Shipley Machine Tool Company
Cincinnati, Ohio

A Bradford Talk

To the "General Purpose" and "Small Shop" Engineer



The compactness in appearance of this 16-in. Bradford Standard Engine Lathe is not contradicted by internal complications. A bed-weight of 100 lb. per foot assures stability. Positive geared feeds, sensitive to the slightest change and controlled by independent gear trains insure accuracy to thousandths without complicated adjustments.

You don't need a "one purpose" machine—yet. On the other hand the nature of your work demands that every tool and machine you have must "earn its keep." To do this you need the all-round machine of which this Bradford Lathe is perhaps the finest example.

From 16-in. to 42-in., Bradford Lathes will take care of the heaviest jobs or the finest and closest micrometer work.

We believe that a little mutual discussion would be profitable to us both. Why not tell us your problems and let us suggest the remedy?

The Bradford Machine Tool Company

Cincinnati, Ohio, U. S. A.

DOMESTIC AGENTS—Swind Machinery Co., Philadelphia, Penna. Taylor Machinery Co., Boston, Mass. Somers, Fitler & Todd Co., Pittsburgh, Penna. The H. A. Stocker Machinery Co., Chicago, Ill. Pacific Tool & Supply Co., San Francisco, Calif. The Mine & Smelter Supply Co., Denver, Colo. The E. A. Kinsey Company, Cincinnati, Ohio, Indianapolis, Ind. Hill, Clarke & Co., New York, N. Y.

Dividing Head

modern, powerful, universal miller is severely uipped with a Dividing Head that is strong mensurate with the machine's capacity

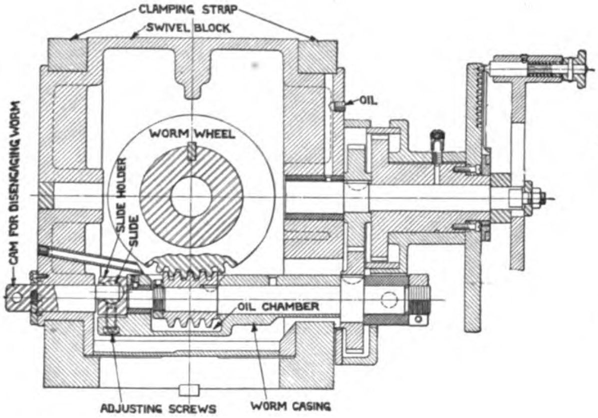


FIG. 3

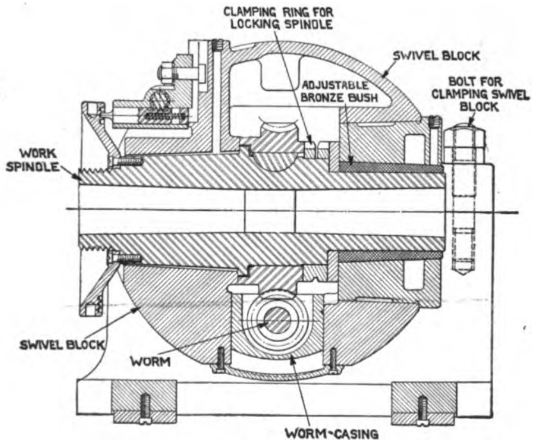
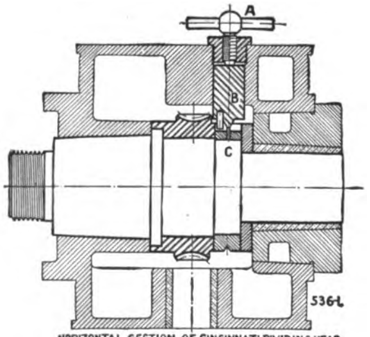


FIG. 4

members which grip the entire circumference of the trunnions. This insures rigidity, and also protects the bearings from injury, thus preserving the alignment of these parts.

These are some of the essential factors that contribute to continued accuracy.



HORIZONTAL SECTION OF CINCINNATI DIVIDING HEAD.

FIG. 5.

The spindle clamp consists of a split ring, C, that is spread by the wedge B by tightening the screw A, thus clamping the spindle endwise, securely, without crowding it out of alignment.

Summing Up—

When you buy Cincinnati Universal Millers, you get Dividing Head[s] like this:

First of all, each size is big enough to stand up to the service required from the machine. We don't limit a ten-horsepower Universal Machine by putting on it a five-horsepower Dividing Head.

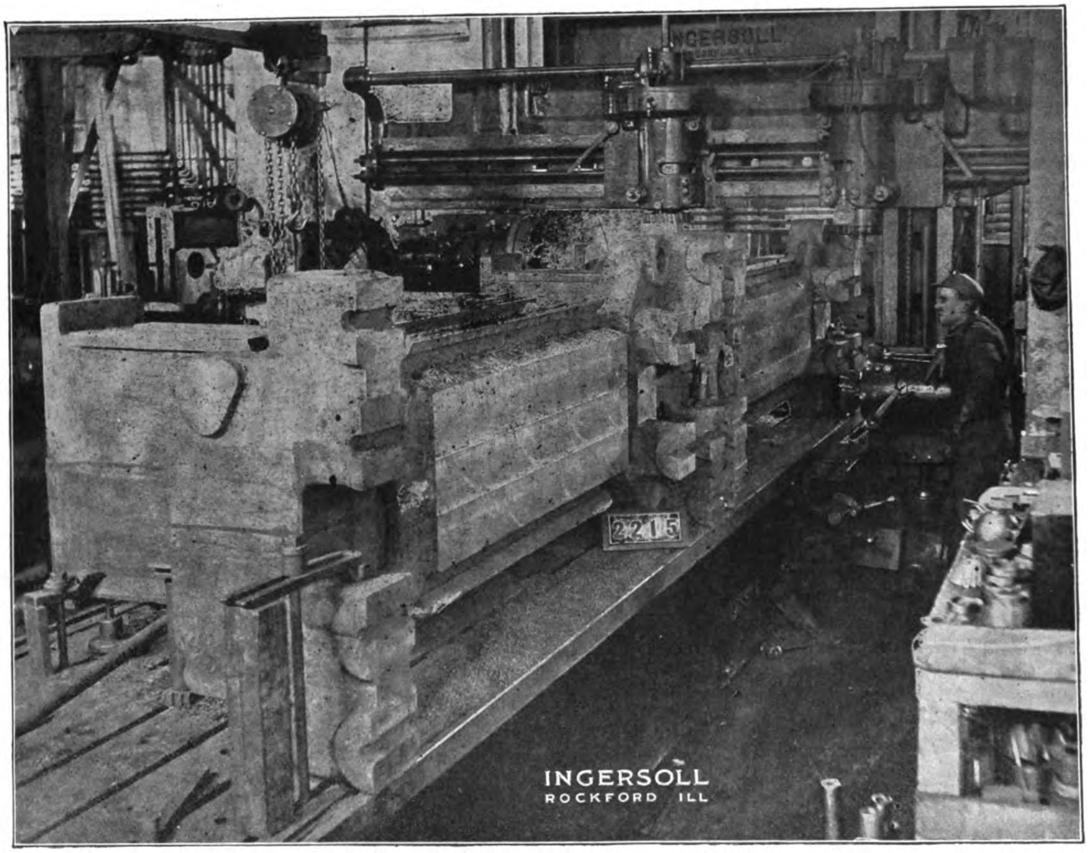
By making them big, they have a chance to retain their original accuracy.

And, we do make them accurate.

You'll find all of this more fully described in pages 67 to 70 in our catalog. Shall we send you a copy?

The Cincinnati Milling Machine Co.

Cincinnati, Ohio



Another Ingersoll Job for An

INGERSOLL MILLER

8 Hours Milling against 24 Hours Planing

Two Ingersoll Fixed Rail Housings are shown here. They are being milled on one of the 10 Ingersoll Millers in our Shop. This one is a 72-inch by 20-foot, 60-hp. machine.

The time required is 8 hours for each casting against 24 hours planer time. The milling includes top, bottom, bearings, faces of crossrail and housings, bevel on crossrail and housings, all at one setting of castings.

Get Bulletin No. 36—"Suggestive Installations."

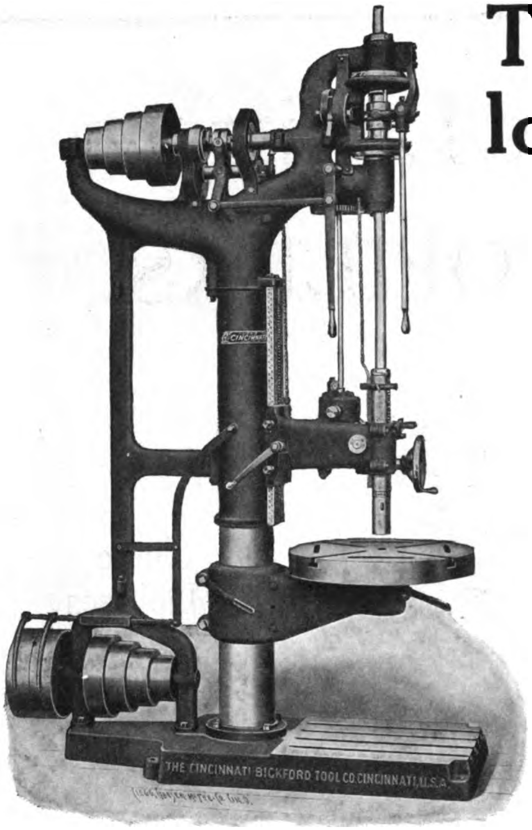
Better still, send us your prints and get our suggestions on your work. It will not obligate you in any way.

The Ingersoll Milling Machine Company

Main Office and Works: Rockford, Ill., U. S. A.

New York Office: 50 Church St., The Walter H. Foster Co., Mgrs. Detroit Office: 806-808 David Whitney Bldg., H. C. Rose, Mgr. Foreign Agents: C. W. Burton, Griffiths & Co., London, E. C.; F. G. Kretschmer & Co., Frankfort-on-Main, Germany; R. S. Stokvis & Zonen, Rotterdam, Holland; Fenwick, Freres & Co., Paris, France; Moscow Machine Tool & Engine Co. (G. Koeppen & Co.), Moscow, Russia.

To the man who is looking for facts



THE CINCINNATI

24 to 42-in.
Heavy Pattern
Upright Drilling
Machines

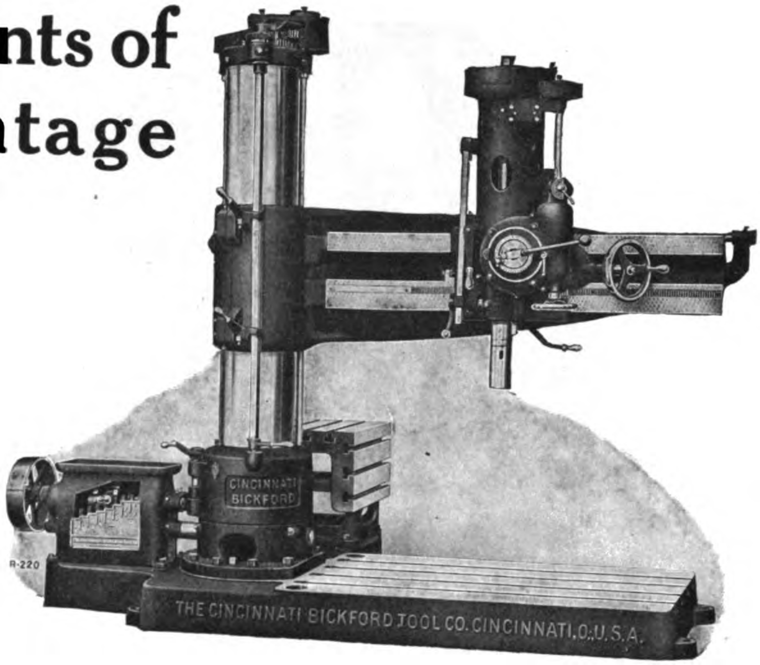
THE drive is furnished in four styles each of which gives, with the back gears, eight carefully selected changes of speed. The Regular Cone Drive necessitates setting the machine parallel with the line shafting while the Right Angle Drive provides for the opposite position. The Belted and Geared Motor Drives permit the drill to be placed at any desired angle. The motors used in these drives are constant speed and therefore require no controllers.

The Tapping Attachment acts through friction clutches and is hence operative at all speeds without shock or noise. It possesses unusual gripping power, is adjustable for wear, and may be disengaged when not required for tapping. Besides eliminating the expense and inaccuracy of tapping by hand, the device effects a great saving in breakage of taps, prolongs the life of their cutting edges, and supplies a convenient means for starting and stopping the spindle when changing tools.

The Automatic Trip disengages the feed at any predetermined depth and guards against the spindle being advanced beyond its intended range of movement.

The Cincinnati Bickford
Oakley,

Specific points of real advantage



CINCINNATI BICKFORD

4, 5 and 6-Foot Regular Plain Radial Drilling Machines

THE head is of unusual construction completely enclosing its gearing, affording protection to the operator and eliminating dust and grit from its working parts, is narrow gibbed on arm and freely adjusted.

The unusually powerful clamping device on column for locking arm in position is very effective and does not change position of arm or drill spindle when operated.

Column fitted with inner trunk having two large ball bearings interposed between them at top which permits the outer one carrying the arm to revolve freely, which allows positioning of drill with extreme ease.

The arm is of most approved design, extremely stiff providing generous support, and long, narrow guideway for head.

Tool Company

Cincinnati. O., U. S. A.

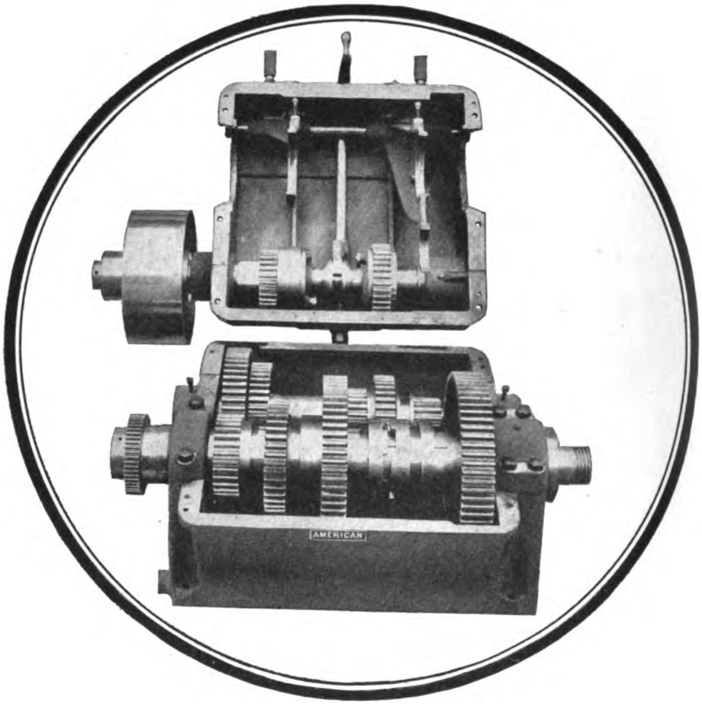
R-313

Presenting evidence regarding the usual production of an unusual machine.

HARTNESS FLAT TURRET LATHE

Stop That Noise

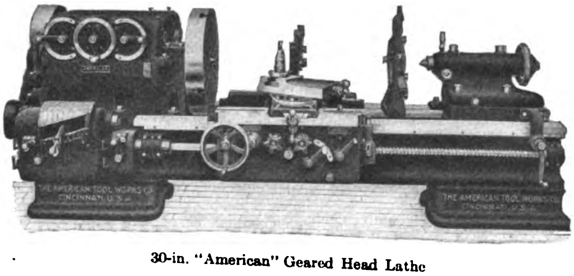
Remember That Your



You can't expect your men to give you the best they have when they are under a constant nervous strain on account of the noise of running gears. The day of quiet-running machinery is here and it is up to you to find and install machines that are noiseless in operation yet high in productive capacity.

Right here is where the "American" Patented Geared Head Lathe fits in.

There is no longer any excuse for a noisy geared head lathe in your shop. The number of running parts in "American" Geared Heads have been reduced to a mini-



30-in. "American" Geared Head Lathe

HERE ARE THE REASONS

The average face and diameter of the gears in "American" Geared Heads are greater than those of any other simila size Geared Heads built.

The material in the gears and shafts is the best we have been able to obtain for the purpose. All the largest gears are semi-steel, while the smaller gears are cut from the bar, some of them being hardened. Shafts are of high carbon

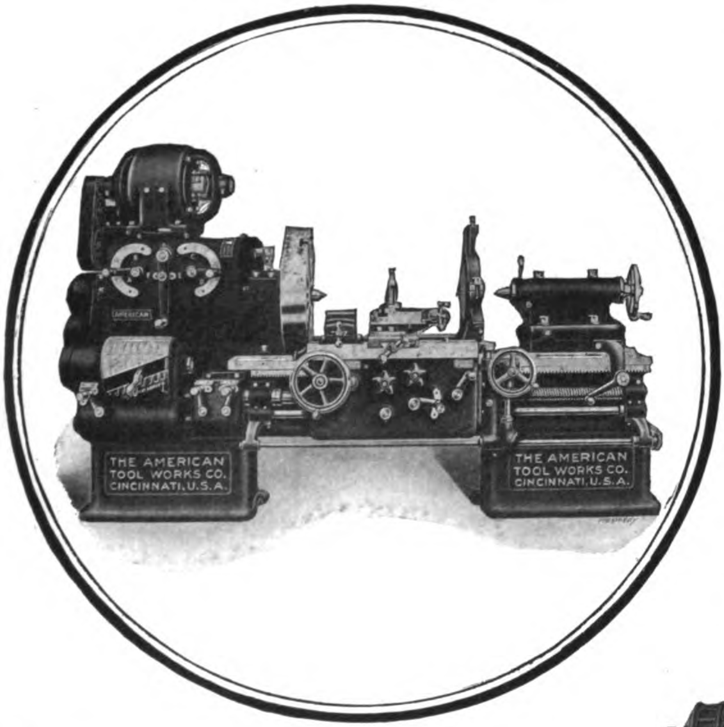
The American Tool Works

Lathes

Planers

In Your Shop

Workmen Have Nerves



mum, the gears are of large diameter, coarse pitch and are cut with special cutters. In addition to this the head is oil-tight permitting the entire head mechanism to run in oil. **This not only insures a quiet drive but greatly prolongs the life of the mechanism.**

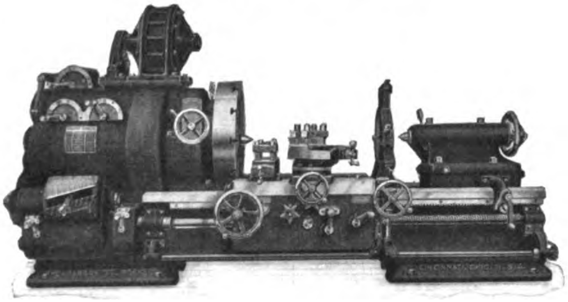
As an indication of the stability of the parts—This new type "American" Geared Head has been on the market for over four years, during which time a great many have been sold, and up to the present **we have not had to replace a single gear in any of the heads.**

IN A NUT SHELL:

crucible steel, and all bearings are bushed with phosphor bronze. The highly efficient gravity oiling system supplied is also very important.

Let us tell you where you can see some "American" Lathes operating in your vicinity then you can see all these things for yourself.

At least, let us send you one of our NEW Catalogs.



36-in. "American" Geared Head Lathe

Company, Cincinnati, U. S. A.

Shapers **Radials**

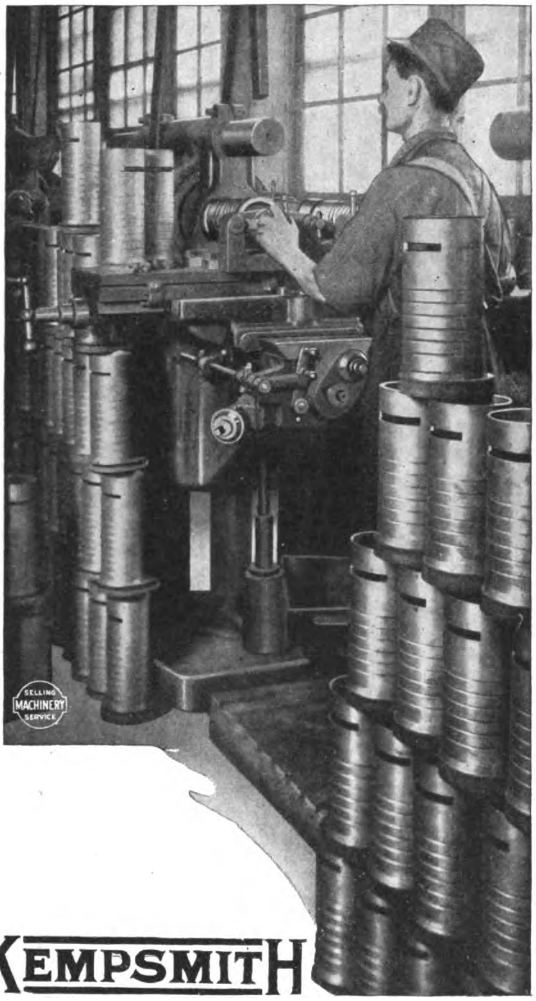
Milling the Sleeves for Willys-Knight Engines

Milling the inlet and exhaust ports in the sliding sleeves for Knight type motors is an economical operation as performed by the Willys-Overland Company (Elyria, Ohio).

The inlet port is $\frac{1}{2}$-in. wide, $3\frac{1}{2}$-in. sector; the exhaust port $\frac{7}{16}$-in. wide, $3\frac{1}{2}$-in. sector.

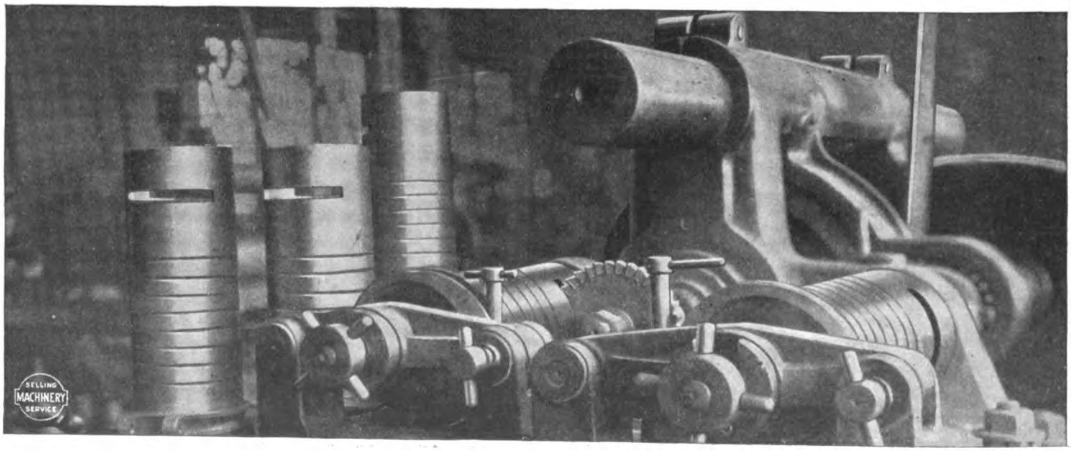
Two fixtures are used on each machine; the operator loads one while the machine is milling the sleeve in the other.

The machines used are No. 2 Kempsmith Plain Millers, and output from each is 250 sleeves per day—which indicates speed and stiffness more than sufficient for all ordinary milling requirements.



May we tell you more about this No. 2 and other Kempsmith Machines?

KEMPSMITH



The Kempsmith Manufacturing Co., Milwaukee, U. S. A.

"Do it Automatically"

Compare this with your own production figures.

There is only one practical method of reducing costs and that is to turn out more pieces per man per day.

Human endeavor along these lines has about reached its limits. The only way to appreciably speed up production is to "Do it Automatically"—the Potter & Johnston way.

P & J Automatics never get tired or lay down on the job. Once it is set up one man can attend to from **two** to **six** machines and every piece will be exactly like its fellows.

This advertisement is written for you Mr. Reader but it will not benefit you unless you act on it.

Suppose you send us on some of your blueprints and production data and let us tell you how much less it will cost to "Do it Automatically."

Offices and Representatives—

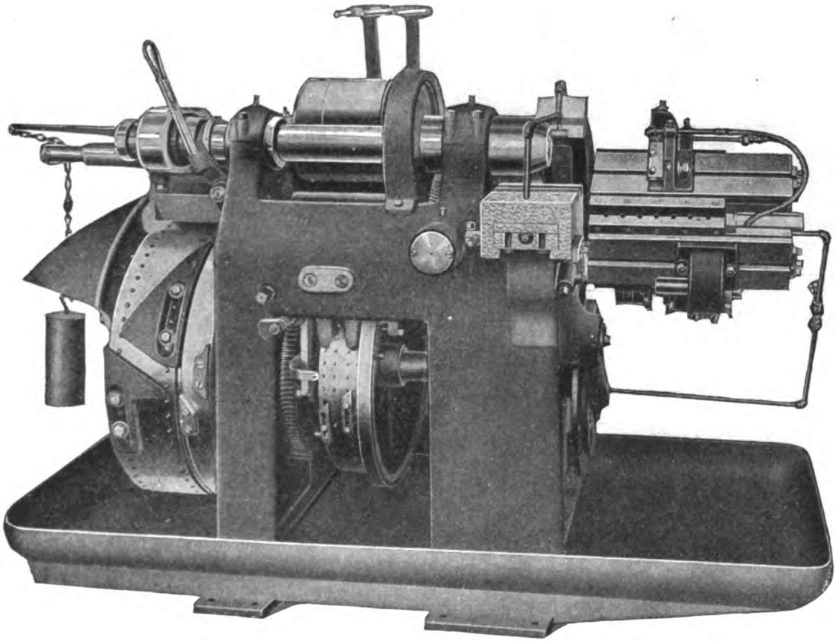
Office for Great Britain and France: 68 Avenue de la Grand Armee, Paris, J. Ryan, Manager. New York Office, Fulton Bldg., 50 Church St., Walter H. Foster, Manager. Detroit Office: Modern Machinery and Engineering Co., 1514 Ford Bldg. Chicago Office: 4213 Sheridan Road, Chas. H. Shaw, Manager. Toronto Office: 1501 Royal Bank Bldg., E. C. Roelofson, Manager.

Abroad—

Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne, England and Glasgow, Scotland. Alfred H. Schutte, Cologne, Brussels, Barcelona, Bilbao; Schuchardt & Schutte, Berlin, Vienna, Stockholm, Copenhagen and Budapest, Ercole Vaghi, Milan.

The very appearance of this machine is an impression of strength. Among our customers who have used *Gridleys* for years, the need for more Single Spindle Automatics means more Gridleys—simply because they are built right to stay right—they're *Durable*.

Buy your Screw Machine equipment on this basis—*Attractive deliveries* on Capacities 2¼",3¼",4¼"sizes.



MANUFACTURING CO.

WINDSOR MACHINE CO.

VERMONT

CANADIAN SCREW PLANT—MONTREAL

DETROIT ATLANTA SAN FRANCISCO WITH FOREIGN REPS.

Also Acme Automatics, Threading Dies and Screw Machine Products at Cleveland, Ohio

What About Control?

THE "NEW BRITAIN" possesses several exclusive features of design which render it very easy of operation and minimize the possibilities of accident.

HAND CONTROL LEVERS on each side and within easy reach of the operator enable power feed to be instantly stopped or started.

A HAND FEED CRANK is also provided for testing all feed movements and tool positions. In setting up, testing and adjusting tools it saves breakage.

THE arrangement of these levers is such that it is impossible to start the power feed until hand feed crank is removed, thus preventing any accident which might otherwise arise through operator's forgetfulness.

THE "NEW BRITAIN" is so designed that, in the event of a tool breaking, by withdrawing the tool slide and throwing out the locking pin, the spindle cylinder can be revolved into the most convenient position for sawing off the end of the bar containing the broken tool.

The "New Britain" Six-Spindle Automatic is smashing production records everywhere. We solicit an opportunity to demonstrate how much it might increase yours.

The New Britain Machine Co.

—Automatic Screw and Chucking Machines—

New Britain, Conn., U. S. A.

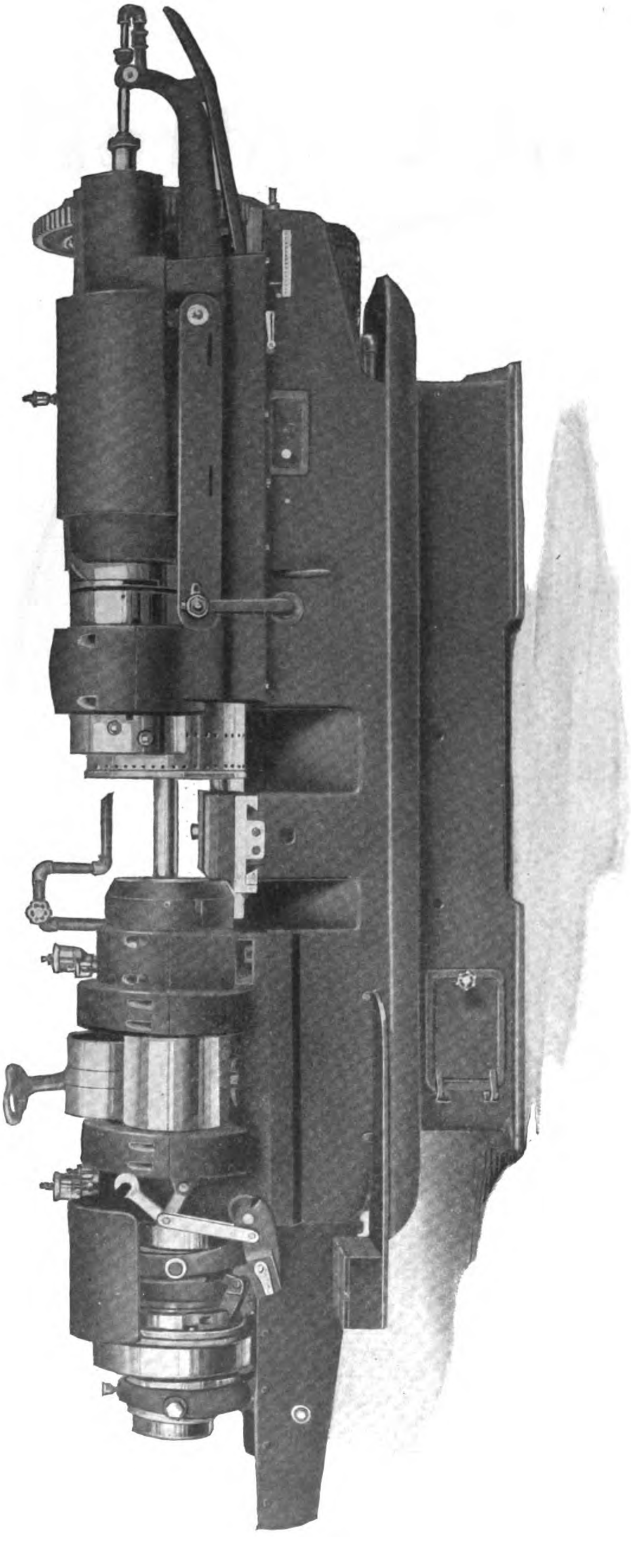
SALES OFFICES:

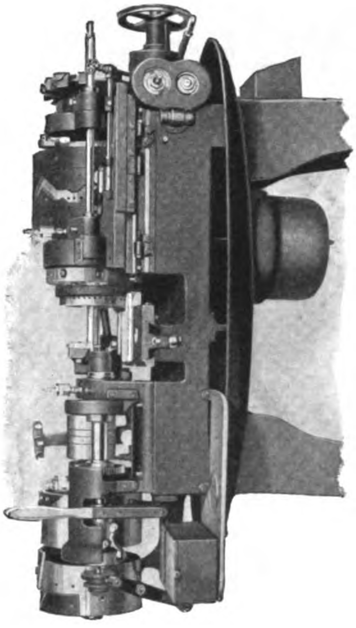
2008 W. Grand Boulevard, Detroit, Mich. (Phone Walnut 2151.)
949 Otis Bldg., Chicago, Ill. (Phone Main 35 and 36.)

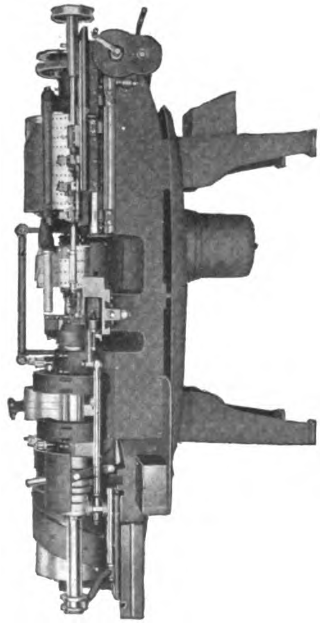
FOREIGN AGENTS:

Coats Machine Tool Co., Ltd., Caxton House, London, Glasgow and Newcastle-on-Tyne.

AUTOMATICS







Nothing Flimsy About Our Design

You will remember there is nothing flimsy about our machine, no overhanging, yielding parts constantly annoying when trying to produce duplicate parts. When you encounter such troubles, up goes your cost. No user of a CLEVELAND has this complaint to make.

Solidity and staying qualities are great assets with us. What we guarantee to do is always done.

Cleveland Automatic Machine Company

Cleveland,
Ohio

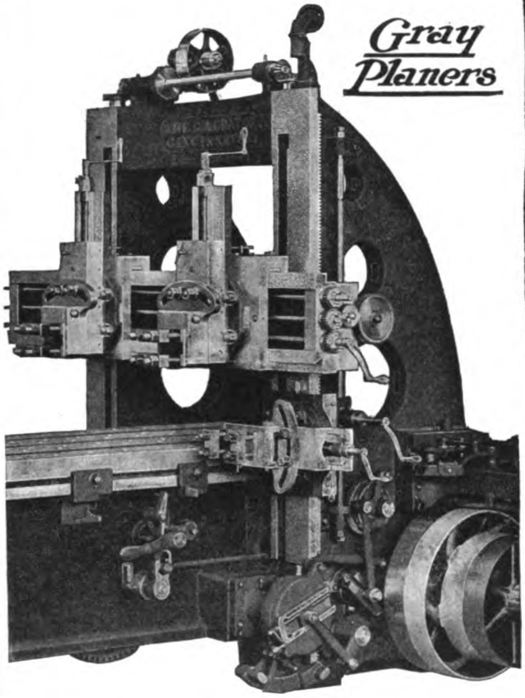
No Torsional Strain

As the driving gears are keyed to the hubs of the pinions the driving power is transmitted through the massive pinion sleeves, thus relieving the shafts of all torsional strain. This insures a smooth movement of the table, increases the life of the cutting tools, and produces better work. We are giving the valuable distinctive features of

GRAY PLANERS

week by week. Write for our illustrated catalog. It tells the whole story.

The G. A. Gray Co.
Cincinnati, O.



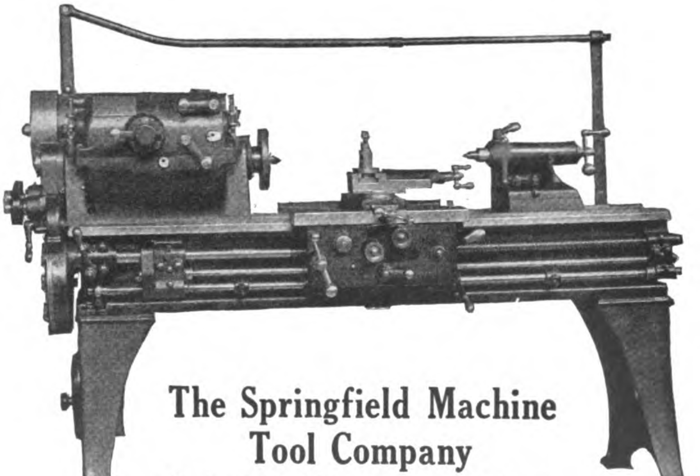
Springfield

Single-Pulley Geared Head Lathe

Investigate the new **Springfield** 14-in. x 6-ft. Single-Pulley Engine Lathe. You will find that correct speeds for all classes of work within the range of the machine are provided within the geared head, and any speed can be instantly obtained. Ball Bearings throughout, with the exception of the main spindle journals, give high transmission efficiency. Simple construction, with every control lever within easy reach, gives speed to all operations. The lathe is started or stopped instantly by means of the clutch pulley and push-rod, and when desired individual motor drive is readily applied, with the motor in any position—on the lathe head or back of the machine, on the ceiling or floor.

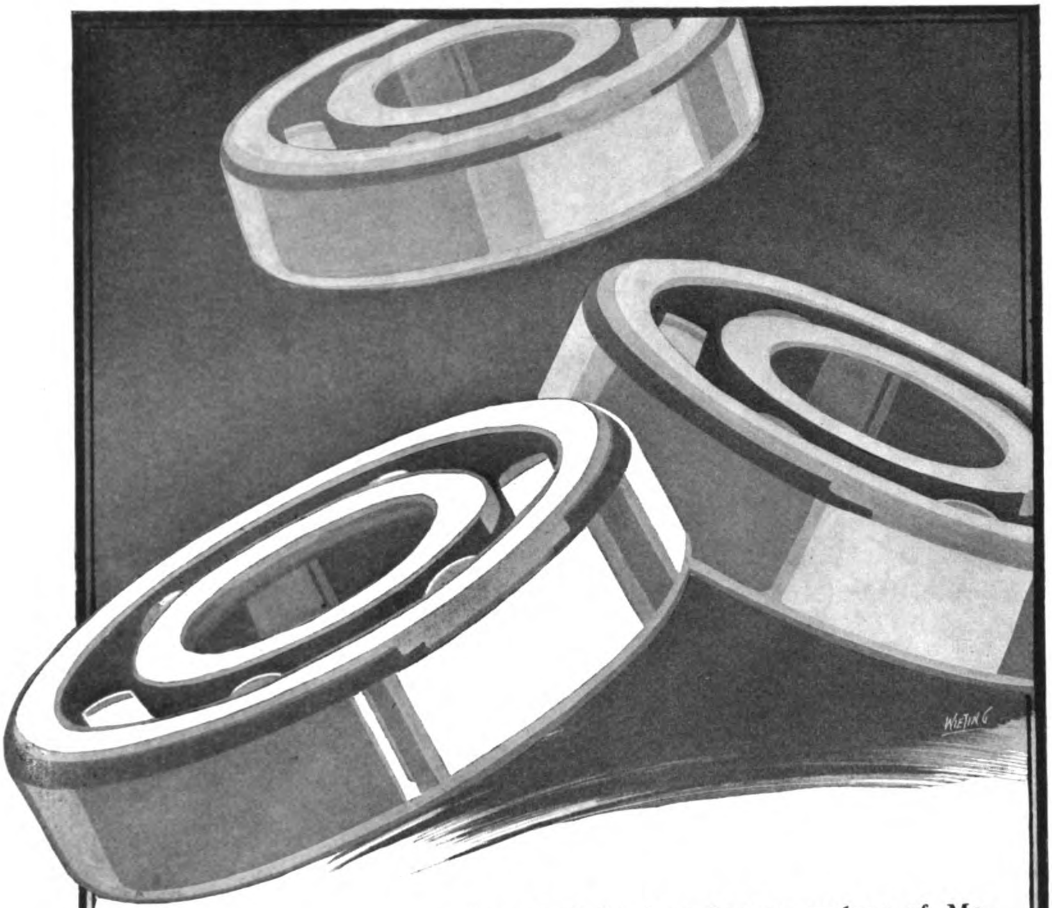
All these are features necessary to successfully meet present-day demands, and in this lathe we have combined them under truly "Ideal" conditions.

Write for complete details.



The Springfield Machine Tool Company
Springfield, Ohio, U. S. A.

HESS-BRIGHT



Several of the best known makers of Machine Tools have used Hess-Bright Ball Bearings for many years—the fact that these manufacturers still prefer this inimitable bearing is concrete evidence of their superiority.

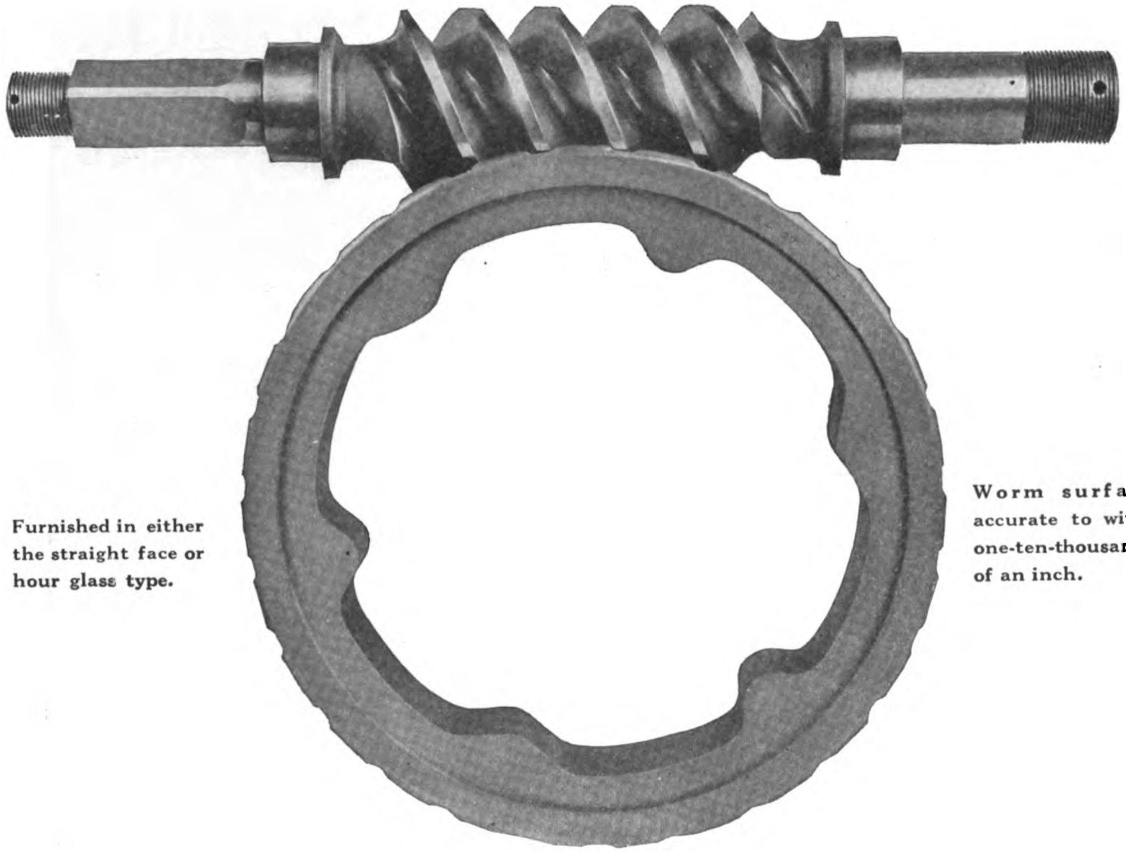
Hess-Bright's Conrad patents are thoroughly adjudicated.

Hess-Bright Mfg. Co.
Front St. and Erie Ave.
Philadelphia, Pa.

BAUSH

WORM DRIVE

Furnished in either the straight face or hour glass type.



Worm surfaces accurate to within one-ten-thousandth of an inch.

From 1% in 1913 to more than 50% in 1916

These figures show graphically the acceptance of the worm gear type of final drive by the truck users of this country. Abroad worm gear was the dominant type of drive even before 1913 and today is accepted as practically the standard type of drive.

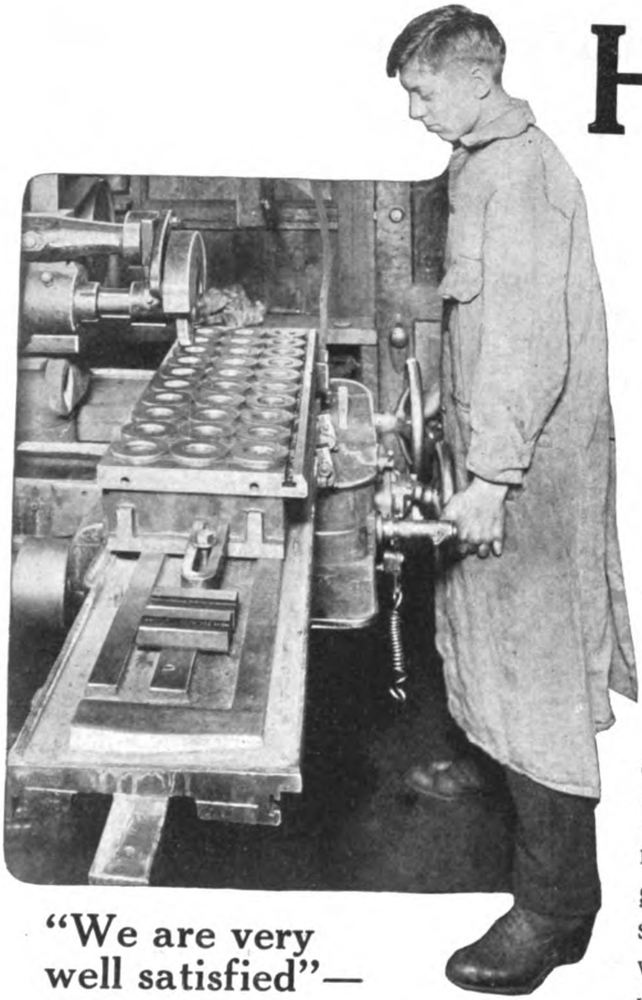
Since 1913, when worm drives were given their first serious consideration in this country, this type of drive has steadily grown in popularity until more than half of all the trucks produced for 1916 will use worm gear driven rear axles.

This dominancy of worm gears is due solely to the greater efficiency of the worm gear type of drive judged from any standpoint. The average life of a worm gear is exceedingly high—it improves with use—it is extremely quiet in operation and requires little or no attention during its entire life.

Baush Machine Tool Company

SPRINGFIELD, MASS.

Manufacturers also of Multiple Spindle Drills,
Lassiter Stay Bolt and Bolt Turning Machines



HEALD MAGNETIC CHUCK

at

Mailometer Shop

"We are very well satisfied"—

—says the manager of the Mailometer Company, referring to the chuck. Results at shops of Dayton Stamping & Tool Co., Page Needle Co., Union Caliper Co., Barber - Colman Co., Crocker-Wheeler Co., National Carbon Co., and scores of others are reasons why *YOU* should investigate HEALD Chucks.

The Mailometer Company, Detroit, uses its Heald Magnetic Chuck mostly for grinding die parts and other special tool work. That is why the machine is equipped with the narrow wheel shown in the photo.

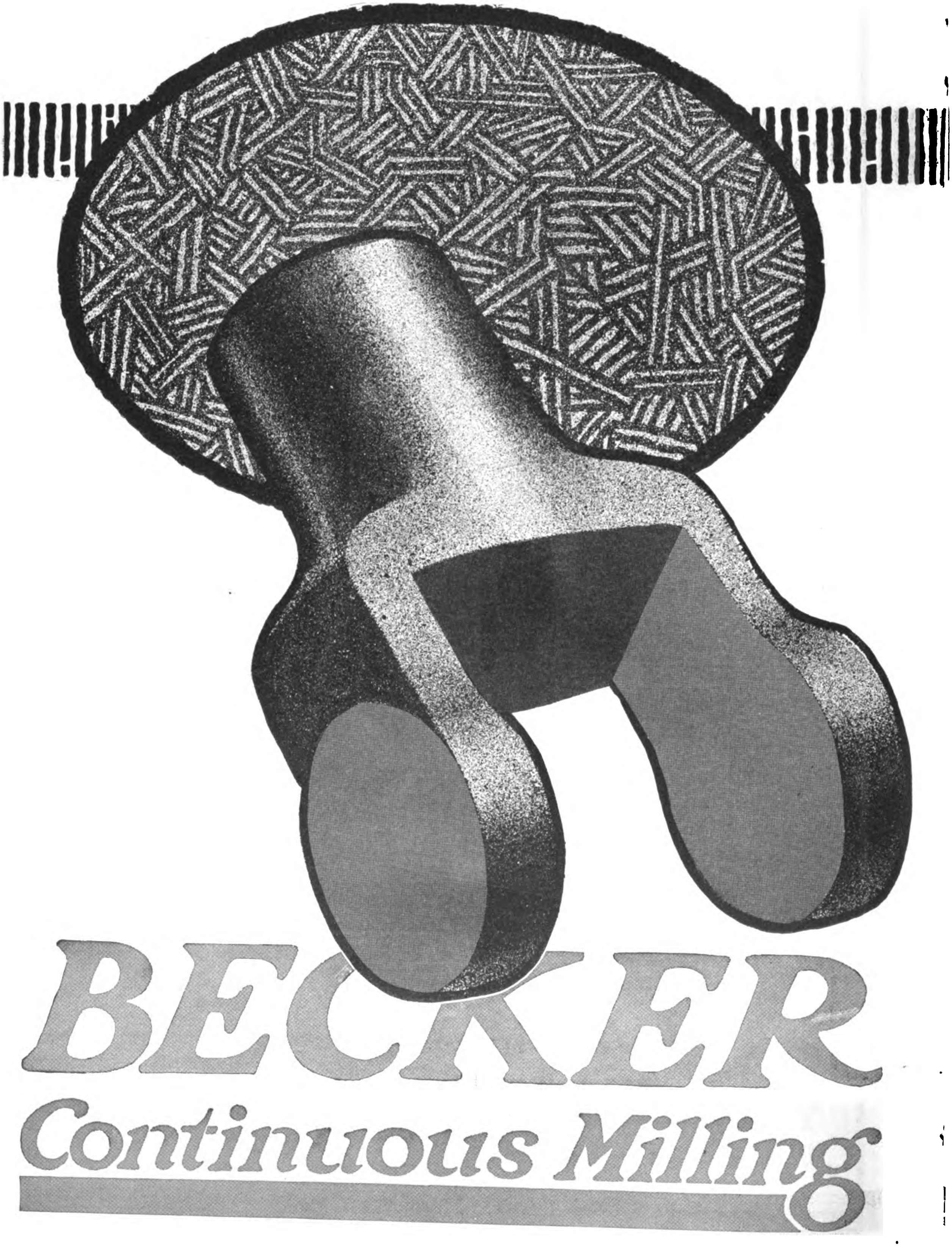
When the picture was snapped, however, the Chuck was loaded with washers which are occasionally handled, though of course a larger wheel would be used, were it a regular operation.

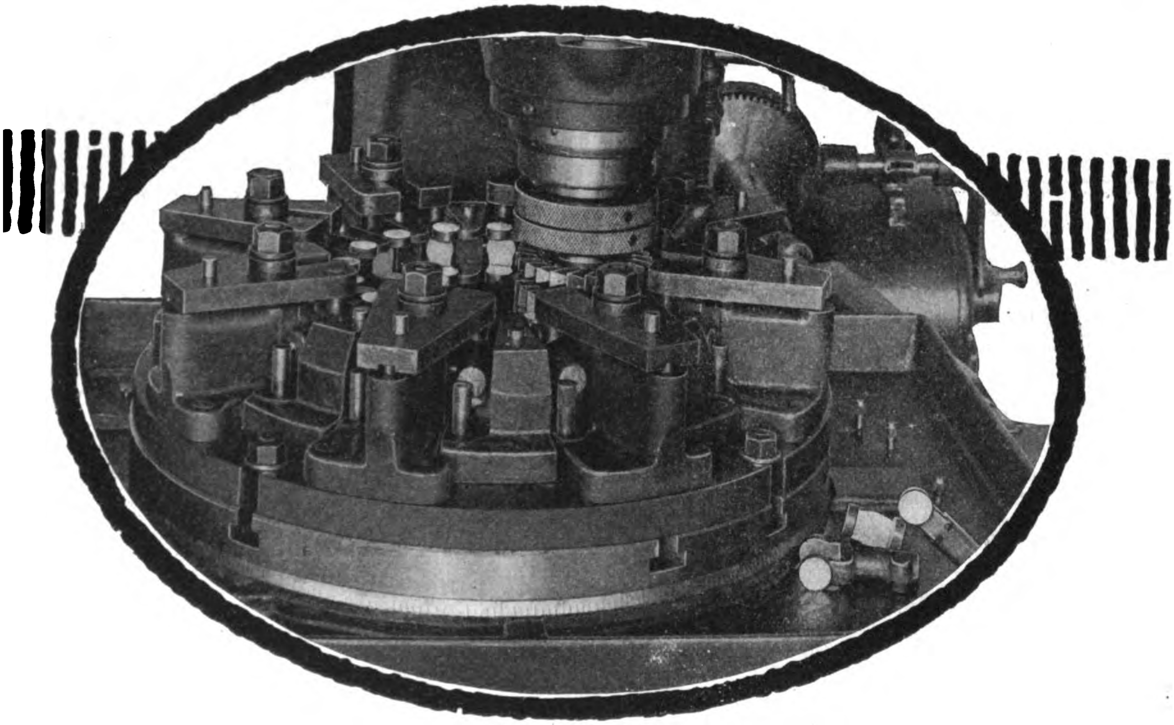
THE HEALD MACHINE COMPANY

10 NEW BOND STREET - - - WORCESTER, MASS.

CHICAGO, 24 So. Jefferson Street
DETROIT, 303 Majestic Building
BRANCHES
CINCINNATI, 692 Provident Bank Building
CLEVELAND, 710 Engineers Building

FOREIGN AGENTS: Alfred Herbert, Ltd., England, Italy, France and Switzerland. Post van der Burg & Co., Rotterdam, Holland.


BECKER
Continuous Milling



Becker increased production over 900%

The Steering Reach Rod End (hard drop forging) illustrated opposite required machining on five faces. Production was at the rate of 25 per hour.

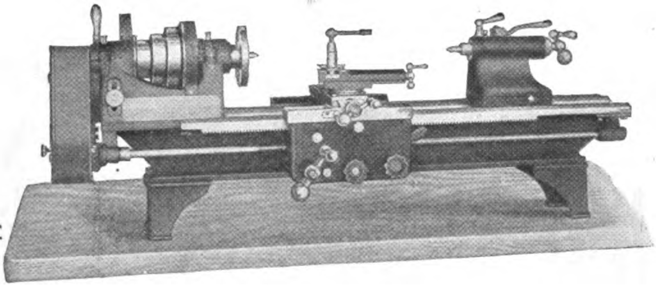
Then Becker Continuous Milling took a hand and multiplied that production by five, practically finishing all five surfaces in one operation with an output of 120 per hour.

Is it not reasonable to suppose that Continuous Milling might affect your output, your profits, in the same positive way? Hadn't you better inform yourself about Continuous Milling and its possibilities? Hadn't you better ask us for the Becker Continuous Milling Book?

Becker Milling Machine Company

Hyde Park, Mass., U. S. A.

AGENTS—Manning, Maxwell & Moore, New York, Philadelphia, Pittsburgh, Chicago, St. Louis, San Francisco, Seattle, Milwaukee and Cincinnati. H. B. Slate, Hartford, Conn. National Supply Co., Toledo, O. Selson Engineering Corp., London. Schuchardt & Schutte, Berlin. Allied Mchry. Co. of America, Paris.



9-in. x 4-ft. "Star" Bench Lathe.

STAR LATHES

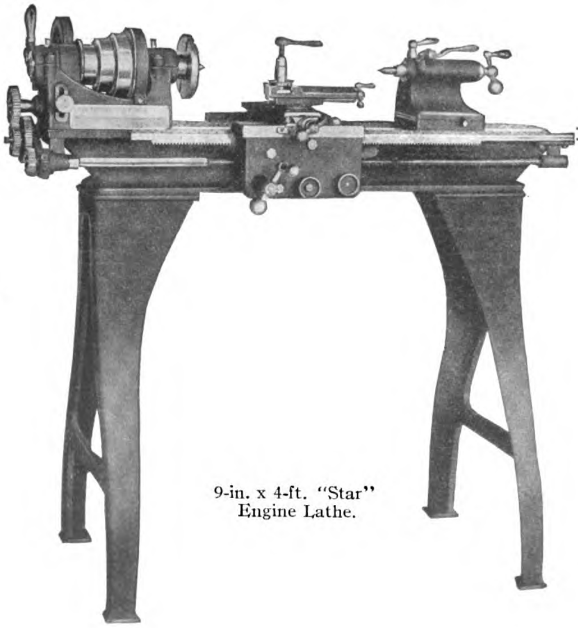
9-in.—11-in.—13-in. swing.

Speed and Accuracy on the Light Jobs

In the shop or the tool room, where there are many moderately light jobs, these Star Lathes are the logical equipment.

They save in first cost and in operating cost. Because of their simplicity and ease of manipulation, they turn out the work with great rapidity. Because of their strength and rigidity, they retain their high precision through long, hard usage.

Read all about them —in Catalog 26-B.



9-in. x 4-ft. "Star" Engine Lathe.

The Seneca Falls Mfg. Co.

687 Water St., Seneca Falls, N.Y.

The Canadian Fairbanks-Morse Co., Ltd., Montreal, Toronto, St. John, N. B.; Calgary, Saskatoon, Winnipeg, Vancouver, Edmonton, Fort William, Hamilton, Ottawa, Quebec, Regina, Victoria.

We Do Not Ask for All Your Belt Business

IF everyone whose trade we are aggressively soliciting on VIM-OAK Leather Belting were to place their entire belting business with us, our works would be far short of capacity, therefore we do not ask for all your business.

HOUGHTON'S
TRADE MARK
VIM-OAK
PATENTED
LEATHER BELT

"More Grip—Less Slip"

We merely ask that you buy just one VIM-OAK Leather Belt and place it upon a normal drive where the belt itself in the mute language of actual service in your own plant and under your own supervision can tell its own story of merit.

You are certainly going to buy this one trial belt some time.

Why not buy it now and get it over with?

You can make your own terms of guarantee.

E. F. HOUGHTON & CO.

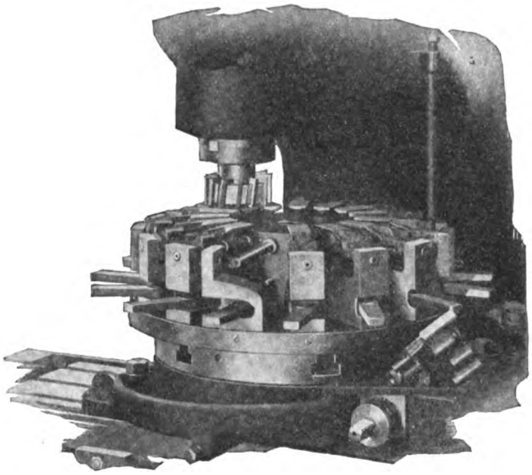
Publishers of The HOUGHTON LINE

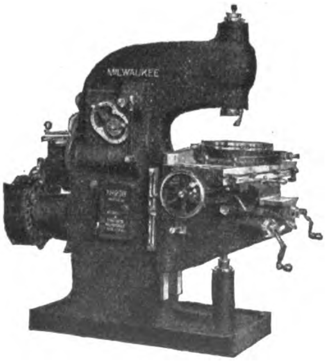
Third and Somerset Streets - Philadelphia, U. S. A.

New York, Boston, Hartford, Syracuse, Buffalo, Baltimore, Pittsburgh, Cleveland, Cincinnati, Detroit, St. Louis

England and Wales: Edgar Vaughan & Co., Ltd., Birmingham, England. Scotland: Jas. S. Crawford & Sons, Glasgow.
Spain: La Maquinaria Anglo-Americana, Barcelona.

MILWAUKEE MILLING MACHINES





Continuous Milling

The illustration shows the continuous milling of cast-iron pump barrels, a Milwaukee No. 1½B Vertical Miller being employed. The surfaces to be milled are very thin and roughing and finishing cuts are taken within an accuracy limit of .0005 in. The pieces are located in the fixture by two previously bored holes and owing to this method the loading and unloading is not as rapid as would be the case where pieces are simply placed in the fixture and clamped. 750 pieces are finished in a day, which is a meritorious performance considering the character of the work and the method of chucking.

Manufacturing milling by the continuous process as illustrated is an advanced step in milling machine practice and is worthy of the serious attention of the management of any machine shop. The cutter is always in the cut and no time is lost in unloading and loading the fixture.

Milwaukee Vertical Millers are particularly well adapted to continuous milling. The spindle is adjustable for wear only as sufficient and accurate adjustment can be obtained by the adjustment of the knee alone just as it is in the horizontal type of millers.

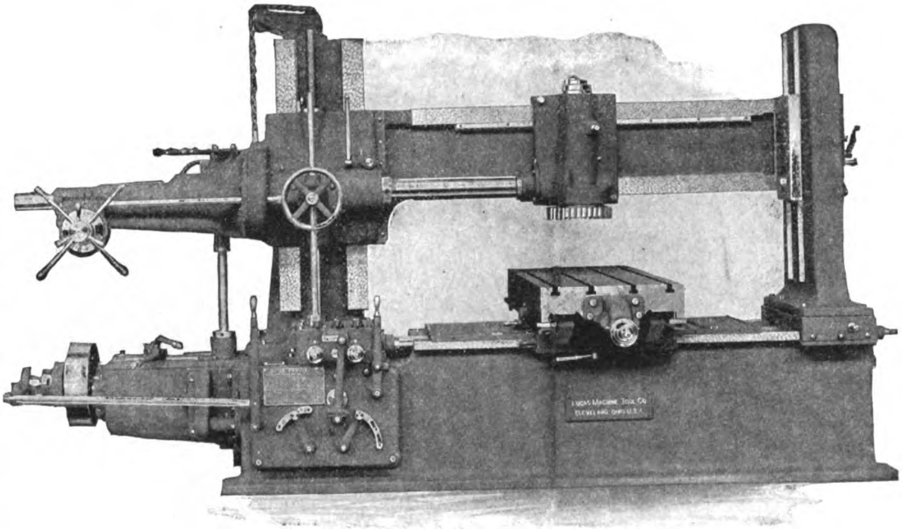
Milwaukee Vertical Millers embody all the general features that have proven so advantageous in Milwaukee Horizontal Millers. The automatic flooded lubrication system is extended to bearings and gears in the spindle head, not one drop of oil overflowing the end of the spindle. The reverse is self-contained which is a valuable asset in continuous and ordinary milling.

Send for Catalog No. 19, illustrating and describing Milwaukee Vertical and Horizontal Millers.

KEARNEY & TRECKER COMPANY
MILWAUKEE, WISCONSIN

Retribution is one of the few things that are sure in this world: therefore we can't afford to make a bad machine.

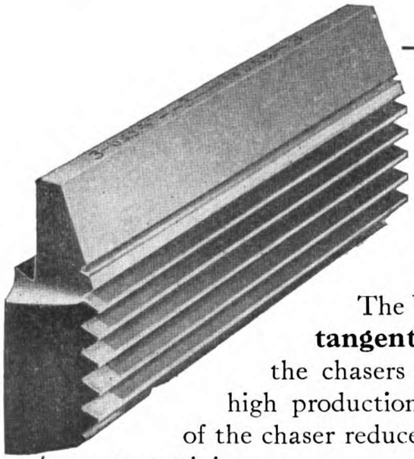
THE "PRECISION" BORING DRILLING AND MILLING MACHINE



WILL NEVER CAUSE ANY REGRETS TO OUR CUSTOMERS OR OURSELVES

The QUALITY has been kept up ALL THROUGH THE RUSH

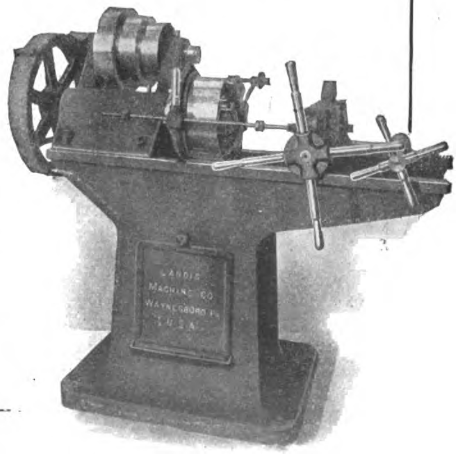
Lucas Machine Tool Co. NOW AND ALWAYS OF **Cleveland, Ohio, U. S. A.**



Every Feature You Want Is Here

The Landis Die by virtue of its design has all the features which are necessary to successful threading.

The **Variable Rake Angle** insures accurate threads, the **tangential disposition** of the chasers to the stock means high production and the **long life** of the chaser reduces the cost of upkeep to a minimum.



Send us your specifications and let us demonstrate to your complete satisfaction that for bolt and pipe threading the Landis Die excels all.

Catalog No. 22 gladly sent upon request.

Landis Machine Company
Waynesboro - - Penna., U. S. A.

There are many important features about the Steinle Turret Lathe that are of vital interest to all lathe users.

Perfect rigidity obtained

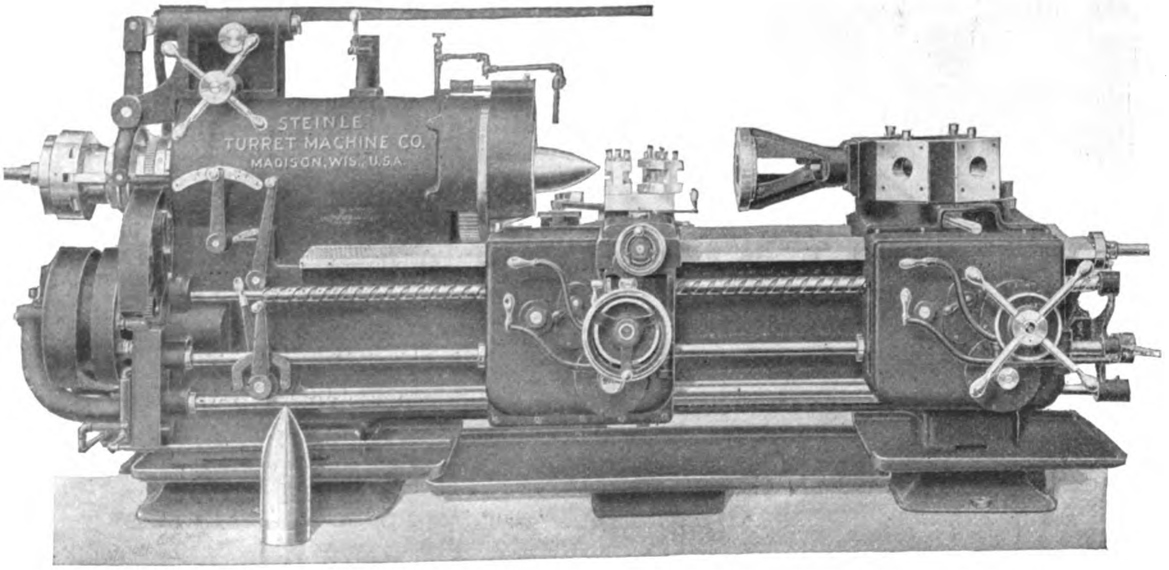
You will notice the general massive construction of this lathe. In order to obtain perfect rigidity, the headstock and bed are cast in one piece.

The tool post carriage is so arranged as to run past the chuck, giving a swing of 21 inches over the carriage and 24 inches over V's.

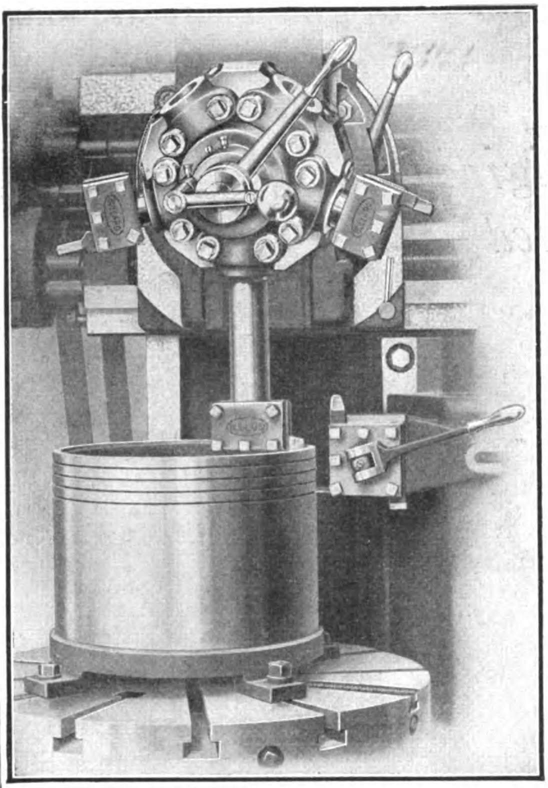
The machine shown below is our regular 24-in. Full Swing Side Carriage Turret Lathe, equipped with collet chuck and special tools for nosing 6-in. shells.

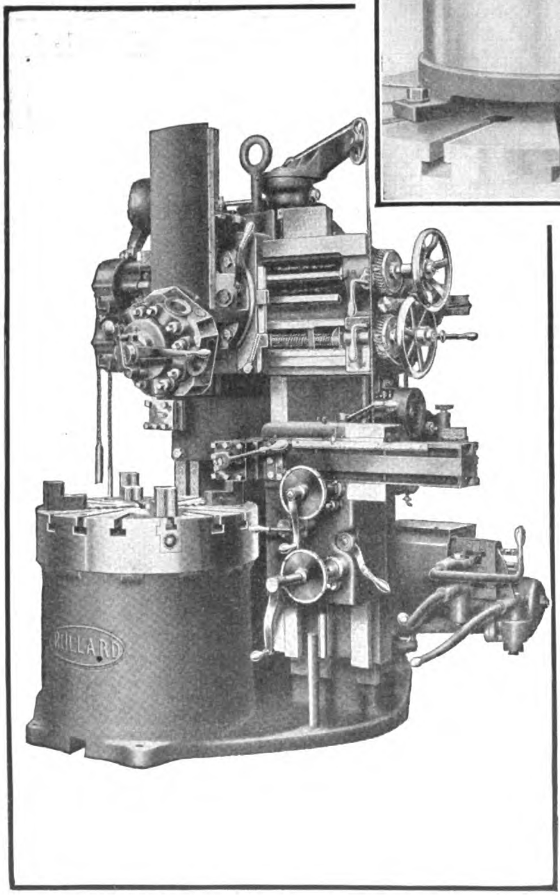
Let us make time estimates on your pieces—show you what a Steinle will produce on your work. No obligation incurred.

Steinle Turret Machine Co.
Madison - - Wisconsin



On time!





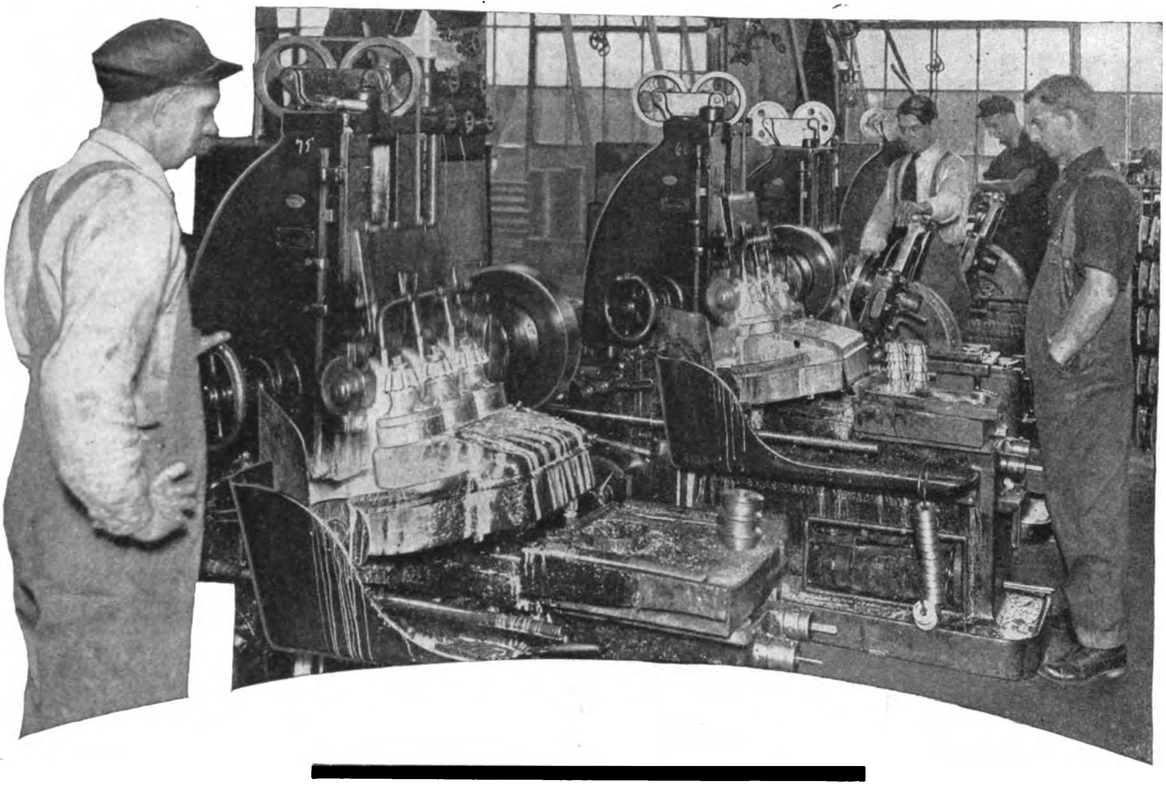
BULLARD

In keeping your work **up to** schedule, in perfecting **your** routing system, the BU**LLARD** VERTICAL TURRET **LATHE** helps tremendously. Es**pecially** in these rushing times.

It is a machine that is **always** ready to do more than i**ts share** of a great range of wor**k.**

*Get to know the Bu**llard** Vertical Turret Lathe. **The** facts are yours upon req**uest.***

The Bullard Machine Tool Co.
Bridgeport, Conn.



Rapid Production

on G & E Multiple-Spindle Gear Roughing Machines.

Roughing out three bevel gears in the same time it takes to rough out one. One of these machines will turn out enough work to keep two to three of your finishing machines busy.

These machines are especially built and designed for this hard work. Send us your blueprints for time estimates.

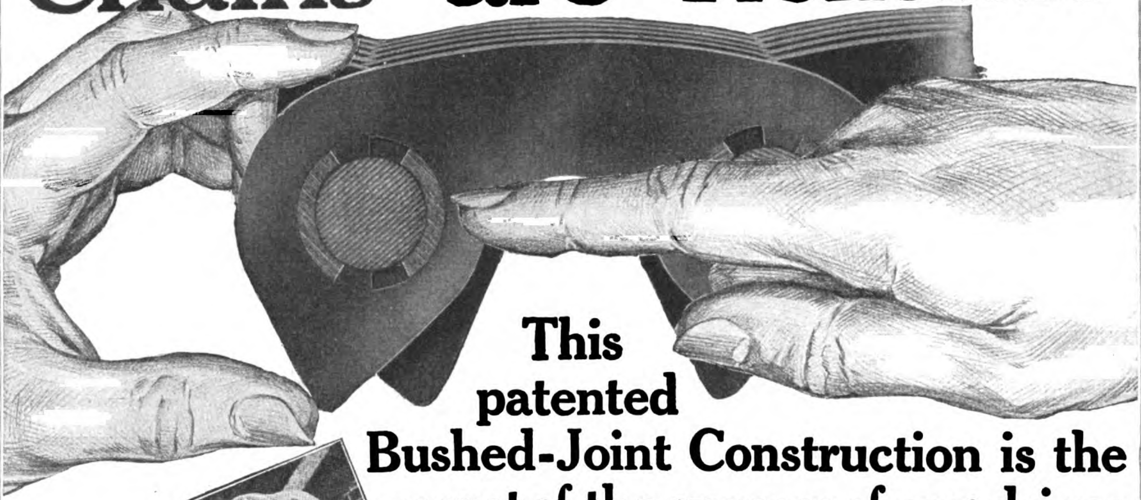
GOULD & EBERHARDT

"HIGH DUTY" SHAPERS

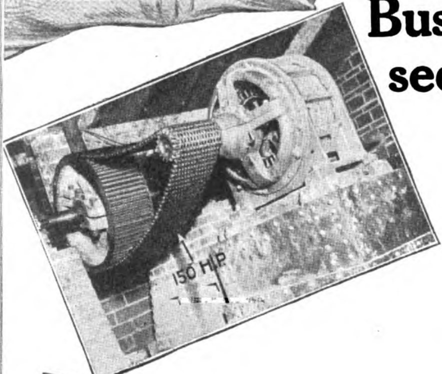
AUTOMATIC GEAR AND RACK CUTTING MACHINERY

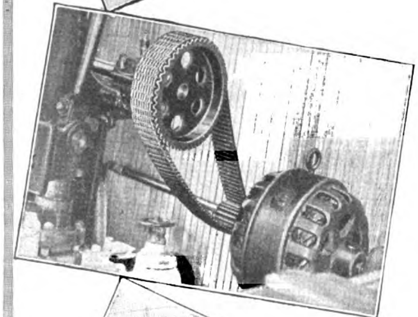
Newark, N. J.

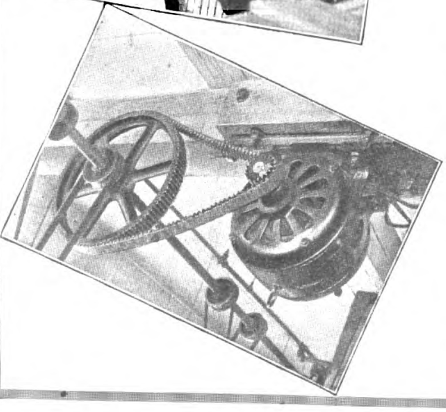
Why Link-Belt Silent Chains are Reliable



This patented Bushed-Joint Construction is the secret of the success of our drives







That's why so many old Link-Belt Silent Chain Drives are in evidence today. They grow old because they possess lasting qualities. This is shown by a vast number of drives in daily use after ten years or more of severe duty. You find them in every line of industry where power is employed.

Maintenance is reduced to a minimum where reliance is placed on

Link-Belt Silent Chain

For the Transmission of Power

Flexible as a Belt—Positive as a Gear
More Efficient than Either

Your problems can be solved by Data Book No. 125—the only price-list book ever published on Silent Chain. Sent prepaid on request. Write to any office.

Look for the Name on the Washers

Look for the Liners in the Joints

LINK-BELT COMPANY

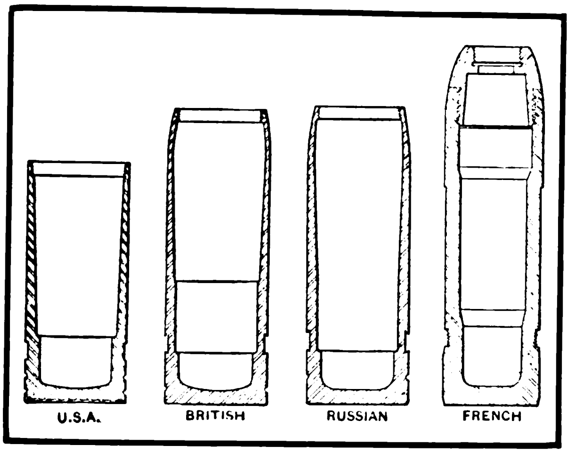
PHILADELPHIA CHICAGO INDIANAPOLIS

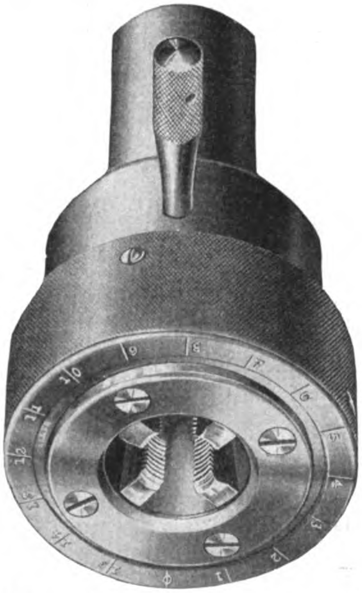
New York..................299 Broadway
Boston..........................49 Federal St.
Pittsburgh..............1501 Park Building
St. Louis......Central Nat'l Bank Building
Buffalo..................698 Ellicott Square
Wilkes-Barre......2nd Nat'l Bank Building
Portland, Ore..............14th & Lovejoy Sts.
Birmingham......General Machinery Co.
Cleveland..........1304 Rockefeller Bldg.
Detroit..................732 Dime Bank Bldg.
Seattle..................580 1st Ave. South

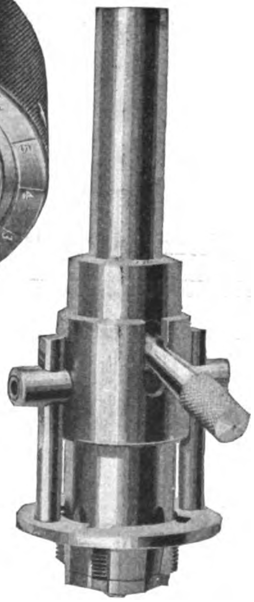
Denver..........Lindrooth, Shubart & Co.
San Francisco....................................
Meese & Gottfried Co., 400 E. 3rd St.
New Orleans..........Whitney Supply Co.
Louisville......Frederick Wehle, Starks Bldg.
Los Angeles ....161 N. Los Angeles St.
Minneapolis............Link-Belt Supply Co.
Knoxville.......D. T. Blakey, Empire Bldg.
Charlotte, N. C.....................................
J. S. Cothran, Commercial Bank Bldg.
Toronto, Can.. Canadian Link-Belt Co., Ltd.

FOR SALE

Experience as Well as Tools







Are you threading shells?

We have the proper tools with which to show you a saving on your work, and the experience to thoroughly advise you regarding the best way to handle your problem.

MURCHEY

Collapsing Taps and Automatic Dies

are being used on English, Russian, Italian and French Shells.

They are the logical tools to use and leading manufacturers in this country and in Canada are employing them.

We can tap any size hole from 1 to 12 in. All chasers used on shell work absolutely guaranteed to be made of high-speed steel of the highest grade.

WRITE FOR CATALOG

Tell us the work you are doing. Get the full story. Let us do for you what we are doing for others.

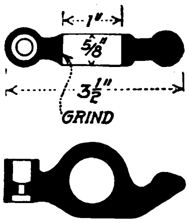
Murchey Machine & Tool Company

Detroit 64 Porter Street Michigan

The Coats Machine Tool Company, Caxton House, Westminster, London, S. W., England, and Fenwick Freres & Company, 15 Rue Fenelon, Paris, France.

The Output

Daily output 800 holes ground in 10 hours.
Highest daily run 1,000 holes.



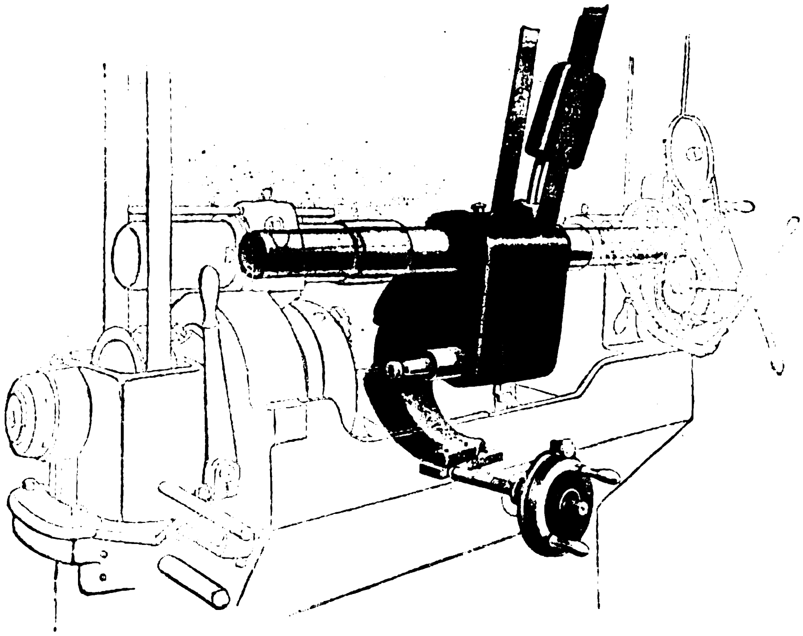
Rocker Arm

Tolerance - -	**.0005**
Stock removed	**.005**
Production per hour	**100**

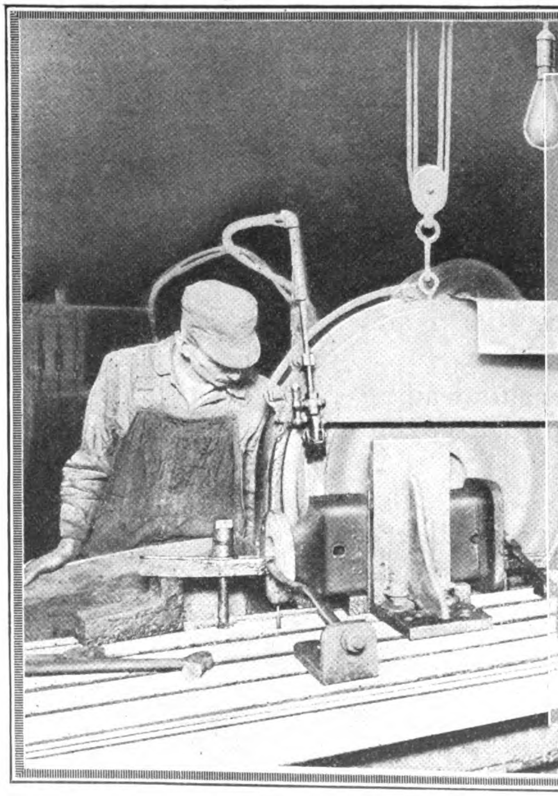
We believe this to be a record run and only possible with a Bryant.

There is a Reason and we would like you to know it. Address

The Reason



Bryant Chucking Grinder Company, Springfield, Vt.



The Story of an Increased Production

WITH a certain make of wheel they were grinding 2,100 large gray iron castings in a Syracuse plant.

A Carborundum service man studied the grinding conditions and specified a Carborundum wheel of a definite grit and grade.

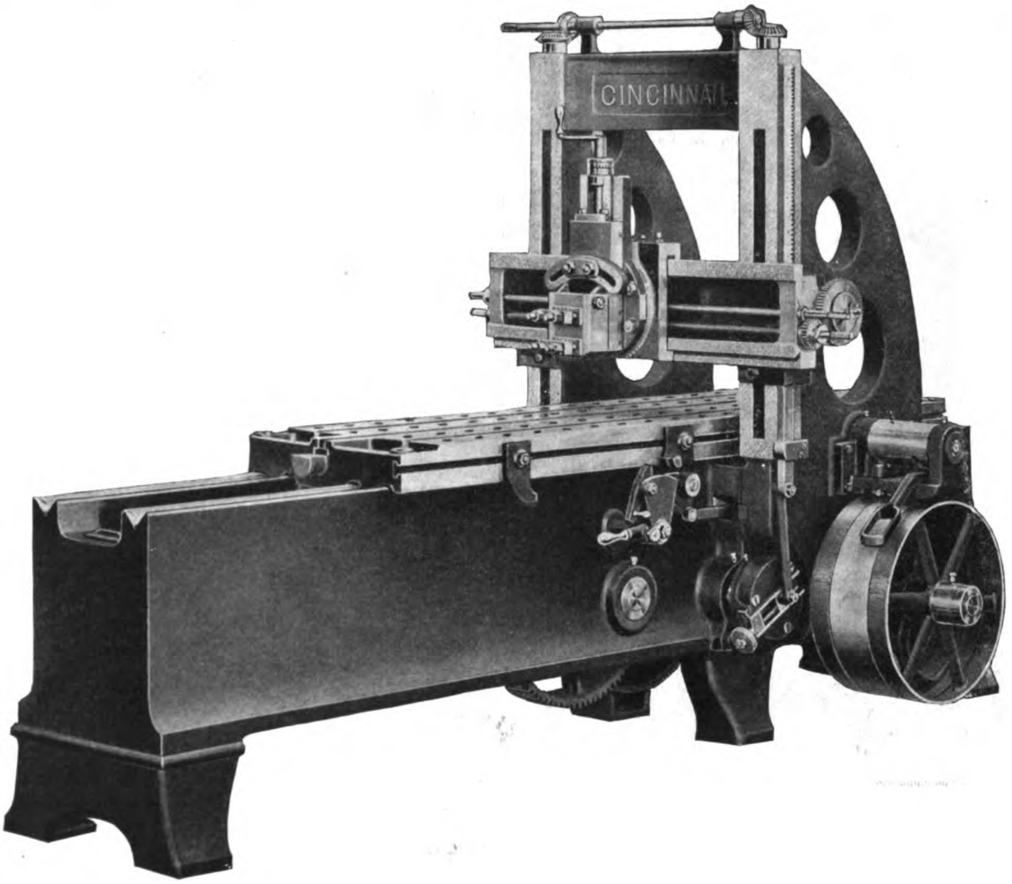
Now, with the right wheel in the right place, they are grinding 3,900 castings under the same conditions.

The Carborundum Wheel cuts faster, cleaner, shows longer life.

Carborundum Service will help you to better bigger grinding results

THE CARBORUNDUM COMPANY
Niagara Falls, N. Y.

New York Chicago Boston Philadelphia Cleveland
Pittsburgh Cincinnati Milwaukee Grand Rapids
Manchester, Eng. Dusseldorf, Ger.



Features Worth Knowing About the Cincinnati 24-in. Heavy Pattern Planer

Regularly Equipped with the Following:

- Quick reverse aluminum pulleys.
- Extra capacity table.
- Chip guard for V-s.
- Bull wheel revolves with shaft in bearings at side.
- Bed bored to jig for shaft bearings.
- Safety locking device.
- Patent gear-shaped tumbler and dogs.
- Bronze bushed self-oiling loose pulleys.
- Down feed screw and collar one-piece construction.
- Micrometer collars for horizontal and vertical feeds.
- Simplex feed gears.
- All gearing completely covered.

The two-speed countershaft drive gives two different cutting speeds with constant return.

All the driving gears are mounted inside the bed, and each gear and pinion is supported by two bearings eliminating all overhang.

The housings are extended to the bottom of the bed, and are bolted against the sides by bolts and dowels; further locked to the bed by good heavy keys.

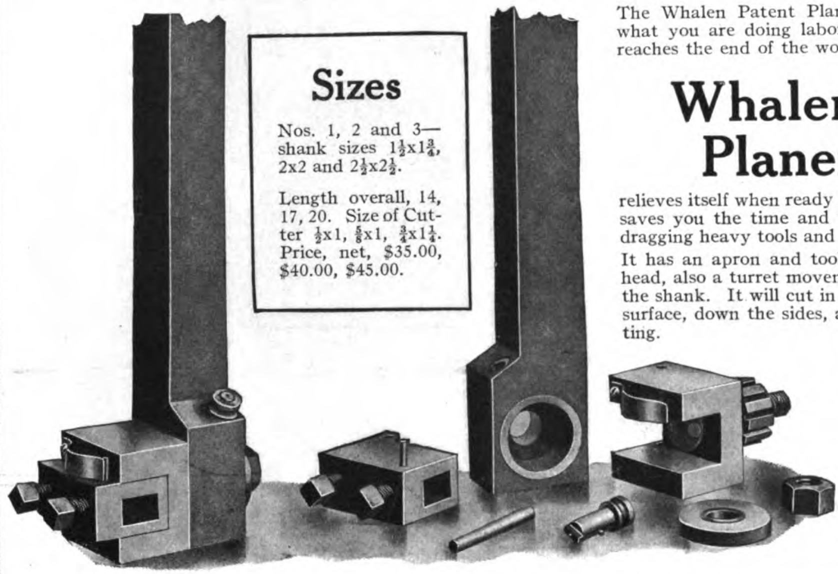
Ends of the bed are made square, instead of S shape rounding. Placing the leg at the extreme end of the bed gives us an exceptionally good support for the table when working its maximum length.

These are only a few of the many features worth knowing about. Get the full story.

The Cincinnati Planer Company

Cincinnati, Ohio, U. S. A.

It Takes Time and Effort to Lift Heavy Tools



Sizes

Nos. 1, 2 and 3—shank sizes $1\frac{1}{2}$x$1\frac{3}{4}$, 2x2 and $2\frac{1}{2}$x$2\frac{1}{2}$.

Length overall, 14, 17, 20. Size of Cutter $\frac{1}{2}$x1, $\frac{5}{8}$x1, $\frac{3}{4}$x$1\frac{1}{4}$. Price, net, $35.00, $40.00, $45.00.

The Whalen Patent Planer Tool does automatically what you are doing laboriously when the planer tool reaches the end of the work.

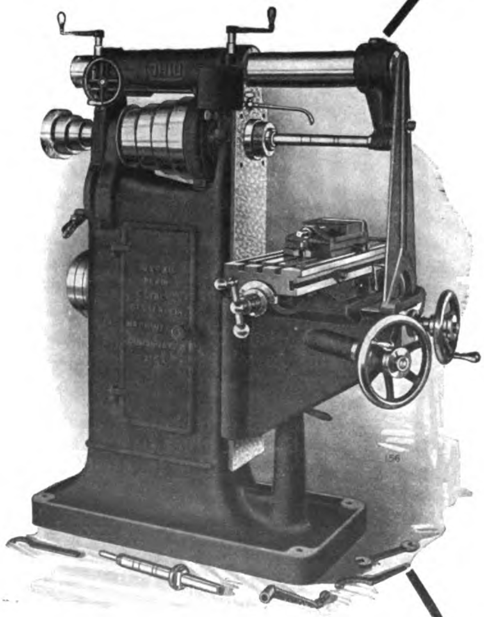
Whalen Patent Planer Tool

relieves itself when ready for the return stroke and thus saves you the time and trouble required in lifting or dragging heavy tools and the clapper block.

It has an apron and tool block the same as a planer head, also a turret movement that works in the end of the shank. It will cut in any position desired, across a surface, down the sides, and do right or left undercutting.

Ask questions and ask for bulletin.

Cincinnati Planer Co.
Cincinnati, Ohio, U. S. A.



THINK

On These Things

They explain briefly why Ohio Milling Machines are so economical in operation. The power, range, convenience and adaptability of these machines have placed them in the front rank for general manufacturing purposes.

The ease of adjustment insures the use of the proper cutting speed.

The cone drive eliminates the loss of power in change-speed gearing.

Oil reservoirs for spindle, back gears and table bearings.

Durability at a maximum—friction at a minimum.

And the initial cost is low. Write for some actual figures.

The Oesterlein Machine Co.

Manufacturers of

Millers OHIO **Grinders**

Cincinnati, U. S. A.


The
CARD
Quality
S.W. CARD MFG. CO.
MANSFIELD, MASS. U.S.A.
CATALOGUE NUMBER 28
TAPS DIES
SCREW
PLATES

Announcing

the publication on July 1st of the new Card Catalog No. 28, which embodies many important changes over the previous catalog, affecting lists of sizes and pitches and list prices of many items in our line of screw cutting tools.

This thoroughly uptodate book contains in addition much tabular information highly valuable to the mechanic.

Using the attached coupon **now**, puts you on the list for its early receipt.

S. W. CARD MFG. COMPANY

MANSFIELD, MASS., U. S. A.

NEW YORK STORE, 62 READE STREET
BERLIN STORE, ARTHUR KAYSER, MGR., ALTE JAKOBSTRASSE, 24.

EUROPEAN AGENTS—Chas. Churchill & Co., London, Birmingham, Manchester and Glasgow. Markt & Co., Ltd., Paris. Ignacz Szekely, Budapest. V. Lowener, Stockholm, Copenhagen, Christiania. R. S. Stokvis & Zonen, Ltd., Rotterdam. R. S. Stokvis & Fils, Brussels. Andrews & George, Yokohama, Tokyo, Osaka. J. Lambercier & Co., Geneva. C. Civita, Milano, Italy. R. D'Auglignac, Barcelona, Spain.

S. W. Card Mfg. Co., Mansfield, Mass.

Gentlemen:—

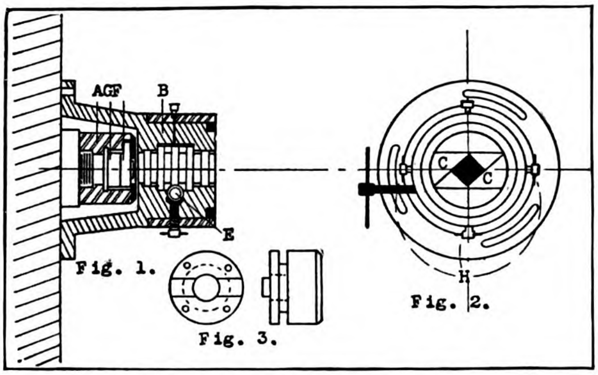
Please send me, free of charge, copy of Catalog No. 28.

Name..

Address..

....

See How Simply and Surely the Radbore Head Drills a Square Hole



Axial Section of Radbore Head

A—Driving member.

B—Stationary guiding member, similar to ordinary drill chuck.

CC—Jaws with interlocking teeth forming master guide in which drill shank turns.

E—Right and left-hand screw for opening and closing jaws.

F—Floating driving dog into which drill is screwed.

G—Loose thrust plate to take up end thrust.

HHH—Locking screws—set upon jaws after running fit has been given the drill.

THE above notation aids in clearly following the operation of the simple principle which makes the success of the Radbore Head.

Guiding member B bolts directly to column of miller or bearing plate of die sinker.

The drill screws into dog G. Tighten chuck jaws so as just to fit the shank and still allow it to rotate.

Dog G does the driving through B. The drill rotates uniformly but also moves around the square opening in the chuck jaws—in a cycle of this movement the cutting points of drill trace a perfect square or a square with fillets in the corners depending on type of drill used.

Now, note on small drawings below that the drill is always in contact with its guide at four points.

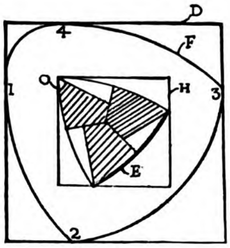


Fig. 4

The Radbore Square Hole is always a commercial hole—accurate, smooth sided and with a flat bottom if desired. Send samples or specifications of your work for further particulars.

Radical Boring Head Corp.

90 West St. - - New York City

Maximum Accuracy—Minimum Cost

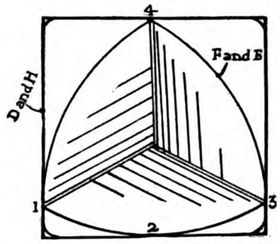


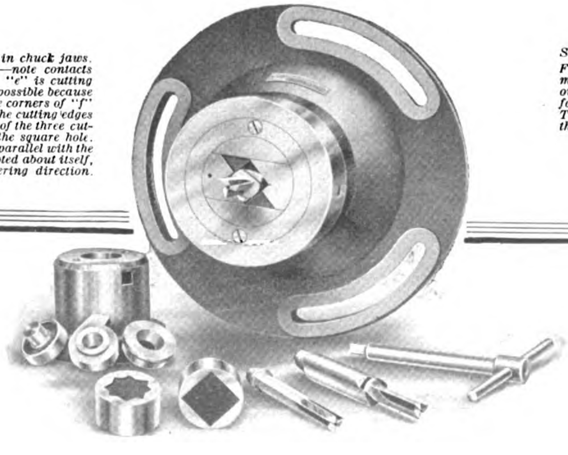
Fig. 5

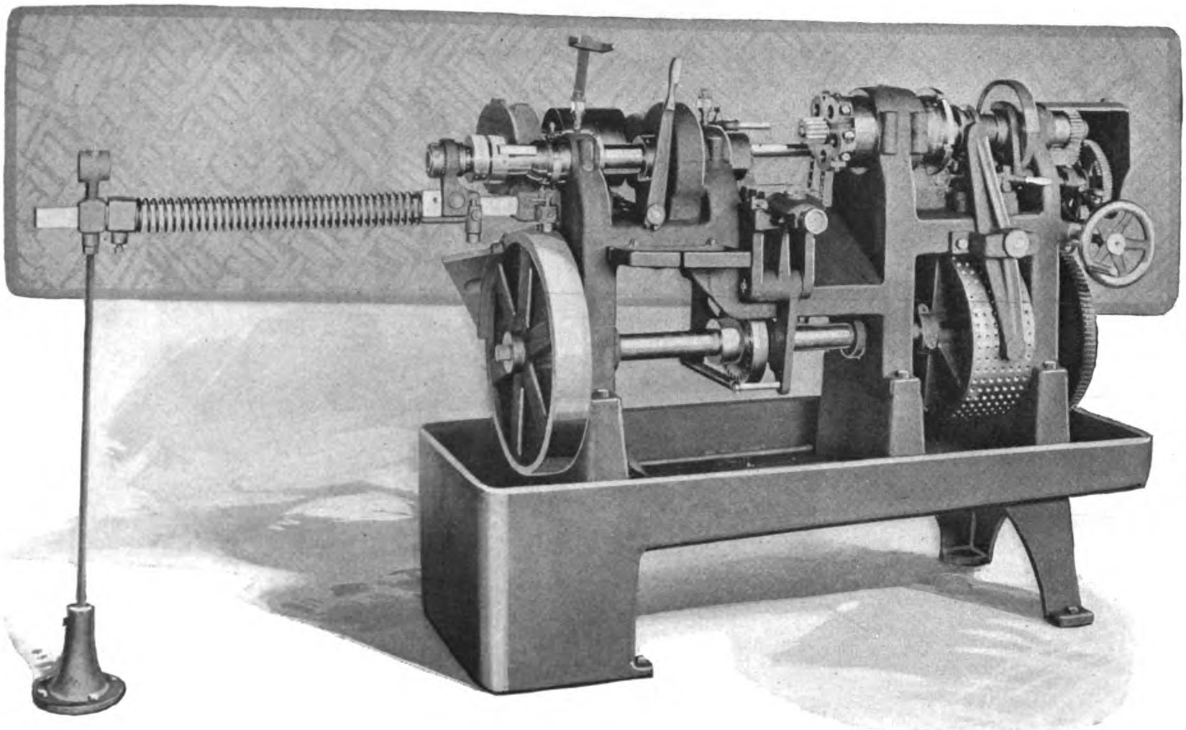
Square holes with sharp corners—

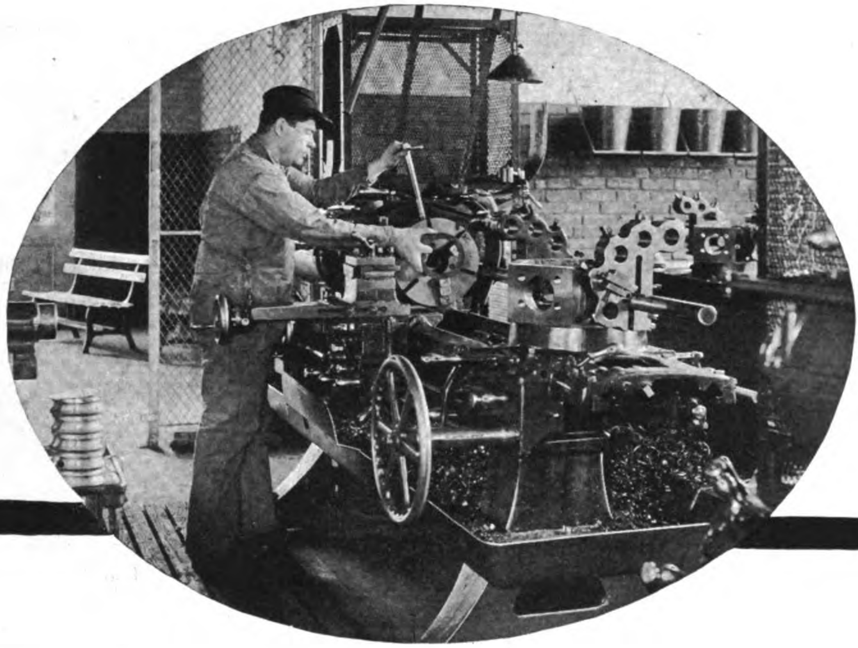
Line "d" represents square opening in chuck jaws. Line "f" is outline of shank of drill—note contacts 1, 2, 3 and 4. "h" is hole being cut. "e" is cutting blade. The perfectly sharp corner is possible because the center of the rounded one of the three corners of "f" at "o" is exactly in line with one of the cutting edges of the blade "e." This means that one of the three cutting edges finishes the periphery of the square hole. The cutting edge is led in straight lines parallel with the sides of "d" and at each corner is pivoted about itself, leading out at right angles to its entering direction.

Square holes with rounded corners—

For this work the shank and drill are made in one piece of same size. Note outline of shank in this case and also four points of contact 1, 2, 3 and 4. These are always present at any stage of the revolution of the drill.







The Speed is there, and Accuracy too

There's power enough to drive the work at the highest speed the cutters will stand, and ten feeds each for the carriage and turret saddle, operating simultaneously, but independent of each other. That means speedy production on the

Universal Hollow-Hexagon Turret Lathes

And there's accuracy. Head and bed are cast in one piece, assuring great rigidity. Turret tools are bolted from inside the hollow hexagon, leaving the entire outer surface of the turret free to support the larger, heavier, stronger tools; and since they need not reach over a "bridged" carriage, the cutters can be shorter and stiffer, reducing chatter to the minimum.

Write for descriptive literature explaining how these machines take two cuts at one time.

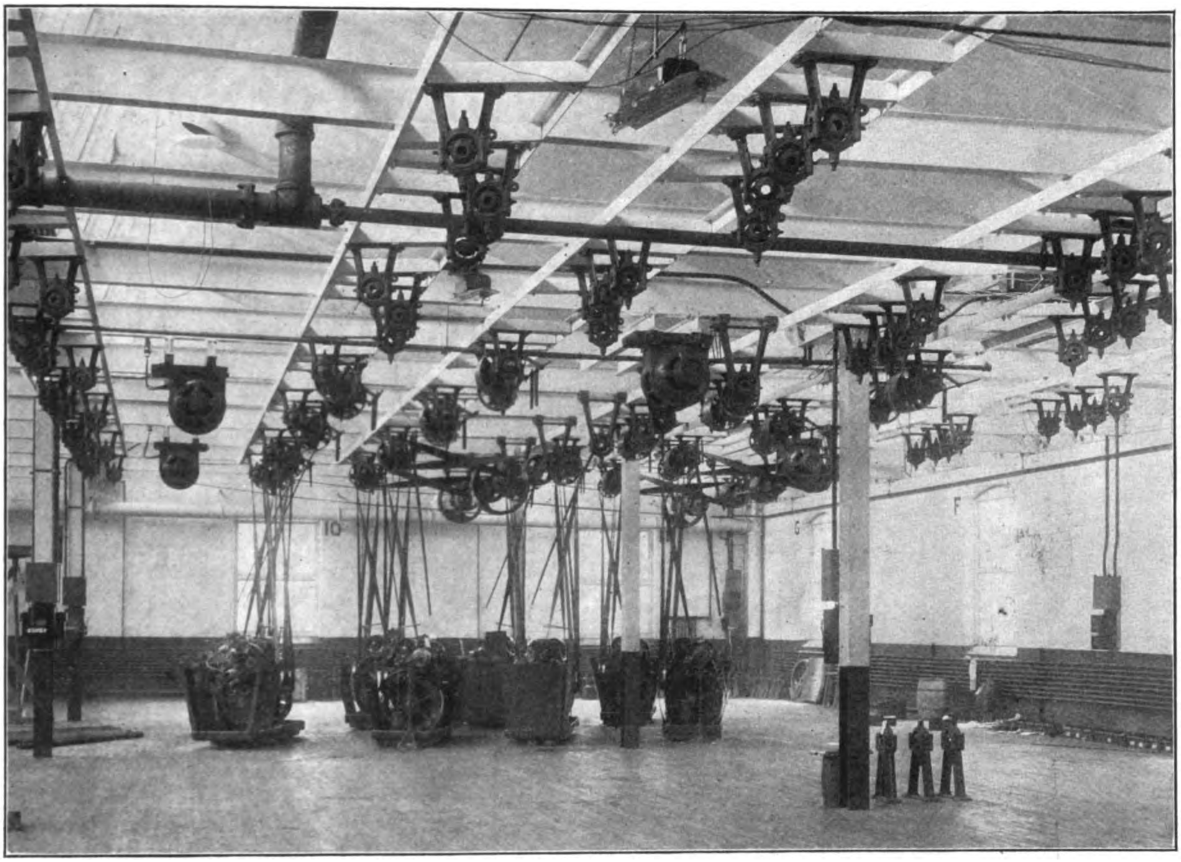
THE WARNER & SWASEY COMPANY

CLEVELAND, OHIO, U. S. A.

TURRET LATHES—TURRET SCREW MACHINES—BRASS WORKING MACHINE TOOLS

NEW YORK Office—Singer Bldg. **Boston Office**—Oliver Bldg. **Buffalo Office**—Iroquois Bldg. **Detroit Office**—Ford Bldg. **Chicago Office and Show Rooms**—618-622 Washington Blvd.

FOREIGN AGENTS: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. Schuchardt & Schutte, Berlin, Vienna, Budapest, Petrograd, Stockholm, Copenhagen, Shanghai and Tokio. Alfred H. Schutte, Cologne, Brussels, Liege, Milan, Bilbao and Barcelona. Benson Brothers, Sydney. A. Asher Smith, Sydney. A. R. Williams Machinery Co., Ltd., Toronto, St. John, Winnipeg and Vancouver. Williams & Wilson, Ltd., Montreal.



A group of Lineshafts and Countershafts on

GURNEY BALL BEARING HANGERS

in process of erection.

They earn the money heretofore spent for generating friction. They save fuel, lubricant and wages now paid out for oiling and repairing. They absolutely safeguard against hot boxes and consequent shut-downs.

Did you receive our new Hanger Catalog H-2?

Gurney Ball Bearing Co.

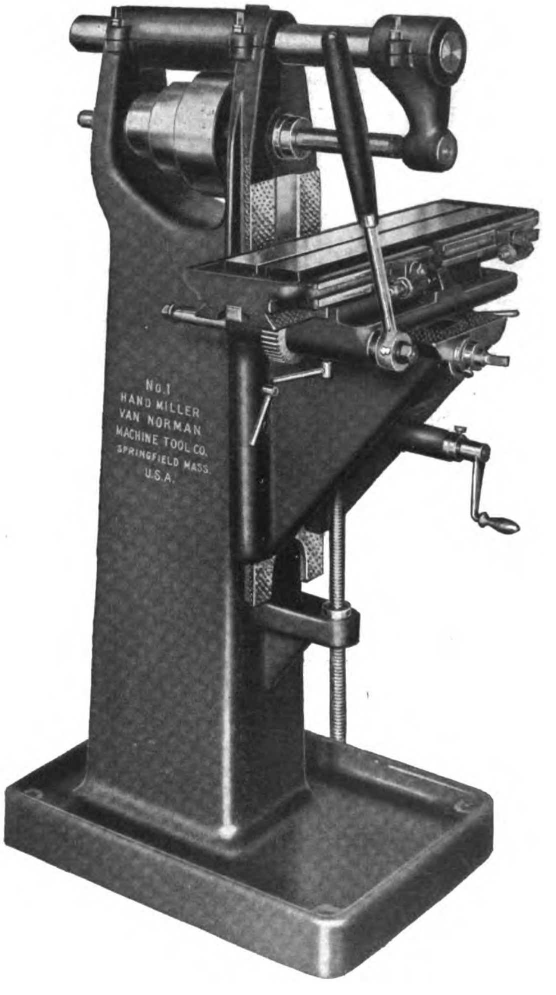
Conrad Patent Licensees

Jamestown - - New York

Quick Delivery on a Limited Number

Large numbers of these machines have been purchased and are making good on production. They are machines of recognized high quality, adapted to perform light and accurate work with great rapidity.

No. 1 Van Norman Plain Hand Miller



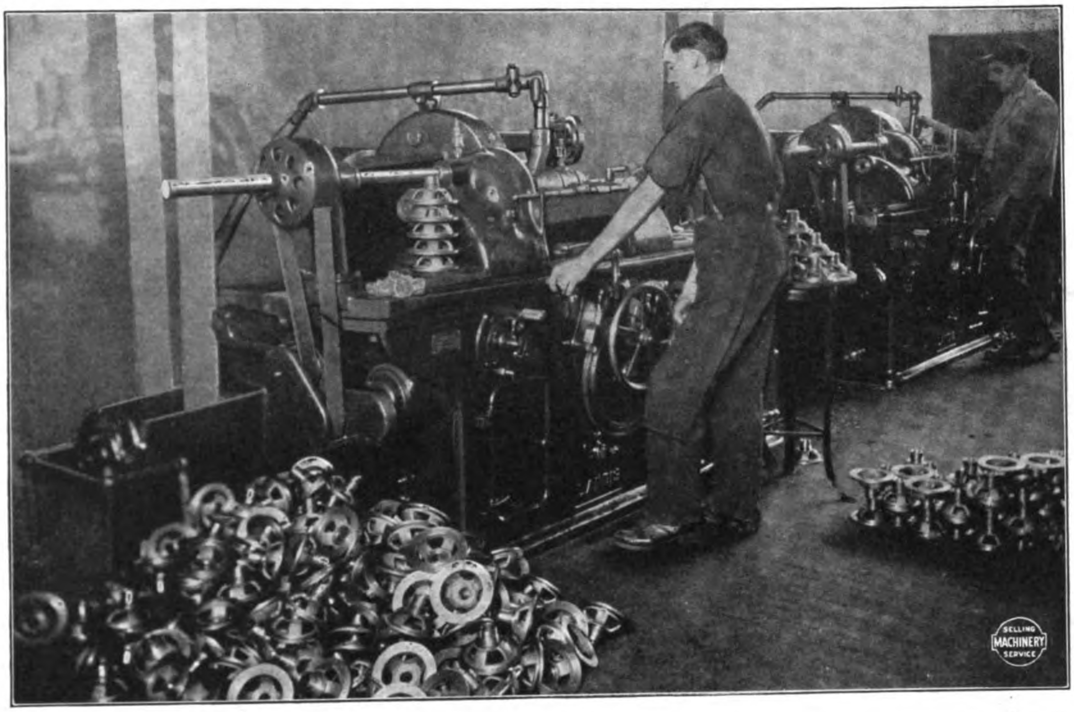
GENERAL SPECIFICATIONS

Vertical Range from top of table to center of spindle....11½ in.
Size of table....27 x 8½ in.
Working Surface of table (inside of oil groove)....22 x 5 in.
Width of T slot in table....⅝ in.
Adjustable Movement of table each way from center....7 in.
Total Adjustment Movement of table....14 in.
Hand Lever operating 180 deg.; carries table....5 in.
Distance from end of spindle to center of T slot in table
With cross slide carried in (minimum)....2¾ in.
With cross slide carried out (maximum)....7¾ in.
Size of taper hole in spindle...B & S. No. 9
Overhanging Arm extension from end of spindle (maximum)....11 in.
3-step Cone Pulley, largest step....8 in.
Width of belt....2¾ in.
Height from floor to center of spindle....43 in.
Base of column....18 x 25½ in.
Diameter of countershaft pulley and largest step of cone....8 in.
Speed of countershaft.about r.p.m..300
Weight—Net 850 lb.—Crated 1,050 lb.

Prompt shipment can be made of a limited number of these machines. Full details, with quotations, furnished on request.

Van Norman Machine Tool Company

Springfield, Mass., U. S. A.



Two Recently Installed LANDIS GRINDERS

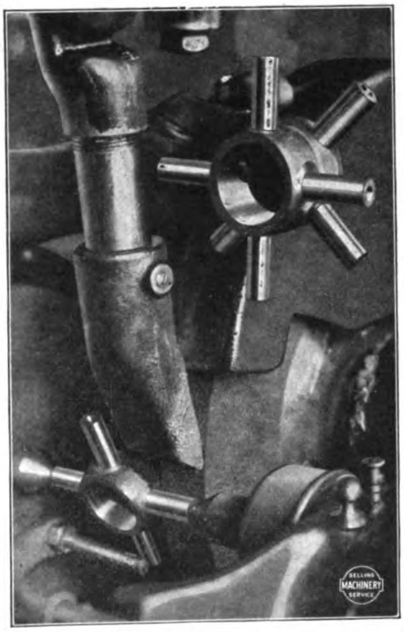
and Some of the Work They Handle

This pair of LANDIS Grinding Machines has been installed six months—and you can judge for yourself what they are doing and how well they are doing it by the work they happened to be on when the photographs were snapped.

The machine in the foreground is grinding hubs, 3-16-in. wide by 1.5745 in. diameter, on malleable iron differential parts; the limits being nothing over and only 0.0005 in. under size. The second machine is grinding differential gear crosses, four ground sections, $\frac{5}{8}$ in. diameter by $1\frac{5}{8}$ in. long, within limits of 0.001 in.

This work is produced in big quantities, by one of the foremost manufacturers of automobile parts of this character, and you can rest assured that the LANDIS is thought to be the most economical Grinding Machine for the purpose or these two never would have been installed.

Let us send the Bulletin and more details on this new LANDIS Self-Contained Grinding Machine—the grinder in which all overhead works are done away with, in which gearless drive, centralized control and many other features contribute to speed and efficiency.



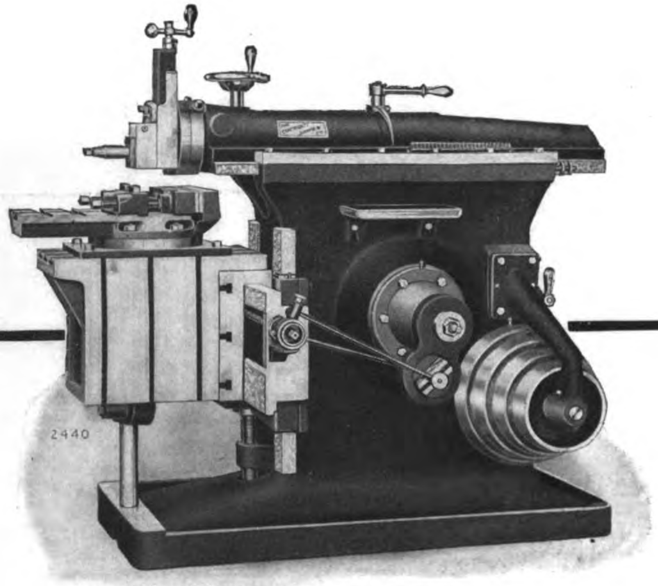
LANDIS

LANDIS TOOL COMPANY, MAIN OFFICE AND WORKS, **Waynesboro, Pa.**

NEW YORK OFFICE, 50 CHURCH STREET

AGENTS: Dewstoe Machine Co., Birmingham, Ala. Harron, Rickard & McCone, San Francisco and Los Angeles.

UNIVERSAL GRINDING MACHINES
CRANK GRINDING MACHINES
PLAIN GRINDING MACHINES
INTERNAL GRINDING MACHINES
ROLL GRINDING MACHINES
CAM GRINDING MACHINES



Make that involved job a cinch

Assuming it is die work of a complicated nature—

The table must be so easily adjusted that the work is get-at-able at every angle.

A wide range of table adjustability is shown in

The Various Tables of the

Cincinnati Shaper

They are peculiarly adaptable to the needs of work that is complicated. The tilting Top for Table, the Revolving Table and the Tilting Table, each one solve a particular problem for you.

Especially is this true of the Revolving Table. It permits work to be held at any compound angle, having a motion of 90 deg. in either direction.

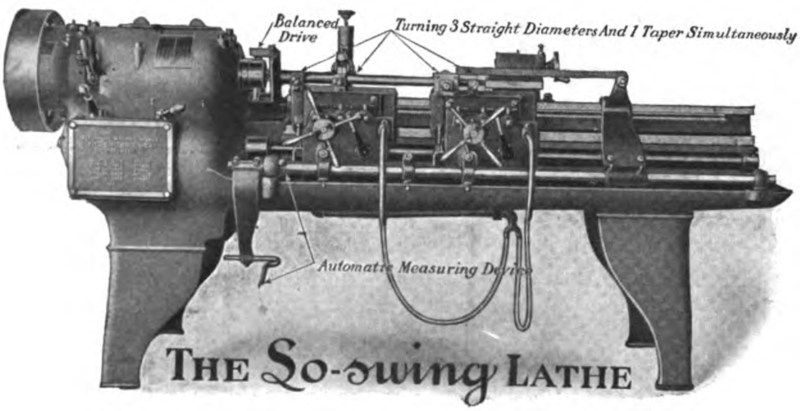
Any one of the tables is readily secured to the apron and in themselves are "production raisers" and "cost reducers."

→ Ask for Catalog G. ←

The Cincinnati Shaper Company

Cincinnati, Ohio

AGENTS—Manning, Maxwell & Moore, Inc., New York City, Philadelphia, Chicago, St. Louis, Boston, Cleveland, Buffalo, Detroit, Cincinnati, Milwaukee; Brown & Zortman Machinery Co., Pittsburgh, Pa.; The National Supply Co., Toledo, Ohio; Eccles & Smith Company, San Francisco, Calif.; Zimmerman-Wells-Brown Co., Portland, Ore.; The Galigher Machinery Co., Salt Lake City; C. T. Patterson Co., Ltd., New Orleans, La.; H. W. Petrie & Co., Toronto, Canada.



A Cold Scientific Analysis Of Lo-swing Savings

Not a general blanket statement.

Not a sweeping claim which is so broad that it concentrates on nothing.

No! Not either of these, but instead, a cold scientific analysis of Lo-swing savings *on the specific work you are doing.*

Such an analysis, as made by the Lo-swing Efficiency and Production Department, is worth more to you than all the glittering generalities ever collected together.

And why? Because we focus the ability of the Lo-swing Lathe to save money down to your particular proposition.

For some, the Lo-swing Lathe will save more than for others. Our set-up and time guarantee is made from the blueprints or drawings which you send us, the figures being absolutely individual and correct.

Isn't such a report worth getting? Give us the opportunity to get to work over your shaft subjects.

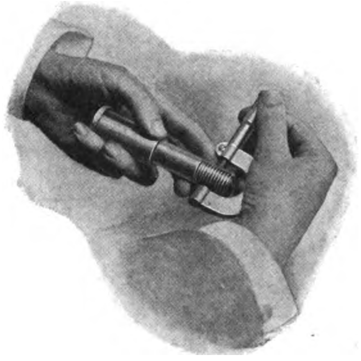
Send in your drawings now, while the desire to do so is fresh in your mind.

Fitchburg Machine Works

Fitchburg, - - Mass., U. S. A.

Sold direct by our own representatives in United States and Canada.

Foreign Representatives: Buck & Hickman, Ltd., London, Birmingham, Manchester and Glasgow. Allied Machinery Co. of America, 3 Rue Paul DuBois, Paris, for France, Switzerland, Italy. The F. W. Horne Co., Tokyo, for Japan.



HARTNESS
AUTOMATIC
DIE

Die-Cut Threads of Accurate Diameter

The man whose hands show in this picture is measuring the *pitch diameter* of the thread. He is not using a special thread micrometer for this purpose, but just an ordinary every-day machinist's micrometer. All he does when cutting a U. S. standard thread, is to have the blanks .003 to .004 inch oversize, and then adjust the die until the chasers trim the tops of the threads to standard diameter, as measured by his micrometer.

He now knows that the pitch diameter is standard. He knows it because he is using a Hartness Automatic Die, whose chasers are accurately made with this very point in mind.

This is worth looking into.

JONES & LAMSON MACHINE COMPANY,
(Automatic Die Dept.)

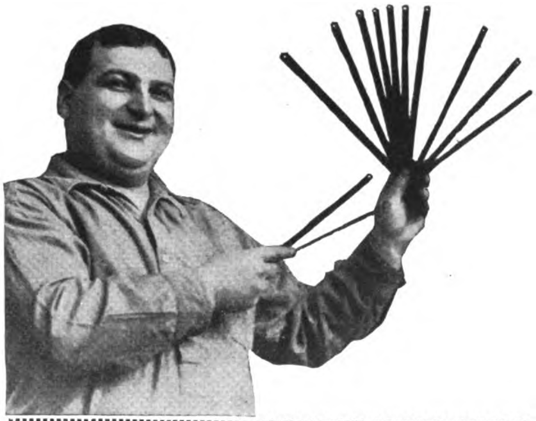
Springfield, Vermont, U. S. A.
97 Queen Victoria St., London, E. C.

AMERICAN AGENTS FOR DIES AND CHASERS

BOYER-CAMPBELL CO.
Detroit, Mich.
E. L. ESSLEY MACHINERY CO.
Chicago, Ill.
W. M. PATTISON SUPPLY CO.
Cleveland, O.

ROBINSON, CARY & SANDS CO.
St. Paul Minn.
CAREY MCHY. & SUPPLY CO.
Baltimore, Md.
BARWOOD-RICHARDS MACHINERY CO.
The Bourse, Philadelphia, Pa.

PACIFIC TOOL & SUPPLY CO.
San Francisco, Calif.
E. A. KINSEY CO.
Cincinnati, O.
Indianapolis, Ind.
MACHINISTS' SUPPLY CO.
Pittsburgh, Pa.



"Some Hack Saw Blades"

Mechanics are men of few words, but they know what is what when it comes to saw blades. When a mechanic says the Simonds hard Edge is "Some Blade," that's all he need say about the quality.

There's a difference and the difference counts in dollars saved.

Ask your dealer.

Simonds Mfg. Company

Fitchburg, Mass. Chicago, Ill.
New York City. San Francisco, Cal.
8 White Street, Moorfields, London, E. C., England.

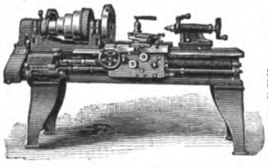
DIAMOND TOOLS

hold their cutting edges for months. Can easily be sharpened and will last for years. Leave a smooth, true and finished surface. These special shaped carbon, black diamond, pointed tools are best for turning paper, cotton, corn husk, rag, fibre, hard rubber, etc.

They turn out a large number of pieces of exact uniform size.

THOS. L. DICKINSON,
66 Nassau St. New York
Successor to John Dickinson. Estab. 1796.

C. W. Burton, Griffiths & Co., London, Sole Agents for Great Britain.



ENGINES LATHES
10-12-14-16 and 18-inch Swing

any length Beds, Quick Change or New Standard. Countershaft or Motor Drive, and with or without Taper Attachment, Draw-in Attachment. Turrets, Chucks, Tools, etc., *Send for Catalogue.*

CHAMPION TOOL WORKS CO.
2424 Spring Grove Ave., Cincinnati, Ohio.

Black Diamond Files & Rasps

Perfect Always

Twelve Medals Awarded at International Expositions

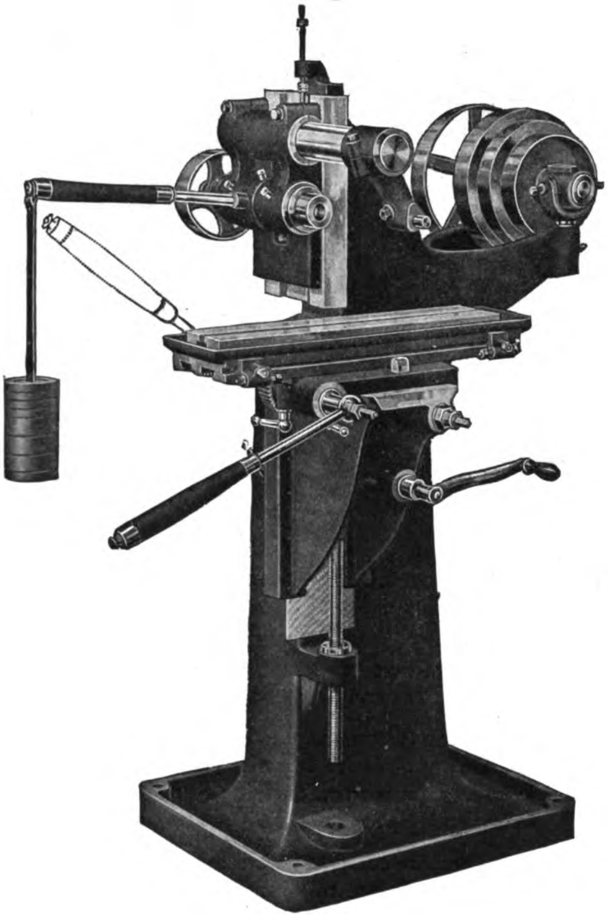
TRADE MARK. TRADE MARK.

FOR SALE EVERYWHERE
Copy of Catalog will be sent free to any interested file user on application.

G. & H. BARNETT CO., PHILADELPHIA, PA.

Owned and Operated by the Nicholson File Co.

This "Whitney" Hand Milling Machine



is as necessary in your shop as the telephone or type-writer in your office.

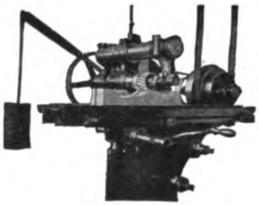
Because it is an all around machine with a wide range of work—capable of taking both light and heavy cuts. It is so well built that it can be used to great advantage in place of larger tools costing twice the money.

It will handle all of your small milling jobs and earn its cost in a short time because there is work constantly turning up that can be done on this machine.

The "Whitney" has features which make it a necessary tool for every shop and tool room. Such as its High-Speed Milling Attachment shown below. This Attachment permits the use of end mills for die sinking, profiling, drilling and all classes of light milling where small cutters and high speeds are necessary.

The Jones & Lamson Machine Co., Springfield, Vt., say: "Your milling machine is one of the most indispensable tools in our milling department on account of its adaptability to many uses."

Keyseating

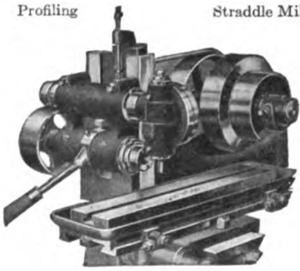


Profiling

Straddle Milling

Sprocket or Gear Cutting

The "Whitney" can do countless operations in addition to those shown here. Simply fill in the coupon for details.



The Whitney Mfg. Co., (A.M.)
Hartford, Conn.

Date..................1916

Gentlemen:

Please send particulars of your Hand Milling Machine.

Name.......................................

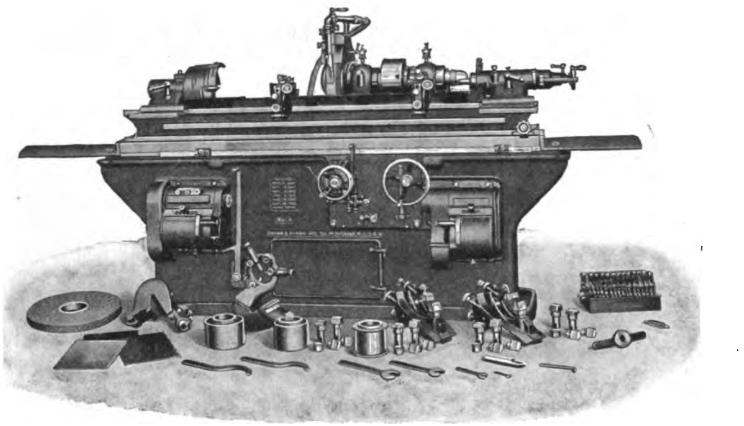
Address....................................

State and City.............................

THE WHITNEY MFG. CO., Hartford, Conn.

CHAINS—KEYS—HAND MILLING MACHINES

FOREIGN AGENTS: C. W. Burton, Griffitns & Co., London. Fenwick Freres & Co., Paris. F. G. Kretschmer & Co., Frankfurt a/M., Germany.



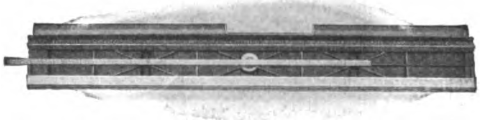
Five Sizes of Plain Grinding Machines. Also Universal, Tool, Cutter and Surface Grinding Machines

Powerful Grinding Machines

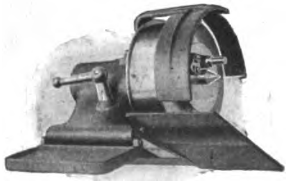
The usefulness of the Plain Grinding Machine is lost if it doesn't have rigidity—unusual rigidity. You may get quality with moderate rigidity, but not quantity.

Now mere weight will absorb vibration, but if not well distributed you have clumsiness and this cuts down quantity again. So every part in Brown & Sharpe Plain Grinding Machines has been studied and given just enough metal to stand up firmly under the heaviest wheel and coarsest feed to be used.

They are compact; note the low-setting type of headstock below. Box form parts like bed and table are thoroughly cross braced; bearings are broad and well backed up with metal. The massive wheel slide in particular, is well supported on walls extending to the floor. And so at every point, they are designed for quantity and quality production.



Under side of table showing closely spaced ribbing



Compact, low-setting headstock

Brown & Sharpe Mfg. Co.,

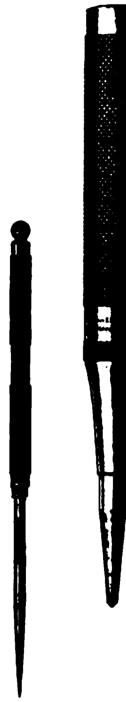
OFFICES: 20 Vesey St., New York, N. Y.; 654 The Bourse, Philadelphia, Penn.; 626-630 Washington Blvd., Chicago, Ill.; 305 Chamber of Commerce Bldg., Rochester, N. Y.; Room 419, University Block, Syracuse, N. Y.

REPRESENTATIVES: Baird Machinery Co., Pittsburgh, Penn., Erie, Penn.; Carey Machinery & Supply Co., Baltimore, Md.; E. A. Kinsey Co., Cincinnati, O., Indianapolis, Ind.; Pacific Tool & Supply Co., San Francisco, Calif.; Strong, Carlisle & Hammond Co., Cleveland, O., Detroit, Mich.; Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; Perine Machinery Co., Seattle, Wash.; Portland Machinery Co., Portland, Ore.

B. & S. Tools That You Need

Did you know that in addition to our big line of mechanics' tools for measuring purposes, which are famous for accuracy, that we also make a number of tools for general shop use that are equally famous for durability and handiness? Here are some examples, all useful tools for men who have to lay out work; look them over.

Such tools get pretty rough use as a rule. That is where B. & S. quality counts. It means the best kinds of steel, drop forged and case hardened parts where the wear comes, clean cut threads and knurling, smoothly finished parts that fit well together. These are the things you want on tools in every day use.



Toolmakers' Vise

Automatic Centre Punch—No hammer required, simply press downward. Punch marks are uniform; point detachable. Several sizes.

Scriber—Finely tempered, detachable point, screws firmly into knurled holder. Made in three styles.

Toolmakers' Vise—Drop forged and case hardened. V-groove in base. Useful when drilling, fitting and laying out work.

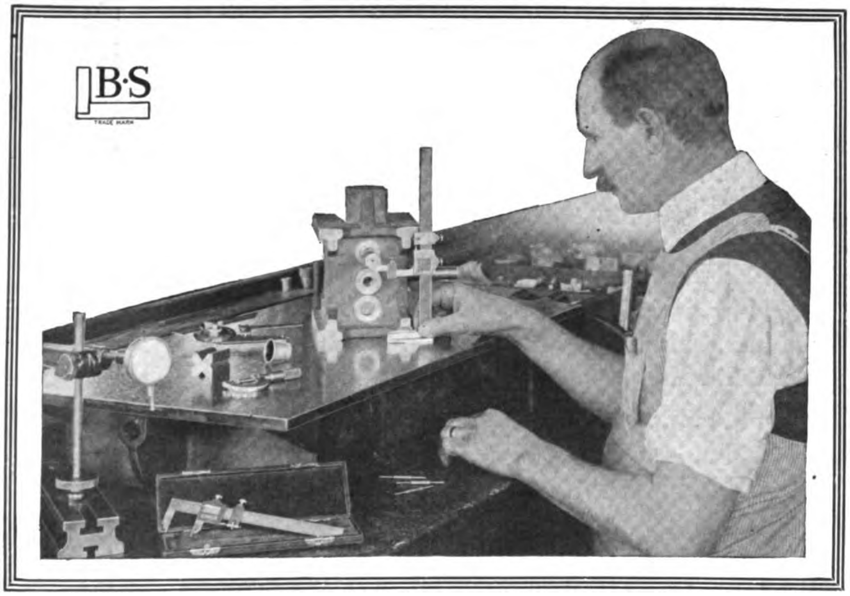
Toolmakers' Clamps—Extra rigid; loose jaw held in position by spring; made in half a dozen sizes.

V-Blocks and Clamps—For holding work accurately in position when laying out. Hardened, and ground true in pairs.

Our free 600-page catalog shows many hundred tools for the tool chest of the mechanic or tool room of the shop.

Toolmakers' Clamp

V-Blocks and Clamps

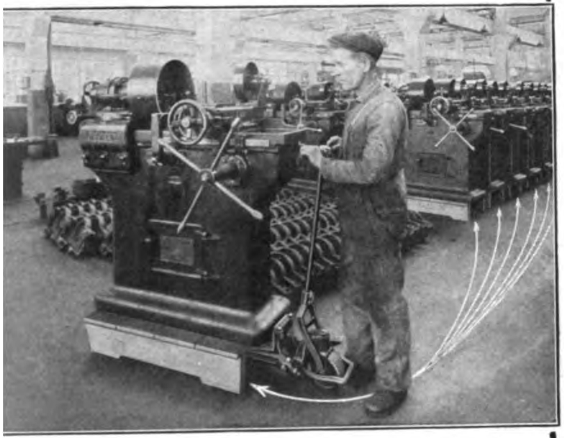


Providence, R. I., U. S. A.

CANADIAN: The Canadian-Fairbanks-Morse Co., Ltd., Montreal, Toronto, Winnipeg, Calgary, Vancouver, St. Johns, Saskatoon.

FOREIGN: Buck & Hickman, Ltd., London, Birmingham, Manchester, Sheffield, Glasgow. F. G. Kretschmer & Co., Frankfort a.M., Germany; V. Lowener, Copenhagen, Denmark, Stockholm, Sweden, Christiania, Norway; Schuchardt & Schutte, Petrograd, Russia; Fenwick Freres & Co., Paris, France, Liege, Belgium, Turin, Italy, Zurich, Switzerland, Barcelona, Spain; F. W. Horne Co., Tokio, Japan; L. A. Vail, Melbourne, Australia; F. L. Strong, Manila, P. I.

Cowan Transveyors



Make Machinery Mobile

Moving machinery with Cowan Transveyors is no more difficult than moving simple cases of merchandise. The idea is the same. **Look at this picture** and figure the time and labor **you** can save by using Cowan Transveyors.

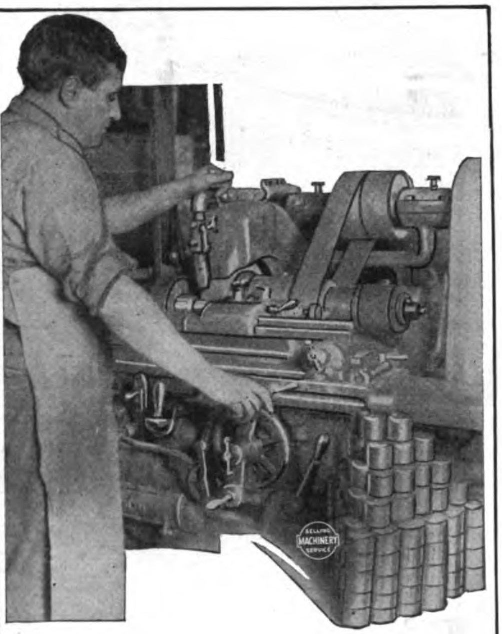
Then, too, they stand up under the load and are eternally on the job.

That's why **The Cowan Truck Company** is known as

Truck Headquarters

16 Water St. Holyoke, Mass.

We have just issued a new catalog showing 24 different uses for Cowan Transveyors. Shall we send you one?



Grinding Steel Rolls for Railway Roller Bearings

Another example of wheel being fed straight into the work is the one shown here—grinding steel rolls for railway roller bearings. The rolls are $1\frac{3}{4}$ in. diameter by $1\frac{1}{4}$ in. long, are carried on centers and driven by a pin that engages a hole in one end. From 0.016 in. to 0.018 in. of hardened steel is removed from each roll and twenty pieces are ground at each truing of the grinding wheel. The table is not traversed, the wheel being fed straight into the work.

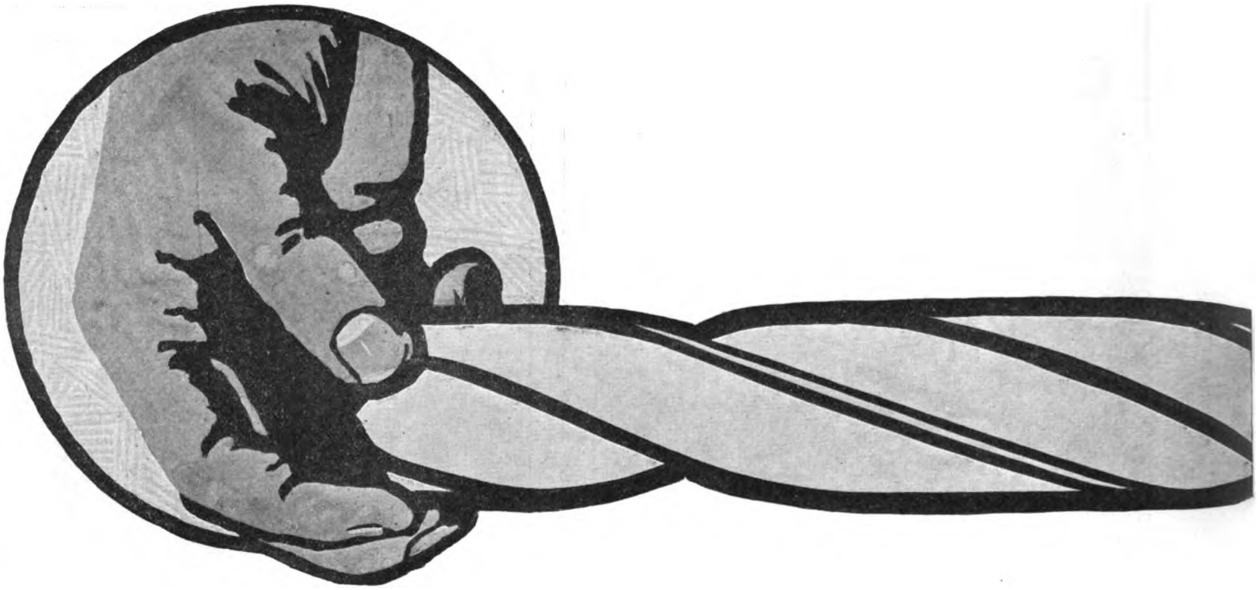
An output of 325 of these rolls in ten hours is average output; when put to the test, as high as forty pieces per hour are ground.

THE WHEEL IS ALUNDUM

Norton Company

Worcester - - Mass.

NEW YORK CHICAGO



Even the "Feel"

Take a Union Twist Drill into your hands. You can almost "sense" its quality—the care and painstaking workmanship which have gone into its making. The weight is so right—the balance so satisfying. And the cutting edge feels so true and keen.

Of course, we do not mean to assume for one minute that the real quality of a drill can be accurately gauged till you have put it to the real test of service.

And that is the test to which we want you to put "Union" Twist Drills. It is in service that their inherent stamina is shown. It is in service that the "feel" of quality is substantiated by the proof of performance.

CAMDEN

Let us make a right-handed job of your rough-turning

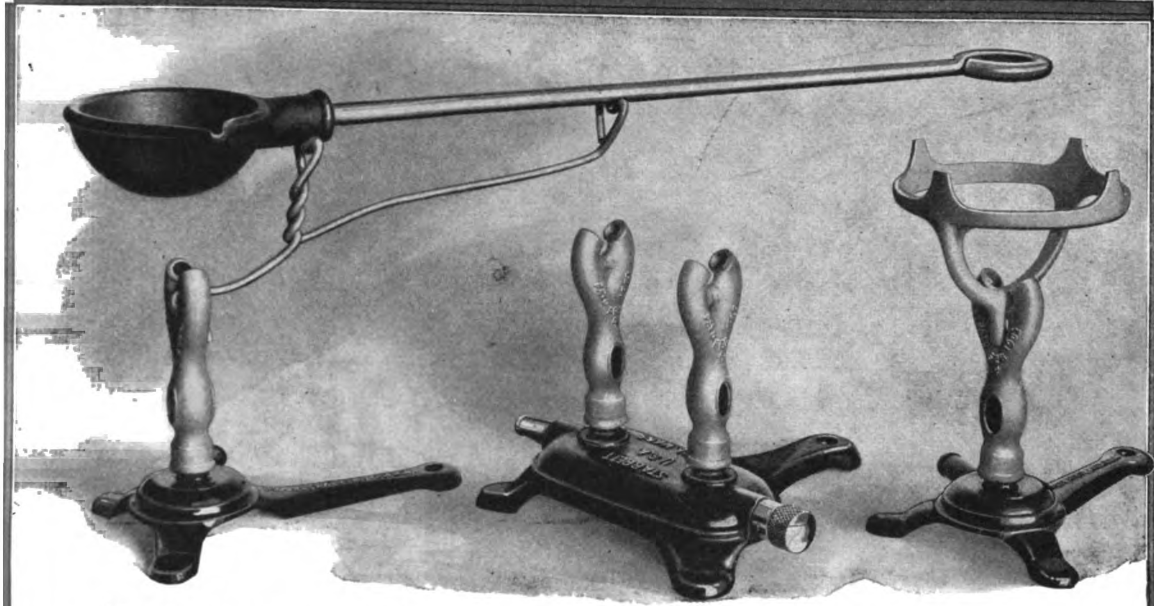
We have the equipment to give you Camden Forgings *as you want them*—of your own analysis, turned to specifications.

CAMDEN FORGINGS

are both dependable and available. Our stock list of steel billets and heavy round bars, etc., is complete enough to meet every need—yours included.

We're ready for your inquiries.

CAMDEN FORGE CO., Mt. Ephraim Ave., Camden, N. J.



TRADE MARK

Starrett Twin Gas Heater

REG. U.S. PAT. OFF.

THIS HEATER is very efficient in the machine shop, especially in the tool-room, for tempering small tools, melting lead, babbitt, etc., and as a forge for light work. You will also find this heater extremely handy, useful and economical in your home. For laboratory work and wherever a blue-flame burner is required the Starrett Twin Gas Heater has no equal.

Its effectiveness lies in its scientific construction. The gas and air is thoroughly mixed for perfect combustion while passing through the deflectors in base of tubes. The tubes cause the flames to penetrate each other at cross-angles, thus producing an intense heat, free from smoke and with no waste of gas.

RETAIL PRICES

No. 100A	Burner only, without base	$0.75
No. 100B	One Burner with base	1.00
No. 100C	Two Burners with base	2.00
No. 100D	Three Burners with base	3.00
No. 100E	Tool Holder only .	.15
No. 100F	Dish Holder . .	.25
No. 100G	Ladle only . .	.25
No. 100H	One Burner with Base, Tool Holder and Dish Holder . . .	1.40

For sale at leading Hardware Stores
Send for Free Starrett Catalog No. 21-C

The L. S. Starrett Co., Athol, Mass.

"The World's Greatest Tool Makers"

London New York Chicago

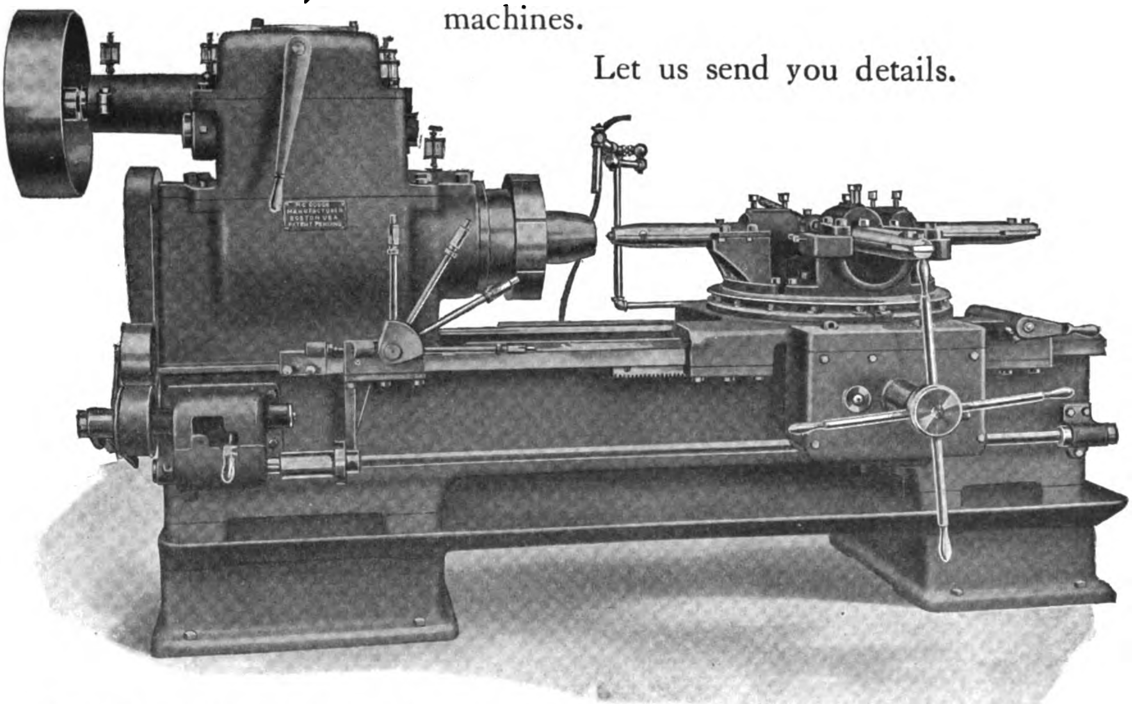
The Johnson Friction Clutch Is Being Used As A Part Of This Machine

The Dodge Turret Lathe

This is a "war" machine and is—to use the makers' description—"designed and built for the utmost speed and precision."

To insure this they added the Johnson Friction Clutch—and they are very pleased with it. You will like it too if you try it out on your machines.

Let us send you details.



Write for Blue Catalog and our latest free booklet; "Clutches As Applied in Machine Building."

Courtesy H. C. Dodge, 175 Old Colony Ave., Boston, Mass.

THE CARLYLE JOHNSON MACHINE CO.
MANCHESTER, CONN.

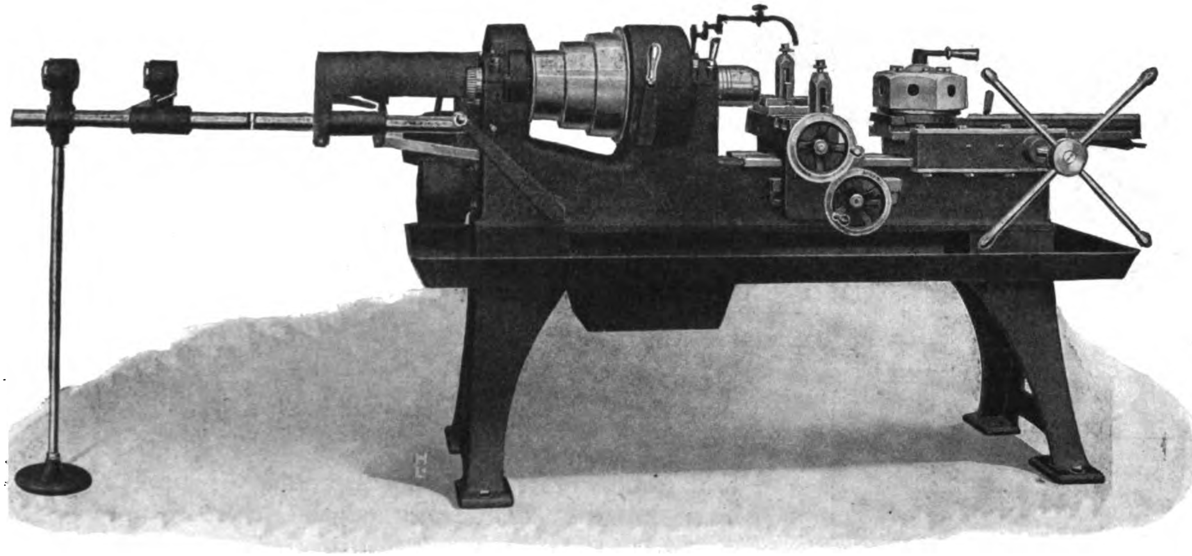
England: The Efandem Co., Ltd., 159/165 Great Portland St., London, W. Sole Agents for British Isles.

Manufactured by

Smurr & Kamen Co.

315 N. Whipple Street - Chicago, Ill.

Plain and Geared Head Screw Machine



The hexagon turret permits of clamping tools for extra heavy work to its flat sides.

The individual independent stop is simple and positive, one stop to each tool. Turret is clamped automatically each time it is indexed.

A number of these machines ready for immediate delivery:

DIMENSIONS	No. 2	No. 3	No. 4	No. 5
Swing over bed	12	14	16	16
Wire Feed capacity	$1\frac{1}{16}$	$1\frac{5}{16}$	$1\frac{5}{8}$	$1\frac{7}{8}$
Auto Chuck capacity	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	$2\frac{3}{4}$
Length of Bed	42	52	58	58
Diameter of hole in spindle	$1\frac{1}{4}$	$1\frac{9}{16}$	$1\frac{7}{8}$	$2\frac{1}{8}$
Turret across or between flats	7	$7\frac{3}{4}$	9	9
Diameter of holes in turret	1	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{1}{2}$
Center of turret to top of slide	$1\frac{7}{8}$	$2\frac{3}{8}$	3	3
Length that can be turned	$5\frac{1}{4}$	$6\frac{1}{4}$	$7\frac{1}{4}$	$7\frac{1}{4}$
Width of belt, three-grade cone	$2\frac{1}{2}$	3	$3\frac{1}{2}$	$3\frac{1}{2}$
Width of belt, two-grade cone	$3\frac{3}{4}$	$4\frac{1}{4}$	$4\frac{3}{4}$	$4\frac{3}{4}$
Speed of countershaft for brass	275	250	200	200
Weight, ready for shipment	1,200	1,450	2,500	2,700

Friction countershaft and other accessories furnished with each machine.

Sold by

Young, Corley & Dolan, Inc.

115 Broadway - - - New York City

CLEVELAND DRILLS

Drill More Holes per Drill

"Don't Scrap This Drill"

Just because its tang is twisted off is no reason for scrapping it. In the tool room you will find a

PERFECT
DOUBLE TANG
SOCKET

Get it. Grind a new tang on the drill—just below the old one—and slip it into the "Perfect Double Tang" socket. You'll have this drill back on the job in three minutes, and it will be 25 to 60 percent stronger than before.

The "Perfect Double Tang" socket gets full drilling life from every drill regardless of the life of the original tang, and it eliminates the waste incident to broken and twisted tangs.

It's in one piece—simple, inexpensive and fool-proof—a necessary adjunct to every economical shop.

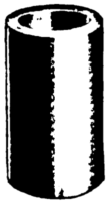
"Perfect Double Tang Socket Catalog No. 318" tells about it in detail. Please specify this catalog as you write, since we have others.

The
Cleveland Twist Drill
Company
New York Cleveland Chicago

Drill with broken tang ready for grinding on new tang.

Drill with new-ground tang ready for the "Perfect Double Tang" socket.

Drill with new-ground tang and "Perfect Double Tang" socket ready for work.



THE FARWELL MILLING ATTACHMENT

MAKES YOUR PLANER A

VERTICAL AND HORIZONTAL MILLING MACHINE

BORING MILL AND PLANER ALL IN ONE

BUILT IN FOUR SIZES

ASK FOR BOOKLET 57

THE ADAMS COMPANY

1908 BRIDGE STREET

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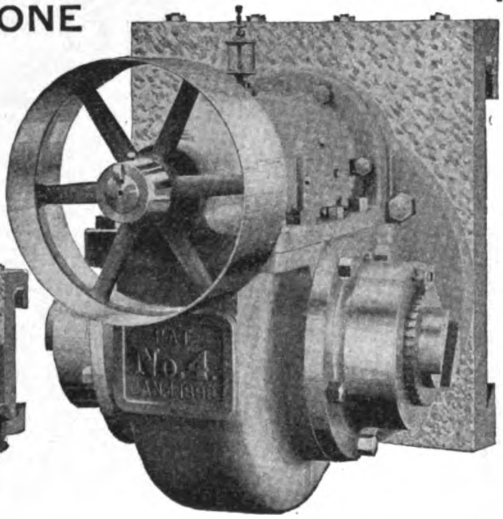

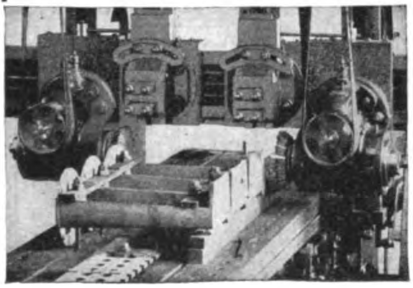

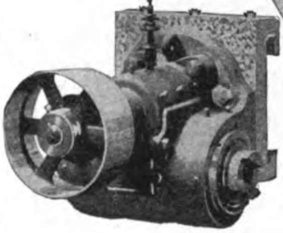

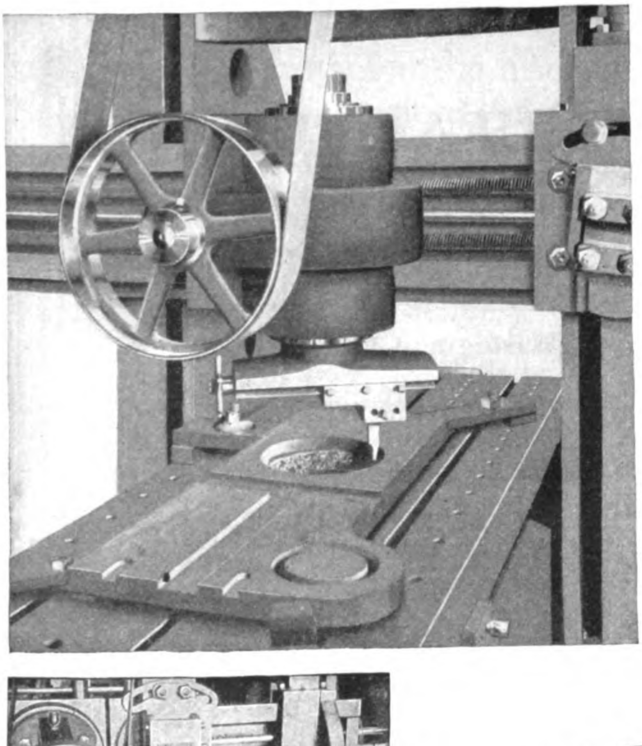

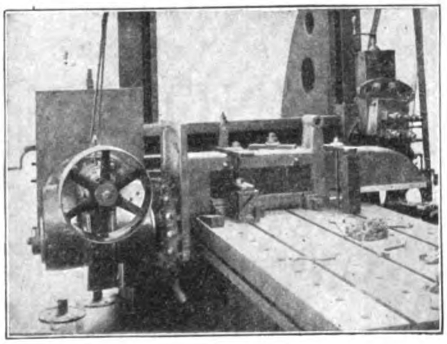

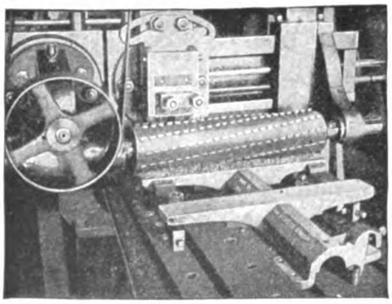

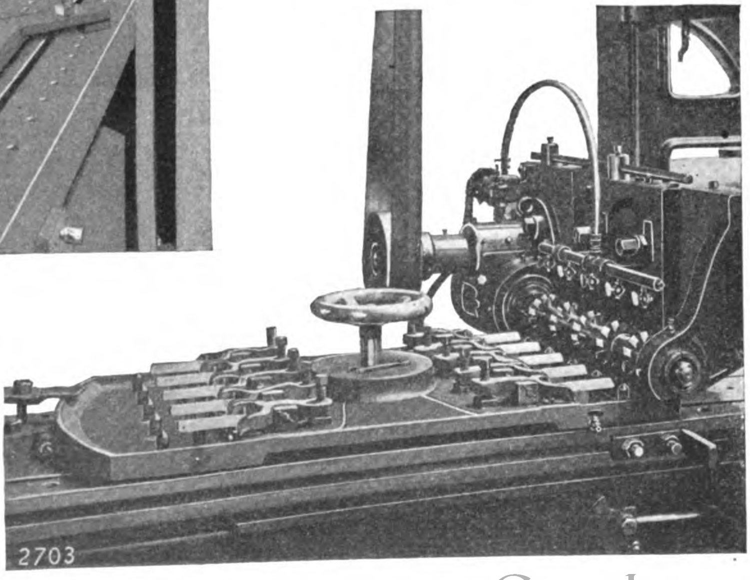

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SPECIAL CHISEL STEEL

The Result of over 70 Years' Experience in Fine Steel Making

A Trial Will Prove its Value

Firth-Sterling Steel Company
Works at McKeesport, Pa.
Boston Philadelphia Cleveland Chicago
New York Pittsburgh Detroit San Francisco

HIGH-SPEED STEEL

A fair stock of all regular sizes on hand for prompt shipment.

Write or wire us your requirements

EDGAR T. WARD'S SONS
44-54 Farnsworth St. - - Boston, Mass.

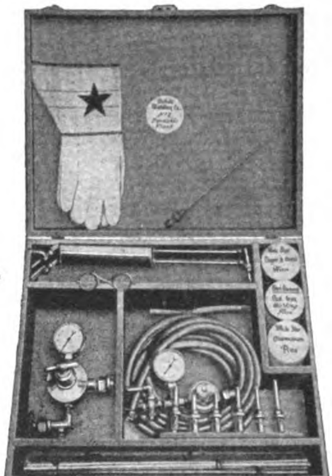
Union Drawn Steel Company of Beaver Falls, Pa.

Makers of Bright Cold Finished Bessemer, Open Hearth and Crucible Steel, in Rounds, Flats, Squares, Hexagons and Special Shapes; straight, accurate to section, with polished superior wearing surface; for Shafting, Duplicate Shafts for machine construction, piston and pump rods, keys, feathers, slides, and guides; Special simple and alloyed steels, cold finished, for all special requirements, particularly adapted for rapid machining in screw machines, hand or automatic.

Branch Offices and Warehouses

Detroit Cincinnati Boston New York Buffalo Philadelphia Chicago
Brown Bros., Ltd., London, E. C.

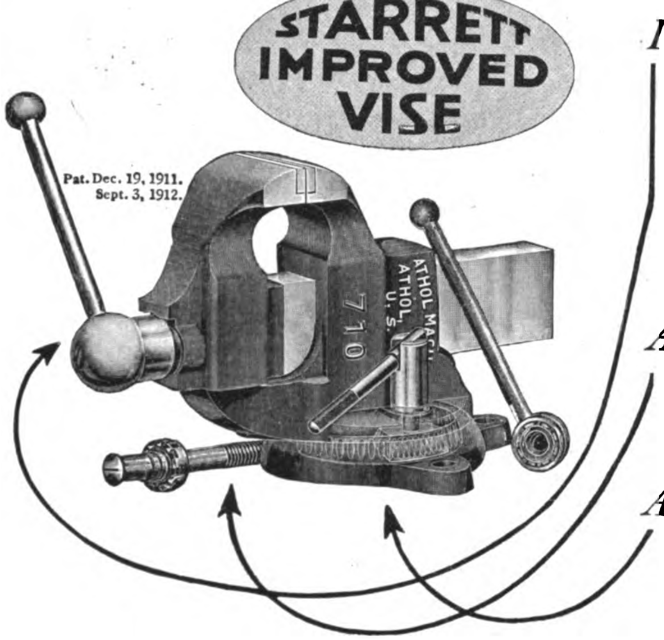
Complete Welding Outfit Low in Price— High in Quality



Contains our regular combination welding and cutting torch. Cast iron, steel, copper, brass, aluminum, bronze and malleable iron are readily and successfully welded with this outfit. We furnish a textbook explaining the proper use and care of the equipment, and the welding of all metals.

Write for catalog covering our complete line of oxy-acetylene welding and cutting equipment.

The Metals Welding Company
4410 Perkins Ave. Dept. M Cleveland, Ohio



It is improved in this way:

You know that in past vises you have always had two troubles with the handle: First, when the jaws were tight the handle always seemed left where it was most in the way. Second, very often, it had a bad habit of slipping through the screw head and planting a blood blister on your hand. In the Starrett Vise both of those troubles are done away with.

As you can see the handle is screwed solidly to the head and does not pass through. Thus, when you have the jaws tight, you simply pull out the screw head and because of a ratchet arrangement, the handle can be swung to any position you desire.

And in this:

In the Starrett Vise, instead of the old-style, coarse pitch, double square thread, there is used a single pitch thread of the buttress type. The same pressure applied to our thread gives twice the power of any double thread of the same pitch. Accordingly, you can make the jaws tighten more easily.

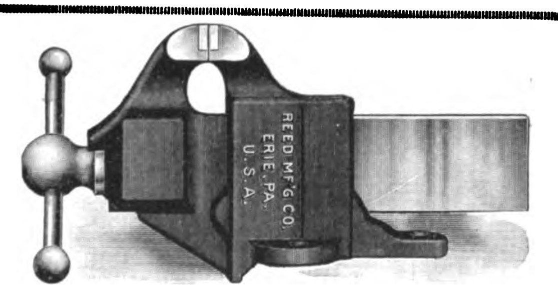
Also in this:

Note that phantom view of the corrugations of the bolt engaging with the corrugations of the base. After the clamp nut is tightened by hand, the swivel base cannot slip. It is absolutely rigid.

Now these are only some of the ways in which a vise has at last been brought up to date to meet modern needs. Get acquainted with these improvements.

At last here, in this Starrett Vise, is a vise with big improvements—several of them. Doesn't this interest you? Write for the booklet "Something New in Vises."

ATHOL MACHINE COMPANY, Athol, Mass., U. S. A.



The Reed Unbreakable Vise

The vise that is strong enough for **any** work because it is guaranteed against breakage under **any working strain**. Write for catalog.

Reed Manufacturing Company, Erie, Penna.

SCREW STEEL AND SHAFTING

Cold Drawn and Planished

Large Stocks—Mill and Warehouses

Immediate Shipments

Screw Machine Products Springs Metal Stampings Tungsten Hack Saw Blades	Seamless Tubing Steel - Brass - Copper Bronze—Aluminum Nickel-Alloy—German-Silver	C. R. Strip Steel Anald. & Tempered Spring Steel Tool & Alloy Steels Magnet Steel

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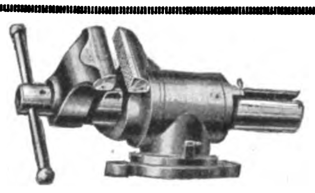
510-512 West 24th St., New York

Branches Philadelphia, San Francisco, Buffalo, Seattle, Cleveland, Los Angeles, St. Louis, Calumet, Mich.



It Swivels to Any Position

The "F & R" Machinist's Vise has the advantage of two complete swivels—and can be positively locked at any angle by two separate methods. Fully described in our new booklet "Vises." **Send for a copy.**

Fulton Machine & Vise Co.
101 West Street, Lowville, N. Y.

WOLFRAM

TRADE **HIGH SPEED STEEL** MARK

An American product throughout. Made from American Stock by American Men. American Chrome, American Vanadium, American Manganese, American Silicon, American Charcoal. Used throughout the U. S. A. Prompt deliveries.

Vulcan Crucible Steel Company

ALIQUIPPA, PA.

With Jig Attachments

VISE

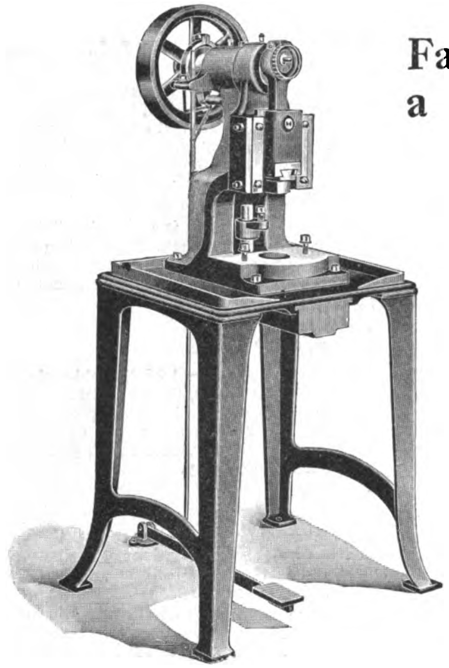
For Your Driller, Miller, Shaper or Planer—3 Sizes

Our Other Tools—Drill Speeders and Knurl Holders

Without Jig Attachment

THE GRAHAM MFG. CO., Providence, Rhode Island

Germany, Austria, Scandinavia, A. Kayser, Berlin, France, Italy, Spain, Holland, Belgium, Fenwick Freres & Co., Great Britain, C. W. Burton, Griffiths & Co.



Fast and Safe Punching Is All a Yankee Power Press Can Do

THE ordinary hand and screw press is rendered obsolete by the little **Yankee Power Press,** which is just the thing for small, light work.

The clutch is so controlled that it cannot make a second revolution until the foot is removed and again applied to the treadle. But if desired the device may be adjusted for continuous motion.

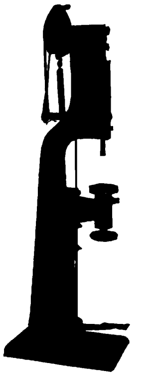
The Yankee is built in three sizes, No. 0, No. 1 and No. 2. It is supplied without table for use on a bench.

We also build cam milling machines, disc and surface grinders and special machinery.

You ought to write for circulars and prices on these products.

The Rowbottom Machine Company

Waterbury, Conn. **Factory, Waterville, Conn.**



Accurate Riveting

with our
"ELASTIC ROTARY"
(Trade Mark)
Blow Riveting Machine.

It strikes a series of light, elastic blows, every one on exactly the right spot, and as the hammer is also revolved rapidly, the rivets are turned down smoothly on all sides, and every head is perfectly finished.

Can we send you catalog 14?

F. B. Shuster Company
New Haven Conn.
Formerly John Adt & Son Established 1866
Also makers of Wire Straightening and Cutting Machines for all kinds and shapes of wire.

Have You Riveting to Do?

If so, you should have the particulars on the

Grant Noiseless Riveting Machine

It will perfectly head rivets at the rate of one a second. It is easily operated. A dollar-a-day boy can take the place of four expert riveters and can turn out as much and better work on this machine.

Send now for Catalog giving details.

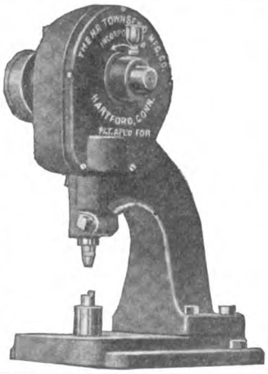
The Grant Mfg. & Machine Co.
85 Silliman Ave. - Bridgeport, Conn., U. S. A.

Riveting in Record Time

The Townsend High Speed Riveting Machine strikes 80 to 1000 uniform, tapping blows every second. Quick as a wink, clean, smooth, finished heads are put on rivets. Different heights of rivets can be handled at one setting. The work itself is never distorted. **Write for circulars.**

H. P. Townsend Mfg. Co.
Hartford, Conn.

Foreign Agents — ALFRED H SCHUTTE, Cologne, Berlin, Paris, Milan, Brussels, Liege Barcelona, Petrograd, Stockholm.
ERNST KRAUSE, Vienna.



18,000 Screws Set in 10 Hours

That's what a Reynolds Automatic Screw-Driving Machine does on one type of work. Perhaps one wouldn't do your special work so fast—but it would do it from two to five times as fast as it could be done by hand. Greater uniformity, too. **Ask for our Catalog.**

Reynolds Pattern & Machine Works
Moline, Ill.

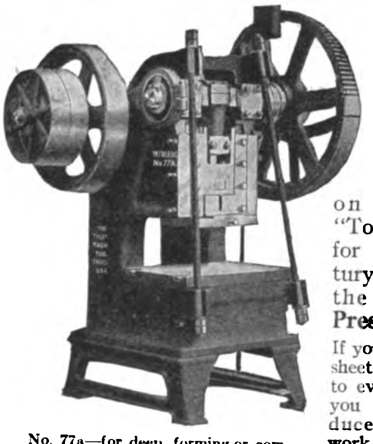
ATLAS Presses

There is nothing to offset the saving when you invest in an Atlas Press. You get two presses for the cost of one when you install Atlas Presses. **Write for the Atlas Bulletins.**

Atlas Press Co., 317 N. Park St., Kalamazoo, Mich., U. S. A.

The Best Performers Under All Conditions

"TOLEDO" POWER PRESSES



No. 77a—for deep forming or combination cutting and forming, etc.

Thousands of manufacturers in all parts of the world have put their seal of approval on the name "Toledo" which, for half a century, has stood for the **Standard Press Product.**

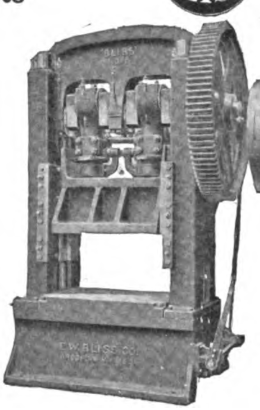
If you have any new sheet metal problem to evolve — or — if you desire to produce your present work more economically—put it up to our engineers—their suggestions and expert advice entails no obligation.

The Toledo Machine & Tool Co.
Toledo, Ohio

There is a size that will successfully meet your exact requirements

BLISS

Presses with correct proportions for use in the manufacture of large sheet iron and steel goods. The large diameter shafts and well gibbed slides allow quantity production that's profitable.



BLISS Double-Crank Presses

Adapted for the economical manufacture of vapor stoves, wrought iron ranges, agricultural implements, paneled ceilings, metal doors, window frames and sashes, metal furniture, shingles, drip pans and a similar class of goods.

150 different sizes and styles.
Catalog 9-A on request.

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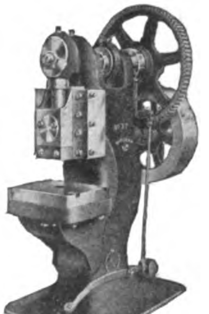
Chicago Office: 622 West Washington Boulevard. Detroit Office: Dime Bank Building. Offices in Europe: 100 Boulevard Victor-Hugo, St. Ouen, Paris—Pocock St., Blackfriars Road, London, S.E.

For Heavy Work

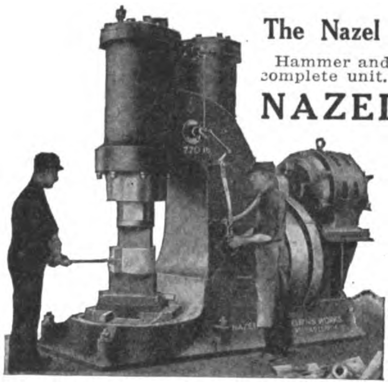
Niagara Punching Presses are remarkably efficient machines for punching and cutting bars and heavy sheet metal, for operating, cutting and forming dies in the manufacture of hardware, etc.

Our complete Catalog is an encyclopedia of Presses. Keep a copy on hand for reference.

A postal brings it.



Niagara Machine and Tool Works
Buffalo, N. Y., U. S. A.



The Nazel Air Hammer

Hammer and compressor one complete unit.

NAZEL Engineering and Machine Works
4039 N. 5th St.
PHILADELPHIA

More economical than steam, more powerful than springs, more efficient than either.

Built in 6 sizes, Belt or Motor.

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FOR GENERAL FORGING

Saves Fuel, Time and Labor. Cuts Forging Costs in Two.

Belt or Motor Driven

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FERRACUTE PRESSES

HUNDREDS OF SIZES AND STYLES

FOR CUTTING, FORMING, PUNCHING, DRAWING AND EMBOSSING BAR AND SHEET METALS, PAPER, LEATHER ETC

FERRACUTE MACHINE CO., BRIDGETON, N. JERSEY, U.S.A

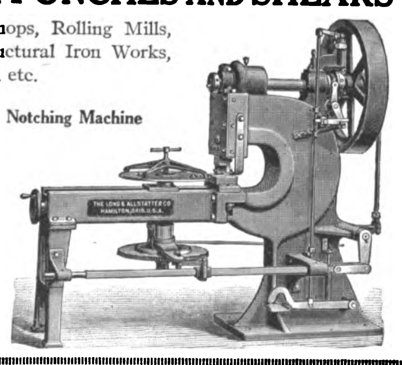
POWER PUNCHES AND SHEARS

For Boiler Shops, Rolling Mills, Bridge and Structural Iron Works, Machine Shops, etc.

Armature-Disc Notching Machine

Manufactured by

The Long & Allstatter Company,
Hamilton, Ohio, U. S. A.



For general Machine and automobile work.

GRANT GEARS

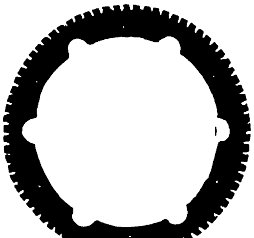
Complete line of spur, bevel, mitre, helical, internal and worm gearing, chains and sprockets always carried in stock ready to ship immediately.
Our facilities for doing every kind of difficult gear cutting are unexcelled.

RUSH ORDERS A SPECIALTY.

Send blueprints, sketches or old gears for free estimate. Gear advice cheerfully furnished. Write.

GRANT GEAR WORKS, Inc., 151 Pearl St., Boston, Mass.
GEORGE B. GRANT

HIGH GRADE GEARS



Your orders with us for Gears, Worms, Sprockets, Racks, Screw Machine Products up to 5½ in. dia., Machine Work, Hoists for Dumping Bodies, etc., will have personal attention.

We have an uptodate shop, modernly equipped and we employ expert workmen.

Send us your blueprints and let us show you what we can do.

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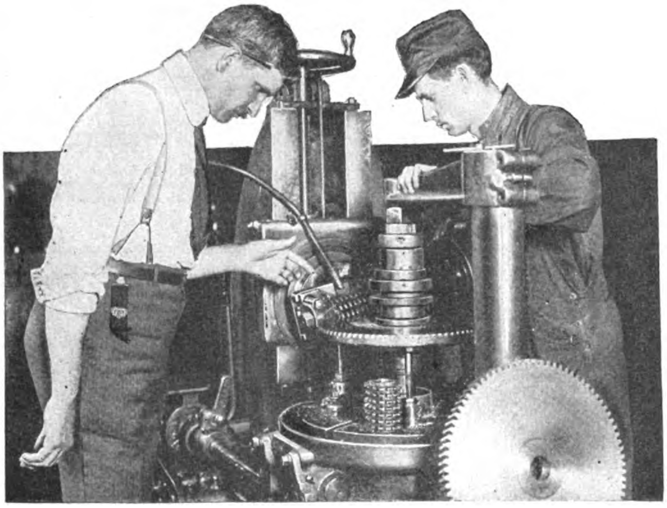
"That Machine Does Fine Work"



**So says Phillie Gear, and he ought to know.
The machine shown in the picture is only one of the many high-grade and expensive units used in manufacturing GEARS PHILADELPHIA.**

Try Phillie Gear on a breakdown job. Spur gears, bevel gears mitre, rawhide, spiral, worm and helical gears and sprockets.

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All Kinds of Gears

Accuracy, quality and prompt delivery characterize this "Day-and-Night Gear Shop."

Forward your blueprints or sample gears and allow us to furnish estimates on your gear cutting.

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Let us quote you on your small gears.

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Let us figure on cutting your gears or on the equipment for doing the work yourselves

FLATHER AUTOMATIC GEAR CUTTING MACHINES

are accurate, rigid and economical.

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You DO Need Us to Make Your Gears—and for Good Reasons.

When you say to yourself "We don't need the New Process Corporation to make our gears—our boys can make 'em just as well," nine chances in ten you have never given the matter real thought.

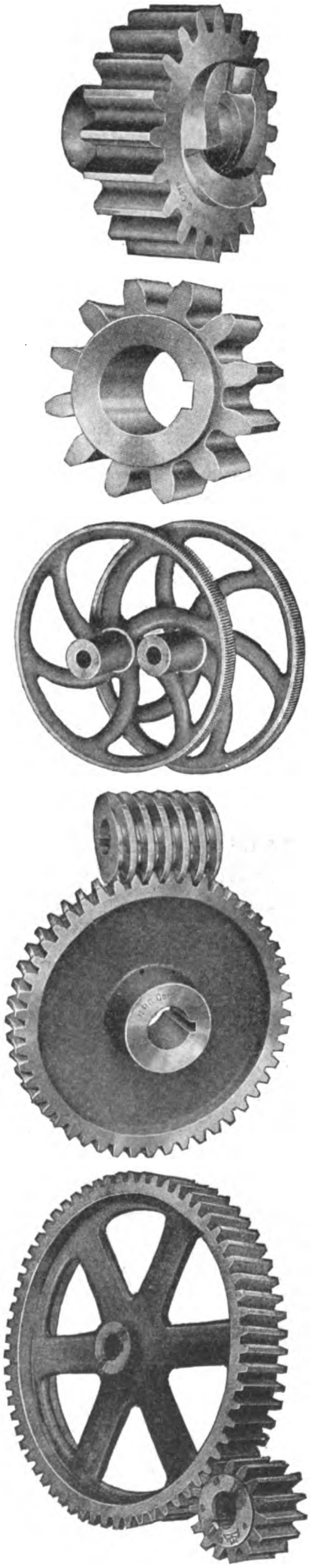
Your men are probably well trained and reliable. They *may* turn out nice gears—and they may *not*. But how on earth can you expect them to compete in cost with our special tools and operatives that produce *gears only*? And can you expect the same accuracy and uniformity as you get from our staff of gear designers, our precise measuring devices and our rigid inspection system? Hardly.

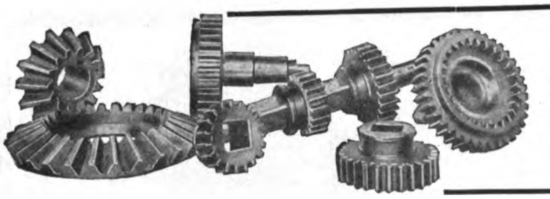
Production in our plant is on a scientific management basis as to both quantity and quality. Our up-to-date equipment of brains, energy, machines and plant assure good product and attractive price—and the free advice of our engineers helps to make strong satisfaction stronger.

Our very first quotation on your prints or specifications would prove interesting.

YOU CAN'T PUT YOUR GEAR WORK INTO BETTER HANDS

NEW PROCESS GEAR CORPORATION
SYRACUSE, N.Y





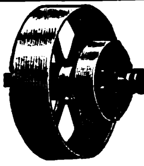
Making Sure

of getting good gears on time and in a hurry at reasonable cost and with minimum trouble is assured if you order them out of our "Bx Gear Problems" Catalog and from the largest and most completely equipped plant in the Central West, viz.:

Foote Bros. Gear & Machine Co.

210-220 N. Carpenter Street — Chicago, Ill.

Specialists in heat-treated gears for tractors and trucks.



Friction Clutch Pulleys and Couplings

THE A. & F. BROWN CO.

ENGINEERS, FOUNDERS, MACHINISTS AND MILLWRIGHTS

79 BARCLAY ST., NEW YORK

POWER TRANSMISSION MACHINERY

ROPE DRIVES A SPECIALTY. — TURNED STEEL SHAFTING

WE LAY OUT, MAKE THE DRAWINGS, FURNISH THE MATERIAL AND ERECT IT

SEND FOR CATALOGUE — WORKS—ELIZABETHPORT, N. J.

Gears of all kinds and sizes

COMPLETE GEARS

1—We supply gears complete, including material.

2—We machine gears complete from material furnished by the buyer.

3—Or we cut the teeth in gear blanks furnished by the buyer.

As gear specialists, we are eminently qualified to select the proper material, and to do the turning and cutting to the best advantage. We recommend our services for the complete operations accepting full responsibility and assuring your complete satisfaction.

"V D & D" Gears

Spurs, Bevels, Mitres Spirals, Helicals, Racks, Worms, Worm Gears, Etc.

The Van Dorn & Dutton Co.

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New York — Atlanta — Salt Lake City

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GEAR SPECIALISTS

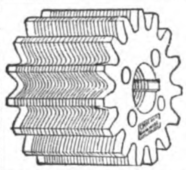
Fawcus Machine Company

PITTSBURGH, PA.

Gears of all descriptions to 24 feet diameter. Heavy machinery designed and furnished for all purposes.

Works: Ford City and Pittsburgh, Pa.

Main Office - - - Pittsburgh, Pa.



Chicago-Rawhide Pinions

The best that selected material and careful workmanship can produce

The Chicago Rawhide Mfg. Co.

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Sawyer Gear Works

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Gears (of all *kinds* and sizes in stock and made to order.

From the cheapest that's *good*

To—the *best* that's made.

Sample our workmanship. Get our prices.

WORM GEARS

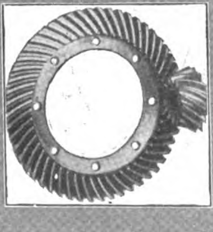
EXCLUSIVELY

25 Years' Actual Experience

Cleveland Worm & Gear Co.

CLEVELAND, OHIO

SPIRAL TYPE BEVEL GEARS



THE LATEST IN AUTOMOBILE DRIVES

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MANUFACTURERS OF GEARS AND BEVEL GEAR CUTTING MACHINERY

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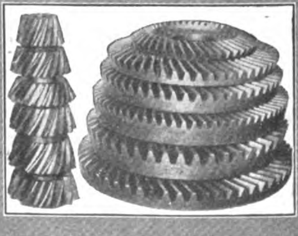

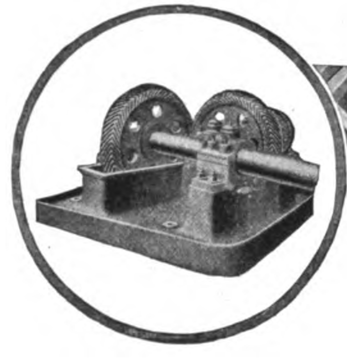

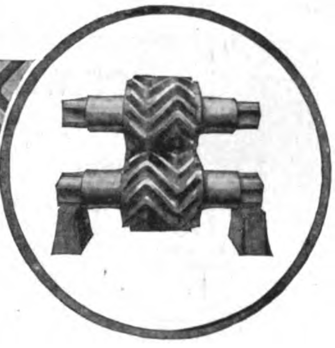

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For Silent Back Axles

**Silent
Strong
Efficient**

**Prompt
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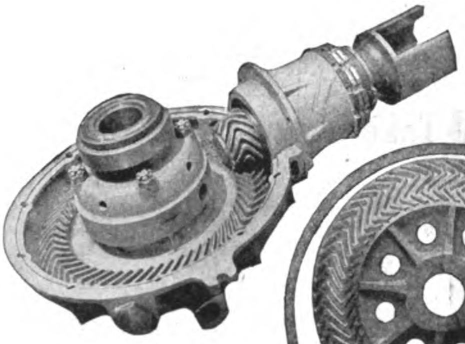


The Citroën Gear Co.

Sole Manufacturers

General Offices and Works **Paris** (France) 31 Quai de Grenelle

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USE STOCK GEARS
and get DELIVERY

if you are having trouble in procuring special gears.

Boston Stock Gears

Include all the standard types. 1,400 sizes.

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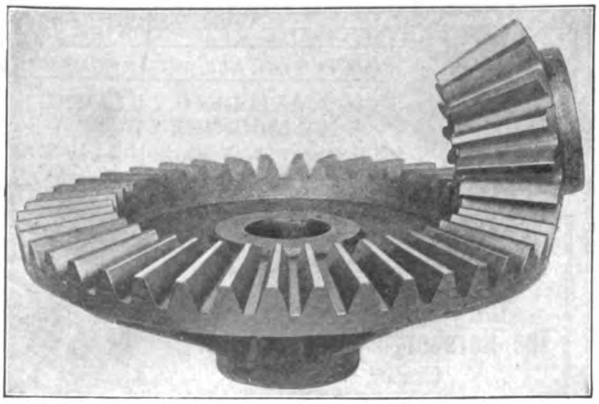
BOSTON GEAR WORKS, Norfolk Downs, Quincy, Mass.



These gears are cut at an angle of 105°.

If these gears were badly cut

We should soon lose all of our business. Instead of this Cincinnati Gears have made themselves known all over the country, for accuracy and efficiency.

Every Cincinnati Gear is just as good as the balance of the order because we do our business that way.

We can give you Cincinnati Service on bevel, mitre, and spur gears, also spiral, rawhide, internal, worms and worm wheels.

Write for Catalog "C."

The Cincinnati Gear Co.

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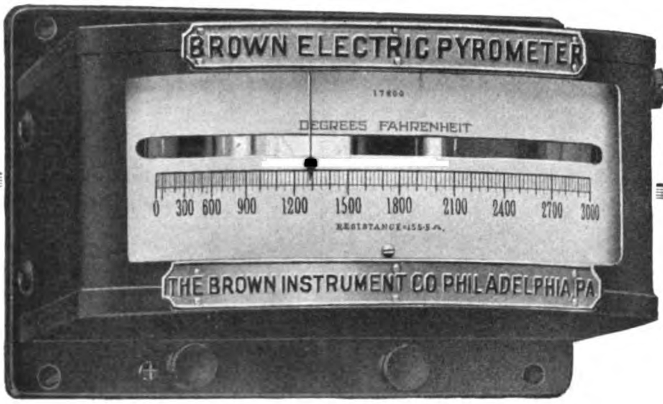

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The Brown Instrument Company, Philadelphia, Pa.

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The New Dial Gauge

Reads to .001 inch. Furnished with dial running from 0 to 100 if desired.

Here is a genuine Randall & Stickney Dial Gauge at the low price of $7.00.

Randall & Stickney Gauges have long been known for reliability and accuracy and this gauge is a strictly high-grade product.

Read U. S. Bureau of Standards Circular No. 38 for their endorsement of Randall & Stickney Gauges.

Write now for any further particulars desired.

Randall & Stickney
Waltham, Mass.

Delivering the Goods+

Attach **Root Automatic Counters** to your producing machinery and they **deliver** the goods **counted**—that's "delivering the goods plus" because

The Root Counters

protect against getting under or over-production. They are accurate, reliable and durable. Guaranteed for 3 years. We'll let you try them free. Send now **for illustrated catalog No. 17.**

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See our Exhibit at Hardware Exchange, Broadway and Murray St., New York.

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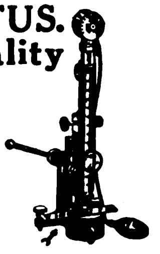
Pyroscope (Temperature Indicator)

There is only one way to make sure of quality in the materials you buy, and in the products you sell—that is to *test* them. The two instruments shown herewith are the simplest and most economical for their respective purposes.

To determine how hard or tough is any metal—what is the resistance to wear or shock—you need the **Shore Scleroscope.**

For control of tempering, annealing or any other heating operation, the **Shore Pyroscope is the practical device.**

Write today for booklets fully describing the uses and benefits of these instruments.

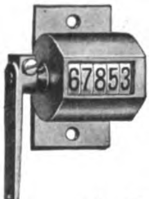


Scleroscope International Standard (Hardness Tester)

Shore Instrument & Manufacturing Company
555-557 W. 22nd Street — New York

Foreign Agents—England, Coats Machine Tool Co. France, Aux Forges de Vulcain. Russia, Iznosskoff-Suckau Co. Japan, Yamatake & Co. Italy, H. W. Ward & Co.

Why Spend the Time to Count, Weigh and Measure Goods by Hand



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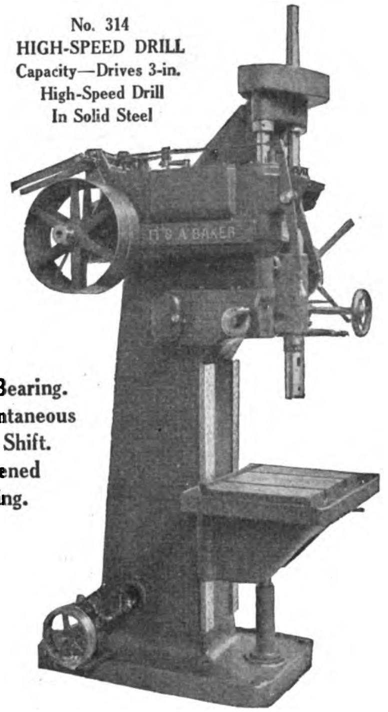
Veeder COUNTERS

A Model for Every Purpose.
Send for Our Booklet—It's Gratis.

THE VEEDER MANUFACTURING CO.
15 Sargeant Street, Hartford, Conn., U. S. A.
Makers of Cyclometers, Odometers, Tachometers, Tachodometers, Counters and Fine Castings

No. 314
HIGH-SPEED DRILL
Capacity—Drives 3-in.
High-Speed Drill
In Solid Steel



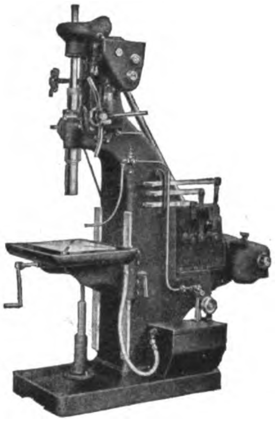
Ball Bearing.
Instantaneous Gear Shift.
Hardened Gearing.

BAKER BROTHERS, TOLEDO, OHIO U. S. A.

Cut Operating Costs

In your repair department and on your manufacturing work by ridding your shop of troublesome, expensive, time-wasting cone and belt drills. Their greater flexibility is but fancied—their grave faults known. Use the

All-Geared
22-in. Self-Oiling Manufacturing Drill



A drill having no cone or inherent belts to buy, slip, shift or maintain. A drill designed for heavy duty, rapid production in manufacturing. Every bearing is **self-oiled**. Eight geared speeds and ten geared feeds are under instant control of operator from front of machine. Safety collar protects absolutely from overload.

This drill will drive a 1½-in. twist drill at the rate of 23 in. per minute in cast iron. You will be interested in bulletin. Write.

BARNES DRILL COMPANY
Incorporated 1907
830 Chestnut St., Rockford, Ill., U.S.A.

Agents for Great Britain: C. W. Burton Griffiths & Co., London, E. C. **France:** R. S. Stokvis & Fils, Paris. **Japan:** Roku-Roku Shoten, Tokio. **Canada:** Canadian Fairbanks-Morse Co., Ltd., Winnipeg, Toronto and Montreal. **Germany and Austria:** E. Sonnenthal, Jr., Berlin, C.2., Cologne, a.Rh., Dortmund and Vienna. **Spain:** Sociedad General de Representaciones, Madrid.

SILVER DRILLS

Holes Drilled in Double Quick Time

These new Silver Power Drills are peculiarly adapted for rush work. The kind of work you may be handling just now. They will help you fill your contracts on time. Ready for shipment. Drop us a line and they go at once. With speed they combine increased strength and efficiency. Made in four styles.

Write or telegraph.

The Silver Mfg. Co.
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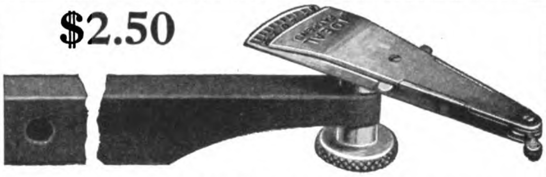
$2.50



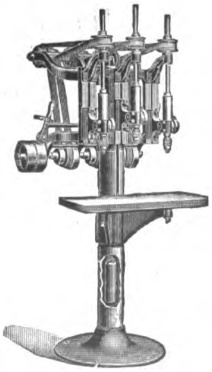
For Unfailing Accuracy

No more practical Test Indicator than the Ideal can be bought for money. It does all that the highest priced instruments can do, in locating the smallest inaccuracies.

Why pay 8 or 10 dollars? The Ideal Test Indicator—at $2.50—will be sent on receipt of price, and we'll refund your money within 30 days — if you are not satisfied. Write us about it.

Dealers are invited to write for terms.

JOHNSON & MILLER, 42 Murray St., N. Y.



If You Want Quality Drilling

Sigourney Drill Presses are guaranteed to run practically true and we offer them for doing high grade work where accuracy is desired.

They are made with one, two, three and four spindles which are very sensitive and run perfectly true.

Write for Illustrated Catalog.

The Sigourney Tool Co., Hartford, Conn.

Counting is the Cheapest Way of Getting Accurate Records

There are no more durable or efficient counters than

"STERLING COUNTERS"

Full particulars and Bulletin No. 6 on request.

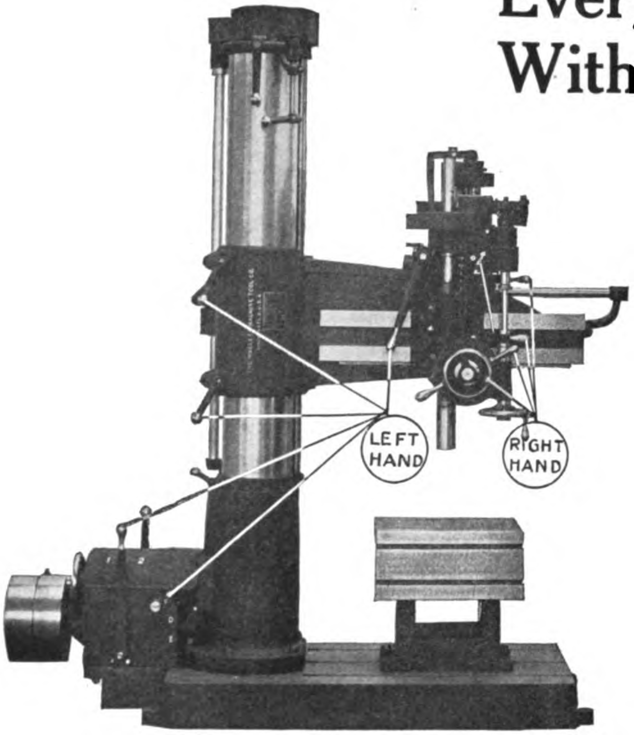
New Haven TrolleySupply Co., **New Haven, Conn.**

UNIVERSALLY ADJUSTABLE NATCO MULTIPLE DRILLS

are the only multiple drills that permit the drilling of large and small holes simultaneously at correct speeds. Send us blue prints for production estimates.

NATIONAL AUTOMATIC TOOL CO.
Seventh and South N. Streets, **Richmond, Indiana, U. S. A.**

Every Control Lever Within Easy Reach



No walking around—no stretching—no need to grope around at a critical moment. The centralized control of Mueller Radial Drills ends all the difficulties formerly encountered by the operator.

On a Mueller every control lever is handy and within easy reach of the operator's hands. He can start and stop the spindle, obtain any one of 12 speeds or 8 feeds, and adjust the spindle within 0.001 in. in any direction without shifting from his initial position.

A Mueller is as powerful, as accurate and as fast as it is convenient.

Our new catalog which contains interesting and valuable information for users of radial drills will be ent on request. Do you want it?

The Mueller Machine Tool Co.
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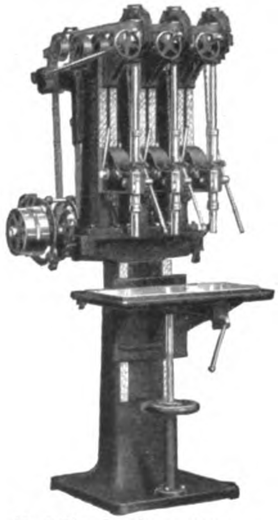
Cincinnati - - Ohio

A Bigger Output



Henry & Wright
Ball Bearing Drilling Machine

The largest output per spindle on all sensitive drilling work up to ¾ in. in diameter is assured with these improved, "easy to operate" ball bearing drilling machines.

Write for latest catalog and free combination speed and feed chart.

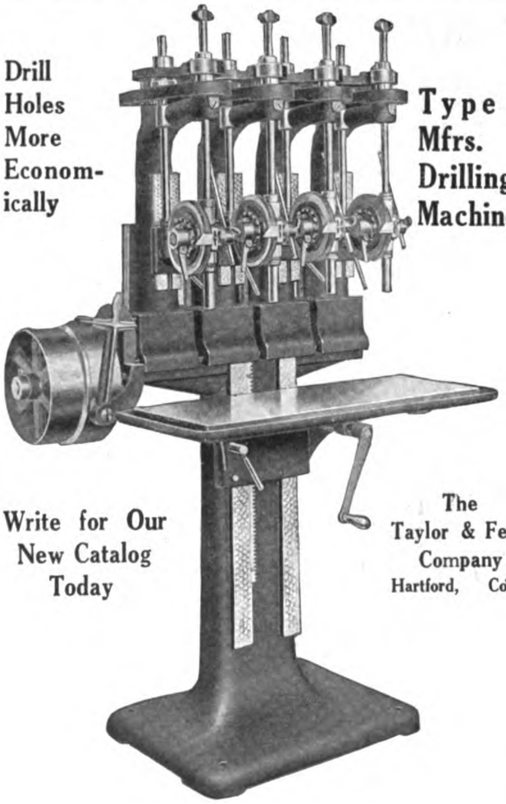
No. 3 Class K, 8-in. overhang

The Henry & Wright Mfg. Co.
760 Windsor Street - Hartford, Conn.

DOMESTIC AGENTS—Hill, Clarke & Co., New York, Boston, Chicago. W. E. Shipley Machinery Co., The Bourse, Philadelphia. Chas. A. Strelinger Co., Detroit, Mich. Colcord-Wright Machinery Co., St. Louis, Mo. Brown & Zortman Machinery Co., Pittsburgh. Coghlin Machinery & Supply Co., Toledo, O. Brandes Machinery Co., Cleveland, O. Carey Machinery & Supply Co., Baltimore, Md.

FOREIGN AGENTS—Wilh. Sonnesson & Co., Malmo, Sweden, Norway, Copenhagen City and Freeport. G. Koeppen & Co., Moscow, Russia. Ing. Ercole Vaghi, Milan, Italy. Bevan & Edwards, Propty, Ltd., Melbourne, Australia. The Allied Machinery Co. of America, Paris, Turin, Zurich, Petrograd.

Drill Holes More Econom-ically



Type C Mfrs. Drilling Machines

Write for Our New Catalog Today

The Taylor & Fenn Company
Hartford, Conn.

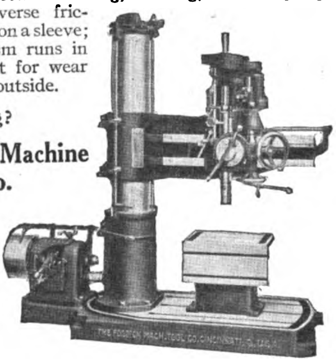
Take the Head—

It is easily and quickly moved by a ball bearing spiral gear on the

FOSDICK Heavy Duty Radial

One lever in front operates double back gear (3 speeds) which, together with the 6 speeds obtained in the speed box, give correct speeds for all drills from ¼-in. carbon to 3-in. high speed.

There are lower speeds for boring, reaming, and heavy tapping; tapping reverse frictions are mounted on a sleeve; no grit—mechanism runs in oil; all adjustment for wear is made from the outside.



Catalog?

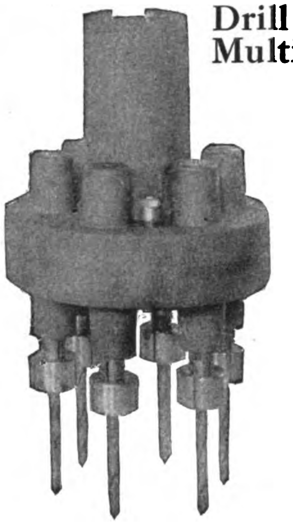
The Fosdick Machine Tool Co.

Cincinnati, Ohio

Agents

Colcord-Wright Machinery & Supply Co., St. Louis. Eccles & Smith Co., San Francisco, Los Angeles, Portland. The Fairbanks Co., New York City, Baltimore. The E. A. Kinsey Co., Cincinnati, Indianapolis. J. L. Osgood, Buffalo. W. M. Pattison Supply Co., Cleveland. Peninsular Machinery Co., Detroit. H. A. Smith Machinery Co., Syracuse. Swind Machinery Co., Philadelphia. Somers, Fitler & Todd Co., Pittsburgh. H. A. Stocker Machinery Co., Chicago, Milwaukee. Taylor Machinery Co., Boston. A. R. Williams Machinery Co., Toronto. C. W. Burton, Griffiths & Co., London. Fenwick, Freres & Co., Paris, Turin, Zurich. Wynmalen & Hausmann, Rotterdam. Rylander & Asplund, Stockholm. Wilh. Sonesson & Co., Malmo. Russian Metal Trading Co., Petrograd. Roku-Roku Shoten, Tokyo. R. S. Scrutton & Co., Sydney.

Let Hoefer Heads Drill Your Multiple Holes—



they will drill a whole group of holes in the time it is now taking you to drill one. No need to change your present equipment. Send us your layouts and write for catalog.

Hoefer Mfg. Co.

Freeport, Ill., U. S. A.

MAXIMUM—EFFICIENCY

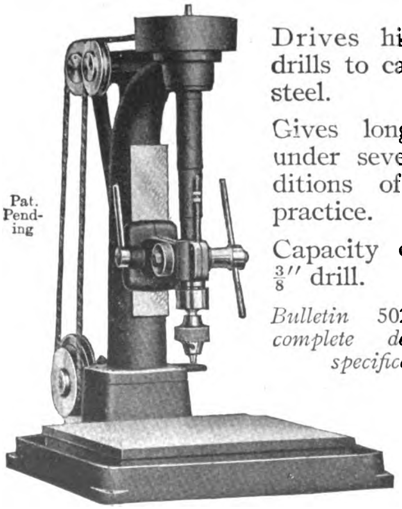
obtained by using this new

HIGH SPEED DRILLING MACHINE

Equipped with Annular Ball Bearings throughout

Can be run continuously at

10,000 R.P.M.



Pat. Pending

Drives high-speed drills to capacity of steel.

Gives long service under severest conditions of modern practice.

Capacity of chuck, 3/8″ drill.

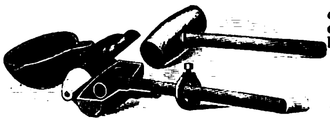
Bulletin 502 contains complete details and specifications.

Send for it now.

BUILT BY

Leland-Gifford Co., WORCESTER, MASS., U.S.A.

Soft Metal Hammers and Vise Jaws



can be poured by a boy with our combination mould and ladle. A great money getter.

Particulars and prices on request.

Charles H. Field

Providence, R. I.

Multiple Drillers *vs.* Single Drillers

Save time, money and space by using "HOLE HOGS." Increase your output and decrease your costs. Put your drilling problems up to us. **We can help you.**

MOLINE TOOL COMPANY, Moline, Ill.

THE CARLTON MACHINE TOOL COMPANY

Has succeeded

The Wm. E. Gang Co. of Cincinnati, O.

And will continue making their

RADIAL DRILLS, sizes 2½, 3, 3½ and 4 ft.

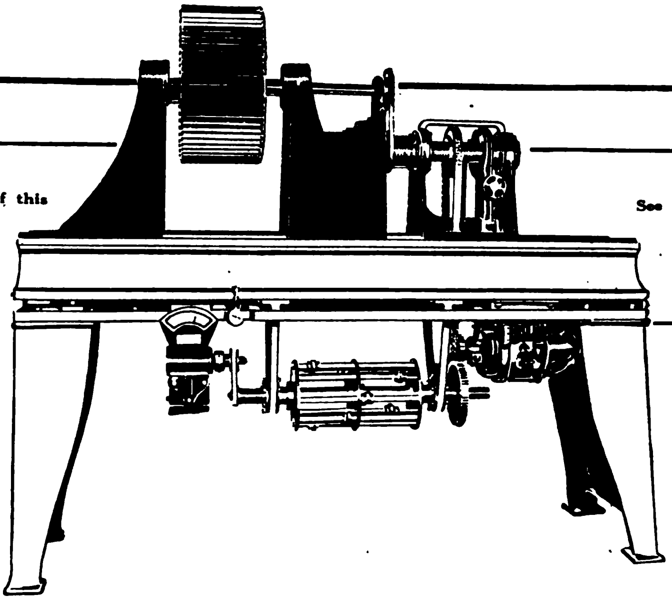
Drill Two Holes for the Cost of One

You can do it with a Nelson two-spindle adjustable drill head.

Let us send you complete information.

Nelson-Blanck Mfg. Co., Clay and Dubois St. Detroit, Mich.

European Office: Coronation House, 4 Lloyds Ave., London, E. C.
Gaston Marbaix, Factory Agent.



For description of this machine see American Machinist, May 18th.

See also our ads. in these columns under June 8, 15 and 22nd.

THE GREAT RAILROAD for whom we built this machine could not use the blowers as delivered by the manufacturers, supposedly balanced by "older methods." The blowers would not stay on motor shafts, or would shear them right off. The vibrations caused by such "practically" balanced blowers were tremendous. Our machine stopped all this, but consider the unusual part of it: the user has to do his own balancing, because the manufacturer cannot.

Incidentally these fans are being balanced at only 450 r.p.m. while their running speed varies from 800 to 1,300 r.p.m. This clearly shows that it is not always necessary to balance at the operating speed, provided that the balance is REAL, not SUPPOSED.

In balancing small objects it is best to operate at high speeds, so as to bring out the trifling amount of unbalance, which under low speeds may not be noticeable. But large, heavy objects can be balanced at much lower speeds than one may think necessary.

A few words about critical speeds: our advice (so far as balance is concerned) is merely to **forget it.** We are perfectly aware of the brilliant work done by the English and German mathematicians in connection with the delicate subject of critical speeds. But this is a highly theoretical subject, with which we are not concerned in the least in discussing balance.

The absurd part of it is that any ignorant laborer, operating the silly "floating bearing" machine will tell you all about the change of the **high side** at, and due to, what he has been told is the CRITICAL speed. We earnestly caution our readers against so idiotic a notion; **that** is not the critical speed at all; it has nothing critical about it and has something to do with the characteristics of the "floating bearing" machine itself. As soon as the latter is thrown into the scrap pile, where it belongs, this **critical speed** will disappear.

It is high time for practical men to revise their notions as to balance. We are trying to share with the readers of the American Machinist what little we know on the subject: it is all common sense and works out exceedingly well. Watch these columns!

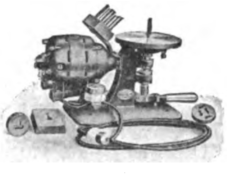
Dynamic Balancing Machine Co.

PHILADELPHIA

Rapid Finishing of Blanking Dies

The finishing of practically any contour surface, with a single cutter, is done on the

ANDERSON
Die Forming Machine



That is one reason for its speed and convenience on work of this character. It is much more rapid than the ordinary reciprocating filing machine.

Ask us to send our demonstrator to show you this machine in operation. We'll be glad to send him anywhere in Massachusetts, Rhode Island, Connecticut, New York and New Jersey.

ANDERSON DIE MACHINE COMPANY
BRIDGEPORT - - - - - CONNECTICUT

Any Board Fits It

Almorth Practical Drawing Table
$9.50
Guaranteed

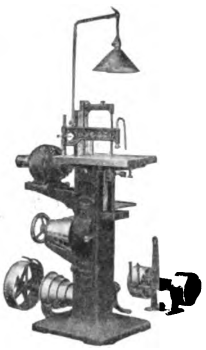
One Hand adjusts to any angle. Thoroly rigid; very simple. Two foot rests; plenty leg room. Price for castings, hinges, cabinet brackets and drawings to complete rest of table, $9.50. Everything except board and cabinet, $13.25. Complete, with best white pine board, 30 in x 42 in., $17. If 3-drawer cabinet is wanted, add $8. Order while prices are low. Send for folder.

G. A. ALMORTH
966 Grand Ave., New Haven, Conn.

Consider the table

It's 17x18 in. and square supported on a yoke with a tilt of 7 degrees, 4 ways.

Rearwin Die Filing Machines



are designed and built to prevent waste motion.

Convenience stands out all over the machine, from the tip of the support that holds the light, down to the foot belt shipper.

Each attachment is where you want it.

Our circular offers a complete description. Had one?

W. D. Rearwin
342 Mill St., N.S., Grand Rapids, Mich.

In a "UNION" there is Safe Keeping

Style G

Assures a safe place for every tool—safe from bangs—safe from knocks—safe from moisture.

UNION
TOOL CHEST

constructed of selected plain or quartered oak—finely finished. A variety of sizes. Guaranteed to meet your entire satisfaction—or money back.

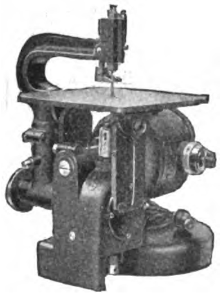
Write for our catalog and prices.

If we have no dealer near you, get our special offer.

UNION TOOL CHEST WORKS
18 Railroad St. Rochester, N. Y.

6 other styles

THERE IS NO DOUBT



About the **Oliver Sawing, Filing** and **Lapping Machine** producing **Dies, Templets** and **Snap Gages** faster than any other method.

It is a powerful well designed machine that saws out the superfluous metal and finishes by filing and lapping in a fraction of the time usually necessary.

Learn more about this useful and valuable machine.

The Oliver Instrument Co., 1168 Cass Ave., Detroit, Mich.

TOOL CASES for Machinists and Toolmakers

You need one of the many styles shown in our free catalog. They are the best built and most practical on the market and it's the up-to-date way to keep tools in good condition and orderly arranged. We ship direct to you and guarantee satisfaction. Send for the catalog now. Mfrs. of Mechanics' High-Grade Tool Cases.

H. Gerstner & Sons. 25-31 Columbia St. Dayton, Ohio

This Ferrule Prevents Splitting

The heavy pressed steel ferrule of the "Doctor" File Handle has an inwardly returned, curved, sharp-edged lip which firmly locks the wooden portion within the enlarged end of ferrule when driven into place.

We have proven the superiority of this handle under hard service. It is manufactured to reduce your file handle costs. A trial will convince you. *Samples free to Firms and Dealers; others send 10 cents in stamps—anyway write today for Free Descriptive Matter.*

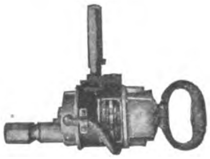
DOANE MANUFACTURING CO., Alls Sta., BOSTON, MASS.
English Agents: Theo. Butler, Ltd., 149 Queen Victoria St., London.

BLUEPRINTS
The WICKES

Continuous Electric. Sells at **half** the **price**. Uses **half** the **current** of others. Perfect prints up to 48" in width and of unlimited length.

WICKES BROS., Saginaw, Mich.

Motors, Generators, Etc.
Built To Last
Crocker-Wheeler Co.
Ampere, N. J.

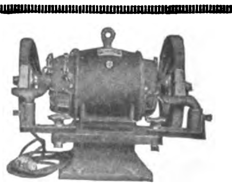


Expensive Equipment Is Not Always Necessary

Take U. S. Electric Tools to the work and save four-fifths of the time usually required on each job. Every kind of portable drill, grinder and buffer ready for prompt delivery. **Write for Catalog.**

The United States Electrical Tool Co., Cincinnati, Ohio

New York Office, 50 Church St. *Chicago Office:* 549 W. Washington Blvd. *Boston Office:* 12 Pearl St. *St. Louis Office:* 612 Victoria Bldg



Want a Ratchet for Hard Work?

Here's a heavy duty ratchet—the Billings' Model A.H.H. that is well adapted to the heavier class of work, that can be used for drilling nickel steel rails, etc.

It's double action (reversible), has large bearing surfaces, and can be adjusted to take up wear.

Write for our catalog of Machinists' Tools.

Billings & Spencer Co.
Hartford, Conn.

HOW MANY LEGS HAS A BENCH ?

"Depends upon its length," you say?

Quite true—double the length, twice the number.

But for a given length of bench, the number of legs required depends upon the *kind of leg* used. It will readily be seen, therefore, that the *price per leg* is not the important factor in the cost of bench construction.

The patented stringer feature (permitting wider spacing) and economy in lumber and labor resulting from their use account for the widespread adoption of

"NEW BRITAIN"
PRESSED STEEL
BENCH LEGS

To build 96 ft. of rigid bench, using old-style legs, requires 17 legs (6 ft. apart); with "New Britain" construction but 13 legs (8 ft. apart) are necessary—a saving of 25% in legs.

In addition you get a bench which is wholly self-supported and, being sectional and fastened to floor only, can be quickly moved without injury.

Why not standardize your bench construction? Bulletin No. 1,200 tells how. It means money in your pocket—and better benches too!

The New Britain Machine Co.
Shop Furniture Originators
20 Chestnut St., New Britain, Conn.

Patented

Try This On Your Lathe

Be permanently protected from accidents caused by clothes catching on the set screw of your lathe dog. The

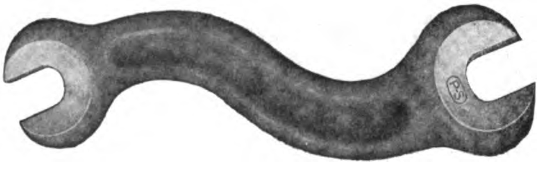
ANTI-ACCIDENT
Crucible Steel Lathe Dog

has a widening frame that is carried completely over the set screw making accidents of the above nature impossible.

Try one on your lathe. You'll use no others. Made in all styles and sizes.

Write for complete details and prices.

West Steel Casting Co.
Cleveland Ohio, U. S. A.



Here's a Good Wrench

Sturdy, long lived, tough under hardest usage. It's made of analyzed steel by experienced men under perfect shop conditions. It's the best wrench you can buy because it's a product of

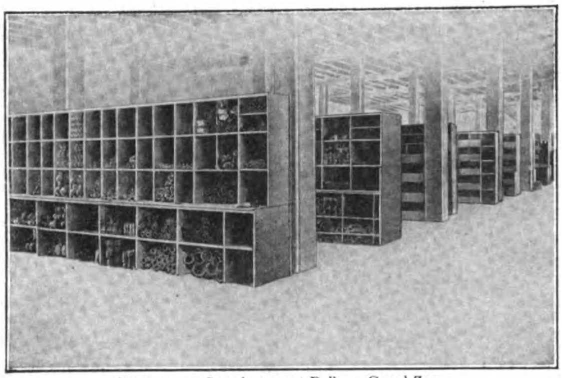
(PS) Drop Forgings

(PS) forgings make good in wrenches—and they make good in every other forging whether it be a trinket or an engine part.

We have a booklet that tells about (PS) drop forgings and (PS) wrenches.

Let us quote.

Page-Storms Drop Forge Co.
Chicopee, Massachusetts



Government Storehouses at Balboa, Canal Zone

Make Inventory Easy

DOES your present stockroom equipment enable you to easily and quickly take inventory of materials on hand? It should because the proper storing and handling of your materials is just as important as the care of your office records.

Concerns like The Packard Motor Car Co., Pennsylvania Railway Co., Marshall Field & Co., The Goodyear Tire & Rubber Co., The Borden Co., The Duff Mfg. Co., and hundreds of others, find inventory taking an easy matter, because their stockrooms are equipped with

Berger's Steel Bins and Shelving

This equipment furnishes ample and convenient storage space for all varieties and sizes of supplies, so that inventory can be made accurately and quickly at any time.

Berger's Sectional Steel Bins and Shelving are strongly constructed on the unit principle, so they can be taken down and rearranged at any time to meet changing conditions.

They afford 25% more storage capacity than wood, will hold exceptionally heavy loads, and are practically indestructible. They are a safeguard against fire, and cannot warp, split or rot.

Reasonable in cost, this equipment represents an investment on which there is virtually no depreciation.

Consider what this equipment would mean in your plant. Then write for full particulars and copy of Catalog R. A.

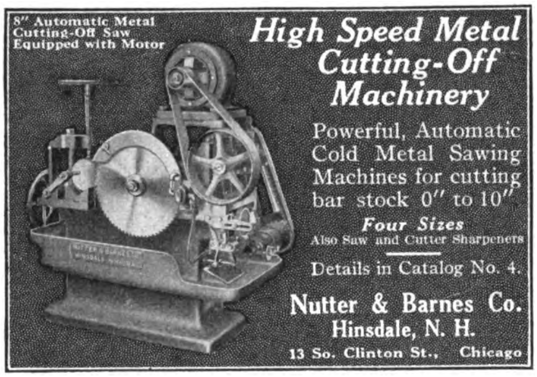
The Berger Manufacturing Co.
Canton, Ohio
BRANCHES:
Boston New York Philadelphia Chicago
St. Louis Minneapolis San Francisco
Export Dept.: Berger Bldg., New York City, U. S. A.

Cochrane-Bly Company

ROCHESTER, N. Y., U. S. A.

Manufacturers of

Metal Sawing Machines (Five Sizes)
Automatic Saw Sharpeners (Two Sizes)
Die Filing Machines (Two Sizes)
Universal Die Shaper



The

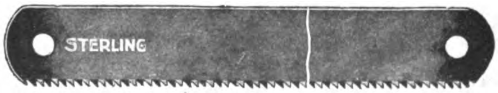
HIGLEY

Cold Metal Saw

Catalog will be sent on application to

Vandyck Churchill Company
93 Liberty Street, New York

HACK "STERLING" SAWS



Diamond Saw & Stamping Works, Buffalo, N. Y.

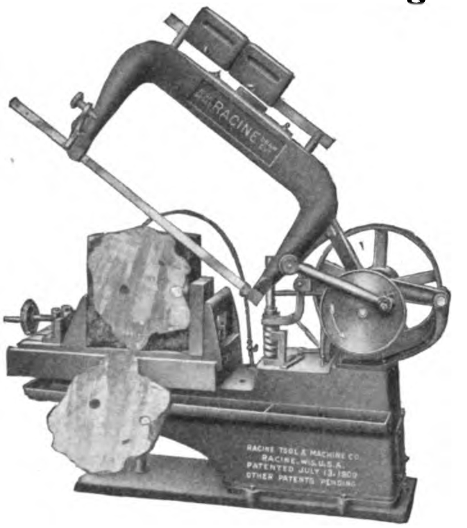
"MILFORD" HACK SAW BLADES

"Go By The Name"

Sample sent on request.

The HENRY G. THOMPSON & SON CO.. NEW HAVEN, CONN.

This is the Real Test of Heavy Metal Cutting



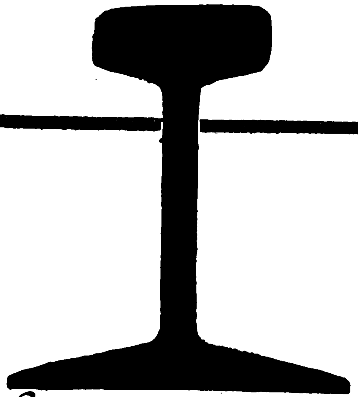
A high-speed "Racine" Metal Cutting Machine was selected to cut this Meteorite (which fell near Gibeon, German Southwest Africa) into slices ¼ in. in thickness. Only 1/32-in. variation was allowed yet this 15x15-in. slab of nickel iron was completely and accurately sliced in 10 hours—6 times faster than any other manufacturer could do the same work.

For rapid, accurate and economical metal cutting choose a Racine with its patented device that clears the blade on the non-cutting stroke, tremendously increasing its output and endurance.

We will send you a Racine on any trial basis you consider fair. Make it prove its worth in your own plant before you spend more than postage.

Manufactured by

RACINE TOOL & MACHINE COMPANY
1400 Jones Avenue - - - - RACINE, WISCONSIN, U. S. A.



If You Want to Do Accurate Metal Cutting Use a Kwik Kut

You'll get accuracy plus lowest cost of production. The photograph shows a section of rail cut with the Atkins Kwik Kut Hack Saw Machine. It is 3/64" thick and does not vary 1/64" anywhere.

Let us show you why and how the Kwik Kut Hack Saw Machine doubles the life of blades, and quickens production.

Write for bulletin IA today.

E. C. Atkins & Company, Inc.
The Silver Steel Saw People
Home Office and Factory, Indianapolis, Ind.
Canadian Factory, Hamilton, Ont.

Branches carrying complete stock in the following cities. Address E. C. Atkins & Co.

Atlanta, Chicago, Memphis, Minneapolis, New Orleans, New York City, Portland, Ore., San Francisco, Seattle, Vancouver, B. C., Sydney, N. S. W.

Let us quote on your requirements of Circular and Slitting Saws for Metal Cutting. Tell us what you wish to accomplish, maker of machine and give any information of value in determining what will best meet your needs. Now is the time. We are prepared to serve you.

Quality Saw & Tool Works
Springfield - - - Mass.

Are You Behind On Cutting Your Steel?

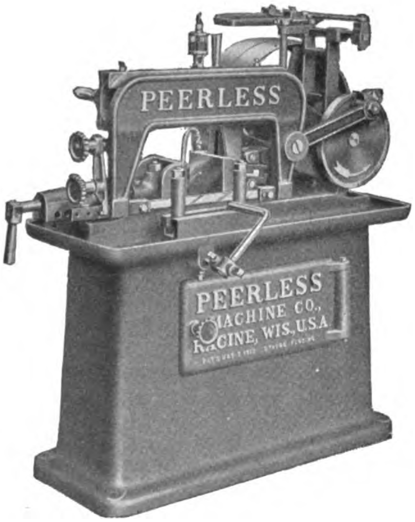
Then read these two paragraphs from a customer's letter. Could anyone expect to hear so favorably from a customer after waiting eight weeks for delivery on machine? It was real production and satisfaction that prompted them to write this letter:

"On arrival of this macnine we were so far behind on cutting that we thought sure one or two more machines would be required for our work, but owing to the high speed and the rapid cutting of this machine it has caught up with our work in a short time. We are now more than pleased that we had the patience and waited delivery on this tool, even if we were put to considerable inconvenience, as a lot of our work had to be sent out to be cut.

We must say that this tool is certainly a great time saver in actual time saved in operating the machine. We figure the operator's time saved alone will soon pay for this tool."

Several other interesting facts in this letter. Would you like a copy together with other descriptive matter?

This machine cuts off 2¼-in. round Manganese bronze in 12 seconds.
Compare this with your cutting time.

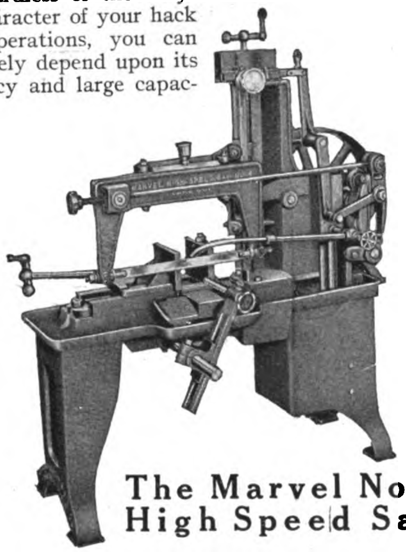


Note its rigid construction: it means increase in production.

PEERLESS MACHINE CO., 1615 Racine St., Racine, Wis.

Always Dependable

Regardless of the varying character of your hack saw operations, you can positively depend upon its accuracy and large capacity.



The Marvel No. 4 High Speed Saw

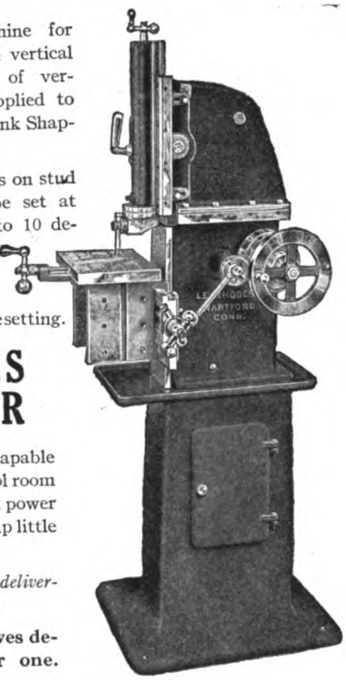
excels in cutting speed, quality and durability under hard service. **Write now for catalog.**

Armstrong-Blum Mfg. Co.
347 N. Francisco Ave. - Chicago, Ill.

For all Tool Room Shaping

Simple, light machine for both horizontal and vertical shaping. Consists of vertical attachment applied to our regular 7-in. Crank Shaper.

Vertical guide pivots on stud so that ram can be set at any angle from 0 to 10 degrees. Irregular pieces and dies cut and relieved without changing the setting.



RHODES SHAPER

An ideal machine capable of doing all your tool room shaping. Minimum power consumer. Takes up little floor space.

We can make quick deliveries on this machine.

Catalog No. 25 gives details. **Write for one.**

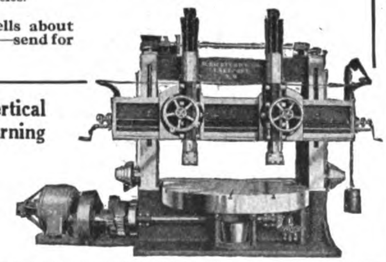
The Rhodes Manufacturing Co.
HARTFORD - - - CONN.

The Table on the Bickford—

is very heavy and driven by means of an internal or annular gear nearly its full diameter. This insures a steady and powerful motion free from lifting or chattering tendencies.

The catalog tells about the other parts—send for a copy *now*.

BICKFORD Vertical Boring and Turning Mill



H. Bickford & Co.
Lakeport, N. H.

PLANERS

Send for Bulletins

Woodward & Powell Planer Co.
WORCESTER, MASS.

SHAPERS

Smith & Mills Company,
Cincinnati, Ohio, U. S. A.

Foreign Agents—C. W. Burton, Griffiths & Co., London. G. & F. Limbourg, Freres, Brussels. Van Reitschoten & Houwens, Rotterdam. Gleanzer Perreaud & Thomine, Paris. Stussi & Zwiefel, Milan.

KELLY SHAPERS

Have the advantage of being the sole machine tool product of an organization of specialists. They possess correct design, unusual accuracy and are easy to operate. Three sizes single geared, four sizes back geared. Write for a Catalog.

THE R. A. KELLY COMPANY, Makers of Shapers only for 25 years
P. O. BOX 488 XENIA, OHIO, U. S. A.

"CLEVELAND" Open Side Planers

Any size from 30" to 72", any length.
Write for the descriptive matter.

See first issue of each month for illustrations.

Cleveland Planer Works Cleveland, Ohio

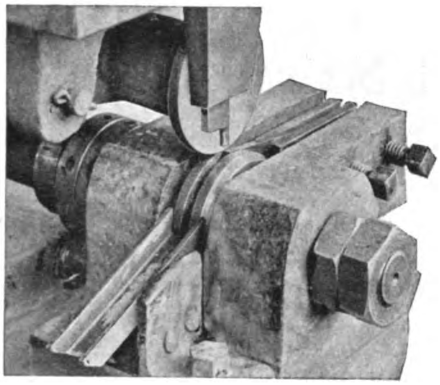
Railroad Shop Equipment

Special Railroad Draw-Cut Shapers furnished with full equipment and attachments for machining Locomotive Axle Boxes. **36-inch Stroke. Traveling Head Draw-Cut Cylinder Planers** with full equipment. **Write for Bulletins.**

Morton Mfg Co., Muskegon Heights, Mich., U. S. A.

"OHIO" PLANERS

PLANERS 22x22 In. to 42x42 In. SHAPERS 14 to 28 In.
THE OHIO MACHINE TOOL CO., Leighton St., Kenton, Ohio, U. S. A.


End View of Machine showing cutter and feed rolls.

Any Shape in Sheet Metal Cut at High Speed

A cutting speed of from 20 to 60 in. a minute in sheet metal of any gauge up to and inclusive of $\frac{3}{16}$-in. in thickness is easily maintained by

GRAY'S
Sheet Metal Cutter No. 1
Patented
(Not a Rotary Shear)

This machine is especially adapted for cutting out intricate shapes, impossible with any other device. No shape is impossible which is within scope of throat of machine.

Admirably adapted for your experimental department, and for special machinery building. For such work as Templets, Gear Covers and Engine Liners, it is indispensable. In use in leading shops of the country. Write for detailed information.

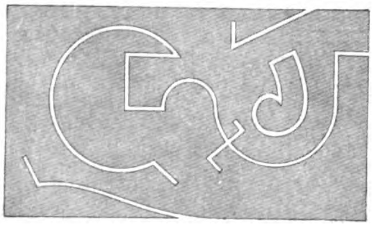
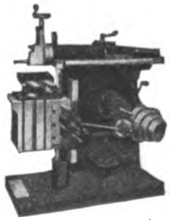


Illustration showing remarkable range of work done.

W. J. Savage Company, Inc.
Knoxville :: Tennessee

John Steptoe Company
North Side, Cincinnati, Ohio



To Get Production

out of a hand miller you must have a heavy, stiff tool like a

STEPTOE

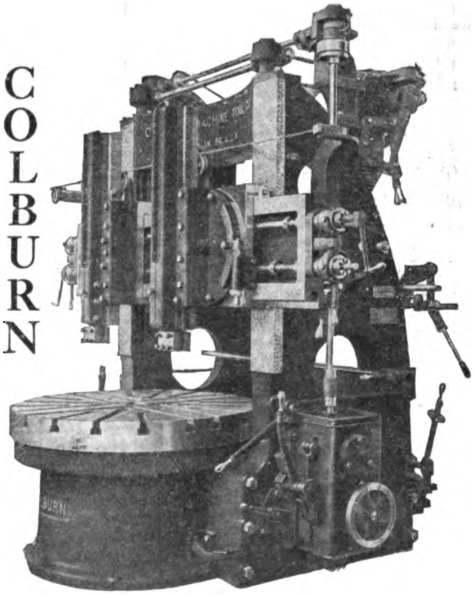
that can be crowded and still produce accurate work. You can run a Steptoe spindle at a high speed because the bronze boxes are of high-grade material.

That means increased production.

Ring Oilers

in Steptoe shapers keep the bearings cool and insure a long life. We can show you improvements that mean quick adjustment with increased production.

C O L B U R N



A good look at the Colburn leaves only the impression in your mind of stiffness, strength, rigidity and ease of operation.
Ask any of our customers if such an impression isn't correct. 30 to 72 in. sizes.

Get our literature.

COLBURN MACHINE TOOL CO.
FRANKLIN, PA.

Efficient and Economical operation is guaranteed by the design of the

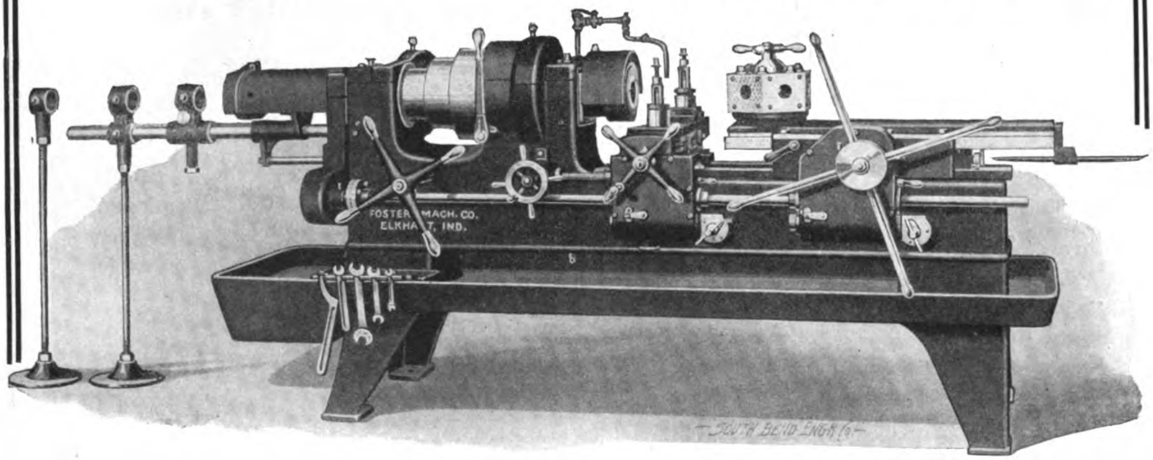
Foster Screw Machine

Square Adjustable Box in the Head Stock; 25% heavier than any other machine of the same size; more accessible and easier to operate; Independent Stop as rigid as the old-style single stop screw.

A description of each and of the feed, gears and complete dimensions are contained in Circular F-9. **Have you had your copy?**

Foster Machine Co., Elkhart, Indiana

Manufacturers of Screw Machines from ½ to 4-in. bar stock capacity on Turret Lathes from 10 to 24-in. swing.



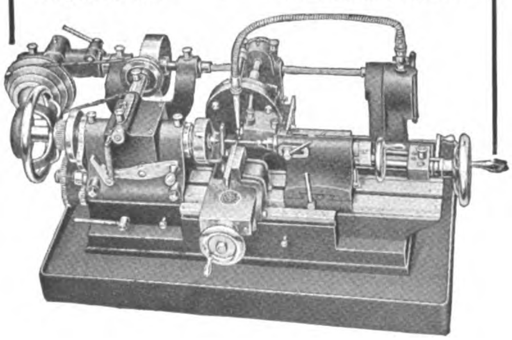
Small Threads to Mill?

Most shops have much small threading to do. Many have found the WALTHAM THREAD - MILLING MACHINE the most profitable, the most satisfactory method of doing this work.

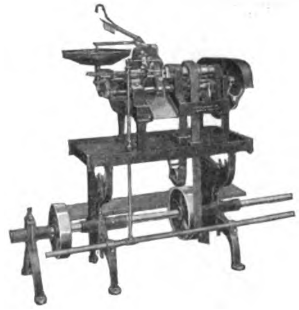
No tool room can afford to be without this machine. For threading pieces up to 3 inches in diameter the WALTHAM is in a class by itself.

Complete details furnished on request.

Waltham Machine Works
High Street - Waltham, Mass.



Wood Screw Plant Equipment



We make a specialty of furnishing machinery and equipment for wood screw plants, consisting of Headers, Shavers, Slotters, Threaders, Pointers, etc. Our illustrated catalog No. 25 describes our machines fully and contains valuable suggestions for those planning the manufacture of wood screws.

Write for a copy.

THE ASA S. COOK CO. 605 FRANKLIN AVENUE HARTFORD, CONN.

Enlarge Your Working Capacity the "Davenport" Way

The wide range of screw machine jobs and the large output made possible on the Davenport Multiple Spindle Automatic Screw Machine, enlarges the working capacity of any shop having this kind of work to do.

There's no sacrifice in accuracy or finish to get the "Davenport" output.

Many users say that they have taken on business which could never be touched under old production costs.

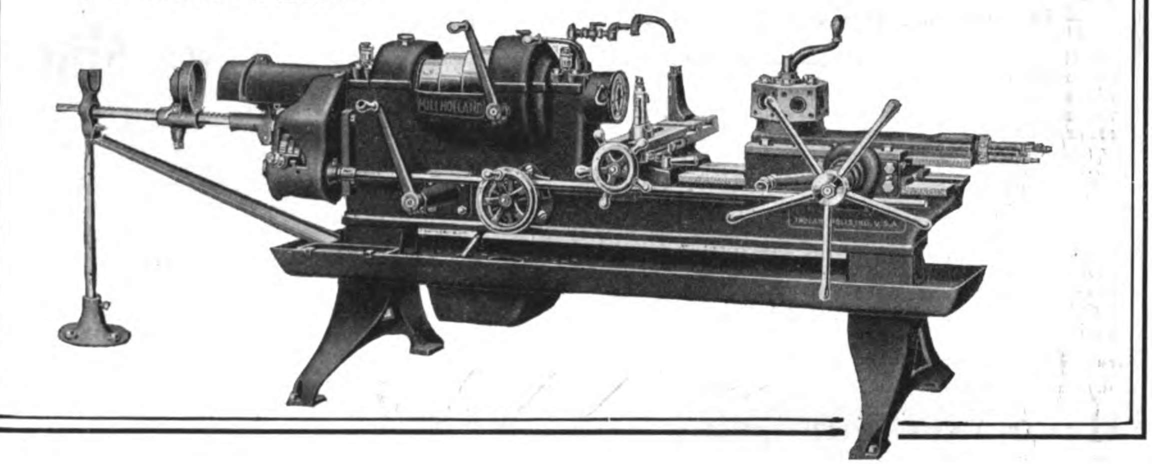
Let us send you our Catalog. Now ?

Davenport Machine Tool Co. **New Bedford, Mass.**

We are manufacturers of Lincoln Type Milling Machines, Bench Milling Machines, Hand Milling Machines, and a line of reliable Screw and Lever Vises. Get our circulars and prices.

The Carter & Hakes Machine Co., **Winsted, Conn., U. S. A.**

MILLHOLLAND



Built for Heavy, High-Speed Production

The Millholland is built for the needs of today. It embodies many features developed during the long experience of the designers. Every detail has been designed and built to secure rigidity under the heaviest cuts. That means a high degree of accuracy, and a production rate that will set the pace in your shop.

Get the details. Write for Bulletin giving complete information.

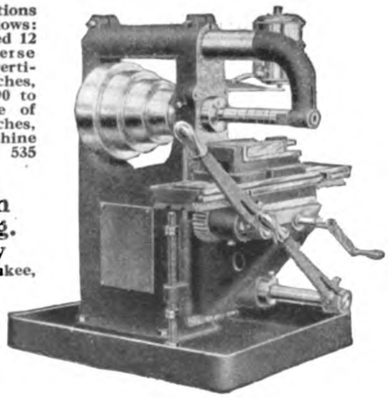
W. K. Millholland Machine Company :: Indianapolis, Ind.

WISCONSIN
BENCH MILLER

For rapid handling and accurate finishing of small duplicate parts you will find this Miller most efficient. Adjustable stops are conveniently placed for limiting vertical and horizontal movements at any position.

Bearing surfaces are scraped true and have suitable means for adjustment. Gears and shafting are all accurately cut and ground to standards. The design and construction, the care and accuracy of manufacture, enable us to guarantee it for a year. Write for catalog.

The specifications briefly are as follows: Longitudinal feed 12 inches, transverse feed 4½ inches, vertical feed 5¾ inches, spindle speeds 90 to 500 r.p.m., size of pan 18x24 inches, height of machine 28½, net weight 535 lb.



Wisconsin Miller Mfg. Company
Station A, Milwaukee, Wis.

The Standard Hand Miller

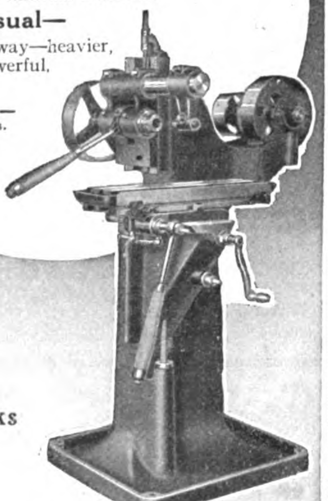
—the machine for accuracy.

That's the big quality embodied in the design and construction of this unusual machine.

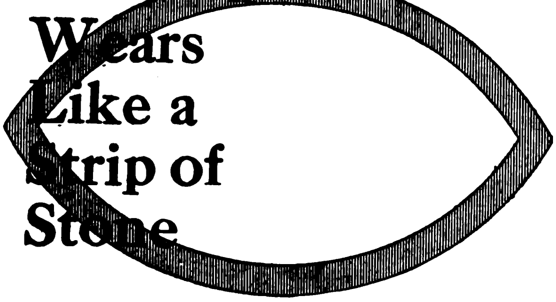
It *is* unusual—

It's bigger in every way—heavier, more rigid, more powerful, and more *accurate*.

Find out why — Get the details. Write today.

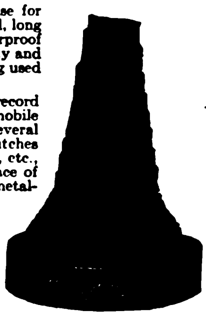


Standard Engineering Works
Pawtucket, R. I.



How about the regular friction facing you now use on your brakes, friction clutches, friction drums, etc.? Does it grip without a slip? And how long will it last?

Raybestos is the logical thing to use for friction facing. It is made of selected, long fibre asbestos, and is heatproof, waterproof and oilproof. It has greater durability and holding power than any friction facing used today.

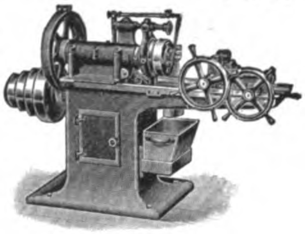


Raybestos has a remarkable 10-year record of satisfactory service in the automobile field. It has also been used for several years in line shaft and machine clutches generally, on hoisting engines, cranes, etc., with the finest results. Use it in place of wood, fibre, cork inserts, leather or metal-to-metal.

Wherever friction surface machinery is used, **Raybestos** is needed. Give us a chance to prove this. Send for the facts.

The Royal Equipment Co.
Bridgeport, Conn.

More Bolt Cutting With Fewer Machines



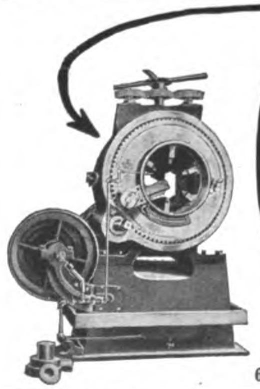
Many features of modernized design and construction make Acme Bolt cutters equal in work capacity to a greater number of machines of other types.

For instance, the vise is opened and closed by a Hand Wheel. The arrangement of carriage and vise is designed to facilitate rapid feeding of machine so important in handling large quantities of small work profitably.

Write for catalog of details.

The Acme Machinery Co., Cleveland, Ohio, U.S.A.

Messrs. C. W. Burton, Griffiths & Co., London, England. Messrs. Schuchardt & Schutte, Petrograd, Russia; Berlin, Germany; Stockholm, Sweden. Alfred H. Schutte, Milan, Italy; Brussels, Belgium; Paris, France; Liege, Belgium; Bilbao, Spain; Barcelona, Spain; Lisbon, Portugal; Cologne-Deutz, Germany; Schuchardt & Schutte, Vienna, Austria, and the Balkan States.

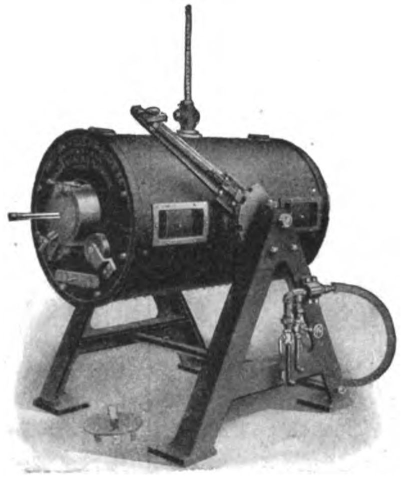


This machine ends all your pipe troubles

Heavy and powerful, it cuts and threads pipe from 4 to 15 inches. Takes less room than any other type. Hand or power operated. Oil pump and U. S. standard dies. Not a Die Stock but a practical machine which enables one man to do four times the work of the old type machines.

The Curtis & Curtis Co.,
66 Garden St., Bridgeport, Conn.

Finish Steel and Iron Work
By
"CARBONIA" Process



No. 64 Heating Machine.

"CARBONIA" or Gun Metal Finish, produced in an AMERICAN HEATING MACHINE, is the ideal finish for steel objects. This process penetrates the metal, but does not change or increase the shape or weight. Being an integral part of the steel, it cannot crack off. A strong resistant to corrosion.

The finish is very attractive to the eye.

"American" Metal Treating outfit (using Gas as Fuel) gives you absolute temperature control. Results are always correct. If you have anything in the coloring, tempering, hardening or annealing of metal products, write us.

American Gas Furnace Company
Gas Engineers and Manufacturers

24 John Street New York

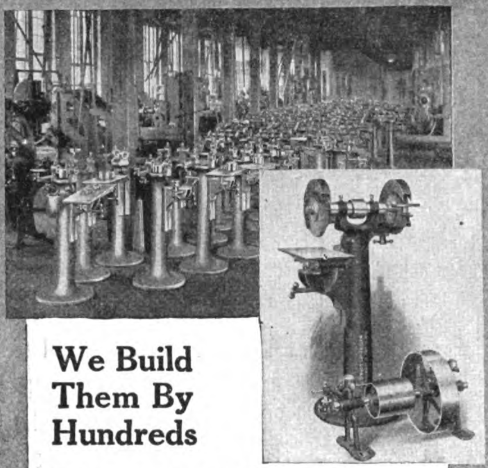
Proof First—Pay Afterward

You have got to be absolutely satisfied that Vitrified Grinding Wheels show both increased quantity and improved quality of grinding work before we'll accept payments for the wheels in use.

This does not mean that the first cost will be lower than ordinary wheels. Wouldn't you pay 10% more to get increased production ranging up to 33%?

Write for free trial data now.

The Vitrified Wheel Co., Westfield, Mass.



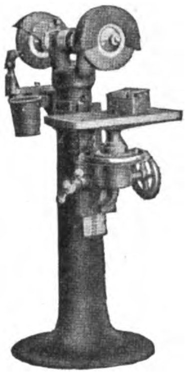
We Build Them By Hundreds

And so we can sell a superior machine at a moderate price without sacrificing any of the advantages of the more costly machines.

The Waterbury Grinder grinds rapidly and accurately, all flat surfaces, dies, punches, planer, lathe and other tools. Has adjustable table and tool rest with large radius of travel. Rigid, 3-point table supports giving great steadiness. A reliable practical grinding outfit.

Only $60 Complete

The Blake & Johnson Co., Waterbury, Conn.



The LA SALLE Micrometer Grinder

$60.

An uptodate tool for the uptodate shop.

Prompt Delivery.

Ask your Dealer—or a card to us will bring our folder.

La Salle Machine & Tool Co.
La Salle, Illinois - U. S. A

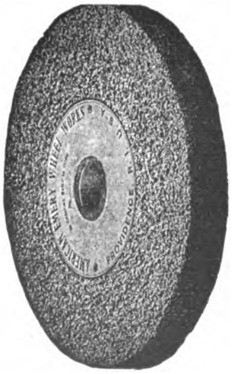
"End View"

Diamond Tools

for truing grinding wheels

For truing grinding wheels are a necessity in the grinding room. Francis Tools always give satisfaction. The diamonds used are securely set and of the hardest and best quality. Tools for Norton and Landis Grinders, also Hand Tools and tools of all descriptions. Prices and descriptive circular on request. We send goods on approval at our expense both ways.

Francis & Co., Hartford, Conn.



AMERICAN

GRINDING WHEELS

Made of either Corundum or Carbolite

VITRIFIED
SILICATE
ELASTIC

Processes, in every size and shape, for all grinding operations

CATALOG

American Emery Wheel Works
Providence, R. I., U. S. A.

Try The Diamo-Carbo Dresser

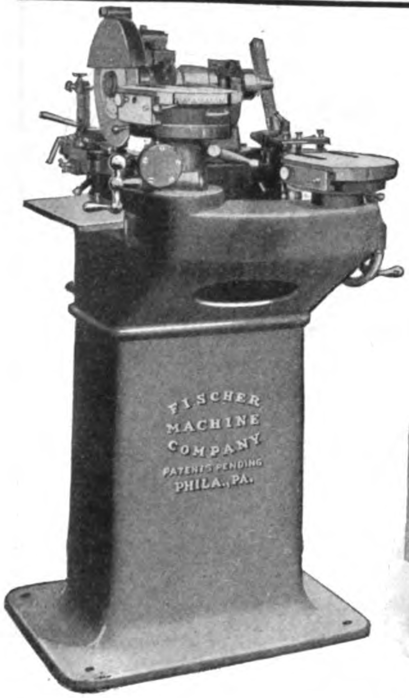
It has been used successfully for ten years. Get our bulletin and trial offer.

DESMOND-STEPHAN MFG. COMPANY **Urbana, Ohio**
Manufacturers of Diamo-Carbo, Magazine, Sherman and Huntington Emery Sheet Dressers

Keep Your Grinder Wheels True

by the use of Craft's Special Grinder Tools. Illustrations show two styles, of Nibs. Also large manufacturer of and expert in making special shapes for turning Hard Rubber, Copper, Bronze and Fiber; Diamond Drills for Granite, Glass and Marble; Glazier's Diamonds, Lens Drills, etc.
Get in touch with me today. Let me know your wants. Anyway, send for catalog.

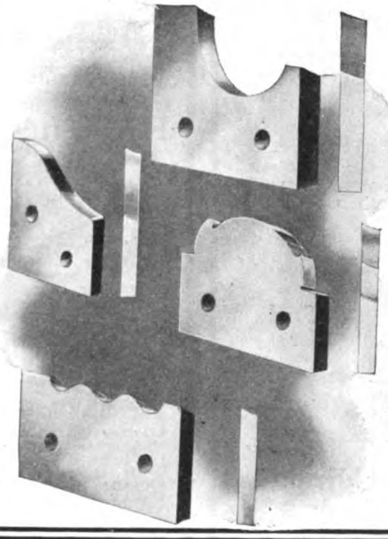
Arthur A. Crafts, 125 Summer St., Boston, Mass.



Inexpensive Profile Grinding

can be performed and at a minimum of time by the

FISCHER PROFILE GRINDING MACHINE



Here's a machine capable of grinding irregular-formed turning tools such as used in the machining of tire moulds, car wheels, etc.—*economically.*

After watching your first-class tool maker take from one to five days on a similar job, perhaps you will not think this possible.

But it is—and you will appreciate it after you have read about it. The description of the grinder-head and the operation of the machine, is included in the circular.

Write for a copy now.

Fischer Machine Co.
310-316 No. 11th Street
PHILADELPHIA

Foreign Agents: F. G. Kretschmer & Co., Frankfort, a.M., Germany; R. S. Stokvis & Zonen, Ltd., Rotterdam, Holland and Paris, France.

Take the machine to the job—and save money

Clean your heavy castings, grind off the sprues and lumps and give them a smooth finish with the

Quinn Swing Frame Grinding and Polishing Machine

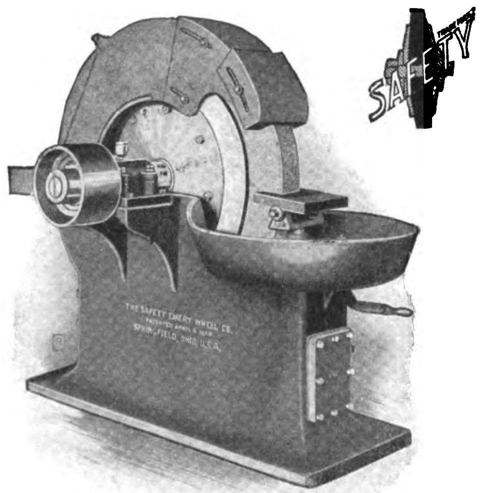
It may be raised, lowered or swiveled to reach any irregularities on the surface to be finished.

Has exceptionally strong construction, bearings which are independent of the joints of machine and easily renewed.

And other features which make for time and money saving.

Write for full description.

Quinn & Co.
222-224 E. 9th St., Cinn., O.



This Safety Tool Grinder

will deliver a few drops or a deluge over tne work, according to the position of the water controlling handle. No Pump, No Pipes to cause trouble. The round bowl prevents slopping over and allows easy access to the wheel by the operator. The Wheels are mounted in large, heavy collars provided with balancing discs.

A card will bring our large new catalogue to you.

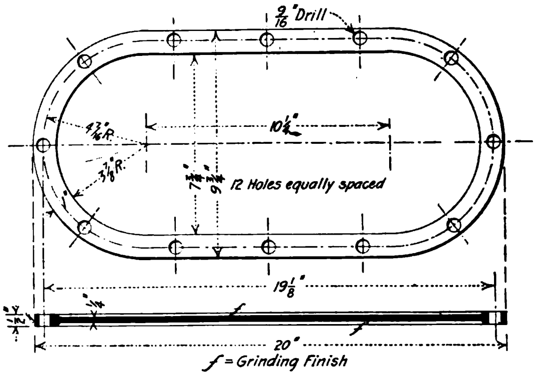
The Safety Emery Wheel Co
Springfield, Ohio

Get Under Cover

All over the country the demand for Safety Appliances is growing. Judges, juries, compensation boards, workmen and even public opinion—are all swinging into line. Why not get credit for being in the front of the parade. Fit your grinding machines with Universal eye guards as a start. It will pay you, not only in safety but in increased output because a "safe" workman works best.

Send for Bulletin

The Safety Engineering Company
1440 Schofield Building - - Cleveland, Ohio



Finishing 2 Sides in 9 min. total time including handling. 1/16 in. stock each side

The above shows the Inlet Cap for 30-hp. Bessemer Gas Engine finished on a BLANCHARD SURFACE GRINDER.

It is one example of scores of parts of this company's oil and gas engines and air compressors which in their own words "are indebted to it for fit and finish as well as for a substantial saving in their cost of production."

Why not investigate the application of this machine to your work?

The Blanchard Machine Co., 64 State Street, Cambridge, Mass., U. S. A.

DOMESTIC AGENTS: Prentiss Tool & Supply Co.; Motch & Merryweather Machinery Co., Marshall & Huschart Machinery Co.; W. E. Shipley Machinery Co.; Kemp Machinery Co.; Robinson, Cary & Sands Co.; Pacific Tool & Supply Co.

CANADA: Williams & Wilson, Ltd.; A. R. Williams Machinery Co., Ltd., GREAT BRITAIN: C. W. Burton, Griffiths & Co. France: Aux Forges de Vulcain.

The Greenfield

A universal grinder with a complete set of fixtures for handling all kinds of tool sharpening, cylindrical, internal and surface grinding. **Sturdy, dependable, accurate, rapid.** Catalog No. 5 on request.

Greenfield Machine Company
Greenfield, Mass., U. S. A.

For the Toolroom and Pattern Shop

This handy little *Anderson Grinder* can make itself invaluable in tool sharpening—both metal and wood working—as well as grinding small parts in manufacturing. Made with base or for bench use.

Write for details

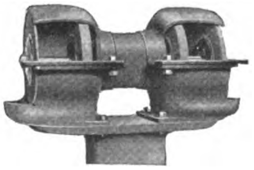
Worcester Pattern and Model Co.
93-95 Foster St.
Worcester, Massachusetts

RANSOM Patent Speed Controller

This is no regulator that you "Guess" may be set correctly. You cannot *possibly* overspeed your wheels. On account of this safety feature, we are able to get 75 to 100% speed variation. This amount of variation nor any amount of speed variation is safe unless you have the Ransom Patent Speed Controller.

Want to know more about it?

RANSOM MFG. CO. - - Oshkosh, Wis.



4-WHEEL GRINDER

for Pattern Shops **$56**
Motor Driven
Ball Bearings
10-in. Wheels

Forbes & Myers
170 Union St., Worcester, Mass.

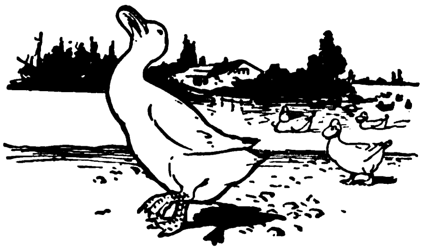
LONG LIFE — EFFICIENT SERVICE FOUND IN DIAMOND GRINDING AND POLISHING MACHINERY

DIAMOND MACHINE CO. Catalog X yours for the asking PROVIDENCE, R.I.

Sterling Grinding Wheels

The result of 32 years' experience. That experience is at the service of your grinding department. Let us solve your problems.

The Sterling Grinding Wheel Company - Tiffin, Ohio



Duxbak has many admirers.

Schieren's Duxbak Waterproof Leather Belting is distinctively different from other kinds of drives, different in the way it is manufactured and different in results. This difference is so apparent that anyone who is used to belting can see after the first day's run that Duxbak gets all the power and delivers it.

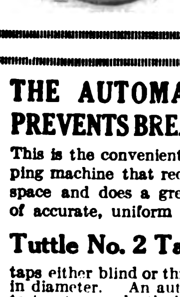
DUXBAK BELTING
TRADE MARK
Reg. U. S. Pat. Off

Chas. A. Schieren Company
ESTABLISHED 1868

Tanners, Belt Manufacturers
41 Ferry St. New York

Boston, 641 and 643 Atlantic Ave., opposite South Station. Philadelphia, 226 North Third St. Denver, 1752 Arapahoe St. Pittsburgh, 337 Second Ave. Chicago, 128 W. Kinzie St. Seattle, Wash., 305 First Ave., South. Petersburg, Va., 122 Shore St. San Francisco, Cal., 139 Townsend St. The Texas Chas. A. Schieren Co., Inc., 205 So. Market St., Dallas, Texas. New Orleans, La., 404-406 Canal St. OAK LEATHER TANNERIES, Bristol, Tenn.

Anyone Can Engrave with This Engraving Machine of Ours

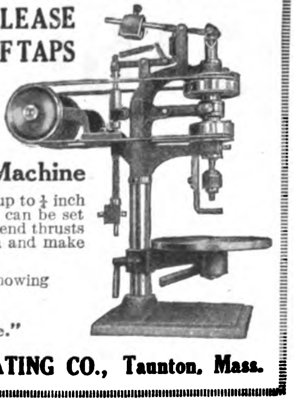


It doesn't take an expert to operate it, so you not only save the cost of a high priced man, but the ordinary workman can turn out work better than the most skillful hand engraver in a fraction of the time the hand workman would take. It is for engraving name and direction plates and similar work.

Details on request.

Geo. Gorton Machine Co., Racine, Wis.

THE AUTOMATIC-RELEASE PREVENTS BREAKING OF TAPS



This is the convenient little tapping machine that requires little space and does a great variety of accurate, uniform work.

Tuttle No. 2 Tapping Machine

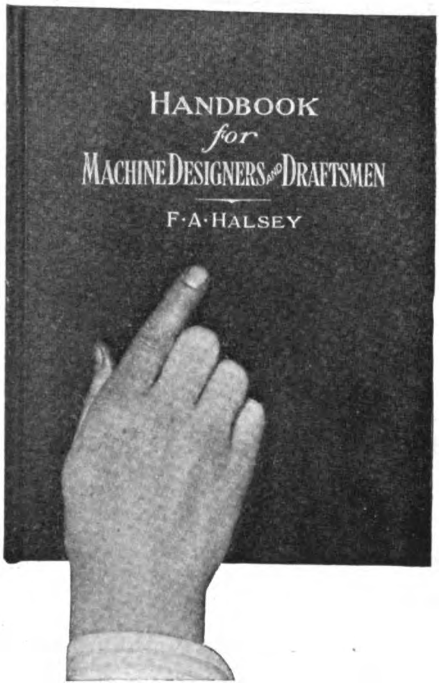
taps either blind or through holes up to $\frac{1}{4}$ inch in diameter. An automatic stop can be set to tap to any depth desired. All end thrusts are ball-bearing to reduce friction and make machine more sensitive.

Send for Illustrated Circular showing all details.

"Tap It On The Tuttle."

EVANS STAMPING & PLATING CO., Taunton, Mass.

An Essential



FOR every man who has anything to do with the design and construction of machinery Halsey's Handbook is an essential.

This is not merely a broad assertion—it is the testimony of the thousands who use the book.

Mr. Halsey faithfully collected data for 33 years to produce this work. For three years he devoted his time exclusively to its production.

As a result he gives all the data and basic facts used in the design of all kinds of machinery and machine parts—the data which designers, draftsmen, superintendents, engineers and machinists need constantly in their work.

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McGraw-Hill Book Co., Inc.,
239 W. 39th Street, New York.

You may send me on 10 days' approval Halsey's Handbook, $5.00 net. I agree to pay for the book or return it postpaid within 10 days of receipt.

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Reference...A6-29
(Not required of subscribers to the American Machinist, or members of A.S.M.E. Books sent on approval to retail customers in the U. S. only.)

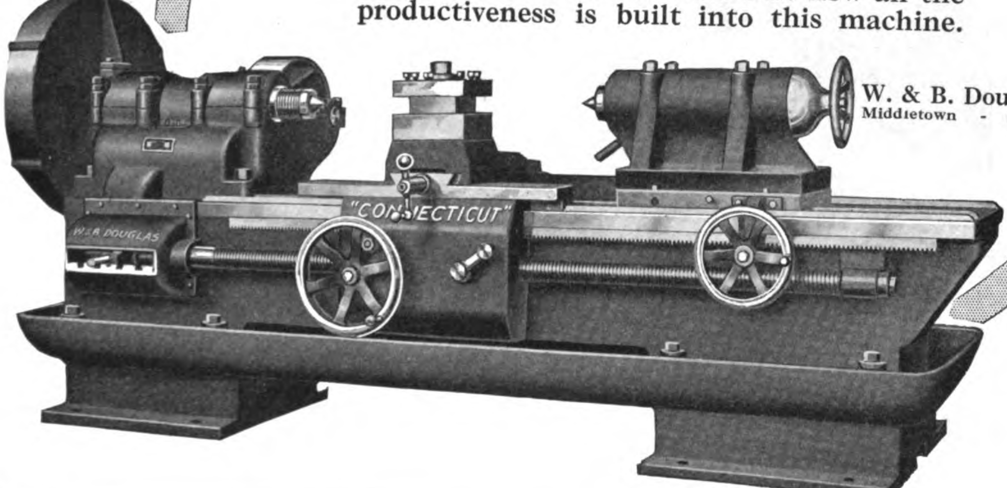
Rigidity, Accuracy and Power—

Three features of **Connecticut Lathes** that make them big producers!

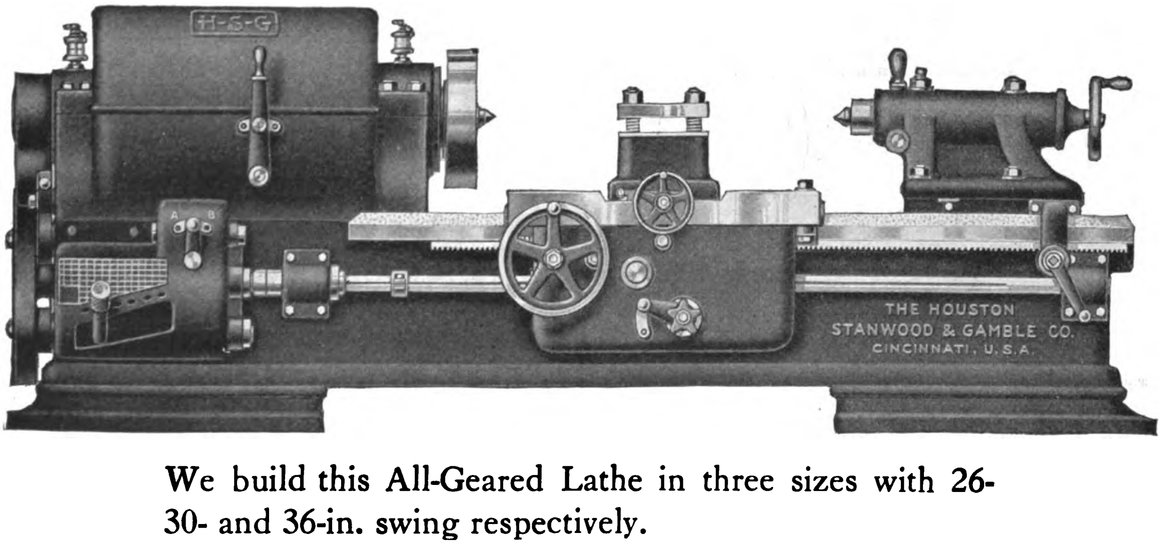
To secure—from unskilled labor—the biggest output: install Connecticut Lathes.

Write for the Bulletin that tells how all the productiveness is built into this machine.

W. & B. Douglas
Middletown - Conn.



H-S-G
TRADE MARK



We build this All-Geared Lathe in three sizes with 26- 30- and 36-in. swing respectively.

It is an extraordinarily heavy and high-powered lathe.

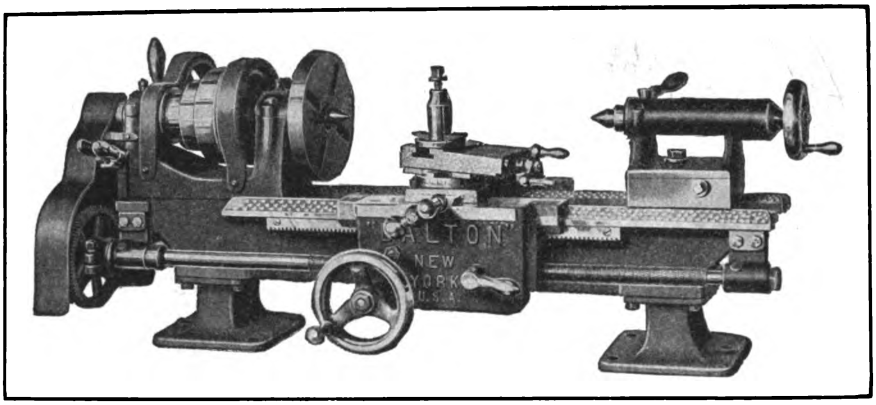
The design, materials and workmanship are excellent.

We can make prompt deliveries.

The Houston, Stanwood & Gamble Co., Cincinnati, U.S.A.

New Model Dalton 6-in. Lathe

Type "B-4"—Actual Swing 7¼ inches



This engine lathe is stronger and more rigid than our previous models, and is especially designed for the finest and most accurate work required of this class of machine tools. Many manufacturing plants are cutting costs by using "Daltons" on small parts in quantities. It has the strength and power for work often done on 12 to 14-in. lathes. Send for Bulletin B-602.

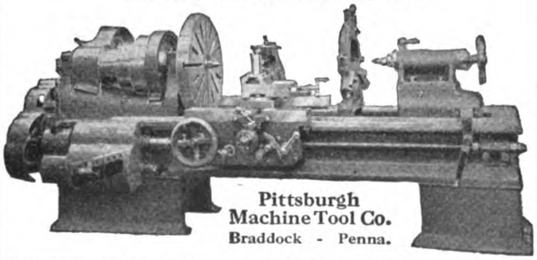
DALTON MACHINE CO., Inc., 1911 PARK AVE., NEW YORK

BIG ORDERS

prove that Pittsburgh Engine Lathes do what is expected of them.

One large American manufacturer ordered $400,000 worth of Pittsburgh Lathes recently.

Agents wanted in all towns of 40,000 and over. Information on request.



Pittsburgh
Machine Tool Co.
Braddock - Penna.

This Points to Quality

After a most exacting investigation the Minerva Motor Co., of Liege, Belgium, ultimately placed an order with us for SIXTY-FIVE

Sebastian Lathes

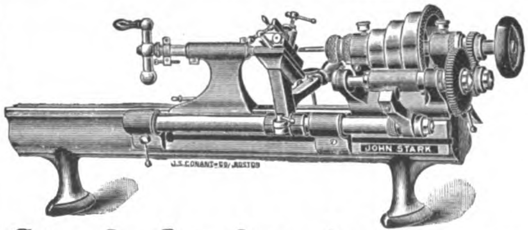
In spite of the keenest foreign and American competition our lathe won out because of its great accuracy, speed, and convenience.

A high grade splendidly built machine that sells at a remarkably low price.

Get in touch with us immediately. We'll gladly furnish catalogs and full details if you'll write.

The Sebastian Lathe Co.

117-119 Culvert Street Cincinnati, Ohio



Stark Lathe Accuracy

is known and appreciated wherever finest bench tools are used. We have had 45 years' experience in building these lathes and we can guarantee their efficiency absolutely.

Ask today for our descriptive Catalog No. 29.

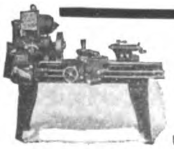
Stark Tool Company, Waltham, Mass.

It's Worth Looking Into

Here is a Speed Bench Lathe which will adapt itself to "a hundred and one" uses in your shop. It takes a full swing of 8 inches and is 20 inches between centers. There are many good features in the Oliver we want you to know. **Write for them now.**

The W. W. Oliver Mfg. Co.

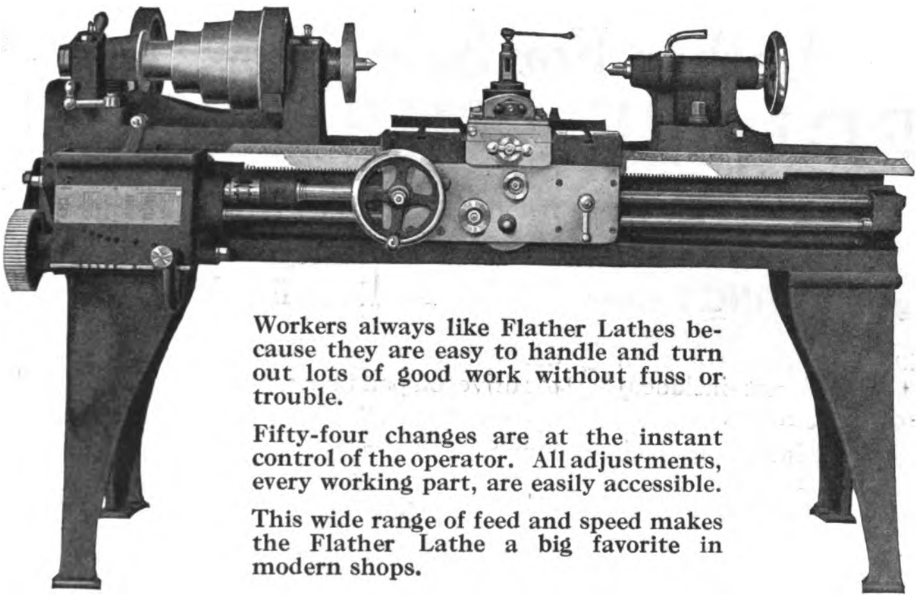
1480 Niagara St., Buffalo, N. Y.



Monarch Lathes are the recognized leaders of all low priced Engine lathes. 14-16-18 and 20 in. sizes. **Send for Catalog and prices.**

The Monarch Machine Tool Co.

Sidney, Ohio



Workers always like Flather Lathes because they are easy to handle and turn out lots of good work without fuss or trouble.

Fifty-four changes are at the instant control of the operator. All adjustments, every working part, are easily accessible.

This wide range of feed and speed makes the Flather Lathe a big favorite in modern shops.

Flather Lathes Boost the Output

Get the complete story of the Flather Lathe. Write to us—today.

Flather & Company, Inc., Nashua, N. H.

Don't Blame the Operator—It's Strictly Up to You

SURE he is running the machine slower than it was intended to run and you are getting less pieces than you should—but that's not his fault. He is trying to keep within the limit of the cooling capacity of the pump. He knows that more speed with that small $\frac{3}{8}$-in. stream would burn up the tool.

IF you really want more production give him a pump and piping that will supply a good HEAVY stream of water compound sufficient to carry away all the heat. Then watch production go up and tool expense go down.

NOW remember this. The "FULFLO" is a small centrifugal pump—a natural pumping principle which assures you a HEAVY flow without too much pressure. The only working part in its pumping action is the impellor. Consequently there are no gears or other close fitting parts to be affected by the grit, dirt or small chips that are always present in the coolant. The "FULFLO" trap arrangement positively prevents loss of its prime without resorting to check valves or any other working part. Since no check valve, relief valve, reverse valve or any other kind of valve is present in the pump or pipe, other than the stop cock, the usual valve troubles are eliminated. All passages are large and open which prevents clogging. As there are no delicate parts to be protected a strainer at the pump is unnecessary. Do you wonder that the "FULFLO" is spoken of as a trouble-proof pump? *Easily attached to any machine.*

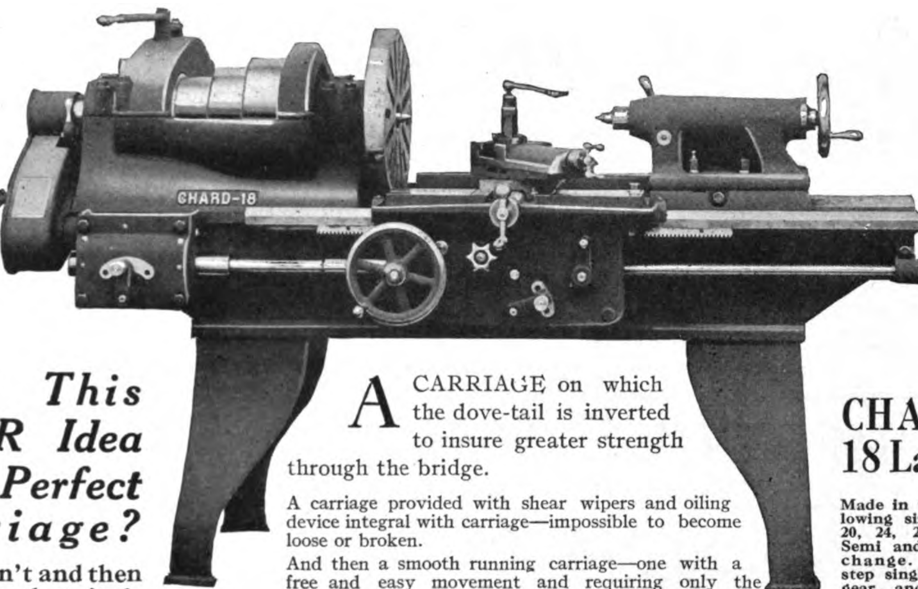
WHEN buying that new machine insist that it be equipped with a "FULFLO." You are entitled to the best.

Price of Pump, $10.00

Pump Pulley Speed	Flow in Gallons per Min.
250 r.p.m.	5 gallons
300 r.p.m.	10 gallons
350 r.p.m.	15 gallons
400 r.p.m.	18 gallons

The Cincinnati Lubricant Pump Co.
2270 Spring Grove Avenue - - Cincinnati

Alfred Herbert, Ltd., European Representative.



Isn't This YOUR Idea of a Perfect Carriage?

See if it isn't and then appreciate that it is the carriage on the Chard Lathe.

A CARRIAGE on which the dove-tail is inverted to insure greater strength through the bridge.

A carriage provided with shear wipers and oiling device integral with carriage—impossible to become loose or broken.

And then a smooth running carriage—one with a free and easy movement and requiring only the **slightest exertion on the part of the operator.**

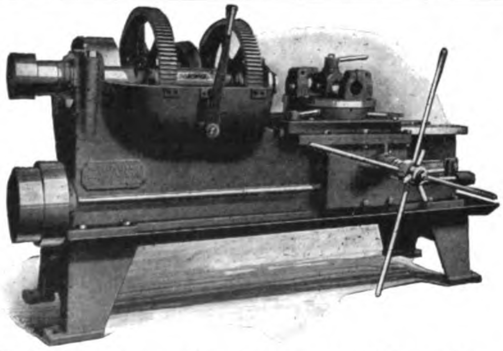
Appreciate, too, that the other parts of the Chard are equally noteworthy. Do you know about them?

CHARD 18 Lathe

Made in the following sizes: 18, 20, 24, 28 inch. Semi and quick change. Four step single back gear and three step double back gear. Write for prices and delivery schedules.

Chard Lathe Company - - Newcastle, Ind.

Domestic Distributors: Vonnegut Machinery Co., Indianapolis, Indiana. English & Miller Machinery Co., Detroit, Michigan. The W. M. Pattison Tool & Supply Co., Cleveland, Ohio. M. S. Zortman Machinery Co., Pittsburgh, Penna. The E. A. Kinsey & Co., Cincinnati, Ohio and Indianapolis, Ind. Federal Machinery Sales Co., Chicago, Illinois.



Four Shell Operations—

turning, drilling, boring and end forming—in the minimum time—on the Cleveland Chucking Lathe.

Built just for 3 to 5-in. shell and shrapnel work. Furnished with turret on cross slide, cross slide with tailstock, or plain carriage with turret.

Ask for the details.

The Cleveland Crane & Eng. Co., Wickliffe, Ohio

Earle
Single-Purpose Lathe

Why 24-in. if 18-in. Will Do It?

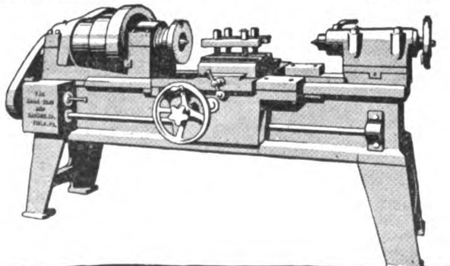
As a rule, very few shops would care to turn high-carbon steels over 4 in., or at most 5 in., in diameter, on 18-in. lathes. The 24 in. has always been the accepted standard for such sizes.

"Twenty-four inch" cross sections, "twenty-four inch" strength with 18-in. swing—those are the chief characteristics of Earle Single Purpose Lathes. Every part of these lathes is designed to take the thrusts, reactions and twisting movements of average 24-in. machines.

This explains why 8-in. and even 10-in. work in high-carbon steel is being turned successfully and economically on Earle Single Purpose Lathes.

We will gladly send you an interesting anal tical folder on Earle Lathe capabilities, and give you any other information you desire, without the slightest obligation, if you will write.

The Earle Gear & Machine Company
101 E. Wyoming Avenue - - - Philadelphia

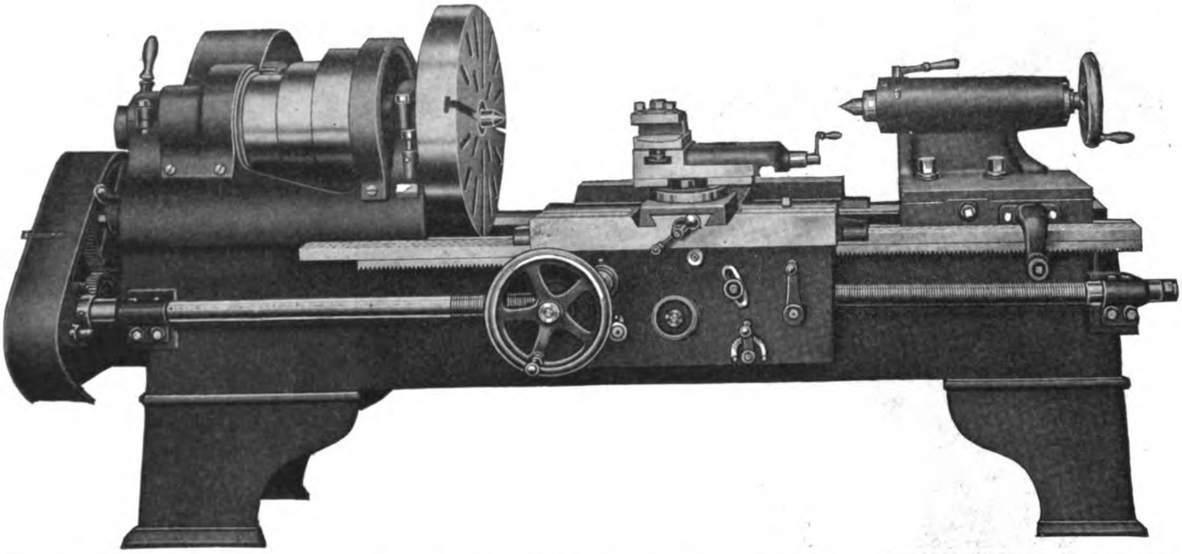


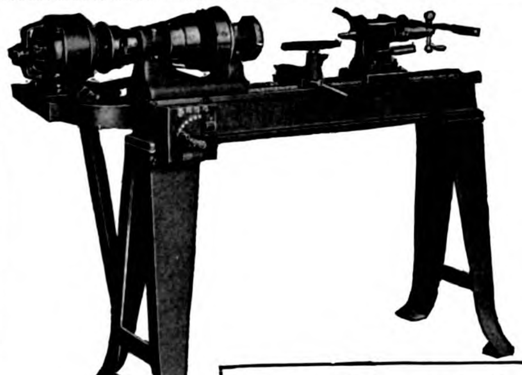
Davenport 22-Inch Lathe—For Extra-Heavy Service

These lathes are built exceptionally rigid and heavy. No feature has been omitted, to secure great strength and power. The bed, the headstock, the tailstock, the carriage—every detail has been designed and constructed with a view to driving the heaviest cut that any tool will stand up against. At present we can make quick deliveries on this machine.

Write at once for Bulletin. It gives full details of construction.

DAVENPORT LOCOMOTIVE WORKS
DAVENPORT - - - - IOWA





A New Blount Lathe —Better, Too

This recent product of the J. G. Blount Company is meeting with universal favor. It is provided with a constant-speed motor mounted on a plate having an extension arm to support a bearing for the outer end of the motor shaft. The lathe spindle, which is made from high-carbon steel, ground to size, is hollow and bored for Morse taper. It runs in self-oiling bronze bearings. Bed is cross braced. A thoroughly dependable machine in all details.

Write for full description and price.

J. G. Blount Co.

WoodlandSt.,Everett,Mass.,U.S.A.

De Fries & Co., Milan. C. W. Burton, Griffiths & Co., London. Adamson & Laurantzon, Christiania. H. G. Aikema, Rotterdam. Manning, Maxwell & Moore, Yokohama, Japan. F. G. Kretschmer & Co., Frankfort, Germany. Leon Chapuis, & Cie, for Grinders, France, Belgium and Switzerland. Bevan & Edwards, Propty., Ltd., Melbourne, Australia.

This Walcott 20-in. Lathe is used exclusively in many shops—here's why:

It is the result of 35 years experience in lathe building.

Among its features are interchangeability of parts, drop-forged gears in apron, all-steel gears in gear box, compound rest as rigid as plain rest, large ways on bed, all gears completely inclosed.

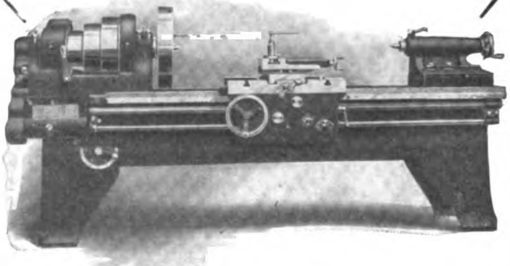
Made in 14, 18, 20, 26 and 28-inch sizes.

Write for complete description.

Walcott Lathe Co.

Successors to

Walcott & Wood Machine Tool Co.
Calhoun Street - - Jackson, Mich.



SPRAGUE ELECTRIC

Quarter Ton Hoist

A New and Much Needed Development

LABOR SAVING
Muscular energy is not wasted when the I-5 hoist is used

I-5 Hoist

Capacity
500 Pounds
A. C. or D. C.

TIME SAVING
The work is ready for machining in a few moments when swung in on the I-5 Hoist

FOR HANDLING SMALL LOADS
WITH
SAFETY—ECONOMY—SPEED

Material moved at the smallest possible expense of operator's time.
A minimum amount of idle time charged against the tool.
A consequent increase in the tool out-put per year.
An increased efficiency on the part of the operator due to the saving in his strength, otherwise expended in handling material.

Write for a copy of descriptive Bulletin No. I-13.

SPRAGUE ELECTRIC WORKS
OF GENERAL ELECTRIC COMPANY
Main Offices: 527-531 West 34th Street, New York, N. Y.
Branch Offices in Principal Cities

WRIGHT

Upon Your Choice

of a hoist depends the protection of life and property. For the small difference in the cost between the best and the cheapest, you cannot afford to take the chance—a mistake is too serious.

You can depend on Wright High Speed Steel Hoists. Their high quality protects you.

Hoist Booklet M-16 tells about them. Write for it.

Wright Mfg. Co., Lisbon, Ohio

HOISTS

CYCLONE
HIGH SPEED

HOISTS

Give you economy in minutes and dollars. They are speedy, they are also very smooth-running and easy to operate. The sturdy design and construction cuts cost of upkeep to the minimum. Sizes ½ to 40 tons. Cyclone Hoists received the highest award in hand-operated chain hoists at the Panama-Pacific Exposition.

Also Moore Anti-Friction Hoists, Direct Differential Pulley Blocks, Standard Screw Chain Hoists, Matchless Trolleys, Plain Trolleys and Trolley Hoists.

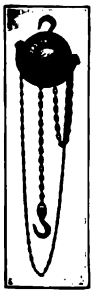
Ask for Catalog C-61 for ready reference. FREE on request—write.

The Chisholm-Moore Mfg. Co.
Lakeside Avenue Cleveland, Ohio

It's a pleasure

to operate the free running and safe

Ford Tribloc
CHAIN HOIST



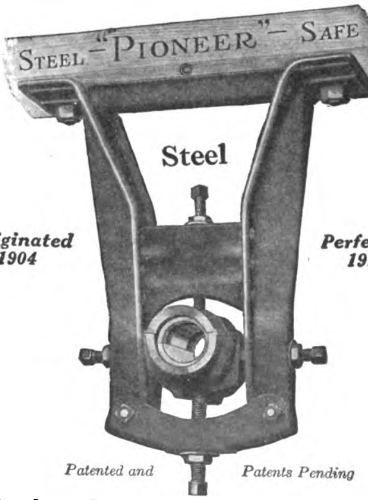
the all steel parts and Loop Hand Chain guide inspire a feeling of confidence and its high efficiency planetary gears make hoisting easy.

Our Catalog tells you all about it. May we mail you a copy?

Ford of Philadelphia

Ford Chain Block & Mfg. Company
140 Oxford Street - - - Philadelphia, Pa.

200 DOLLARS



***Originated* 1904** ***Perfected* 1914**

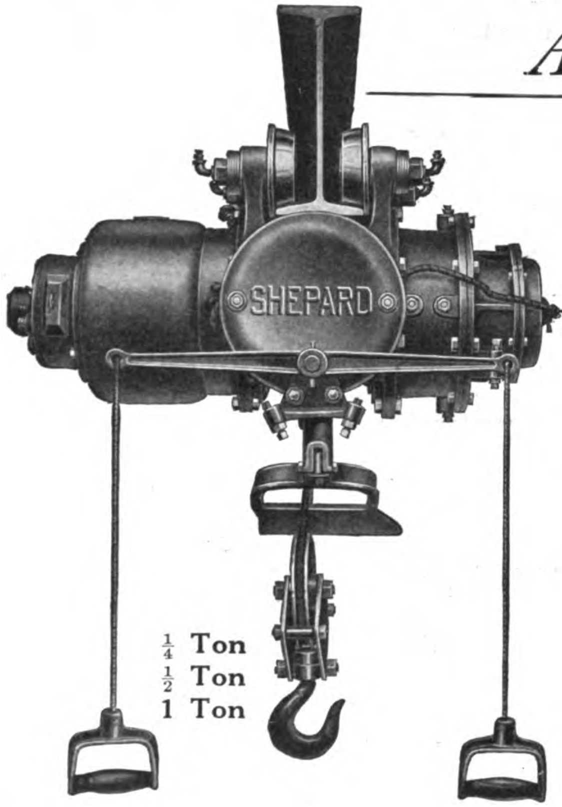
Patented and Patents Pending

This is what a Boston Millwright told our Mr. Friel:

"If you have $1000.00 worth of cast iron hangers to put up, I'll charge you $1000.00 to erect them, but if your 1914 "PIONEER" STEEL HANGERS are substituted I'll tackle the job for $800.00.

If You Don't See Why—Ask Us

STANDARD PRESSED STEEL CO.
Philadelphia, U. S. A.



ANNOUNCING

Our New Hoist for Light Loads

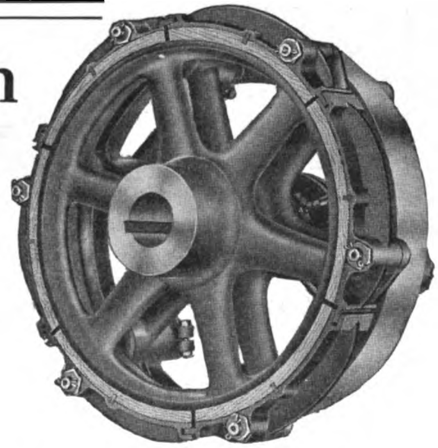
The constant demand made upon us for a small hoist embodying "Shepard" features prompted us to add this sturdy little hoist to our line.

This hoist has all the salient features of our established line of hoists including Balanced Drive, insuring permanent alignment, Heat Treated Steel Gears and Oil Bath Lubrication thruout. Oil-tight inclosures that positively exclude dirt and grit.

Our Hand Book HI tells the story and it's yours if you write for it.

Shepard Electric Crane & Hoist Co.
Main Office and Works: Montour Falls, N. Y.
New York Philadelphia Pittsburgh Chicago

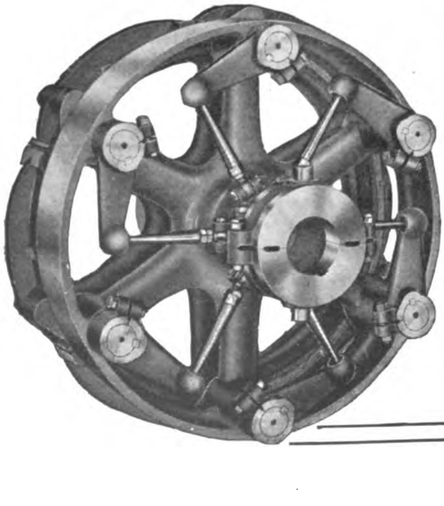
The LOMBARD Clutch Will Open Your Eyes



to a better grade of service and a surer degree of dependability.

The *entire friction surface* provides the grip—that's one point. The contact is wood on iron—that's another. And the action is direct, without the use of springs.

The LOMBARD is called "The Clutch with the Holding Power." No lubrication required, jig built, with interchangeable parts. Easily adjusted.

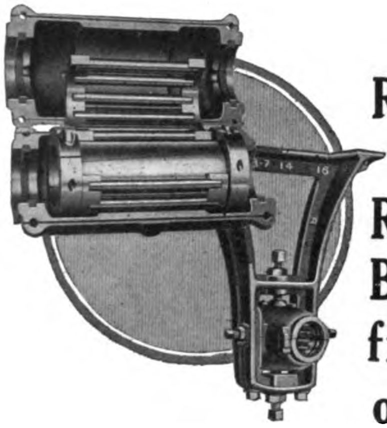


Made in sizes from 8 in. up to 46 in., and larger when specially required. 16 inches and above can be furnished split.

Write for Descriptive Circular

It will tell you the whole story and will open your eyes to the things you want to know about this practical and efficient clutch.

HOLYOKE MACHINE COMPANY
Worcester - - - - - Mass.



Old Reliable "Sells" Roller Bearings fit 95% of all Standard Hangers and can be installed over night.

John D. Sellers
Manager

Royersford Foundry & Machine Co.
50 North Fifth Street - - - Philadelphia

Babbitted Ring Oil Bearings, Shaft Hangers, Collars and Couplings, Punches and Dies, Punching and Shearing Machines, Sensitive Drill Presses, Drill Presses, Foot Presses, Grinding and Polishing Machines, Tumbling Barrels, "Rollerine" the ball and roller bearing lubricant.

Greater Speed in the Shipping Room

With a light truck to handle the numerous small loads, your shipping gang will work a great deal more smoothly and quickly. Here's the light-load truck for that purpose.

CLARK

$22

Light Load Transfer Truck

Write at once for Bulletin L-31.

The George P. Clark Co.
Windsor Locks, Conn.

Capacity 1,000 lb.

Over 60,000 pulleys—3 to 120 in. in diameter—stocked at centres named below, and additional thousands stocked by over 200 dealers insure prompt deliveries. Write for quotations and delivery dates.

American Pulley Company
4210 - 60 Wissahickon Avenue.
Philadelphia, U. S. A
New York—33-35 Greene St.
Boston—165 Pearl St.
Chicago—124 S. Clinton St.
Seattle—536 First Avenue, S.

Aeroplane Characteristics *not* pulley essentials

The resistance of the air against the propeller and planes of an aeroplane raises the heavy machine against gravity.

Bear in mind that the machine *depends* on the beating (displacing) of the air by the propellers.

The energy required for raising an aeroplane is very great.

Still some *belt pulleys* beat the air so hard that one would think they had been built for *fans* or *propellers* rather than *pulleys*.

AMERICAN STEEL SPLIT PULLEY

You can tell these "aeroplane" pulleys quite easily by standing near them. The *breeze* gives them away.

Stand under an AMERICAN—or have you ever tried? You didn't feel any breeze *then*!

Just this one difference between AMERICANS and other belt pulleys accounts for so much of the reduced power waste so noticeable *right after* a shop has been re-equipped with AMERICAN STEEL SPLIT PULLEYS.

The arms of AMERICANS *cut* the air.

Consider this feature in its relation to power consumption when you need pulleys again.

American Pulley Company
Philadelphia, U. S. A.

There's Resiliency but No Stretch

In most "so called" endless belts you will find resiliency and cling—but these virtues are usually offset by the fact that stretching is unavoidable.

Tilton Patented Endless Belts

are not "so called" but really endless—they are woven so—and they are pretreated so that stretching is absolutely eliminated. Yet they have pulley cling that delivers every bit of power transmitted to them.

Send for a sample belt today. Give size.

Arthur S. Brown Manufacturing Company
Tilton, N. H.

We Can Supply it in a Rush

If it's a chain, whether it be large or small; roller or block we have it for you.

Our Catalog No. 18 is worth keeping on file—send for it.

The Baldwin Chain & Mfg. Co.
Worcester, Mass.

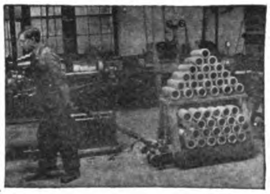
A National-Chapman Elevating Truck, with its complement of cheap wooden platforms, saves the cost of many platform trucks and from two to four men's labor. This truck is equipped with powerful appliances for easy lifting, lowering, steering and hauling. It turns in its own length in narrow aisles, between machines, etc., Is equipped with Hyatt Roller Bearings.

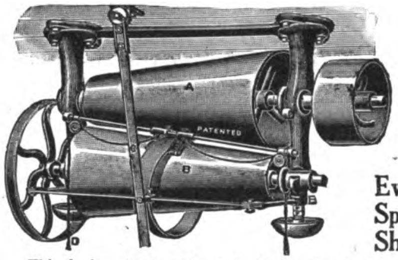
Send for Illustrated Catalog B.T.—Just off the press.

NATIONAL SCALE COMPANY
100 Montgomery Street
Chicopee Falls, Mass.
Manufacturers of National Counting Machines.

NATIONAL ELEVATING ROLLER BEARING TRUCKS CHAPMAN

Do Trucking at ½ Cost. Eliminate Rehandling





Have you any machines that require variable speed? If so, it's up to you to investigate the

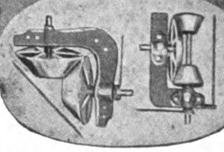
Evans Variable Speed Counter Shaft

This device affords without doubt the simplest and most effective way of obtaining variable speed. All you have to do to get any desired speed from 1 to 6 is pull the cord. Over 10,000 sets are in use. That's a pretty sure sign of the satisfaction they give.

Let us send you Catalog 25. It explains.

Evans Friction Cone Co., 1288 Centre St., Newton Center, Mass.
A. Warden & Co., 48 Shepherdess Walk, City Road, London, E. C., England.

ROCKWOOD
Paper Frictions



No Breakage From Sudden Shocks

The best engineers are using Friction Transmission. Replacing toothed gears under proper conditions, it satisfactorily meets a wide variety of requirements—unlimited speeds—(forward and reverse) quick starts—sudden stops—highly-efficient and noiseless in operation.

Rockwood Paper Frictions are the acknowledged standard. Made to fit your specifications.

Our booklet, "Friction Transmission," gives data and formulae invaluable to the designer. *Sent free on request* to those who state occupation and firm connected with.

The Rockwood Manufacturing Co.
1910 English Avenue, Indianapolis, Ind., U. S. A.

Buy a Caldwell Friction Clutch

Send for Catalogue A1

Applied to Iron and Wood Pulleys, Gears and Sprocket Wheels, Gas Engines

W. E. Caldwell Co. (Inc.,) Louisville, Ky., U.S.A.

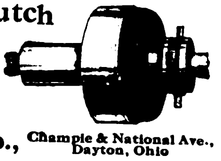
Arguto NON-METALLIC

Oilless Bearings

for loose pulleys, friction clutches, high speed machinery. Eliminates lubrication—runs from 8 to 15 years without oiling.

ARGUTO OILLESS BEARING CO.
147 Berkley Street Philadelphia

A Safely Adjustable Clutch



This is the Edgemont Friction Clutch, which, as you may have heard, is absolutely safe. It is adjustable with cover in place. Made with standard diameters, metal on metal contact.

Write for Catalog E.

The Edgemont Machine Co., Champie & National Ave., Dayton, Ohio

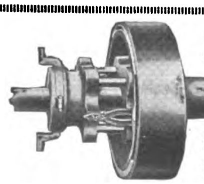
The Clutch That Delivers 100% Power

STANDARD COUNTERSHAFT CLUTCH

Baechle Patent

Pulley Price List No. 4 Describes It.

Standard Pulley Co., Cincinnati, O.



Maximum **Power With Minimum Weight**

These are but two of the features of the heavy-duty

O. K. Combined Friction and Positive Clutch

Has the advantage of a friction clutch in gradually picking up the speed of a driven shaft **or pulley, plus the positive drive of a** jaw clutch. **Read the circular for details.**

O. K. Clutch & Machinery Co., Columbia, Pa.

CLARK FLEXIBLE COUPLING

Stronger and simpler than rigid couplings and flexible at all times. Eliminates all friction due to misalignment. Simple to install.

Send for details, sizes and prices.

I. H. DEXTER CO., Inc.
Clark Flexible Coupling Co. Inc.
27 Walker Street - - - - New York
Darling Bros., Ltd., Montreal, Que., Canada. Pacific Net & Twine Co., Seattle, Wash., U. S. A.

What Was He Worth?

To Himself—To His Family—And to You

After you have trained an intelligent workman so that he is a valuable unit in your organization, why run the chance of crippling him so that he becomes of no value to himself, to his family, or your organization by exposing him to whirling projections on flange couplings and set collars?

Protect your men and your own interests by using

Bull Dog Shaft Couplings

Cathcart U. S. Patents issued and pending

Foreign patents applied for.

These couplings are simple and safe. They have a smooth surface with no projections. Simply a metal cylinder having two eccentric chambers, each containing a rolling lock. The coupling may be slipped on with the hands—no tools required.

Write for full information, prices, and the name of the nearest supply house.

Manufactured by

Automatic Shaft Coupling Company

Alexandria, Va.

Supply Houses Carrying Stock:

Diamond Specialty & Supply Co., Philadelphia, Pa.
Codd Tank & Specialty Co., Baltimore, Md.
Standard Supply & Equipment Co., Trenton, N. J.
Lyon & Grumman Co., Bridgeport, Conn.
L. L. Ensworth & Son, Hartford, Conn.
Chas. H. Newman, 309 Broadway, New York City.
Chas. A. Templeton, Inc., Waterbury, Conn.
Central Distributing Co., Jackson and Detroit, Mich.
Ryther & Pringle Co., Carthage, N. Y.
Culpeper Machine Co., Inc., Culpeper, Va.
The Macan Co., Jr., Easton, Pa.
Lewis E. Tracy Co., 127 Broad St., Boston, Mass.
Crawford Mill Supply Co., Winston-Salem, N. C.
Charlotte Supply Co., Charlotte, N. C.
Montgomery & Crawford, Spartanburg, S. C.
Fulton Supply Co., Atlanta, Ga.
Carolina Supply Co., Greenville, S. C.
The Union Iron Works Co., Selma, Ala.
Turner Supply Co., Mobile, Ala.

72-36

This is Swaging

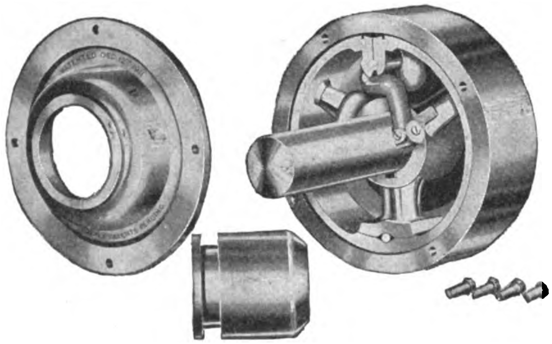
The swaging process is to hammer, squeeze and knead metal into any shape. That toughens it. The Dayton strikes from 2,000 to 6,000 blows a minute.

Write for our catalog.

Excelsior Needle Co.

Torrington, Conn.

Coventry Swaging Co., Ltd., White Friars Lane, Coventry, Agents for Great Britain; Fenwick Freres & Co., 8 Rue de Rocroy, Paris, France, Agents for France, Italy, Belgium, Spain, Portugal and Switzerland.



The Modern Machine Tool Drive

Stop wasting power with antiquated methods of transmission, use the

CLEVELAND Friction Clutch

It starts gradually, without shock, and stops instantly when released. Self-oiling, without waste of oil. Dirt-and-dust proof.

Get full information on this powerful, dependable clutch. **Ask for bulletin. We guarantee quick deliveries.**

The Reliance Gauge Column Co.

6009 Carnegie Ave., Cleveland, Ohio, U. S. A.

Conserve Your High Speed Steel

By using Armstrong Tool Holders

MADE IN 11 SIZES, Cutters $\frac{3}{16}$ in. to $1\frac{1}{8}$ in. sq.
also made in Right and Left Offset

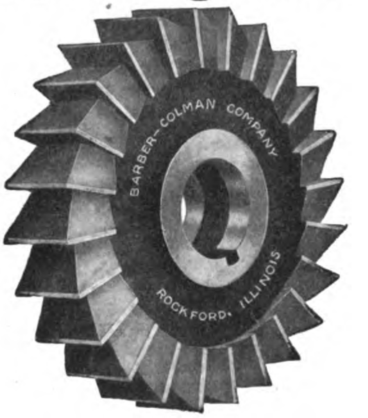
MAKE ONE POUND OF HIGH SPEED TOOL STEEL EQUAL 10 LBS. IN FORGED LATHE TOOLS. **SAVE ALL *FORGING and* 70% GRINDING.**

Our catalog sent for the asking.

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
315 N. Francisco Ave., CHICAGO, U. S. A.

ARMSTRONG TOOL HOLDERS WON THE GRAND PRIZE AT THE PANAMA-PACIFIC EXPOSITION

B-C Milling Cutters



A Cutter is either good or bad, according to whether it does, or does not do your work properly and to your entire satisfaction.

The B-C Cutter business is built upon the ability to furnish *good* cutters, not occasionally but consistently—*every time.*

Make your next order a B-C order.

BARBER-COLMAN COMPANY

ROCKFORD, ILLINOIS

You Will Agree With Us—

The quality of Buckeye Twist Drills is firmly established.

We have spared no expense in equipping our factory with modern tool-making machinery. Our workmen are skilled.

All steels are carefully selected and our intimate knowledge of heat treating the different steels assures a tool of exceptional strength and durability.

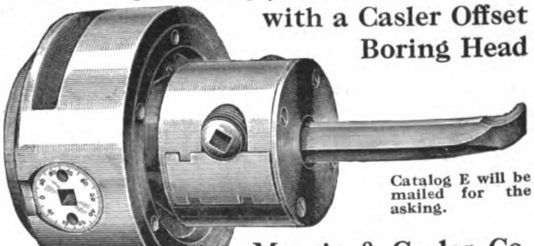
You will agree with us—The Buckeye has quality.

There's quality in our catalog. Send for your copy *today.*

Buckeye Twist Drill Co.
Alliance, Ohio

Bore holes more Accurately, more Quickly, more Easily

with a Casler Offset Boring Head



Catalog E will be mailed for the asking.

Marvin & Casler Co.
Canastota - - N. Y.

"Westhaven" "OK" Brand

DRIVE PIN PUNCHES

Made in a large assortment of sizes. Ask to see them at your tool dealers.

The Westhaven Mfg. Co. - - New Haven, Conn.

Expanding Mandrels
Tool Holders—Movable Benches
Power Hack Saws

And all of both superior design and quality.

Western Tool & Mfg. Co., Springfield, Ohio

"VICTOR" Collapsing Tap

Cuts perfect threads, trips positively, operates rapidly, is built strong and durable. The very tool you need for that hard shell work.

We guarantee satisfactory work. **Right Prices.**

PROMPT DELIVERY **LET US PROVE IT**

Write today for Circular No. 10.

VICTOR TOOL CO., Waynesboro, Pa., U. S. A.

SELF OILING UNIVERSAL JOINTS

Once oiled, our Universal Joints do not need attention for a year. Made of the finest material—used by many of the large users of Universal Joints.

Write today for Catalog and price list.

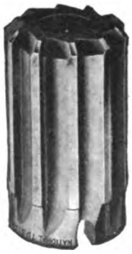
Mutual Machine Company
27 Wells Street,
Hartford, Conn.

NATIONAL
T. D. & T. Co.

High Speed Fluted Chucking Reamers

High Speed Rose Chucking Reamers

High Speed Semi-Rose Chucking Reamers



Write for Complete Catalog

National Twist Drill & Tool Co.
Detroit, Mich.

H. E. Barton Tool Co., 104-106 So. Jefferson St., Chicago, Ill.
National Twist Drill and Tool Co., 29-33 Lafayette St., N. Y.

This Threading Tool Will Save Money In Any Machine Shop

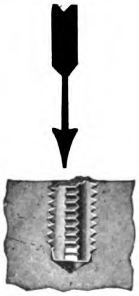
The method of holding the cutters is simple and effective. They will not slip.

Cutters have the proper clearance.

Cutters are ground to correct angles, insuring perfect threads. To sharpen, just grind the cutting edge. This may be done until the whole circle is used up.

Send for our 56-page catalog showing our complete line of tools.

UNION CALIPER COMPANY
MACHINISTS TOOLS OF QUALITY
ORANGE, MASS. U.S.A.



Write for Circular

This Ever Happen to You?

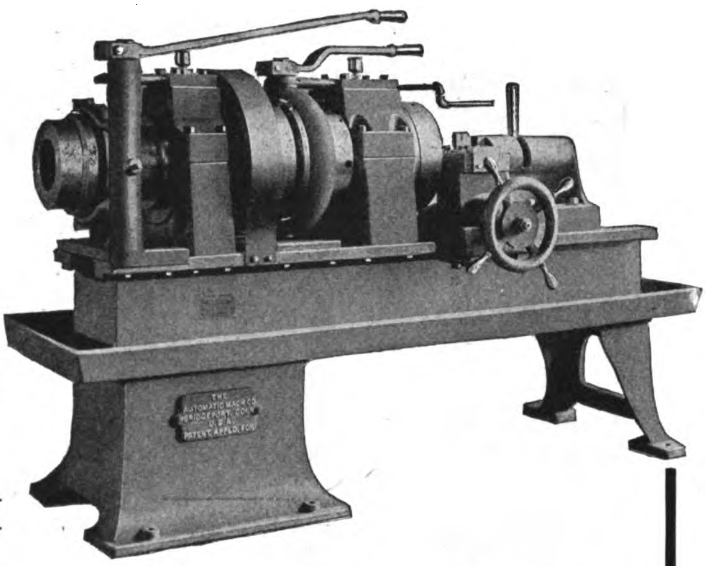
If you had fingers of steel—long, slim and strong which could reach down into the flutes of a broken tap, stuck fast in the work the problem of getting the tap out would be easy. You'd merely twiist—and out it would come.

That's the principle of the **Walton Tap Extractor.** The crucible steel fingers of this strong device go down into the flutes, grip the broken end and enable you, operating a wrench on the squared outer end, to back the tap out quickly and easily, without injuring the thread.

When such a time, labor and money saving device exists, why be without it a day longer? Yours on 60 days' trial.

THE WALTON COMPANY
HARTFORD, CONN.

Easy On The Workman



"The Automatic"

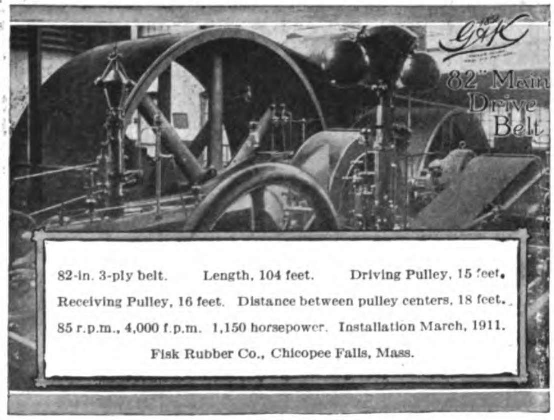
Cutting-Off Machine

for copper or steel tubes is a well-made rugged machine that will increase your production.

It will help finish your contract on time. The actual time necessary for one cycle of operation on the small machine, i.e., to feed, chuck and cut-off 3 to 6 bands is less than one minute. There are three sizes—$3\frac{3}{4}$, $6\frac{3}{4}$, 11 in.

Write for full details.

The Automatic Machine Co., BRIDGEPORT, CONNECTICUT



One Inch or Eighty-Two Inch

Machine Belt or Main Drive Belt. For any service and every service, G & K Belts give absolute satisfaction.

Because like the Fisk 82-in., all G & K Belts are carefully constructed from leather of our own tannage, tanned slowly, uniformly and expressly for belting purposes. They possess the essential qualities of pliability, firmness with minimum stretch, great tensile strength and durability. Lastly, they are absolutely guaranteed as to quality and workmanship.

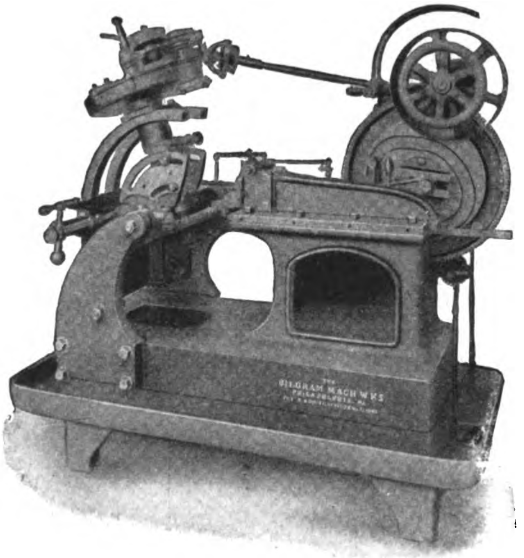
There is a G & K belt for every drive in your plant—its use means maximum production and low cost of operation. Why not let us serve you?

THE GRATON & KNIGHT MFG. CO.

Oak Leather Tanners and Belt Makers

Worcester - - Mass., U. S. A.

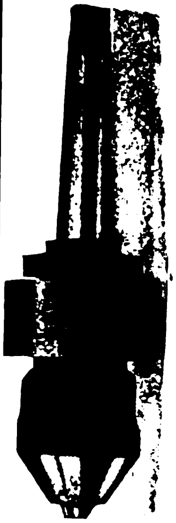
BEVEL GEAR GENERATORS



Bevel Gears

are cut by us theoretically correct, and so are adapted to fine machinery of all kinds. We have special facilities for cutting SPUR, WORM, SPIRAL, MITRE, INTERNAL and ELLIPTICAL Gear Wheels. Let us quote on your specifications.

The Bilgram Machine Works 1233 Spring Garden St. Philadelphia, Pa.



This Chuck Is a Tap Saver

IT'S THE NEW Bicknell-Thomas Tapping Chuck

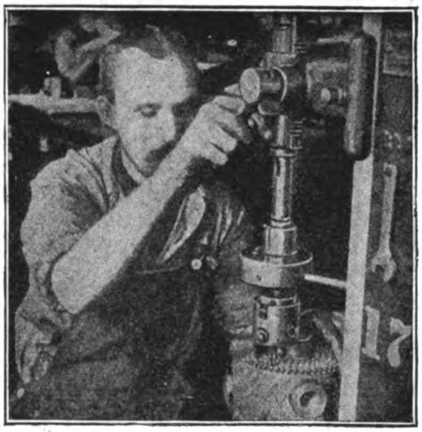
provided with an adjustable friction drive which slips under strain in such a manner that breakage of taps is impossible. It is simple, efficient, durable, works within the smallest compass on multiple-spindle machines, and is especially useful for blind tapping. Five sizes, capacities $\frac{1}{8}$ in. to 1 in.

To prove that the Bicknell-Thomas Chuck is a Tap Saver, we will send one on trial. WHICH SIZE?

BICKNELL-THOMAS COMPANY

GREENFIELD, MASS., U. S. A.

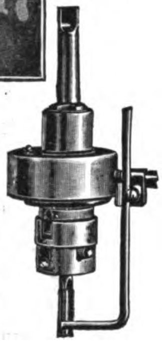
Errington Auto Reverse Friction Tapper



Style C.

Tapping Blind Holes in Air Cooled Automobile Cylinder

(AMERICAN MACHINIST, Mar. 14, 1907.)



The breakage of a single tap on this job would cause an intolerable blemish in the appearance of the piece and result in heavy loss in time and money. The **Errington Sensitive Adjustment and Quick Reverse** insure perfect results. Regulate the power of the machine to **just** drive and remove all danger of **breaking the tool or injuring the work** Fool proof, fits any drill press, and taps steel as safely as cast iron. Seven sizes, $\frac{3}{8}''$ to $2''$.

ERRINGTON, 41 Cortlandt St., NEW YORK

136 West Lake St., Chicago

A Report On GARVIN Wrenchless Chucks

from a large brass goods plant advises a 50% reduction in cost by the use of these chucks. Is this not worth while investigating at your plant?

Two and Three Jaw Carried in Stock

For Further Information { Ask Your Dealer or Write Us Direct

Full description in Chuck Catalog.

The Garvin Machine Company

Spring and Varick Sts. 50 Years in New York City

"CUSHMAN" CHUCKS AND FACE PLATE JAWS

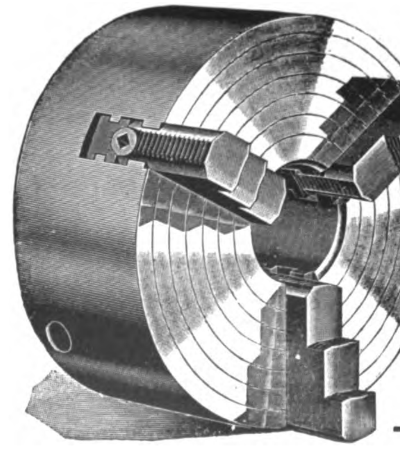
If you need a Chuck of any kind let us show you what we can furnish. We have a very complete line of

LATHE CHUCKS and DRILL CHUCKS

We also manufacture Portable Jaws for large face plates and tables.

Let us send you our catalog describing Chucks for all requirements.

THE CUSHMAN CHUCK CO., Hartford, Conn.



Geared Scroll Combination Chucks

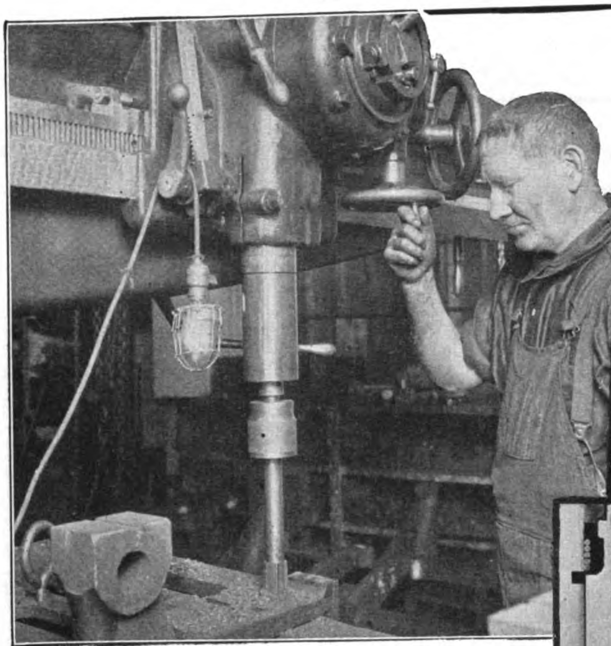
Each jaw is reversible and may be independently adusted by its separate screw. It is not necessary to throw any combination device "in" or "out" to make the chuck "Universal" or "independent," for the wrench may be directly applied to Scroll or Screw Mechanism, as required. These chucks are specially convenient for holding duplicate work by a previously finished surface. **Let us send you our complete catalog on chucks.**

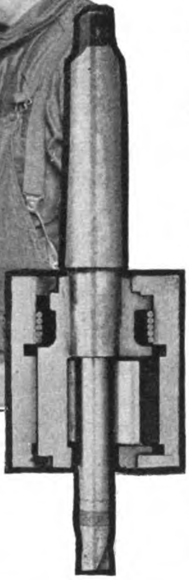
D. E. Whiton Machine Co.

New London, Conn.

Sole European Agents—Selson Engineering Co., Ltd.
"Whiton" Chucks sold and kept in stock by principal dealers all over Europe.

In Cleveland—





Before the workman reamed this 2-in. hole it was drilled—the tool change took less than 2 seconds—because he didn't have to stop the spindle.

The Cleveland Automatic Machine Co. is daily demonstrating the efficiency and versatility of

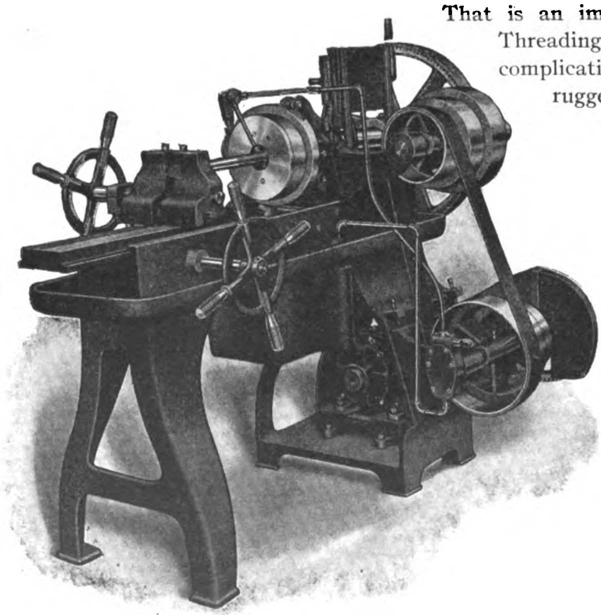
WAHLSTROM Automatic Drill CHUCKS

in the manufacture of high-grade automatic machinery. Operating a 2-inch straight shank reamer in a 1-inch chuck as pictured here is but one way in which The Wahlstrom Chuck is unusual—it is positively driven, self-centering, wide in tool range and thoroughly automatic.

There's another style Wahlstrom chuck which will hold W T S tools whether they have a tang or not.

Wahlstrom Tool Co.
350 Carroll St., Brooklyn, N. Y.

Anybody Can Learn to Run Them In a Few Moments



That is an important item of economy. Little Giant Threading Machines are free from time-consuming complications. The parts are all of simple design and rugged cnstruction.

Little Giant Threading Machines

with automatic opening die heads are adaptable to any work within their capacity. They are used for threading bolts, nuts and pipe.

Gears are covered with guards for protection. The equipment of each machine is on a rack by the head, in full view and easy reach. Any length of thread can be cut. Little Giant Threading Machines are furnished with motors attached as shown in illustration, when so specified.

Write for Catalog No. 34 on "Screw Cutting Tools and Machinery."

Greenfield Tap and Die Corp.
Wells Brothers Co., Div.
A. J. Smart Mfg. Co., Div.
Wiley & Russell Mfg. Co., Div.
Greenfield, Mass., U. S. A.
New York Chicago Philadelphia
Detroit London
Wells Bros. Co. of Canada, Ltd., Galt, Ont.

Employment Dept.

RATES: Positions Wanted, 3 cents a word, minimum charge 50 cents an insertion, payable in advance. Other advertisements, 5 cents a word, minimum charge $1.00 Count 4 words for blind address care of our New York or Chicago offices. Advertisements for bids, $2.40 an inch.
ANSWERS addressed to us at 10th Ave. and 36th St., New York or 1144 Monadnock Block, Chicago, will be forwarded without charge (excepting circulars etc.)
IMPORTANT: Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents—send copies. Advertisers' names will not be furnished under any circumstances. Copy received until 10 A.M. Friday for following Thursday's issue.

NOTE: Copy for the issue of July 6 will be required one day earlier than noted above.

Positions Open

Foreign

AN EXPERT in the designing of machines for manufacturing twist drills and milling cutters; only thoroughly competent men need apply. To the right man we offer a steady position for not less than three years at his own terms; New York City interview. P866—Am. Mach.

Cuba

STRUCTURAL DETAILER wanted for structural shop in Havana, Cuba; must be fully experience, rapid and accurate on mill building work; state experience, references and salary at once; good position for right man. Address American Steel Co. of Cuba, Box 654, Havana, Cuba.

Connecticut

A MAN thoroughly competent to take charge of automatic screw machine department wanted. Address, stating experience, wages expected, etc., P836—Am. Mach.

District of Columbia

A-1 LATHE HANDS on close and accurate work for chasing and finishing of threads; mechanics only are wanted. Apply Employment Dept., P. O. Box 1812, Washington, D. C.

Illinois

SUPERINTENDENT of factory wanted engaged in the manufacture of oil and gasoline engines; must be familiar with modern methods of manufacture, active, tactful, a close student of human nature and a natural leader; exceptional manufacturing men, even though not actively engaged in gas-engine work, are encouraged to reply; position offers a splendid opportunity for one who can qualify; give complete experience. P653 —Am. Mach., Chicago.

EXPERT in the heat treatment of all kinds of steel; a liberal salary and permanent position to one who can qualify. P814—Am. Mach., Chicago.

Indiana

FIRST-CLASS TOOL AND GAGE MAKERS wanted, accustomed to close, accurate work. Apply the Stenotype Co., P. O. Box 814, Indianapolis, Ind.

Kansas

FIRST-CLASS FOREMAN wanted for snap work department in a large foundry; good opportunity for advancement for a man who will be able to handle men to advantage; must understand both floor and machine work; advise present position, giving references and salary expected. P843—Am. Mach., Chicago.

Massachusetts

FIRST-CLASS JIG AND GAGE MAKERS wanted; only those accustomed to close work need apply. Walter H. Wade, 311 Atlantic Ave., Boston, Mass.

Michigan

ASSISTANT FOREMAN wanted for assembly department on high-grade gasoline engines; also machine-tool operators and tool makers; 8 hours a day. P840—Am. Mach., Chicago.

MACHINISTS—Young men with some machine-shop experience, to learn operating die-cutting machines in Michigan; write age, experience, salary. P842—Am. Mach.

Missouri

THE WAGNER ELECTRIC MFG. CO.'S ATHLETIC ASSOCIATION wishes to add to its boxing and wrestling talent, and will find room for good, clean amateur talent or promising material, who are either tool makers, machinists or automatic machine operators. Address C. L. La Barge, Secretary Athletic Association, Wagner Electric Mfg. Co., St. Louis, Mo.

New Jersey

ASSISTANT FOREMAN for department in shop manufacturing electrical appliances; must be thoroughly experienced on lathes, grinders, milling machines, familiar with piece-work system and modern shop methods, able to break in unskilled help. If you desire a permanent position write fully about your experience, age, nationality and what salary you expect. "Foreman," P846—Am. Mach.

DRAFTSMAN wanted on multi-color press design; state experience, age and expected salary. P809—Am. Mach.

New York

EXPERIENCED OXY-ACETYLENE WELDER wanted. In answering please give experience, wages expected and references. Ingersoll-Rand Company, Painted Post, N. Y.

BLACKSMITH AND TOOLDRESSER wanted, man thoroughly competent to heat and harden high-speed and carbon steels. In answering give references, experience and wages desired. P221—Am. Mach.

COMPETENT CLERK for order and traffic dept. wanted; experienced in iron and steel, particularly tool steels and alloy steels and specialties preferred; to receive attention state age, experience and wages expected. "Opportunity" P855 —Am. Mach.

MACHINISTS to learn operating die-cutting machines and eventually act as demonstrators, United States; also some for Europe; write age, experience, salary. P841—Am. Mach.

TOOL MAKERS wanted on jigs, fixtures and gages; highest wages and steady work; call or address Neptune Meter Co., Jackson Ave. and Crane St., Long Island City, N. Y.

TOOLMAKERS and experienced machine operators wanted; steady work and good pay. In answering please state experience or apply in person if possible. Ingersoll-Rand Co., Painted Post, N. Y.

PLANT MANAGER wanted for Ohio factory; 300 hands; iron and brass finished products; no foundry; a high-grade executive required with ability to handle men, assume entire management and with qualifications beyond superintendent. P 823—Am. Mach.

DIE MAKER experienced in round die work for friction top cans; steady work. In answering please give experience, wages expected and references. P856—Am. Mach.

Ohio

PLANT MANAGER wanted for Ohio factory, 300 hands; iron and brass finished products; no foundry; a high-grade executive required with ability to handle men, assume entire management and with qualifications beyond superintendent. P864—Am. Mach., Chicago.

Pennsylvania

MECHANICAL DRAFTSMEN, layout men, detailers and tracers. Address Chief Clerk, Engineering Dept., Westinghouse Electric & Mfg. Co., East Pittsburgh, Penn.

ASSISTANT FOREMAN wanted for iron foundry; man experienced on heavy work; must be able to furnish references. State experience, age and salary expected. Mesta Machine Co., P. O. Box 1124, Pittsburgh, Penn.

ASSISTANT FOREMAN wanted for steel foundry; must be competent man on heavy work; state age, experience and salary expected; give references. Mesta Machine Co., P. O. Box 1124, Pittsburgh, Penn.

MECHANICAL DRAFTSMAN wanted; experienced in paper-mill machinery; none others need apply. P867—Am. Mach.

MOULDER FOREMAN wanted to take charge of iron roll department; state age, experience and salary expected; give references. Mesta Machine Co., P. O. Box 1124, Pittsburgh, Penn.

EXPERIENCED MAN wanted to take charge of jarring machines in foundry doing heavy work; state experience, age and salary expected; give references. Mesta Machine Co., P. O. Box 1124, Pittsburgh, Penn.

FIVE MECHANICS to head machinery erecting gangs; unmarried, sober and reliable men wanted, with knowledge of boiler work preferred; wages $100 month. P788—Am. Mach.

MACHINE DESIGNER for boiler shop wanted; structural shop and ship-yard machinery; permanent position; applicant state fully experience. P853—Am. Mach.

PRESS ROOM FOREMAN wanted, familiar with sheet metal manufacturing, particularly drawing brass tubes; must have executive ability; state age, past experience, where now employed and wages expected; plant in central Pennsylvania; excellent opportunity for the right man. P835—Am. Mach.

Rhode Island

FOREMAN GRINDER wanted to take charge of department on automobile parts; experienced in all branches of grinding on various makes of machines, with ability to handle help and get maximum production; state age, experience and pay expected. P865—Am. Mach.

Tennessee

MECHANICAL ENGINEER wanted; one who is thoroughly familiar with steam engine and gasoline engine design, also steam boilers and a general line of machinery; permanent position for right party; give full experience, reference and salary expected in first letter. P815—Am. Mach.

West Virginia

WE HAVE GOOD POSITIONS OPEN for die and tool makers and good all-around machinists. P759—Am. Mach.

Additional Positions Open Advertisements, page 170

Employment Agencies

The Agencies advertising here agree to refund any registration fee on demand any time within the first six months when no position is secured.

THE ENGINEERING AGENCY, INC., Monadnock Block, Chicago, established 22 years, finds high-grade men for executive and technical positions for manufacturers. Less than 2% of men selected through us in 1914 were discharged for any cause other than completion of work. Note high employment efficiency. Send detailed description of men needed—we do the rest.

EMPLOYERS' REFERENCE & BOND ASSN., INC., Lapham Bldg., Providence, R. I., procures capable engineers and executives to meet your needs.

H. H. HARRISON & CO., Association Bldg., Chicago, registers high-grade manufacturing executives, technical, semi-technical and commercial men. Forward complete data of requirements for immediate attention.

CORRESPONDENT

THE UNDERSIGNED plans and conducts correspondence for positions in technical, manufacturing and professional lines for $2,500 to $15,000 men exclusively; complete privacy assured; no commission charged; only service fee and postage. Send name and address only, in confidence, for prefatory details. R. W. Bixby (Established 1910), 81 Niagara Square, Buffalo, N. Y.

ASSOCIATION

FIRST-CLASS MACHINISTS, tool makers, die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood and metal pattern makers, brass polishers, buffers, finishers, millwrights, hammermen and blacksmiths, who wish to increase their opportunities, to register with the free employment department of the National Metal Trades Association, 1021 Peoples Gas Bldg., Chicago, Ill.

Positions Wanted

MECHANICAL ENGINEER, 20 years' experience design and production, machine tools, cranes, hydraulic machinery, gas engines, small tools, etc., desires change; now employed as superintendent. PW862—Am. Mach.

Canada

SUPERINTENDENT or general foreman by a technical graduate with 12 years' practical experience; experienced on design of tools and machining of 8- and 9.2 shells; can lay out plant. PW859—Am. Mach.

Illinois

SUPERINTENDENT—Mechanical engineer at present employed as assistant superintendent in plant employing approximately 400 men desires change about July or Aug. 1; age 35 years, a hustler and thoroughly familiar with modern manufacturing methods; capable of estimating contract work, buying raw material and getting out work in specified time; can take complete charge of office and factory; experience 15 years marine engines, air compressors, general and special machinery, all kinds of gearing and tools; location immaterial; references. PW824—Am. Mach., Chicago.

MECHANICAL ENGINEER, university graduate, familiar with modern production methods, national experience, very many lines, who has constructed hundreds of new and special machines, who possesses the necessary experience, judgment, education, imagination, punch and power to achieve results, invites correspondence from parties who need a strictly high-class engineer for consultation, invention, designing, development, etc. PW847—Am. Mach., Chicago.

Indiana

AS EXECUTIVE or factory manager by tactful, progressive and tenacious man of experience and excellent record, now employed; systematic production understood, modern methods appreciated and commercial necessity grasped; interested in high-grade, permanent position only; available 30 to 40 days. PW838—Am. Mach.

Maine

EFFICIENCY ENGINEER, young man, technical graduate; experience in time-study work, costs, designer and neat draftsman of automatic machinery; transmission machinery, factory and mill buildings. PW861—Am. Mach.

Michigan

GENERAL SUPERINTENDENT or production manager, practical and technical; 15 years' responsible executive positions; experience: automobiles, heavy steam and gas engines, machine guns and munitions; any accurate interchangeable work with modern production methods. PW857—Am. Mach., Chicago.

New Jersey

GENERAL FOREMAN or foreman, 20 years' experience, 11 years as executive; positively can make good; reference. PW851—Am. Mach.

New York

ASSISTANT SUPERINTENDENT, production, or mechanical engineer; expert on interchangeable manufacture, rapid production, modern efficiency methods; plant maintenance; highest references relative to character, executive and productive ability. PW845—Am. Mach.

BUSINESS OR SALES MANAGER wants connection with machinery manufacturer who would consider the manufacture of several special machines; especially for South American trade; advertiser worked up through machine and pattern shops to five years designing and drafting machinery to traveling salesman, sales manager and business manager; might invest few thousand in a year or so; will give and expect good credentials. PW854—Am. Mach.

DESIGNER AND DRAFTSMAN with machine-shop practice and graduate engineer, inventive ability, desires position where these qualifications are essential. PW839—Am. Mach.

DRAFTSMAN, technical graduate, American; six years' experience arrangements and detailing electrical and mechanical. PW848—Am. Mach.

SALES ENGINEER, production engineer or publicity by mechanical engineer; can advise as to layout, machines and equipment. PW794—Am. Mach.

MECHANICAL ENGINEER and designer of many years' experience, specializing on automatic paper-handling machinery, desires position as high-class designer and developer of intricate automatic machinery and devices; wishes to work practically independent of drafting room; New York City or vicinity. PW849—Am. Mach.

MECHANICAL ENGINEER, college graduate, good executive and salesman, large experience in power transmission, conveying, elevating and general machinery, foundry work, etc., open for position. PW844—Am. Mach.

MACHINIST — First - class tool - die maker, experiment tool designer, technically trained, 20 years' wide experience, best references, wishes position as foreman. PW827—Am. Mach.

I HAVE AN UNDENIABLY SUCCESSFUL RECORD as an organizer of factories and handler of men; am a practical mechanic of large experience in many varieties of manufacture. I am now giving satisfactory service to a large corporation in the East, but for strictly personal reasons wish to make a change to the West or Middle West; can furnish references of the most convincing kind. PW821—Am. Mach.

FOREMAN, German nationality, 30, wants change; 12 years' experience in manufacturing small interchangeable parts, assembling of small machinery and the handling of male and female help to best advantage; A-1 references; salary expected, $28 per week. PW858—Am. Mach.

POSITION AS TOOLROOM FOREMAN wanted by American, age 35; wide and varied experience. Details furnished on addressing PW860—Am. Mach.

Ohio

A FIRST-CLASS MACHINE TOOL SUPERINTENDENT, at present employed by a well-known company, wishes to make a change; has had a general experience in the manufacture of all kinds of machine tools; also able to supervise the designing; replies confidential. PW 746—Am. Mach., Chicago.

AS MANAGER or general superintendent by a man of wide and successful experience in the supervision and management of plants consisting of machine shops, foundries, blacksmith, woodworking, sheet metal and contributing departments, including main office; will guarantee an open-shop policy without labor troubles; straight salary or commission. PW 805—Am. Mach., Chicago.

Pennsylvania

SUPERINTENDENT OR WORKS MANAGER, now successfully in charge of manufacturing plant embracing machine shop, foundry, smith shop, woodworking department and all other manufacturing departments, including factory accounting, production and planning departments; experienced in designing and production of special tools, jigs, etc., including organizing and systematizing along modern producing lines; middle-aged and married; will consider change and can give satisfactory reasons for same. PW 834—Am. Mach.

Wisconsin

DRAFTSMAN, young man, experienced in shop work and mechanical drafting, desires position as detailer or layout man; good references. PW850—Am. Mach., Chicago.

Wanted

TWIST DRILLS, CARBON STEEL, jobbers' lengths—we are open to purchase large quantities continuously, send price list, discount and cash terms to Wm. Hall (Sheffield), Ltd., Alma Works, Sheffield, England.

AGENTS AND SALESMEN

FACTORY AGENTS for the Fractiometer; adds and subtracts, shows the decimal equivalent quicker than figures are written; $1\frac{5}{8} - \frac{41}{64} = \frac{63}{64} = 0.984375$; great labor saver for designers, draftsmen, machinists and others; sent on approval; price 50c. Fractiometer Co., Rochester, N. Y.

TOOL STEEL SALESMAN wanted for New England; technical graduate familiar with machine-shop practice preferred. Address with full particulars. W852—Am. Mach.

SALESMEN wanted by progressive concern; must be a mechanic, acquainted with the latest shop methods and believe absolutely in the limit system; exceptional opportunity for the right man; state age and experience. W810—Am. Mach.

SALESMAN wanted, having experience in tool steel and alloyed steels preferred; opportunity for advancement. In order to secure attention, application must positively state age, experience and salary expected. "Permanent," W816—Am. Mach.

EXPERIENCED MACHINE TOOL SALESMEN wanted; must be hustlers who have proven ability to get business; give experience and reference of former employers. W863—Am. Mach., Chicago.

Contract Work

PUNCH PRESS TOOLS, jigs, fixtures, etc. Taylor-Shantz Co., Rochester, N. Y.

MACHINERY, small or medium, designing, models, dies or jigs, 1 to 1,000 or more, right to your blueprints. Estimates submitted. Berggren & Pearson Machine Co., 221-227 Canal St., New York City.

WE ARE IN POSITION to take on additional work for the following machines: 36-in. Fellows gear shaper, 24-in. Gisholt lathe, 2-in. hand screw machine, 3x36 Jones & Lamson and 2 horizontal boring machines. The Sinclair-Scott Co., Baltimore, Md.

MECHANICAL ENGINEERING AND MACHINE DESIGN—Do you want a special machine peculiarly adapted to your product and more economical than the standard machine? Wide experience in work of this character enables me to name time estimates which can be fulfilled. W. L. Schellenbach, 520 First National Bank Bldg., Cincinnati, Ohio.

FIRMS WANTED to take on extremely close contract work on small parts suited to screw machines, lathes, J. & L. millers, and internal and external grinders. In replying, state machines available. W806—Am. Mach.

TOOL AND DIE WORK wanted; also work for a plain Morton grinder, size 6x36". Address American Standard Motion Picture Machine Co., 168 S. Boulevard, New York City.

Additional Contract Work Advertisements on pages 176-181 inc.

Miscellanoues

GET A "LAST WORD," the Test Indicator Par Excellence. Described in Nov. 18 issue, "American Machinist." H. A. Lowe, 1374 E. 88th St., Cleveland, Ohio.

Patent Attorneys

PATENTS. C. L. Parker, patent attorney, McGill Bldg., Washington, D. C. Inventor's handbook sent upon request.

Business Opportunities

NEW FIREPROOF FACTORY, equipped with electrically driven modern machine tools, also woodworking machinery; 100 miles from New York; transportation via N. Y. C. R.R., B. & A. R.R. and Hudson River; private siding; interest in business if desired. BO349—Am. Mach.

WATER POWER for sale, 500 hp. combined with an established business over 30 years; a going concern with best reputation; no labor trouble. Address Langdon C. Foster, Fulton, N. Y.

For Sale

CAMDEN, N. J., immediate occupancy, suitable for war orders or any business; brick buildings, 93,000 feet of floor space, with very fine power plant; 4.6 acres on water front, Philadelphia lighterage limits; price a decided bargain; substantial mortgage. L. N. Creighton, Agent Bayonne, N. J.

HEAVY-DUTY DRILLING MACHINE; drawings, patterns, jigs and stock of parts; fully developed and ready for manufacturing. FS772—Am. Mach.

16 LB. ASSORTED SPRINGS, light and heavy coils, 75 varieties for repairs and experiments, $2. Hubbard Spring Co., Pontiac, Mich.

Second Hand Machinery

Advertisers' Names

BLESSER Mfg. Co., J., Springfield, Ill.

C. & F. CO.—Chandler & Farquhar Co., 419 Atlantic Ave., Boston, Mass.

CINCINNATI Planer Co., The, Oakley, Cincinnati, Ohio.

DAVIS Machine Tool Co., W. F., 32 North Clinton St., Chicago, Ill.

HIMOFF Machine Co., 128 Mott St., New York City.

MANN Lithopress Co., The, Machine Tool Dept., 58 Walker St., N.Y. C.

PARMELE, Charles L., 50 Church St., New York City.

VONNEGUT Machinery Co., Indianapolis, Ind.

Chucking Machines

58 Potter & Johnson No. 6A automatic, new.—DAVIS.

Cold Saws

3 No. 5—6" Nutter-Barnes.—C. & F. CO.

Cold Saw Machines

18 Newton No. 500 with 20" inserted tooth blades.—DAVIS.

Drilling Machines

26" Rockford, with sliding head, back gears, power feed.—DAVIS.

4 Henry & Wright No. 1 style K, new; 12 Colburn size D2, new; 25 Colburn size D4, new; 1—24" Hoefer, new.—DAVIS.

[Radial]

36" Dreses radial cone drive, quick-return tapping attachment.—DAVIS.

3' Mueller, 5' Dreses.—C. & F. CO.

Four Myers bench drill presses with chucks (new); Aurora 20" swing, vertical drill press, power feed, back gear, $150.—MANN.

Gear Cutters

30" Flather, fine condition.—Dreses Machine Tool Co., Cincinnati, Ohio.

Generators

180-kw., 3-ph., 220-V., 60-cy., 514-r.p.m. generator with exciter.—The Watson-Stillman Co., Aldene (Roselle P.O.), N. J.

Grinders

12"x42" Landis, universal.—DAVIS.

B. & S. No. 2 surface.—PARMELE.

No. 16 Brown & Sharpe plain, 10"x72"; Norton 10"x50" plain; Warner & Swasey, double spindle, internal.—C. & F. CO.

Universal tool and cutter grinder—Wells No. 190, complete with all attachments, new.—DAVIS.

Kettles, Soda

2—40-gal. gas-heated soda kettles, in good condition; make us an offer.—Wagner Electric Mfg. Co., St. Louis, Mo.

Keyseaters

1 No. OO Baker, $185.—CINCINNATI.

Lathes

34" Gisholt with 4" hole.—VONNEGUT.

19"x6' Porter, with three-step cone, double back gears.—DAVIS.

Advertisers' Names are abbreviated in most of these items. Complete names and addresses head the list.

Draper 18"x18' lathe, turret on shears, with power feed, 2⅛ hole in spindle.—PARMELE.

14"x6' LeBlond QCG, motor drive; 14"x 6' Prentice QCG, C.R.; 16"x8' Prentice, geared head, QCG; 19"x8' Reed, C.R.; 26" x12' Reed, C.R.; 30"x10' Fifield, triple geared.—C. & F. CO.

1—16"x8' Barker, new; 38-16" Fairbanks-Morse, new.—DAVIS.

Bradford 24" swing x 12' engine lathe, plain change gear, 2" hollow spindle, comp. rest, form 4½" belt; new Morris engine lathe, 18"x8' double back gear, semi-quick change, comp. rest, hollow spindle; Lodge & Davis 18"x10' engine lathe, taper attachment, plain change, hollow spindle, comp. rest.—MANN.

Milling Machines

No. 3½ Garvin plain, with countershaft, $400.—A. H. Wadell, Rahway, N. J.

1 No. 2 LeBlond plain, 3-step cone pulley, single back gear, quick change gear for feed, good condition, $775; 1 No. 3 Le Blond plain, 3-step cone pulley, double back gear, quick change gear for feed, good condition, $1,050.—HIMOFF.

Planers

Slightly used 42"x42"x26', 4 heads, 4 speed gear box on housings and motor drive; fine condition.—Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

1—24"x24"x6' L. & D.—BLESSER.

Whitcomb, crank; 30"x30"x8' Flather, 2 heads; 48"x48"x20' Putnam, 2 heads.—C. & F. CO.

40"x40"x12' New Haven with one or two heads.—DAVIS.

Presses

Punch presses—A variety from 900 to 9,000 lb. in weight.—VONNEGUT.

Screw Machines

[Automatic]

6—⅝" Cincinnati, $800 each.—CINCINNATI.

One 4¼" Cleveland auto.—BLESSER.

¾" and ⅞" 4-spindle National-Acmes; No. 55—1⅝" 4-spindle National-Acme.—C. & F. CO.

6 No. 3 Stecher, new.—DAVIS.

Shafting

12,000 to 15,000 lb. 1⅝" cold roll shafting at less than regular present price, mill lengths. Address the Dairy Cream Separator Co., Lebanon, Ind.

Shapers

20" Hendey, geared friction.—DAVIS.

20" Smith & Mills, gear box drive; 24" Hendey, friction; 15" American Tool Works Co.'s, crank.—C. & F. CO.

Shears

1—60" type I-H Collier Smith rotary shear.—VONNEGUT.

Traveling Cranes

One 40' span, 15-ton electric traveling crane, D.C., 220 volts, hoist 12 hp., trolley 7 hp., bridge 10 hp. This crane has just been removed to make way for a new one. Hoisting motor should be renewed. —Murray Iron Works, Burlington, Iowa.

Turret Lathes

2"x24" J. & L. cone head; 1¼" Pratt & Whitney wire feed screw machine, geared friction head, power feed to the turret, latest pattern.—C. & F. CO.

22" Libby full swing side carriage turret lathe; excellent condition; including two motors and tools.—COFFIN VALVE CO., Neponset, Boston, Mass.

2"x24" J. & L. cone-head-type, motor driven, with bar equipment.—DAVIS.

12"x5' Wells with 7¼" three-jaw universal chuck and six-hole turret.—DAVIS.

WANTED

36" Niles pulley lathe, gear feed preferred; must be in good condition. Union Iron Works, Decatur, Ill.

We need immediately a planer type surface grinder for finishing drop forging dies. Capacity 20"x20"x4' more or less; need not have oscillating attachment. We also need 20" back geared Gould & Eberhardt shaper. Tools must be in strictly first-class condition and price reasonable.—Bonney Vise & Tool Works, Inc., Allentown, Pa.

To Advertisers of Second Hand Machinery

With the July 6th issue we will discontinue the "list" form of advertising as above and substitute the sale of space by the "inch."

This will give each advertiser an individual space in which to display his advertisements of Second Hand Machinery, For Sale or Wanted.

The following rates will apply:

1 in.	$3.00	15 in.	2.70 an in.
4 in.	2.90 an in.	27 in.	2.60 an in.
8 in.	2.80 an in.	50 in.	2.55 an in.

(Rates for larger spaces furni hed on request.)

$400,000 Worth of Machine Tools

FOR IMMEDIATE DELIVERY

Most of them only about a year old

Our Entire Equipment For Sale consisting of a complete line of machinery suitable for the manufacture of 3 to 6-inch shells or general manufacturing purposes, including:

Lathes	*Planers*
Jones & Lamson's	*Thread Cutting Machines*
Gridley's	*Grinding Machines*
Shapers	*Also Some Large Heavy Tools*

Send for Catalog, listing same in full, or better still, come to Providence and look the machines over in our plant.

PROVIDENCE ENGINEERING WORKS - Providence, R. I.

FOR SALE

Engine Lathes 21-in. Swing, 8 ft. 6-in. bed with Turret.

Hurlburt & Rogers 6-in. Cutting-Off Machines.

These are new machines and have never been used. They were purchased in excess of our requirements.

Prices will interest you. Will send photograph.

Address your inquiry to the Purchasing Agent, Mead-Morrison Mfg. Co., East Boston, Mass.

New Machinery and Tools

for sale account cancellation contracts, shipments same day we receive your order.

ALLEN HIGH-SPEED BALL BEARING DRILLING MACHINES

9—2 spindle 3—3 spindle
10—4 spindle

D'ARMOUR BENCH DRILL PRESSES

20—12x$\frac{1}{16}$-in. Drill Presses

SMURR & KAMEN PLAIN HEAD SCREW MACHINES

7—No. 4 Machines

GEOMETRIC DIE HEADS AND TAPS

25—2-in. Style C 5—1¼-in. Style D
10—1-in. Style D 25—1½-in. Style ML

NEPTUNE METER CO.

Jackson Ave. and Crane St. Long Island City, N. Y.

Only reliable products can be continuously advertised

FOR SALE
Air Compressor and Engines

1—Chicago Pneumatic Tool Co. "Franklin" air compressor. Duplex Steam cylinder 19 in. diameter, L.P.A. 19 in., H.P.A. 14 in., common stroke 14 in., capacity 690 cubic feet.

1—Harris Corliss horizontal single cylinder 12x36 in. engine 90 hp.

1—Armington & Sims horizontal single cylinder 9x12 in. engine 50 hp.

For prices and further information address

Universal Winding Company - Providence, R. I.

MACHINE TOOLS

PLANERS

36-in. Detrick & Harvey open side, 13-ft. bed..... $2,000
36x36 in. x 8-ft. Sellers, 4 heads.................. 1,200
24x24 in. x 6-ft. Pease, 1 head..................... 450

AUTOMATIC SCREW MACHINES

Three (3) Brown & Sharpe No. 2, each............ 500
Two (2) $2\frac{1}{4}$-in. Gridley, single spindle, each....... 1,500
National Acme 4 spindle, $\frac{11}{16}$-in. capacity.......... 1,250

MILLING MACHINES

No. 5-B Becker Vertical, table 53x14-in.; equipped with rotary table.............................. 1,850
Lodge & Davis Universal No. 2, back geared...... 850

HORIZONTAL BORING MACHINES

Lucas Horizontal Precision Boring Machine, $2\frac{1}{4}$-in. capacity..................................... 2,000
No. 0 Bement Horizontal Boring, Drilling and Milling machine, $2\frac{3}{8}$-in. bar...................... 950

GRINDERS

Landis, plain, 8x38............................. 1,400
Two (2) No. 5 Rivet, each...................... 500

Pipe Machines

Jerecki No. 7, 2-in. capacity...................... $75
Jerecki No. 12, 6-in. pipe, direct connected engine drive.. 400

RADIAL DRILLS

4-ft. Western full universal..................... 900
5-ft. Pond.. 750
42-in. Baush....................................... 500

UPRIGHT DRILLS

48-in. Prentiss, sliding head, back geared, power feed... 400
36-in. Prentiss, sliding head, back geared, power feed... 275
24-in. Snyder, sliding head, back geared, power feed 150

ENGINE LATHES

52 in. x 16-ft. Gleason, heavy, triple geared....... 2,500
50 in. x 20-ft. Fifield, massive pattern............ 2,750
24 in. x 18-ft. Lodge & Shipley, quick change gear, taper attachment, motor drive................. 2,000
18 in. x 10-ft. Robbins, compound rest, etc........ 625
18 in. x 10-ft. Rahn Larmon, compound rest, power cross feed, hollow spindle, taper attachment.... 600

These are just SAMPLES of our stock, comprising every make and size of LATHES, PLANERS, SHAPERS, BOLT CUTTERS, MOTORS, KEYSEATERS, ETC.

WRITE FOR OUR OUR STOCK LIST.

The Co-operative Used Machinery Company

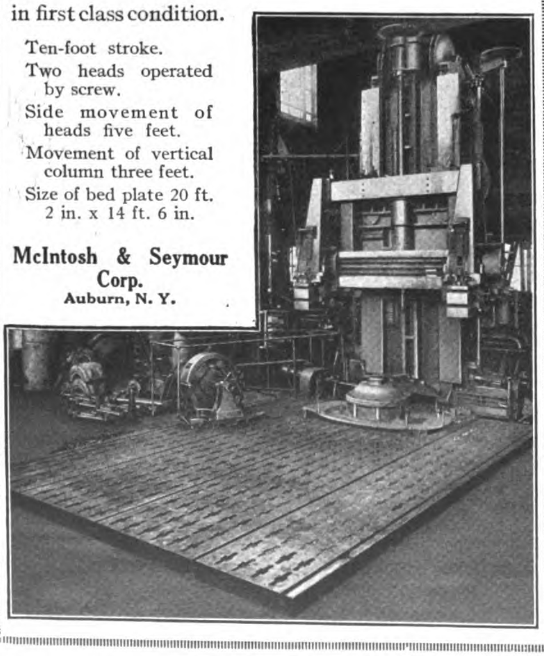
50 Church Street, Suite 482, Telephone Cortlandt 665 Warehouse, 408 Claremont Avenue, Jersey City. **New York.**

FOR SALE
VERTICAL SLOTTER

in first class condition.

Ten-foot stroke.
Two heads operated by screw.
Side movement of heads five feet.
Movement of vertical column three feet.
Size of bed plate 20 ft. 2 in. x 14 ft. 6 in.

McIntosh & Seymour Corp.
Auburn, N. Y.



CHARLES L. PARMELE

MACHINE TOOLS
NEW AND SECOND-HAND

Removed to **50 Church Street, N. Y. City** (Room 372)
(Telephone—Cortlandt 785)

FOR SALE

One 100-hp. Walrath gas engine, 12x12x12, friction clutch, pulley, magneto, outboard bearing.
Two 100-hp. Turner—Fricke gas engines, direct-connected to $67\frac{1}{2}$-kw., 250-d.-c.-volt generator, complete.
One Beaman & Smith adjustable 2-spindle boring mill.
One Bliss horizontal boring and tapping machine. All second-hand in good operative condition. Priced low.

Latshaw Machinery Company, Pittsburgh, Penna.

WOODWORKING MACHINERY
FOR SALE

Complete outfit of woodworking machinery, including planers, circular saws, swing saws, boring machines, scrapers, etc.

FS807—American Machinist.

HI-GRADE USED TOOLS

Lathes—H. S., C. R.
26 in. x 16 ft. Draper, T. A.
18 in. x 8 ft. L. & S. Pat. Hd. T. A.
18 in. x 8 ft. Fay & Scott
18 in. x 4 ft., 6 in. American, Q. C.
16 in. x 8 ft. L. & S. Q. C.
12 in. x 5 ft. Davis

Keyseater, No. 1 Davis
Drill Presses, 20-in., 28-in. slid. hd.
Planer, 24 x 24 in. x 8 ft. L. & D.
Planer, 16 x 16 in. x 3 ft. P. & W.
Motor, 100 hp., 220 v. dc., 780 rev.
Motor, 30 hp., 220 v. dc., 575 rev.
Screw Machine, $\frac{1}{2}$-in. Cleveland Auto.

McCOY-BRANDT MACHINERY COMPANY
Office and Warehouse: 216-18 Penn Ave., Pittsburgh, Pa.

Used Machinery

BORING MILLS
62-in. Vertical, two heads
5-in. bar Beaman & Smith horizontal
3½-in. bar Binsse horizontal

DRILLING MACHINES
Two-spindle Henry & Wright
Four-spindle Foote-Burt, power feed
Four-spindle Barr
Six-spindle National
6-sp. Gardam, adjustable
12-sp. Gardam multiple
21-in. Prentice Bros., upright
24-in. Sibley & Ware B. G. & P. F.
32-in. Cincinnati upright
4 and 3-ft. Dreses plain radials
4-ft. Niles radial
5-ft. American, radial
No. 25 Foote-Burt high speed

GEAR CUTTERS
22x4-in. Gould & Eberhardt, spur and bevel
11 Slate pinion cutter
64 x 16-in. G. & E. spur
No. 13 Brown & Sharpe, spur and bevel
18-in. Bilgrim gear planer

LATHES
11 x 5 Barnes
14 x 6 Lodge & Shipley
14 x 6 Young
16 x 6 Reed
20 x 10 Le Blonde
20 x 8 Lodge & Davis
26 x 14 American
28 x 14 Pond
26 x 14 New Haven
36 x 26 Fifield
38 x 10 Harrington

MILLERS
No. 1 P & W hand
Garvin, Lincoln
No. 2 Becker, vertical
No. 3 Reed, plain
No. 1 Van Norman Duplex

PLANERS
16 x 16 x 3 Pratt & Whitney
24 x 24 x 8 Pratt & Whitney
37 x 37 x 8 Gleason
30 x 30 x 8 Gray
52 x 36 x 12 Powell, two heads

MISCELLANEOUS
No. 17 Higley cold saw
20-in. Prentiss crank shaper
24-in. Hendey friction shaper
18-in. x 7-ft. Fay & Scott universal turret lathe
3½-in. Cleveland automatic screw machine
No. 1 B & S internal grinder
13-in. Gisholt turret lathe
No. 6 Hilles & Jones shear
Nos. 2, 3 and 4 Lapointe broachers
No. 1 Burr cold saw
No. 3A Warner & Swasey screw machine
1½-in. Reliance bolt cutter
No. 52 V & O press

Prentiss Tool & Supply Co.
149 Broadway - New York

LOOK!

And for Immediate Delivery

FELLOWS No. 6 Gear Shaper

ONE MONTH IN USE

Capacity External 35 in. Dia., 5 in. face, 4 pitch.

Capacity External 28 in. Dia., 3 in. face, 4 pitch.

Complete equipment also miscellaneous TOOLS and CUTTERS.

Hill, Clarke & Company, Inc.
156 Oliver Street - Boston
also
136 Cedar Street - New York City

SECOND HAND MACHINERY

Boring Machines.
No. 1 Barrett Cylinder Borer, 3½-in. bar, 5-ft. centers.
34-in. Colburn vertical, one head.
42-in. Bullard standard, one swivel, one turret head.
42-in. Bullard Rapid Production, one swivel, one turret head, quick power traverse.

Radial Drills
5-ft. Prentice Bros. plain, gear feed, tapping. (3)

Gear Cutting Machines.
6-in. Bilgram bevel gear generator.
18x4-in. Brainerd, spur.
48-in. Gould and Eberhardt spur.
Norris four spindle multiple semi-automatic.

Grinding Machines.
12x42-in. Landis universal.
12x72-in. Norton plain.

Engine Lathes.
24 in. x 12-ft. Peerless, compound rest 4-step cone.
24 in. x 12-ft. Fifield, compound rest.
24 in. x 16-ft. New Haven, compound rest, 4-step cone.
26 in. x 13-ft. Pond, compound rest.
13 in. x 6-ft. Blount speed lathe.

Milling Machine.
36x36 in. x 8-ft. Ingersoll Slab.

Planers.
16x16 in. x 4-ft. Pease.
24x24 in. x 5-ft. Gray.
24x24 in. x 6-ft. Lodge & Davis.
30x30 in. x 6-ft. Pond.

Screw Machines.
1-in. Pratt & Whitney hand screw machine.
No. 6 Warner & Swasey, latest pattern (3, one with power feed.)

Shapers and Slotters.
18-in. Smith & Silk plain crank.
16-in. Baker Bros. draw stroke, new.
20-in. Baker Bros. draw stroke slotter.

MARSHALL & HUSCHART MACHINERY CO.
17 S. Jefferson St., Chicago, Ill. 915 Chemical Building, St. Louis, Mo.

You Save Half Now!

in selections made from the equipment of five great industrial plants just purchased by us. Get prices on specimen snaps below. Write for our complete Machinery List No. AM-252.

15 24-in. B.G.; P.F. drill presses. 10-20 S. & L. F.
1 5-ton standard gauge locomotive traveling crane, 36-ft. boom.
1 Cincinnati double end punch and shear.
1 Pond engine lathe, 30-in. x 15-ft. B.G.; H.S.; C.P.R.
1 Lodge & Shipley engine lathe, 20-in. swing, 10-ft. bed, patent head, B.G.; Q.C.G.; C.P.R.; friction countershaft.
1 Bickford Drill & Tool Co. No. 2 60-in. radial drill, with tapping attachment.
1 Mitts & Merrill keyseater and countershaft.
1 Brown & Sharpe No. 13 Automatic gear cutter.
1 Special surface grinder with 12½-in. magnetic chuck and countershaft.
8 Cleveland automatic screw machines, ¾-in., 1¼-in., 2-in., 2¼-in. and 3¼-in.; all with countershafts.
1 24-in. Fellows gear shaper.
1 72-in. x 18-ft. Harrisburg Fdry. & Machine Co. planer, motor drive. (Also 5 other plane.s.)

Chicago House Wrecking Co., 35th and Iron Sts., CHICAGO, ILL.

Screw Machines

HAND AND AUTOMATIC

6—⅝ Automatic Screw Machines.
6—¾ Hartford Automatics.
6—1⅝ Hartford Automatics.
1—2¼ Gridley Automatic.
1—4¼ Gridley Automatic.
1—1x7 Acme Screw Machine.
2—1x6 Pratt & Whitney Screw Machines.
2—1⅝x6 Gray Screw Machines.
2—3x36 Jones & Lamson Lathes.
1—36x26x8 Putnam Planer.
1—30x30x10 Sellers Planer.
1—42x36x14 D. H. Cincinnati Planer.
1—4-Spindle Avey Drill.
1—Niles Floor Planer Head.
1—Grindstone and Frame.
1—Wet Tool Grinder.

The Cincinnati Planer Company
Cincinnati - - - Ohio

LATHES and TURRETS

12 in. x 5 ft. New Sheperd (5)
13 in. x 5½ ft. New Carroll Jamieson
13 in. x 7½ ft. New Carroll Jamieson (2)
13 in. x 5½ ft. LeBlonde Quick Change
14 in. x 10 ft. Prentiss T. A.
15 in. x 6 ft. New Carroll Jamieson Quick Change
16 in. x 6 ft. Blaisdell
16 in. x 6 ft. Harrington
16 in. x 7 ft. Wheeler
17 in. x 8 ft. New National, Q.C.G. (15)
18 in. x 8 ft. Lodge & Davis
19 in. x 8 ft. 6 in. Rahn Mayer
18 in. x 10 ft. Rahn Mayer, T.A.
18 in. x 10 ft. Cincinnati
18 in. x 14 ft. Fitchburg
20 in. x 10 ft. Flather
20 in. x 10 ft. Blaisdell
21 in. x 8 ft. Beaman & Smith heavy duty
3-19 in. x 8 ft. New Sidney swing 21 in. over V's
24 in. x 10 ft. Putnam
24 in. x 16 ft. Union
26 in. x 12 ft. Pittsburg D.B.G., Q.C.G.
27 in. x 14 ft. Star
26-48-in. x 14 ft. New Double Spindle McCabes New Style (11)
26-48-in. x 18 ft. New Double Spindle McCabes New Style (2)
28 in. x 13 ft. Harrington
28 in. x 15 ft. Harrington
30 in. x 15 ft. New Haven blocked to 36 in.
40 in. Swing Conradson semi-automatic turret 3½ in. H.S.
2x24 in. Jones & Lamson (2)
2½ in. Wire Feed B. G. Friction head Foster Ring
14 in. x 7 ft. Foster Ring B. G.
14 in. x 5 ft. Bridgeport
14 in. x 5 ft. Warner & Swasey Fox

Frank Toomey, Inc.
127-131 N. 3rd Street - - Philadelphia, Pa.

Contract Work

Contract Work

Dies
Jigs
Cutters
Gauges
Reamers
Fixtures
Designing
Special Tools
Metal Specialties
Special Machinery
Automatic Machinery
Thread-Cutting Tools

Let Us Solve Your Problems

Successful and economic production of interchangeable parts depends greatly upon accuracy, permanency and type of tools, dies, jigs, fixtures, gauges, etc. Our modern and thoroughly up-to-the-minute factory gives us one of the

Finest Tool Rooms in Country

We employ only the highest grade skilled specialists, tool and die makers; we have the latest and most improved machinery; these facts together with our method of production enable us to turn out high-grade work most economically.

Send for quotations—mail us blueprints for bids—forward samples of work and note our charges and the grade of work.

When we say we will deliver upon a certain day, it will be delivered that day—not the following. One trial will convince you. Try us.

KRASBERG MFG. COMPANY
412-420 Orleans Street - - Chicago, Ill.

Here's the Work We Do—

Jigs, Fixtures and Gauges. Tool work and light machine work of every description.

Here's How We Do It—

Accurately and economically Better have our estimate for future reference. Send us your blueprints and specifications now.

F. C. Sanford Manufacturing Co.
Bridgeport - - Connecticut

Engineering Service To Manufacturers

You need perhaps, jigs, gages, fixtures and other special tools for your plant. We can help you here. We design and build all kinds of special machinery. Our experience with manufacturers of fuses and war munitions may be of interest to you.

Write us for particulars.

The Carroll Engineering Co., Dayton, O.

SMALL MACHINES AND PARTS MANUFACTURED ON CONTRACT

We have an up-to-date machine plant, with every facility for making small machines, parts, novelties, etc., in quantities.
We want to do the manufacturing—you do the selling.
Submit your blue prints to us and we will tell you what we can do.

Crane Puller Co., 54 Lake Street, Arlington, Mass.

Excellent Workmanship and First-Class Service at

QUALITY MACHINE WORK

Moderate Cost

The Luster-Jordan Co.
NORRISTOWN, PA.

Contract Work

Contract Work

Our Men are not "Agin the Management"

If you will consider a moment you will appreciate that this means that a higher class of workmanship must result.

Every man in our plant constantly uses his best endeavors to produce the finest in whatever he does, be it a jig, fixture or special machine, and to perform this duty in a reasonable length of time.

Rush is a word that our men know often spells disaster—but on the other hand their chief interest is not in how fast the clock runs in combination with how slow they dare feed a machine tool.

These men will design and build your jigs, fixtures and special machines better and in the long run quicker.

Don't you want them for your work?

Hartford Special Machinery Co.
287 Homestead Avenue - Hartford, Conn.

SHEET METAL STAMPINGS

Shims
Pipe Clips
Special Washers
Light Drawn and Flat Work

The Kales-Haskel Co., Detroit, Michigan

G.P.&F. Service
"Knowing How Since 81"

SPECIAL STAMPINGS

More than thirty-four years' experience in drawing, spinning and stamping metals and a plant covering more than fifteen acres of floor space enables us to do difficult work right. Send blueprints or samples for estimates.

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FOR EVERY MARKING NEED

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We make dies, jigs and fixtures. Our work is of the highest quality and our prices are very reasonable. We employ highly skilled die-makers and our equipment and shop conditions are practically perfect.

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Our large well equipped shop is making the most accurate tool and gauge work at lowest cost.

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Engine Bases
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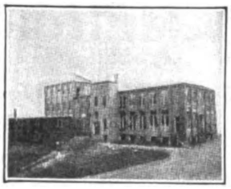

to attain better and quicker results from your **special machines** by building them for you in any quantity in this modern factory at a much lower cost than you could possibly secure in your own shop.

Our engineers, machinists and draftsmen are men trained in their line of work. Special machinery, machine parts, dies, jigs, fixtures and tools designed and built to your order—in any quantity. Special rates on contracts.
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Send us blueprints and we will gladly furnish estimate.

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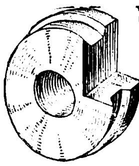

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Only the most exact and searching tests can reveal the error, but it is there all the same.
Souther Inspection Service protects you from these and other troubles.
Let us tell you how.

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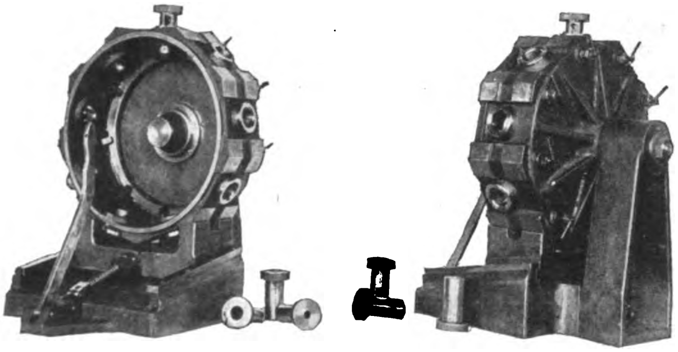
TRADE MEHL MADE MARK



At first they decided to sacrifice Quality for speed—

So they withdrew a fixture order that had been placed with us and turned it over to another shop—

But the order was returned to us soon after, and we have done all of that company's work since.

DO NOT infer that Mehl-made Jigs, Fixtures, Dies, Gages and special machinery require extra time in the making—

On the contrary they are built in a minimum of time—quality considered.

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Special Tool Work

is the backbone of our main line and we are especially well equipped in every division of our plant to execute all orders with speed and accuracy. We have the men—the machines—the ability.

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JIGS, TOOLS, FIXTURES, GAGES, DIES

Best Quality Workmanship, Expert Tool Makers
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We have doubled our lathe equipment and have installed other new equipment.

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Send specifications for estimates, correspondence invited.

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Machine parts in large or small quantities.

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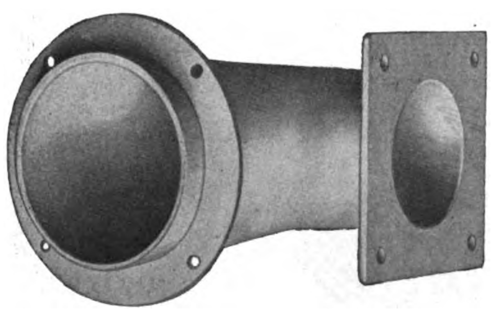
Toot! Honk! We are making millions of automobile parts for high-grade machines—better castings at less cost—of aluminums and white brasses. And thereby we have saved thousands of dollars for others. Let us show you how you can obtain better castings and at the same time cut your production costs. Send today for particulars and interesting booklet.

Better diecastings

Stewart Manufacturing Company
Wells Street Bridge :: Chicago



This talking-machine part is now die-cast cheaper than formerly machined from brass sand castings.

MORE than one manufacturer in close competition thanks our *"Quality* Die Castings" for the saving they afford against the cost of machine finishing.

Perhaps we can cut your production cost, too.

LIGHT MFG. & FOUNDRY CO.
Pottstown, Pa., U. S. A.

(72)

This Way Is Easier

Just immerse the wash basket of parts to be cleansed of oil, grease and chips into the Gray & Prior **Soda and Potash Kettle.**

This is the easiest way to thoroughly and economically cleanse newly made machine parts, such as screws, nuts, bolts, gears, studs, etc.

Two cents worth of common sal soda to the gallon of boiling water takes the place of expensive gasoline cleansing and eliminates all fire risk.

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"Coes"

on a wrench stands for Quality and Service. They are our watchwords. When you want a wrench think of "Coes."

Write for the Facts. about Coes Wrenches.

Coes Wrench Co.
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Made to your formula. Machined to your specifications. Brass and Bronze Castings. Special machine work.

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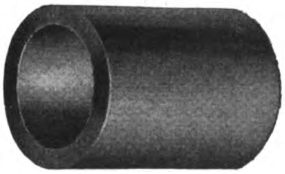

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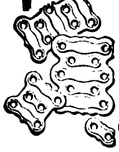
CRESCENT BELT FASTENERS

run over the pulleys without thump or loss of traction. The power transmitted is always uniform—and the joint will "outlast the belt."



Send for Booklet Five

Crescent Belt Fastener Co.
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You use them, perhaps. Get our catalog of **Steel Stamps, Interchangeable Solid Steel Type, Steel Letters, Figures,** etc., and save money. Used for stamping and embossing metals of all kinds.

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Try the **MILLER KEYSTONE FLUX** for all metals, especially for making metals strong and clean. Our RADIOCLARITE is known the world over as an economizer and quality raiser for Brass and Bronze.

Send for a trial order. We ask no pay unless it proves satisfactory after trial.

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There is nothing better than the Best

To secure 100% Economy and 100% Efficiency, use W. N. Best oil and tar burners and furnaces for Annealing, Case Hardening, Tempering, Forging, Heat Treating, etc. Send for Catalog.

"There is nothing better than the Best"

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Manufacturers of "Stamford Superior Stock" in

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A. J. Witt, Manager, Cumberland Foundry & Mfg. Co., Nashville, Tenn., was until a few months ago like hundreds of other foundries—fairly successful and contented.

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Business jumped—began to boom—orders poured in beyond capacity, although his castings cost more—Why? Because

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Isn't it reasonable to suppose what he has done for Witt and hundreds of others he can do for you? Why not get the whole story—free for the asking—no obligation incurred.

McLain's System

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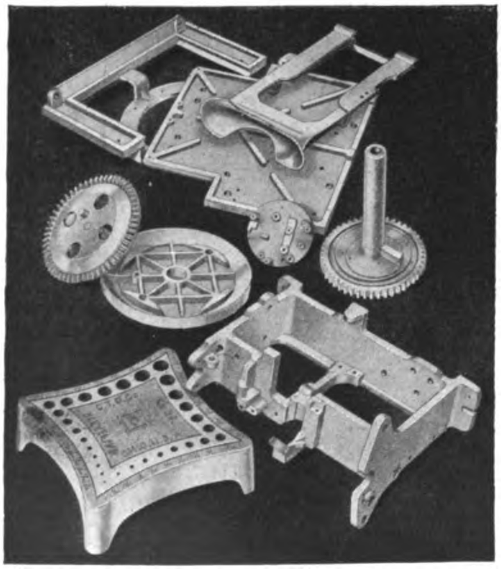
The Franklin Die-Casting Process

The Direct Way to Results



The parts shown above were produced at a saving to our customers over the usual machine methods.

We can reduce your manufacturing cost, too. Let us have your samples or blue prints for quotation.

Booklet "H" on request.

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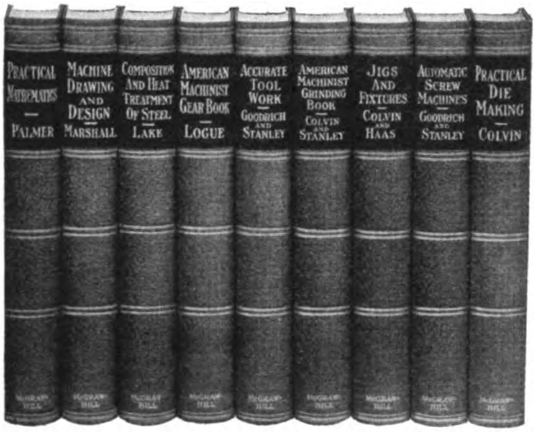
Especially in Machine-Shop Practice—



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facts and details which must be unvarying in their practical application to the work you are doing. No experimentation must be indulged in.

When you read books you do so in order to improve upon your own methods—to increase your knowledge and earning power. There are no other incentives. Books purporting to tell how to improve methods, knowledge and earning power in the machine-shop field must necessarily be of a high standard, otherwise they could not possibly receive recognition at the hands of the machine-shop man of today, who demands accuracy, authoritativeness, conciseness.

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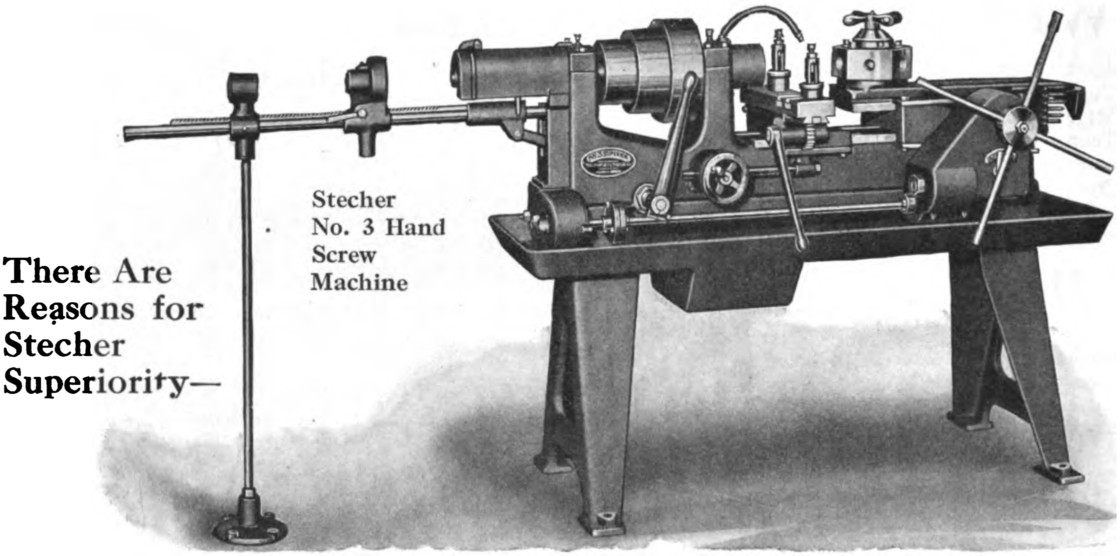

Stecher No. 3 Hand Screw Machine

There Are Reasons for Stecher Superiority—

The efficient and economical operation of the machine is not the result of chance. There are reasons for its quality, finish, accuracy and workmanship.

And all of these reasons are pointed out in the descriptive circular. Have you had YOUR copy?

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A Stronger Set Screw Reasonably Priced

The Eagle Safety Set Screw is made from selected bar stock, strong enough to triumph over every strain to which it is exposed under actual service conditions. It's reasonably priced, too.

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Get Our Booklet "7-A"

"Barnes-made" Springs are guaranteed to be satisfactory. They are not ordinary "Commercial" Springs, but are made with care and precision, and their action may be depended upon.

We make every known type from every known spring material.

We have a booklet that is very interesting. Please ask for Booklet "7-A."

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Man'f'rs of "Barnes-made" Products

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THE NO-SLIP PULLEY CEMENT

is a scientifically prepared cement that may be quickly applied with a brush to metal, wood or composition pulleys. It furnishes a hard, dry surface that absolutely prevents belt slipping, without loss of power through adhesion.

Every gallon is sold under a guarantee to produce results or no pay asked.

Send for our Booklet, which contains a test from the Massachusetts Institute of Technology, also testimonials from many satisfied users.

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We design and build furnaces for every purpose using any fuel. If you do ANNEALING, HARDENING, TEMPERING, CASE-HARDENING, CYANIDE HARDENING, FORGING, MELTING, etc., write us for catalog No. 47.

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Replace Your Man-Killers With a Safe, Reliable Invention!

Wild beasts of prey are less treacherous than the man-killing setscrews and flange couplings which so often take their toll in shops and factories.

A loose sleeve, an open jumper or an overall support offers these old-fashioned contrivances their opportunity to slay or mangle your men. That can all be eliminated by the use of a horse-sense coupling—one that locks itself—locks harder as the load is increased—and has no screws, bolts or nuts to catch clothing or hair. Such a coupling is the

Bull Dog Shaft Coupling

This coupling, endorsed by the Workman's Compensation Bureau and the American Museum of Safety, is simply a smooth metal cylinder in which are two eccentric chambers each having a rolling lock that grips the shaft solidly.

BULL DOG SHAFT COUPLING TRADE MARK REGISTERED

No tools are needed to put on or take off the coupling—there is nothing to wear out—nothing to mar the shaft. It will take care of considerable error in alignment with little or no power loss.

Our free booklet with full description and sizes and prices sent to interested executives.

Automatic Shaft Coupling Company

Alexandria—Virginia

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Central Distributing Co.	Detroit, Mich.	Lyon & Grumman Co.	Bridgeport, Conn.
Central Distributing Co.	Jackson, Mich.	Chas. A. Templeton, Inc.	Waterbury, Conn.
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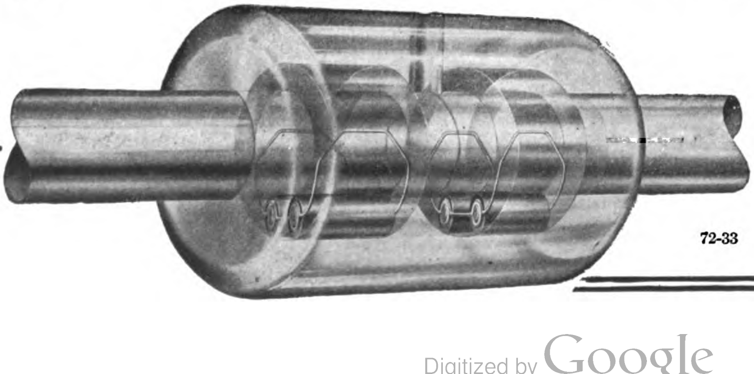

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72-33

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"New Yankee"
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Will grind your drills perfectly, saving up to $\frac{2}{3}$ of your drill cost.

Most drill breakage, and a large proportion of wear, result from improper grinding. It's impossible to get the point of a drill exactly centered, with each cutting lip at the same angle—by any method of hand grinding. But with the "New Yankee" it's practically impossible to get anything but absolutely perfect grinding—a boy can do it.

Let us give you actual details on the "New Yankee" Drill Grinder—how it's built and what it is actually doing. Write to us.

Wilmarth & Morman Co.
1187 Monroe Avenue
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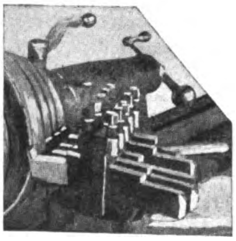
Have That Safe Feeling

IF you run up against a problem in your shop that you are not exactly sure about, ask Information Dept., American Machinist, N. Y.

TOTALLY DIFFERENT

from any other tool holder on the market, the

REX Tool Post



More than doubles the capacity of your lathe.
You can set as many Rex posts as you like, close up together, each one making a different cut *at the same time.*
This means increased output *at lower* cost so the Rex more than pays for itself in a very short time.

Write for Bulletin

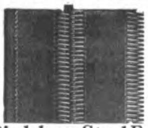
Rex Mfg. Co., Hyde Park Dist., Boston, Mass.

C·O·L·U·M·B·U·S

The massive, powerful 21-in. Engine Lathe—single purpose, heavy duty, especially adapted to fast, accurate outside turning of shells up to 9.2 in. and boring up to 6 in.

The Dunlap Mfg. Co. :: Columbus, Ohio

The Jackson Belt Lacing Machine

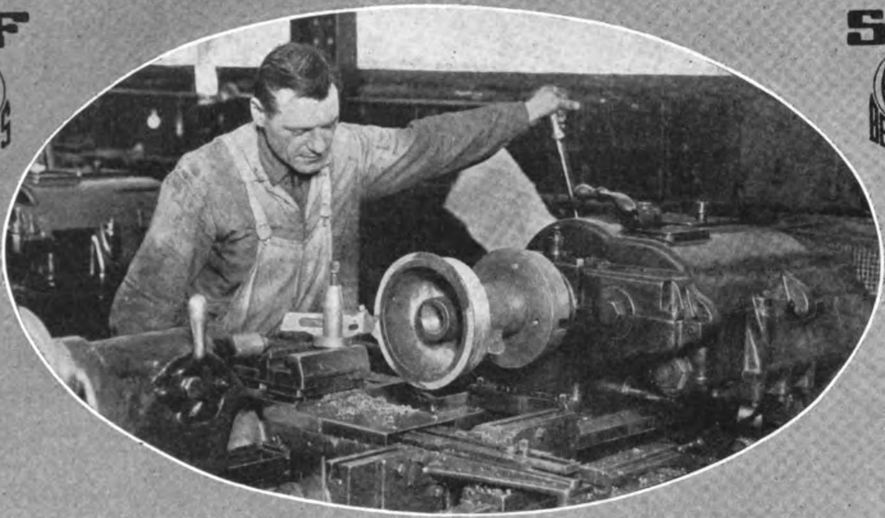


saves its cost every few months. It's light and portable and produces a joint in three minutes that will stand a tensile strength of 1900 lbs. With it one man can do in three minutes at a cost for material of one cent, what usually requires a half hour of two men's time and 10 to 12 cents worth of rawhide the old way. Write for the "Jackson Book."

BirdsboroSteelFoundry & MachineCo., Birdsboro, Penn.

SKF BALL BEARINGS

SKF BALL BEARINGS



Making It Easier For The Lathe To Do Its Work

Here you see an 18-in. Greaves-Klusman Lathe at work in the plant of the Ward Motor Vehicle Co. at Mt. Vernon, N. Y.

They write—"The SKF Ball Bearings after nine months hard work are in perfect condition."

This paragraph taken direct from this Company's letter, shows the kind of service rendered by SKF Ball Bearings.

And the service is strenuous in the extreme. The lathe is working on cast steel wheel hubs, the 10-in. diameter of drum being finished in two operations.

To quote again from the letter: "Very little time is required for oiling these machines as all the ball bearings are oiled from the gear cases."

SKF Ball Bearings are standing up to hard service in this case, as well as they do in all. Nine months steady use in a "hog for work" fails to impair their remarkable efficiency one iota.

Look for SKF. It is your guarantee of quality. It means that SKF Ball Bearing thrusts increase the accuracy of the cut and reduces the power consumption of the lathe.

Write for Bulletin No. 25 for more details.

SKF BALL BEARING CO.

Hartford - - - - - - - Connecticut

Buyers Cyclopedia

Abrasive Materials
American Emery Wheel Works, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y. New York City, Chicago, Boston, Phila., Cleveland, Cincinnati, Pittsburgh, Milwaukee, Grand Rapids, Manchester, Eng.; Dusseldorf, Germany.
Carborundum, Aloxite, garnet abrasive products. Carborundum and Aloxide grains, Carborundum paper and cloth, Aloxite cloth, garnet paper and cloth, Carborundum sharpening stones, rubbing bricks.
Dickinson, Thomas L., 64 Nassau St., N. Y. City.
Norton Co., Worcester, Mass., U. S. A. Cable: "Norco." Branches: New York, 151 Chambers St.; Chicago, 11 N. Jefferson St.; Niagara Falls, N. Y.; Chippewa, Ont., Canada; Bauxite, Ark.; Wesseling, Bz. Coln, Germany.
Alundum and Crystolon. Alundum is an artificial aluminous abrasive for grinding steel and steel alloys. Crystolon is a carbide of silicon abrasive, made in the electric furnace, for grinding cast, wrought or malleable iron, brass, bronze, aluminum, marble and materials of like physical characteristics.
Safety Emery Wheel Co., Larch St., Springfield, O. Agents: Farmer & Co., London; Adler Eisenchitz, Milan; Allied Machy. Co. of America, Paris.
Springfield Grinding Co., Springfield, Mass., U. S. A. Address inquiries to factory, Chester, Mass., U. S. A.
"Maxf" grinding materials.
Vitrified Wheel Co., Westfield, Mass.

Accumulators, Hydraulic
Elmes, Chas. F., 1001 Fulton, Chicago, Ill.
Watson-Stillman Co., 42 Church St., N. Y. City.
Worthington Pump & Machinery Corporation, 115 Broadway, New York City.

Air Lifts
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Michigan Ave., Chicago, Ill.
Patented, improved foot-pieces, well heads and boosters.
Worthington Pump & Machinery Corporation, 115 Broadway, New York City.

Air Purifiers and Coolers
American Blower Co., 1400 Russell St., Detroit.
Worthington Pump & Machinery Corporation, 115 Broadway, New York City.

Analyses, Chemical
Souther Engineering Corp., Hy., Hartford, Conn.

Arbors
Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
Cleveland Twist Drill Co., Cleveland, Ohio.
Cushman Chuck Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Co., Hartford, Conn.
Pratt Chuck Co., Frankfort, N. Y.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Union Mfg. Co., New Britain, Conn.

Axles
Camden Forge Co., Mt. Ephraim Ave., Camden, N. J.

Balancing Machines, Dynamic
Dynamic Balancing Machine Co., Philadelphia, Pa.

Balancing Ways
Bowsher Co., N. P., South Bend, Ind.

Balls, Brass and Bronze
Auburn Ball Bearing Co., 25 Elizabeth St., Rochester, N. Y.
Hoover Steel Ball Co., Ann Arbor, Mich.

Balls, Steel
Abbott Ball Co., Box 1233, Hartford, Conn.
Auburn Ball Bearing Co., 25 Elizabeth St., Rochester, N. Y.
Frasse & Co., Peter A., 417 Canal St., N. Y. C.
Hoover Steel Ball Co., Ann Arbor, Mich.
New Departure Mfg. Co., Bristol, Conn.

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Root & Vandervoort Engineering Co., East Moline, Ill.
Traylor Engineering & Mfg. Co., Allentown, Pa.
For turning copper bands in shells 2" to 6".

Barrels, Tumbling
Abbott Ball Co., Box 1233, Hartford, Conn.
Mott Sand Blast Co., 1157 E. 138th St., N. Y. C.
Pangborn Corp., Hagerstown, Md.
Royersford Fdry. & Mach. Co., Royersford, Penn.

Bars, Boring
Cleveland Twist Drill Co., Cleveland, Ohio.
Detrick & Harvey Mach. Co., Baltimore, Md.
Marvin & Casler Co., Canastota, N. Y.
Underwood & Co., H. B., 1026 Hamilton St., Philadelphia, Penn.
Catalog sent on request.

Bars, Bronze Cored
American Bronze Co., Berwyn, Penn. 429 Ford Bldg., Detroit, Mich. Cable: Ambrocom, Phila.
All sizes "Non-Gran" bronze bars 12" long.
See advertisement on back cover.
Bunting Brass & Bronze Co., 726 Spencer St., Toledo, Ohio.

Bearings, Ball
Auburn Ball Bearing Co., 25 Elizabeth St., Rochester, N. Y.
Thrust and annular ball bearings to 26" diam.
Ball & Roller Bearing Co., Danbury, Conn.
Fafnir Bearing Co., The, New Britain, Conn. Detroit Office: 752 David Whitney Bldg.; Chicago Office: Cor. Clinton and Monroe St.
All sizes. Light, medium and heavy types. Radial ball bearings, single and double row. Ball thrust bearings. Angular contact bearings for combined radial and thrust loads. Cone or magneto type bearings.
Gwilliam Co., 58th St. and Broadway, N. Y. City.
Thrust, annular and roller bearings. All types, all sizes, metric and inch dimensions. Distributor New Departure Bearings.
Hess-Bright Mfg. Co., Front St. and Erie Ave., Philadelphia, Penn. Cable: Hessbright.
Ball bearings made for heavy duty and high speeds, on both annular and thrust loads.
New Departure Manufacturing Co., The, N. Main St., Bristol, Conn. Cable: Departure, Bristol. Branch: 1016-17 Ford Bldg., Detroit, Mich.
New Departure ball bearings in three types, double row, single row and radax.
Agents throughout the country.
Norma Co. of America, 1790 Broadway, New York. Cable: Normaco, New York.
Ball bearings of open separable type rigidly mounted. Thrust units made in both single and double types with or without housings.
S K F Ball Bearing Co., Hartford, Conn. Cable Address: Skayef, Hartford.
S K F ball bearings, both radial and thrust, are made in all international standardized sizes from Swedish crucible steel. The design of these bearings is such that they are self-aligning; that is, the inner race automatically adjusts itself to compensate for any shaft deflection or load change. The bearing consists of an outer race, an inner race, two rows of balls and a single piece retainer.
U. S. Ball Bearing Mfg. Co., Oak Park, Ill. Cable: Ballbear.
Radial and thrust types.

Bearings, Die-Cast
Acme Die Casting Corp., Bush T. 5, Brooklyn.
Doehler Die Casting Co., Court and Ninth St., Brooklyn, N. Y. Branch: Toledo, Ohio. Cable: Doehler, Brooklyn.
Germann Bronze Co., 345 W. 19th St., Erie, Penn.
Light Manufacturing & Fdry. Co., Pottstown, Pa.

Bearings, Journal
American Bronze Co., Berwyn, Penn. 429 Ford Bldg., Detroit, Mich. Cable: Ambrocom, Phila.
Arguto Oilless Bearing Co., Philadelphia, Penn.
Bunting Brass & Bronze Co., 726 Spencer St., Toledo, Ohio.
Sterling Specialty Co., Newcomerstown, Ohio.

Bearings, Roller
Ball & Roller Bearing Co., Danbury, Conn.
Gwilliam Co., 58th St. and Broadway, N. Y. City.
All types and sizes. Thrust, journal and taper.
Norma Co. of America, 1790 Brodaway, N. Y. C. Cable: "Normaco," New York.
Royersford Fdry. & Mach. Co., Royersford, Penn.

Belt Cement
Graton & Knight Mfg. Co., Worcester, Mass.
Houghton & Co., E. F., 240 W. Somerset St., Philadelphia, Penn.
Schieren Co., Chas. A., 41 Ferry St., N. Y. City.

Belt Clamps
Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., The, New Haven, Conn., U. S. A.

Belt Dressings and Fillers
Crescent Belt Fastener Co., 381 4th Ave., N. Y. C.
Graton & Knight Mfg. Co., Worcester, Mass.
Houghton & Co., E. F., 240 W. Somerset St., Philadelphia, Penn.
Rhoads & Sons, J. E., 32 N. 3d St., Phila., Pa.
Schieren Co., Chas. A., 41 Ferry St., N. Y City
Texas Company, Dept. A, 17 Battery Pl., N. Y. C.
White & Bagley Co, Worcester, Mass.
"Neverslip" belt dressing.

Belt Fasteners
Bristol Co., Waterbury, Conn.
Clipper Belt Lacer Co., 1004 Front Ave., Grand Rapids, Mich.
Crescent Belt Fastener Co., 381 4th Ave., N. Y. C.

Belt Lacing
Chicago (Ill.) Rawhide Mfg. Co., 1301 Elston Ave.
Clipper Belt Lacer Co., 1004 Front Ave., Grand Rapids, Mich.
Crescent Belt Fastener Co., 381 4th Ave., N. Y. C.
Graton & Knight Mfg. Co., Worcester, Mass.
Houghton & Co., E. F., 240 W. Somerset St., Philadelphia, Penn.
Rhoads & Sons, J. E., 32 N. 3d St., Phila., Pa.
Schieren Co., Chas. A., 41 Ferry St, N Y. City.

Belt Shifters
Le Blond Machine Tool Co., Cincinnati, Ohio.

Belt-Lacing Machines
Birdsboro Steel Fdry & Mach. Co., Birdsboro, Pa

Belting, Chain
Caldwell Son Co., H. W., 17th St. and Western Ave., Chicago, Ill.
Link-Belt Co., 39th St. and Stewart Ave., Chicago, Ill. Philadelphia and Indianapolis.
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Conn.

Belting, Endless
Brown Mfg. Co., Arthur S., Tilton, N. H.
Tilton patented endless belts; woven in one continuous piece without seam, lap or splice. Not affected by oil, heator moisture,and will not stretch.
See advertisement and send for catalog.

Belting, Leather
Chicago (Ill.) Rawhide Mfg. Co., 1301 Elston Ave
Graton & Knight Mfg. Co., Worcester, Mass.
Get "Spartan Book No. 3."
Houghton & Co., E. F., 240 W. Somerset St., Philadelphia, Penn.
Rhoads & Sons, J. E., 32 N. 3d St., Phila., Pa. 122 Beekman St., N. Y.; 342 W. Randolph St., Chicago.
Oak tanned; Watershed Oak and Tanate.
Schieren Co., Chas. A., 41 Ferry St., N. Y. City

Benches, Work
Manufacturing Equipment & Engineering Co., 209 Washington St., Boston, Mass.
New Britain Machine Co., New Britain, Conn.
Portable and stationary work stands, pressed-steel trays, with or without drawer.
Western Tool & Mfg. Co., Springfield, Ohio.

Bench Legs
New Britain Machine Co., New Britain, Conn.
Pressed steel, electrically welded; patented stringer feature permits wide spacing of legs without wall support.

Bending Machines, Power
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.

Blocks, Chain (See Hoists, Hand)

Blocks, Die
Halcomb Steel Co., Syracuse, N. Y.

Blowers
American Blower Co., 1400 Russell St., Detroit.
American Gas Furnace Co., 24 John St., N. Y. C.
Ingersoll-Rand Co., 11 Broadway, New York City.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Penn.

Blue Printing Machinery
Wickes Bros., Saginaw, Mich.

Blue Prints
Wickes Bros., Saginaw, Mich.

Bolt and Nut Machinery
Acme Machinery Co., Cleveland, Ohio. Cable Address: Acme, Cleveland.
Baush Machine Tool Co., 604 Wason Ave., Springfield, Mass., U. S. A.
Stay bolt threading machines and bolt turning machines for both straight and taper bolts.
Davis Machine Tool Co., Inc., 311 St. Paul St., Rochester, N. Y.

Some of the Advantages of

SYMINGTON

Single Purpose Shell Machines

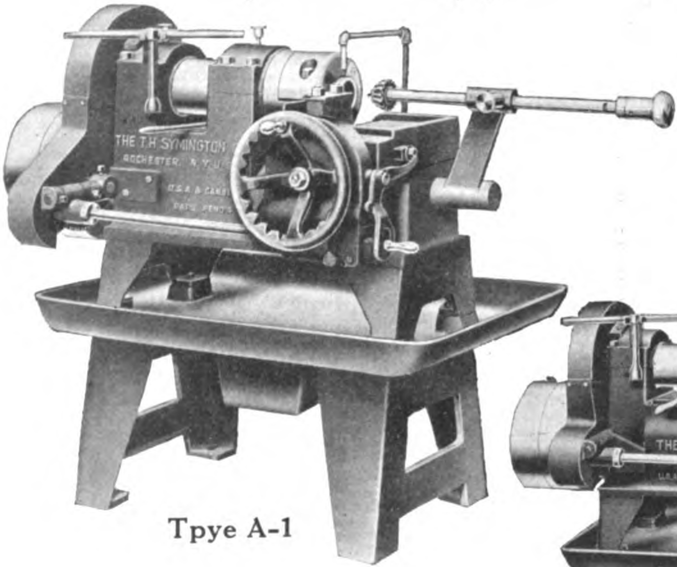
Large and Heavy Slides and Moving Parts
—to reduce vibration, maintain accuracy and original alignment, and give durability

Less Number of Joints Between Support of Tool and Support of Work
—to diminish spring of tool and work supports and increase rigidity

Less Distance Between Spindle Bearing and Ways
—to increase rigidity and accuracy

More Room and Better Support for Cutting Tools
—to make the tooling more simple and inexpensive

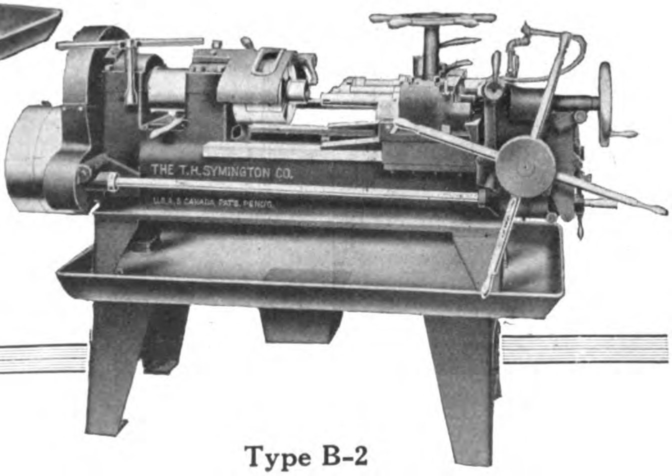
The operations are simplified and are performed by unskilled labor.



Tpye A-1

THE T. H. SYMINGTON COMPANY

Machine Tool Dept. Rochester, N. Y.



Type B-2

Detrick & Harvey Mach. Co., Baltimore, Md.
Greenfield Tap & Die Corp., Greenfield, Mass.
Landis Machine Co., Waynesboro, Penn.
Bolt cutters, single, double and triple head, ½" to 4". Staybolt machines 1½". Bolt pointers 1½", 2". Equipped with variable speed motor or belt drive. Agents: Alfred Herbert, Ltd., entry, England; Alfred H. Schutte, Berlin, Cologne, Brussels, Bilbao and Barcelona; Ernst Krause & Co., Vienna, Austria; D. Drury & Co., Johannesburg, South Africa; Benson Bros., Sydney and Melbourne, Australia.
National Machinery Co., Tiffin, Ohio.
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Reed-Prentice Co., Worcester, Mass.
Victor Tool Co., Waynesboro, Penn.
Wells Bros. Co., Greenfield, Mass.

Bolts and Nuts
National-Acme Mfg. Co., Cleveland, Ohio.

Bone, Case Hardening
Houghton & Co., E. F., 240 W. Somerset St., Philadelphia, Penn.

Books, Technical
McGraw-Hill Book Co., 239 W. 39th St., N. Y. C.
Colvin & Stanley's American Machinist Handbook, $3 postpaid. Halsey's Handbook for Machine Designers and Draftsmen, $5 postpaid. Croft's American Electrician's Handbook, $3 postpaid. Van Deventer's Handbook of Machine Shop Management, $2.50 postpaid. Machine Shop Library, a set of nine volumes covering the practical side of machine shop practice, $16 postpaid.

Boosters
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Penn.

Boring and Turning Mills, Vertical
Betts Machine Co., Wilmington, Del. Cable: "Bettwell."
Sizes 5' to 30' swing.
Bickford & Co., H., Lakeport, N. H.
Five sizes, 4, 5, 6, 7 and 8 ft. swing, either belt or motor driven, swivel heads. Power traverse if desired. Send for catalog.
Bullard Machine Tool Co., Bridgeport, Conn.
Cincinnati Planer Co., Cincinnati, Ohio.
Colburn Machine Tool Co., Franklin, Penn.
Sizes 30", 34", 42", 48", 54", 60", 72".
Detrick & Harvey Mach. Co., Baltimore, Md.
Mitts & Merrill, 913 Tilden St., Saginaw, Mich.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Sellers & Co., Inc., Wm., Philadelphia, Penn.

Boring, Drilling and Milling Machines, Horizontal
Barnes Co., W. F. & John, 1995 Ruby St., Rockford, Ill.
Baush Machine Tool Co., 604 Wason Ave., Springfield, Mass., U. S. A.
Special multiple spindle horizontal drilling machines.
Beaman & Smith Co., Providence, R. I.
Betts Machine Co., Wilmington, Del. Cable: "Bettwell."
Coats Mach. Tool Co., Inc., 30 Church St., N. Y. C.
Detrick & Harvey Machine Co., Baltimore, Md. Cable: Detharvey.
Spindle 3½" to 8". Floor type only. Motor or belt drive. All gear feeds. Rapid power traverse. Rotary tables for hand or power and universal tilting table. Screw-cutting attachment can be furnished. Any size bed.
Fosdick Machine Tool Co., Cincinnati, Ohio.
Horizontal No. 0, spindle 3⅛.
Hoefer Mfg. Co., Freeport, Ill.
Lucas Machine Tool Co., E. 99th St. and N. Y. C. R.R., Cleveland, O. Cable: Lucas, Cleveland.
Three sizes, 3", 3¾" and 4½" spindles.
For boring, milling and drilling as separate operations, or all three operations, at one setting of the work.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., 7th and S. N St., Richmond, Ind. Cable: Natco, Richmond.
Horizontal multiple spindle drilling machine. Three sizes, 2 to 150 spindles from 2 to 5 directions simultaneously.
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Pawling & Harnischfeger Co., Milwaukee, Wis.
Prentiss Tool & Supply Co., Singer Bldg., N. Y. C.
Sellers & Co., Inc., Wm., Philadelphia, Penn.
Springfield Machine Tool Co., Springfield, Ohio. Cable: Montanus. Spindle and axle boring machines, 2 sizes, 7"x60" and 11"x84".
Universal Boring Machine Co., Hudson, Mass., U. S. A. Cable: "Horizontal," Hudson.
No. 3-A Universal (horizontal) boring machine has 3" main boring bar with 28" continuous feed table 24" by 48" with 36" power crossfeed. No. 3½ Universal (horizontal) boring machine has 3½" main boring bar with 30" continuous feed, 30" vertical movement. Table 30" by 48" with 36" power crossfeed.
Vandyck Churchill Co., 93 Liberty St., N. Y. C.

Boring Heads
Marvin & Casler Co., Canastota, N. Y.
Radical Boring Head Corp., 90 West St., N. Y. C.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

Boring Tools
Union Caliper Co., Orange, Mass.

Western Tool & Mfg. Co., Springfield, Ohio.
Williams Co., J. H., 35 Richards St., Brooklyn.

Boxes, Tote (See Furniture, Machine Shop)

Broaches
Lapointe Co., J. N., New London, Conn. Cable: Lapointe, New London.
Lapointe Machine Tool Co., Hudson, Mass.
For any class of work, for use on any broaching or keyseating machine.
Send for Catalog "C."
Taft-Peirce Mfg. Co., Woonsocket, R. I.

Broaching Machines
Lapointe Co., J. N., New London, Conn. Cable: Lapointe, New London.
Five sizes.
No. 0 machine, capacity to cut keyways ¼" wide by 2" long, sq. holes ½" sq. by 1" long. No. 1 machine, keyways ⅝" wide by 3" long, sq. holes ¾" sq. by 1½" long. No. 2 machine, keyways ¾" wide by 8" long, sq. holes 1½" sq. by 4" long. No. 3 machine, keyways 1½" wide by 10" long, sq. holes 3" sq. by 6" long. No. 4, keyways 2½" wide by 20" long, sq. holes 5" sq. by 12" long.
Lapointe Machine Tool Co., Hudson, Mass. Cable: "Lapointe, Hudson."
Four sizes—No. 1, square holes up to ¾"; No. 2, square holes up to 1¼"; No. 3, square holes up to 3"; No. 4, square holes up to 4". Round or irregular shapes of larger sizes can be handled. Send for Catalogue C.

Bronze
American Bronze Co., Berwyn, Penn. 429 Ford Bldg., Detroit, Mich. Cable: Ambrocom, Phila.
"Non-Gran" high-speed bearing bronze for solid nonadjustable bronze bushings.
See advertisement on back cover.
Lumen Bearing Co., Buffalo, N. Y.

Buffing or Polishing Machines
Barnes Co., W. F. & John, 1995 Ruby St., Rockford, Ill.
Blake & Johnson Co., The, Waterbury, Conn.
Blount Co., J. G., Woodland St., Everett, Mass.
Bryant Chucking Grinder Co., Springfield, Vt.
Forbes & Myers, 172 Union St., Worcester, Mass.
Greenfield Machine Co., Greenfield, Mass.
Heald Machine Co., 10 New Bond St., Worcester, Mass.
Landis Tool Co., Waynesboro, Penn. Cable: Landis, Waynesboro.
Types—Universal and plain cylindrical, internal, crank, roll, ball bearing race grinding machines.
New Britain Mach. Co., New Britain, Conn.
Plain and ball bearing, drop-head, down-belted, floor and bench types.
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Norton Grinding Co., Worcester, Mass.
Rowbottom Machine Co., Waterbury, Conn.
Royersford Fdry. & Mach. Co., Royersford, Penn.
Safety Emery Wheel Co., Larch St., Springfield, O.
Union Twist Drill Co., Athol, Mass.
U. S. Electrical Tool Co., Cincinnati, Ohio.
Van Norman Machine Tool Co., Wilbraham Ave., Springfield, Mass.
Vitrified Wheel Co., Westfield, Mass.
Walker & Co., O. S., Worcester, Mass.
Wells & Son Co., F. E., Greenfield, Mass.
Wilmarth & Morman Co., 1187 Monroe Ave., Grand Rapids, Mich.
Worcester Pattern & Model Co., Worcester, Mass.

Bulldozers
Toledo Machine & Tool Co., Toledo, Ohio.

Bushings
American Bronze Co., Berwyn, Penn. 429 Ford Bld., Detroit, Mich. Cable: Ambrocom, Phila.
All sizes Non-Gran cored and solid bars 12" long. Also castings and bushings.
See advertisement on back cover.
Bunting Brass & Bronze Co., 726 Spencer St., Toledo, Ohio.
Lumen Bearing Co., Buffalo, N. Y.
Phosphor Bronze Smelting Co., 2200 Washington Ave., Philadelphia, Penn.
Sterling Specialty Co., Newcomerstown, Ohio.

Calipers
Athol Machine Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Randall & Stickney, Waltham, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Union Caliper Co., Orange, Mass.
Williams Co., J. H., 35 Richards St., Brooklyn.

Cam Cutting Machines
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Rowbottom Machine Co., Waterbury, Conn.
For cutting all kinds of cams in general use.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

Cams
Boston Gear Works, Norfolk Downs, Mass.
Rowbottom Machine Co., Waterbury, Conn.
All kinds, all sizes to order.

Can-Making Machinery (See Sheet Metal Working Machinery)

Cars, Industrial
Link-Belt Co., 39th St. and Stewart Ave., Chicago, Ill. Philadelphia and Indianapolis.

Castings, Aluminum
Acme Die Casting Co., Bush. T. 5, Brooklyn.
American Die Castings Co., 39 S. 6th St., Newark, N. J.
Bunting Brass & Bronze Co., 726 Spencer St., Toledo, Ohio.
Doehler Die Casting Co., Court and Ninth St., Brooklyn, N. Y. Branch: Toledo, Ohio. Cable: Doehler, Brooklyn.
Douglas, W. & B., Middletown, Conn.
Germann Bronze Co., 345 W. 19th St., Erie, Pa.
Light Manufacturing & Fdry. Co., Pottstown, Pa.

Castings, Brass and Bronze
American Bronze Co., Berwyn, Penn.
Bunting Brass & Bronze Co., 726 Spencer St., Toledo, Ohio.
Doehler Die Casting Co., Court and Ninth St., Brooklyn, N. Y. Branch: Toledo, Ohio. Cable: Doehler, Brooklyn.
alloys.
Douglas, W. & B., Middletown, Conn.
Germann Bronze Co., 345 W. 19th St., Erie, Pa.
Imperial Brass Mfg. Co., 1214 W. Harrison St., Chicago, Ill.
Light Manufacturing & Fdry Co., Pottstown, Pa.
Lumen Bearing Co., Buffalo, N. Y.
Phosphor Bronze Smelting Co., 2200 Washington Ave., Philadelphia, Penn.
Stamford Rolling Mills Co., 25 Broad St., N. Y. C.
Stewart Mfg. Co., J. K., Wells St. Bridge, Chicago, Ill.
Titanium Alloy Mfg. Co., The, Niagara Falls, N.Y.

Castings, Die Molded
Acme Die Casting Co., Bush T. 5, Brooklyn.
Doehler Die Casting Co., Court and Ninth St., Brooklyn, N. Y. Branch: Toledo, Ohio. Cable: Doehler, Brooklyn.
Die castings in aluminum, zinc, tin and lead alloys.
Franklin Mfg. Co., 400 S. Geddes St., Syracuse, N. Y. Cable: Franklin.
Die cast parts in aluminum, zinc, tin and lead base alloys.
Germann Bronze Co., 345 W. 19th St., Erie, Pa.
Light Manufacturing & Fdry. Co., Pottstown, Pa.
Lumen Bearing Co., Buffalo, N. Y.
Moberg, Inc., C. J., Mt. Vernon, N. Y.
National Lead Co., Rm. 1901, 111 Bway., N. Y. C.
Cable Address: Lead Co.
Accurate die-castings of special alloys of zinc, tin, aluminum.
Phoenix Die Casting Co., 21 Illinois St., Buffalo.
Stewart Mfg. Co., J. K., Wells St. Bridge, Chicago, Ill.
Titanium Alloy Mfg. Co., The, Niagara Falls, N.Y.

Castings, Iron
Athol Machine Co., Athol, Mass.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Douglas, W. & B., Middletown, Conn.
Farrel Foundry & Machine Co., Ansonia, Conn.
Holyoke Machine Co., Worcester, Mass.
McLain, David, 909 Goldsmith Bldg., Milwaukee, Wis.
Springfield Tool Mach. Co., Springfield, Ohio.
Stewart Mfg. Co., J. K., Wells St. Bridge, Chicago, Ill.
Taylor & Fenn Co., The, Hartford, Conn.

Castings, Semi-Steel
Farrel Foundry & Machine Co., Ansonia, Conn.
McLain, David, 909 Goldsmith Bldg., Milwaukee, Wis.
Springfield Mach. Tool Co., Springfield, Ohio.

Castings, Steel
Cincinnati Steel Castings Co., Cincinnati, Ohio.
West Steel Casting Co., Cleveland, Ohio.

Cements, Belt
Graton & Knight Mfg. Co., Worcester, Mass.
Schieren Co., Chas. A., 41 Ferry St., N. Y. City.

Cements, Iron
Felton, Sibley & Co., Inc., 136 N. 4th St., Phila.
Moller & Schumann Co., 8 Gerry St., Brooklyn.
Smooth-On Mfg. Co., Jersey City, N. J.

Centering Machines
Detrick & Harvey Machine Co., Baltimore, Md. Cable: Detharvey.
For heavy forgings and guns. 2" to 14" swing.
Hendey Machine Co., Torrington, Conn.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Wells & Son Co., F. E., Greenfield, Mass.
Whiton Mach. Co., D. E., New London, Conn.

Centers, Planer
Cincinnati Planer Co., Cincinnati, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Chains (See Sprockets and Chains)

Chains, Driving
Baker Bros., Toledo, Ohio.
Link-Belt Co., Nicetown, Phila., Pa. New York, Pittsburgh, Boston, St. Louis, Buffalo, Wilkes-Barre, Detroit, Cleveland, Seattle, Portland, Ore.; Los Angeles, Denver, Minneapolis, New Orleans, San Francisco, Birmingham, Toronto.
Link-Belt silent chain.
Send for 112-page data book No. 125.
Morse Chain Co., Ithaca, N. Y., U. S. A. Branches: New York, Boston, Chicago, Pittsburgh,


Carbon electrode used for cutting or heavy current welding
Metal electrode builds up or fills cavities when welding
Light portions show welded tube ends in locomotive
BENEATH the C & O locomotive illustrated above, which has welded seams and flue sheets, is shown a partly completed locomotive flue sheet. The light portions show flue ends which have been welded by a G-E arc welding outfit, one type of which, used by the American Locomotive Company, is shown at the bottom of this page.
This welder does its own chipping, so work can go on when your chippers are busy elsewhere. The control of heat and building of metal possible with this welder prevents distortion, uneven crystallization and cavities.
A G-E Arc Welder will repair worn or broken parts while they are in place.
Our nearest office will be pleased to give you additional information.
General Electric Company
General Office: Schenectady, N. Y.
District Offices in:
Boston, Mass. New York, N. Y. Philadelphia, Pa. Atlanta, Ga. Cincinnati, Ohio
Chicago, Ill. Denver, Colo. San Francisco, Cal. St. Louis, Mo.
Sales Offices in all Large Cities.
6242

Cleveland, San Francisco, St. Louis, Atlanta. Minneapolis, Detroit, U. S. A.
Sizes—⅜" to 3" in pitch, widths to suit powers.
Capacities—¼ hp. to 5,000 hp.
Morse "Rocker-Joint" (rolling friction principle) silent type chains exclusively, for the transmission of power for any purpose.
Licensees for Europe: Westinghouse Brake Co., Ltd., 32 York Rd., Kings Cross, London, N.
Whitney Mfg. Co., The, Hartford, Conn., U. S. A.
Cable Address: "Whitney, Hartford."
Roller—All American sizes. Block, 1" pitch, ⅛", 3/16", ¼", 5/16", ⅜" wide. Silent types, ⅜", ½", ⅝", ¾", 1" pitch, in variety of sizes.
See advertisement and send for catalogs containing useful data and information for engineers and designers.

Checks, Time and Pay
Matthews & Co., Jas. H., Pittsburgh, Penn.

Chemists
Souther Engineering Corp., Hy., Hartford, Conn.

Chip Handling Systems
American Blower Co., 1400 Russell St., Detroit.

Chucking Machines, Automatic
Bullard Machine Co., Bridgeport, Conn.
New Britain Machine Co., New Britain, Conn. 2008 W. Grand Blvd., Detroit; 949 Otis Bldg., Chicago; Cleveland.
"New Britain" Multiple-Spindle Automatics, single- and double-head types; single-head, four and five spindles, five sizes; double-head, six spindles, two sizes. For chucking castings, forgings and second-operation bar work. Performs all operations simultaneously and automatically, a finished piece being removed and a rough blank inserted at each indexing, the entire series of operations being completed in the time of the longest single operation.
Agents: Coats Machine Tool Co., Ltd., Caxton House, London, Glasgow and Newcastle-on-Tyne; Alfred H. Schutte, Cologne and Berlin; Donauwerk Ernest Krause & Co., Wien, Prague and Budapest.
Potter & Johnston, Pawtucket, R. I.
"P. J. Manufacturing Automatics." 4 sizes, 5A, 6A, 7A, 8A. Range of work varies from about 2½ diam. to 40" diam.
Warner & Swasey Co., The, Cleveland, Ohio.

Chucking Machines (See Lathes, Horizontal Turret)

Chucks, Centering
Cushman Chuck Co., The, Hartford, Conn. New York, San Francisco.
One size. Used on bench for centering short pieces from ¼" to 1½" diameter.

Chucks, Drill and Tap
Almond, T. R., 6 Maple Ave., Ashburnham, Mass.
Automatic Drill Chuck Corp'n, Majestic Bldg., Detroit, Mich.
Sizes No. 6, ⅛ in. to ⅜ in.; No. 8, 3/16 in. to ½ in. No key, collets, etc. Self-centering.
Bicknell-Thomas Co., Greenfield, Mass.
Celfor Tool Co., Buchanan, Mich.
Cleveland Twist Drill Co., Cleveland, Ohio.
Cushman Chuck Co., The, Hartford, Conn. New York, San Francisco.
Six sizes and 2 styles holding from 0 to 1" diameter drills, rods, etc. 3-jaw and 4-jaw type.
Detroit Twist Drill Co., 644 Fort St., Detroit.
Greenfield Tap & Die Corp., Greenfield, Mass.
Gronkvist Drill Chuck Co., 18 Morris St., Jersey City, N. J.
"Gronkvist" automatic 5, "Kupke" keyless 3.
Horton & Son Co., E., Windsor Locks, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Peter Bros. Mfg. Co., Algonquin, Ill.
Pratt Chuck Co., Frankfort, N. Y.
Scully-Jones Co., 649 Railway Exchange Bldg., Chicago, Ill.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, Ohio.
Union Mfg. Co., New Britain, Conn.
Victor Tool Co., Waynesboro, Penn.
Wahlstrom Tool Co., Brooklyn, N. Y.
"Wahlstrom Automatic Chucks." Tools may be changed while spindle is running. Made in 2 styles, as follows: Chucks for straight shank tools made in 3 sizes; take drills up to 1". No keys. Chuck for taper shank tools made in 1 size only—holds No. 1, 2 or 3 Morse taper shank tools whether the tool has a tang or not. No collets, no keys.
Whitney Mfg. Co., The, Hartford, Conn., U. S. A.
"Presto" chuck, with 3 sizes, No. 2, 3 or 4. Morse taper. Or can furnish with shanks left blank. "Holm Patent" friction tapping device, 3 sizes. ¼" to ⅜" taps, ¼" to ⅝" taps, 7/16" to 1¼" taps. This device is interchangeable with the "Presto" chuck.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., The, Hartford, Conn. New York, San Francisco.
38 styles. 27 sizes from 2" to 36".
Hoggson & Pettis Mfg. Co., The, New Haven, Conn., U. S. A. Cable Address: "Puissant," New Haven.
Manufacturers of "Sweetland" lathe chucks. Complete line of combination universal, independent geared, scroll, two-jaw, box, body and car wheel chucks. Face plate jaws and reversible jaws.
Horton & Son Co., E., Windsor Locks, Conn.
Jones & Lamson Mach. Co., Springfield, Vt.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Thomas Elevator Co., 20 S. Haynes Ave., Chicago, Ill.
Union Mfg. Co., New Britain, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Magnetic
D & W Fuse Co., Providence, R. I. Cable: Nonarching.
A flat, rotary, vertical, swiveling, waterproof, heatproof, equipped with demagnetizing switch.
Heald Machine Co., Worcester, Mass., U. S. A. Cable Address: "Heald." Branches: Chicago, Detroit, Cleveland, Cincinnati.
Agents: Great Britain, Alfred Herbert, Ltd., Coventry. For France, Alfred Herbert, Ltd., Paris. For Holland, Post Van Der Burg & Co., Rotterdam.
Walker Co., O. S., Worcester, Mass.

Chucks, Planer
Cincinnati Planer Co., Cincinnati, Ohio.
Cushman Chuck Co., Hartford, Conn.
D & W Fuse Co., Providence, R. I.
Hoggson & Pettis Mfg. Co., The, New Haven, Conn., U. S. A. Cable Address: "Puissant," New Haven.
Manufacturers of "Sweetland" planer chucks. Complete line, both round and square base, 8 sizes 6 to 30 in.
Horton & Son Co., E., Windsor Locks, Conn.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Conn.
Walker Co., O. S., Worcester, Mass.

Chucks, Split
Ames Co., B. C., Waltham, Mass.
Rivett Lathe & Grinder Co., Brighton, Boston, Mass. Cable Address: Edrivett.
Ten sizes. Capacity up to 1" diameter hole. Tool steel split chucks.
See our advertisement on inside of back cover.
Stark Tool Co., Waltham, Mass.

Clamps, Machinists'
Armstrong Bros. Tool Co., 315 N. Francisco Ave., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Hammacher, Schlemmer & Co., 13th St. and 4th Ave., New York City.
Starrett Co., L. S., Athol, Mass.
Western Tool & Mfg. Co., Springfield, Ohio.
Williams Co., J. H., 35 Richards St., Brooklyn.

Clocks, Time
Calculagraph Co., 1438 Jewelers Bldg., N. Y. C.

Clutch and Brake Friction Facing
Royal Equipment Co., The, Bridgeport, Conn., U. S. A. "Raybestos" facings, swings and blocks for use in clutches, brakes, etc., in place of wood or fiber blocks, leather, cork inserts, metal to metal, etc. Produce enormous holding power and will outwear regular friction facings many times. Retains the coefficient friction its entire life.

Clutches, Friction
Automatic Shaft Coupling Co., Alexandria, Va.
Bicknell-Thomas Co., Greenfield, Mass.
Brown Co., A. & F., 79 Barclay St., N. Y. City.
Caldwell Son Co., H. W., 17th St. and Western Ave., Chicago, Ill.
Edgemont Machine Co., Chample and National Ave., Dayton, Ohio.
Evans Friction Cone Co., 1288 Centre St., Newton Centre, Mass.
Holyoke Machine Co., Worcester, Mass.
Johnson Mach. Co., Carlyle, 52 Main St., Manchester, Conn. Cable: Carlyle, Hartford.
5 sizes both single and double, capacities up to 5" diam. shafting. Weight 12 to 100 lb. Price $10 to $75. For use on overhead shafting with or without pulleys, and as a one-way cut-off coupling to connect ends of two shafts.
Agents: The Efandem Co., 159 Gt. Portland St., London, W., Eng.; Wilhelm Sonesson, Malmo, Sweden; Schuchardt & Schutte, Berlin, Germany; Glaezner & Perreaud, Paris, France.
Link-Belt Co., 39th St. and Stewart Ave., Chicago, Ill. Philadelphia and Indianapolis.
O. K. Clutch & Machy. Co., Columbia, Penn.
Reliance Gauge Column Co., 6009 Carnegie Ave., Cleveland, Ohio.
Standard Pulley Co., The, Cincinnati, Ohio.
3 sizes, both single and double up to 2 3/16" diameter.

Coal Handling Machinery
Caldwell & Co., Inc., W. E., Louisville, Ky.
Link-Belt Co., 39th St. and Stewart Ave., Chicago, Ill. Philadelphia and Indianapolis.

Coilers, Spring
Garvin Mach. Co., Spring and Varick St., N. Y. C.

Coils, Electrical
D & W Fuse Co., Providence, R. I.
General Electric Co., Schenectady, N. Y.

Collars, Spacing
Scully-Jones Co., 649 Railway Exchange Bldg., Chicago, Ill.

Collets
Pratt & Whitney Co., Hartford, Conn.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., The, Hartford, Conn., U. S. A.
"Presto" collets for use in "Presto" chucks. Spring collets for holding cutters with straight shanks ½" diameter.

Compounds, Carbonizing, Casehardening and Tempering
American Comp. Co., 469 Atlantic Ave., Boston.
Basic Mineral Co., The, North Side, Pittsburgh, Pa.
Compounders of the C. M. Miller original and genuine and improved Thermo Titanium and Basic Flux for iron and semi-steel. Also Radioclorite and the C. M. Miller Bronze Alloy Flux for brass melting and all alloys.
Coats Mach. Tool Co., Inc., 30 Church St., N. Y. C.
Houghton & Co., E. F., 240 W. Somerset St., Philadelphia, Penn.
Shore Instrument & Mfg. Co., 555 W. 22nd St., New York. "Enamellite."

Compounds, Cleaning
White & Bagley Co., Worcester, Mass.

Compounds, Cutting, Drawing, Drilling, Grinding and Screw Cutting
Cataract Refining & Mfg. Co., Buffalo, N. Y. Cable Address: "Catarefin," London, 36 Kingsway.
Crescent Oil Co., 30 Church St., New York City
Houghton & Co., E. F., 240 W. Somerset St., Philadelphia, Penn.
Oil City Oil & Grease Co., Oil City, Penn.
"Germania Lubro Compound" soluble oil.
"Pensoil" mineralized lard oil.
Texas Company, Dept. A, 17 Battery Place, N. Y.
White & Bagley Co., Worcester, Mass.
"Economy" cutting lubricant. "Economy" grinding lubricant. "Minolard" cutting oil for automatics.

Compounds, Pipe-Joint
Smooth-On Mfg. Co., Jersey City, N. J.

Compressors, Air and Gas
Blanchard Machine Co., Cambridge, Mass.
Chicago Pneumatic Tool Co., Fischer Bldg., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York.
Branches: Boston, Birmingham, Butte, Cleveland, Chicago, Denver, Duluth, El Paso, Knoxville, Los Angeles, Phila., Pittsburgh, St. Louis, Seattle.
Sullivan Mchy. Co., 122 S. Michigan Av., Chicago
Steam and power drive, any capacity, any pressure.
Worthington Pump & Machinery Corporation, 115 Broadway, New York City.

Conduits, Interior
General Electric Co., Schenectady, N. Y.

Cones, Friction
Evans Friction Cone Co., 1288 Centre St., Newton Centre, Mass.

Connecting-Rods and Straps
Standard Gauge Steel Co., Beaver Falls, Penn.

Contract Work
American Die & Tool Co., Reading, Penn.
Becker Milling Mach. Co., Hyde Park, Mass.
Blanchard Machine Co., 64 State St., Cambridge, Mass.
Columbus Die Tool & Mach. Co., Columbus, Ohio.
Cowdrey Mach. Wks., C. H., Fitchburg, Mass.
Crane Puller Co., 54 Lake St., Arlington, Mass.
Dover Parts Co., Geo. W., Providence, R. I.
Excel Manufacturing Co., Boston, Mass.
Fenn Mfg. Co., Hartford, Conn.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Grant Mfg. & Machine Co., 85 Silliman Ave., Bridgeport, Conn.
Grayson Tool & Mfg. Co., Indianapolis, Ind.
Harris Eng Co., The H. E., Bridgeport, Conn.
Hartford Special Mchy. Co., The, 287 Homestead Ave., Hartford, Conn.
Holyoke Machine Co., Worcester, Mass.
Krasberg Mfg. Co., 410-420 Orleans St., Chicago, Ill.
Luster-Jordan Co., Norristown, Penn.
Mallometer Co., Detroit, Mich.
Mehl Machine Tool & Die Co., Roselle, N. J.
Meisel Press Mfg. Co., 946 Dor. Ave., Boston.
New Britain Machine Co., New Britain, Conn.
New England Mchy. Co., Stiles St., New Haven.
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Reynolds Pattern & Machine Co., Moline, Ill.
Rowbottom Machine Co., The, Waterbury, Conn.
Sanford Mfg. Co., F. C., Bridgeport, Conn.
Sheffield Mach. & Tool Co., The, Dayton, Ohio.
Taft-Peirce Mfg. Co., Woonsocket, R. I. Majestic Bldg., Detroit; Woolworth Bldg., N. Y. City.
Manufacturers of special machines, machine parts and tools. Design and build tool equipments, jigs and fixtures.
Wadell, Bowen & Jackson, Rahway, N. J.

Controllers and Starters, Electric
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Penn.

Cotter Pins
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, Ohio.
Whitman & Barnes Mfg. Co., The, Akron, Ohio.

Counterbores
Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.

Counters, Revolution
Bristol Co., Waterbury, Conn.
New Haven Trolley Supply Co., New Haven, Conn.
Root Co., C. J., 100 Stone St., Bristol, Conn.
Veeder Mfg. Co., 15 Sargeant St., Hartford, Conn.

Countershafts
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Norton Grinding Co., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.

Counting and Printing Wheels
Doehler Die Casting Co., Court and Ninth St., Brooklyn, N. Y. Branch: Toledo, Ohio. Cable: Doehler, Brooklyn.
Franklin Mfg. Co., 400 S. Geddes St., Syracuse.

Counting Machines
National Scale Co., Montgomery St., Chicopee Falls, Mass.
22 sizes, for counting parts and pieces ranging from 25,000 to the ounce, to pounds, to the piece, loads aggregating 5 tons.
New Haven Trolley Supply Co., New Haven, Conn.
Root Co., C. J., 100 Stone St., Bristol, Conn.
Veeder Mfg. Co., 15 Sargeant St., Hartford, Conn.

Couplings, Shaft
Almond, T. R., 6 Maple Ave., Ashburnham, Mass.
Automatic Shaft Coupling Co., Real Estate Trust Bldg., Washington, D. C.
Sole Selling Agents: Campbell Machry. Co.
Dexter Co., I. H., 27 Walker St., New York.
Edgemont Machine Co., Champie and National Ave., Dayton, Ohio.
Independent Pneumatic Tool Co., Thor Bldg., Chicago, Ill.
Standard Gauge Steel Co., Beaver Falls, Penn.

Cranes, Portable
Canton Foundry & Machine Co., Canton, Ohio.
Albert Herbert, Ltd., Coventry.

Cranes, Traveling
Chisholm-Moore Mfg. Co., Cleveland, Ohio.
Cleveland Crane & Engineering Co., Wickliffe, O.
Electric or hand power. 5 to 200 tons capacity.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger Co., Milwaukee, Wis.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Vandyck Churchill Co., 93 Liberty St., N. Y. C.
Whiting Foundry Equipment Co., Harvey, Ill.
Wright Mfg. Co., Lisbon, Ohio.
Yale & Towne Mfg. Co., 9 E. 40th St., N. Y. City.

Crank Pin Turning Machines
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Underwood & Co., H B., 1026 Hamilton St., Philadelphia, Penn

Cupola Practice
McLain, David, 909 Goldsmith Blg., Milwaukee, Wis.

Cupolas and Ladles
Paxson Co., J. W., 1021 N. Delaware Ave., Phila.

Cutters, Milling
Barber-Colman Co., Rockford, Ill.
Becker Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
5,000 stock sizes. Special cutters to order.
Federal Screw Corp., Providence, R. I.
Ingersoll Milling Machine Co., The, Rockford, Ill.
Standard cutters. Special cutters developed.
Ask for catalogue No. 30-C.
Krasberg Mfg. Co., 410-420 Orleans St., Chicago, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, Ohio.
Union Twist Drill Co., Athol, Mass.

Cutting-Off Machines
Coats Mach. Tool Co., 30 Church St., N. Y. C.
Cochrane Bly Co., Rochester, N. Y.
Curtis & Curtis Co., The, 66 Garden St., Bridgeport, Conn.
Davis Mach. Tool Co., Inc., 311 St. Paul St., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Earle Gear & Machine Co., 101 E. Wyoming Ave., Philadelphia, Penn.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Gorton Machine Co., Geo., Racine, Wis.
Hurlbut, Rogers Machinery Co., South Sudbury, Mass. Cable: "Hurlbut."
Two styles, cone and accelerated. Seven sizes, 2" to 10".
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Nutter & Barnes Co., Hinsdale, N. H. 13 South Clinton St., Chicago, Ill.
Will handle bar metal in single pieces or multiples up to 10-10" round or square.
Root & Vandervoort Eng'g. Co., East Moline, Ill.
Vandyck Churchill Co., 93 Liberty St., N. Y. C.

Cutting-Off Machines, Pipe
(See Pipe Cutting and Threading Machines)

Cutting-Off Tools
Oxweld Acetylene Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Union Caliper Co., Orange, Mass.
Western Tool & Mfg. Co., Springfield, Ohio.

Cutting Oil Filters **(See Filters, Oil)**

Cutting, Oxy-Acetylene
Davis-Bournonville Co., Jersey City, N. J.
International Oxygen Co., 115 Broadway, N. Y.
Metals Welding Co., The, Cleveland, Ohio.
Oxweld Acteylene Co., Chicago, Ill.

Cut-Outs, Electrical
D & W Fuse Co., Providence, R. I.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

Dealers, Machinery
Co-Operative Used Machinery Corp., 50 Church St., N. Y. C.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Hill, Clarke & Co., 156 Oliver St., Boston, Mass.
Prentiss Tool & Supply Co., Singer Bldg., N. Y. C.
Strong, Carlisle & Hammond Co., Cleveland, Ohio.
Toomey, Inc., Frank, Philadelphia, Penn.
Vandyck Churchill Co., 93 Liberty St., N. Y. C.

Diamond Tools
Crafts, Arthur A., 125 Summer St., Boston, Mass.
Dickinson, Thomas L., 64 Nassau St., N. Y. City.
Francis & Co., 50 State St., Hartford, Conn.
Diamonds and diamond-pointed hand and grinder tools for all mechanical purposes.

Die Making Machines
Acme Die Casting Corp., Bush Terminal No. 5, Brooklyn, N. Y.
Anderson Die Machine Co., Bridgeport, Conn., U. S. A. Anderson Die Forming Machines and Cutters for making blanking dies, irregular shaped drawing dies and templates, irregular shaped gages, formers for cams and profiling machines, small work and metal patterns and similar work.
See advertisement and send for catalog.
Grayson Tool & Mfg. Co., Indianapolis, Ind.
Keller Mechanical Engraving Co., Brooklyn, N. Y.
Agents: England, France and Italy, Alfred Herbert, Ltd.
For automatically sinking dies, stamps, etc., up to 22"x15".

Dies, Die Casting
Keller Mechanical Engraving Co., Brooklyn, N. Y.
Agents: England, France, Italy, Alfred Herbert, Ltd.

Die Sinking Machines, Automatic
Keller Mechanical Engraving Co., Brooklyn, N. Y.
Agents: England, France and Italy, Alfred Herbert, Ltd.
For automatically cutting drop-forge sheet-metal forcers, and dies, up to 22"x15".

Dies, Pipe Threading
Bignall & Keeler Mach. Wks., Edwardsville, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Wells & Son Co., F. E., Greenfield, Mass.

Dies, Sheet-Metal
Becker Milling Mach. Co., Hyde Park, Mass.
Columbus Die Tool & Mach. Co., Columbus, Ohio
Ferracute Mach. Co., Bridgeton, N. J.
Gem City Machine Co., Dayton, Ohio.
Keller Mechanical Engraving Co., Brooklyn, N. Y.
Agents: England, France and Italy, Alfred Herbert, Ltd.
Krasberg Mfg. Co., 410-420 Orleans St., Chicago, Ill.
Mailometer Co., Detroit, Mich.
Mehl Mach. Tool & Die Co., Roselle, N. J.
Modern Tool Die & Mach. Co., Columbus, Ohio.
Niagara Mach. & Tool Works, Buffalo, N. Y.
Sheffield Mach. & Tool Co., The, Dayton, Ohio.
Steel Products Engineering Co., Springfield, Ohio.
Stevens Mfg. Co., Dayton, Ohio.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Toledo Machine & Tool Co., Toledo, Ohio.
Waltham Mach. Works, High St., Waltham, Mass.

Dies, Sub-Press
Becker Milling Mach. Co., Hyde Park, Mass.
Columbus Die Tool & Mach. Co., Columbus, Ohio.
Gem City Machine Co., Dayton, Ohio.
Grayson Tool & Mfg. Co., Indianapolis, Ind.
Hartford Special Mchy. Co., Hartford, Conn.
Krasberg Mfg. Co., 410-420 Orleans St., Chicago, Ill.
Mailometer Co., Detroit, Mich.
Mehl Mach. Tool & Die Co., Roselle, N. J.
Accuracy of work obtained by long and varied experience.
Modern Tool Die & Machine Co., Columbus, Ohio.
Nelson Tool Co., Inc., 781 E. 142nd St., N. Y. C.
Pratt & Whitney Co., Hartford, Conn.
Sheffield Mach. & Tool Co., The, Dayton, Ohio.
Steel Products Engineering Co., Springfield, Ohio.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Waltham Mach. Works, High St., Waltham, Mass.

Dies, Threading-Opening
Eastern Machine Screw Corp., New Haven, Conn.
Errington, F. A., 39 Cortlandt St., New York City.
Geometric Tool Co., New Haven, Conn. 545 W. Washington Blvd., Chicago, Ill. Cable: Metric.
For all classes of external screw threads of any diameter, length and form.
Greenfield Tap & Die Corp., Greenfield, Mass.
Ideal Tool & Mfg. Co., Beaver Falls, Pa. Boston, H. B. Eaton & Co. Cable: Idealdico, New York.
Leon Chapius, 26 Bd. Magenta, Paris.
Sizes ¼", ½", ¾", 1", 1¼", 2", for accurate fine and heavy thread cutting.
Jones & Lamson Machine Co., Springfield, Vt., U. S. A. Cable: Turret. Branch: Jones & Lamson Mach. Co., 97 Queen Victoria St., London, E. C.
Sizes: Nos. 1, 3, 4, 6 and 9 dies. Capacities: $\frac{9}{16}$", 1¼", 1½", 2" and 3" respectively.
An automatic opening die for use on turret lathes, automatic screw machines, engine lathes, drill presses, etc. Has wide range. Fine threads can be cut with large dies without stripping. Chasers have special lead control feature, giving accurate pitch.
Foreign Agents: Germany, Switzerland, Austria-Hungary, M. Koyeman, Charlottenstrasse 11, Dusseldorf, Germany; France, Spain, Belgium, F. Auberty & Co., 91 Rue de Maubeuge, Paris. Domestic Agents: E. A. Kinsey Co., Cincinnati, O.; E. A. Kinsey Co., Indianapolis, Ind.; Boyer-Campbell Co., Detroit, Mich.; E. L. Essley Machinery Co., Chicago, Ill.; Robinson, Cary & Sands Co., St. Paul, Minn.; Carey Mchy. & Supply Co., Baltimore, Md.; W. M. Pattison Supply Co., Cleveland, O.; Barwood-Richards Machy. Co., The Bourse, Philadelphia, Penn.
Landis Machine Co., Waynesboro, Penn.
Rotary die heads ¼" to 4". Automatic screw cutting ½", 1¼". Solid adjustable ½", 1".
Using the Landis chasers, insuring unchanged cutting contour and long life.
Murchey Mach. & Tool Co., 64 Porter St., Detroit.
National Acme Mfg. Co., Cleveland, Ohio.
National Machinery Co., Tiffin, Ohio.
Warner & Swasey Co., Cleveland, Ohio.
Wells Bros. Co., Greenfield, Mass.

Disinfectants
Houghton & Co., E. F., 240 W. Somerset St., Philadelphia, Penn.

Dogs, Lathe and Milling Machines
Hammacher, Schlemmer & Co., 13th St. and 4th Ave., New York City.
Page-Storms Drop Forge Co., Chicopee, Mass.
Union Caliper Co., Orange, Mass.
Williams Co., J. H., 35 Richards St., Brooklyn.

Drafting Tables
Almorth, G. A., 968 Grand Ave., New Haven, Conn.
Can be readily assembled to any board and is easily knocked down. Shipping weight for export, 85 lb. Frame complete for 31-inch leg room, $13.25.

Dressers, Grinding Wheel
American Emery Wheel Works, Providence, R. I.
Crafts, Arthur A., 125 Summer St., Boston, Mass.
Desmond-Stephan Mfg. Co., Urbana, Ohio.
"Diamo-Carbo" for tool grinding wheels, "Huntington & Sherman" for coarse wheels.
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Trade-mark: "Sterling."
Dickinson, Thomas L., 64 Nassau St., N. Y. City
Francis & Co., 50 State St., Hartford, Conn.
Heald Machine Co., 10 New Bond St., Worcester, Mass.
Standard Tool Co., Cleveland, Ohio.
Vitrified Wheel Co., Westfield, Mass.

Drill Holders
Armstrong Bros. Tool Co., 315 N. Francisco Ave., Chicago, Ill.
Union Caliper Co., Orange, Mass.

Drill Speeders
Graham Mfg. Co., Providence, R. I.

Drilling Machine Heads
Baush Machine Tool Co., 604 Wason Ave., Springfield, Mass., U. S. A.
Adjustable multiple spindle portable drilling machine. Heads for use on all makes of drilling machines.
Hoefer Mfg. Co., Freeport, Ill.
Langelier Mfg. Co., Providence, R. I.
Nelson-Blanck Mfg. Co., Clay and Dubois St., Detroit, Mich.
Five sizes; capacities No. 0 to 1⅛" drill; weight 10 to 68 lb. Price $50 to $85.
Clamps rigidly to machine, quick adjustment.
Newman Manufacturing Co., 717 Sycamore St., Cincinnati, Ohio.
Newman quick-action four-in-one changeable drill head, carries four tools and requires but a moment to switch from one tool to another.

Drilling Machines, Automatic
Baker Bros., Toledo, Ohio.
Baush Machine Tool Co., 604 Wason Ave., Springfield, Mass., U. S. A.
Multiple head station type drilling machines for drilling, counterboring, reaming and spot facing. All tools regardless of size run at proper speed and feed.
Langelier Mfg. Co., Providence, R. I.
National Automatic Tool Co., 7th and South N St., Richmond, Ind. Cable: Natco, Richmond.
Five sizes, 2 to 200 spindles, each spindle with or without independent changes of drill speeds.

Drilling Machines, Bench
Ames Co., B. C., Waltham, Mass
Barnes Co., W. F. & John, 1995 Ruby St., Rockford, Ill.

Have You Thought of Milling Those Threads

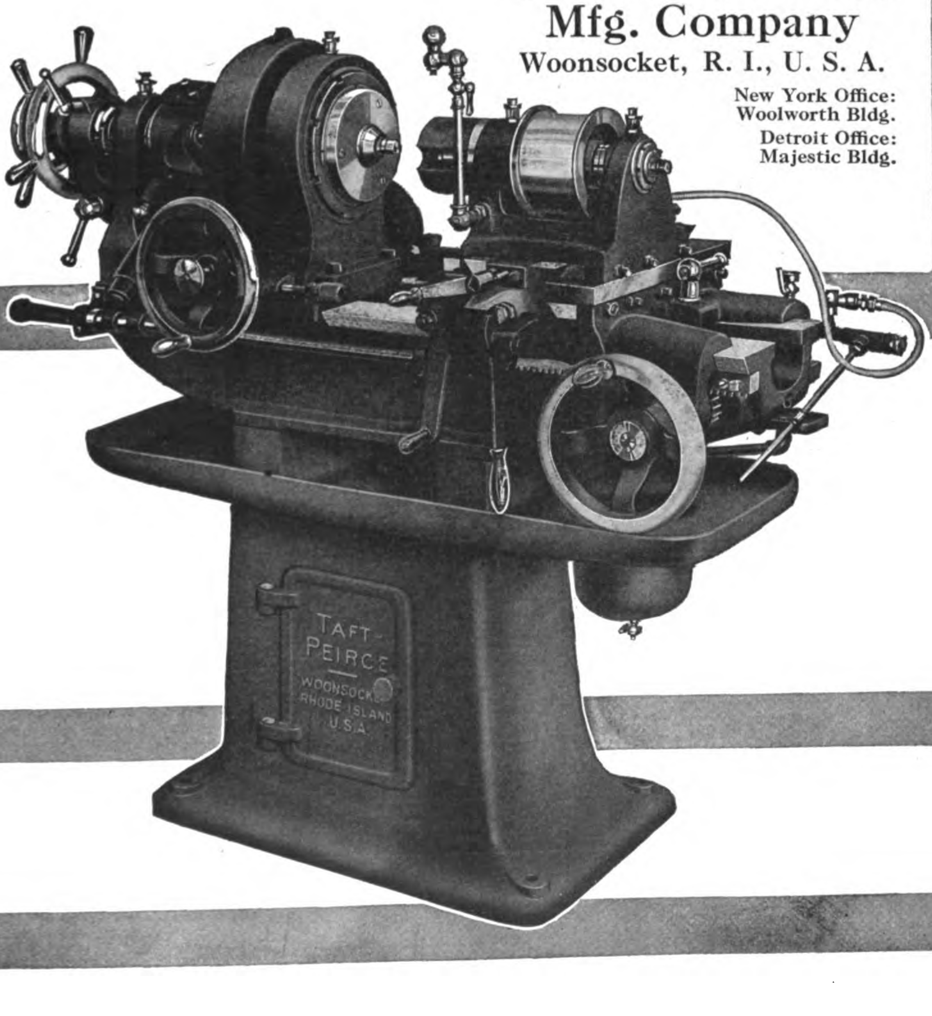
Are you familiar with the saving in time, the increase in production in the use of the Archdale Type Thread Milling Machine on work within its range?

Especially adaptable in cutting short threads, this machine uses a milling cutter of practically the same width as the length of thread to be cut, and finishes the complete thread *in one revolution of the work.*

Let us make time estimate on some of your threading. Write for the descriptive bulletin.

The Taft-Peirce Mfg. Company
Woonsocket, R. I., U. S. A.

New York Office: Woolworth Bldg.
Detroit Office: Majestic Bldg.



Clark Elec. Co., Jas., Jr., 521 Main, Louisville, Ky.
Hisey-Wolf Machine Co., Cincinnati, Ohio.
Hoefer Mfg. Co., Freeport, Ill.
Langelier Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.
Robinson Tool Works, Waterbury, Conn
Sigourney Tool Co., Hartford, Conn.
Silver Mfg. Co., The, Salem, Ohio.
Stecher Co., The Charles, 1576 Crossing St., Chicago.
U. S. Electrical Tool Co., Cincinnati, Ohio.

Drilling Machines, Electric and Hand
Chicago Pneumatic Tool Co., Fischer Bldg., Chicago, Ill.
Cincinnati Electrical Tool Co., Cincinnati, Ohio.
Clark Electric Co., Inc., Jas., Jr., 521 W. Main St., Louisville, Ky.
Gem Mfg. Co., 3257 Spruce St., Pittsburgh, Pa.
Hisey-Wolf Machine Co., Cincinnati, Ohio.
Independent Pneumatic Tool Co., Thor Bldg., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York.
Neil & Smith Electric Tool Co., Cincinnati, Ohio.
Silver Mfg. Co., The, Salem, Ohio.
Temco Electric Mfg. Co., Leipsic, Ohio.
U. S. Electrical Tool Co., Cincinnati, Ohio.
Van Dorn Electric Tool Co., Cleveland, Ohio.

Drilling Machines, Gang
Baker Bros., Toledo, Ohio.
Barnes Drill Co., 830 Chestnut, Rockford, Ill.
Colburn Mach. Tool Co., Franklin, Penn.
Cincinnati Bickford Tool Co., The, Oakley, Cincinnati, Ohio. Cable: Augustus, Cincinnati.
Seven sizes, ranging from 20" to 42", with from two to six spindles.
Single or individual round or square tables, with or without tapping attachments, cutting lubricant equipment and with an individual cone or right-angle drive or a continuous rear shaft driven by a belt or motor.
Langelier Mfg. Co., Providence, R. I.
Moline Tool Co., Moline, Ill.

Drilling Machines, Heavy Duty
Baker Bros., Toledo, Ohio.
Five sizes, 2-inch to 16-inch capacity.
Colburn Machine Tool Co., Franklin, Penn.
Sizes 24"x36" swing, with or without tapping or other attachment, plain or compound table.
Hoefer Mfg. Co., Freeport, Ill.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Symington Co., The T. H., Rochester, N.Y., U.S.A.

Drilling Machines, Horizontal (See Boring, Drilling and Milling Machines, Horizontal)

Drilling Machines, Multiple Spindle
Baush Machine Tool Co., 604 Wason Ave., Springfield, Mass., U. S. A. Cable Address: "Baush."
Complete line of multiple spindle drilling machines, both vertical and horizontal. Also special multiple drilling machines built to order for any work.
Langelier Mfg. Co., Providence, R. I.
National Automatic Tool Co., 7th and South N St., Richmond, Ind.
Ten sizes of vertical type, ranges from 8" round head with 8 spindles to 20x48" rectangular head with 72 spindles, head feed down or table feed up, with or without power feed to head or table. Independent change of speed in head to each spindle to suit the size of holes being drilled, with neutral positions for all spindles not in use. Machines may be equipped with automatic tapping attachments, lubricating system for work, motor drive, adjustable tables, or box tables; also a complete line of 2-, 3-, 4- and 5-way horizontal and vertical type machines with fixed or adjustable spindles.
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Co., Worcester, Mass.
Sellers & Co., Inc., Wm., Philadelphia, Penn.
Stecher Co., The Charles, 1576 Crossing St., Chicago.

Drilling Machines, Pneumatic
Independent Pneumatic Tool Co., Thor Bldg., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York.
"Little David," all sizes, types and gearing combinations for drilling, reaming, tapping, flue rolling, stud seating, etc.

Drilling Machines, Radial
American Tool Works Co., The, Cincinnati, U. S. A. Cable: "Lathe, Cincinnati."
Sizes—Plain, 2, 2½, 3, 3½, 4, 5, 6, 7-ft. arms; full universal, 4, 5, 6, 7 ft. Sensitive radial 3 ft. ball bearing throughout. Sizes 2 to 3½ ft. inclusive equipped with back gears; 4 to 7 inclusive with triple gears. All full universal are triple geared. Four different types of drives for all sizes: Cone drive, geared speed box for belt and motor drive and direct connected variable speed motor drive without speed box.
See our advertisement on pages 14 and 15.
Baush Machine Tool Co., 604 Wason Ave., Springfield, Mass.
Cincinnati Bickford Tool Co., The, Oakley, Cincinnati, Ohio. Cable: Augustus, Cincinnati.
Regular plain type: 6 sizes, ranging from 2½' to 6'. Universal type: 3 sizes, ranging from 4' to 6'. High speed, high power type, with a 5, 6, 7 or 8' arm and base.
Plain and universal radials furnished with a cone, speed box, variable speed motor or motor and speed box drive. The high-speed radial with a speed box, variable speed motor or constant speed motor and speed box drive. All types of plain, universal and high-speed radials can be furnished with cutting lubricant equipment. Plain and high-speed types with air column binder.
Dreses Machine Tool Co., 227-241 W. McMicken Ave., Cincinnati, O. Cable Address: Dreses.
Sizes—Plain 2½ to 7 ft. Half and full universal 4 to 7 ft.
Cone, speed variator (single pulley) and motor drive.
Fosdick Machine Tool Co., Cincinnati, Ohio.
Sizes: High speed manufacturing, 2', 2½', 3'; heavy duty, 3', 3½', 4', 5', 6'. Cone pulley, gear box, constant or variable speed drives. Plain tilting or universal tables.
Carlton Mach. Tool Co., Cincinnati, Ohio.
Sizes 2½', 3', 3½', 4'.
Harrington, Son & Co., Inc., Ed., Philadelphia, Pa.
Morris Mach. Tool Co., Cincinnati, Ohio.
2½', 3' and 3½'. Cone pulley gear box, constant speed motor, with gear box and variable speed motor.
Mueller Machine Tool Co., Cincinnati, Ohio.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Reed-Prentice Co., Worcester, Mass.
Sellers & Co., Inc., Wm., Philadelphia, Penn.
Strong, Carlisle & Hammond Co., Cleveland, Ohio.
Almond high-speed radial drill intended for light drilling and tapping. Ball bearing throughout. Entirely self-contained. Radius of 48" up to within 12" of column. Drill can be brought over any part of work with one motion of arm. Spindle speeds from 195 up to 2,000 r.p.m.

Drilling Machines, Sensitive
Coats Mach. Tool Co., Inc., 30 Church St., N. Y. C.
Henry & Wright Mfg. Co., 760 Windsor St., Hartford, Conn.
One to 8 spindles, 300 models drilling up to 1¼". Weights, 760 lb. to 5,000 lb.
Agents: Hill, Clarke & Co., Boston, New York and Chicago; Chas. A. Strelinger Co., Detroit; W. E. Shipley Mchry. Co., Philadelphia; Brandes Machy. Co., Cleveland, Ohio.
Knight Machinery Co., W. B., 2000 Lucas Ave., St. Louis, Mo.
Langelier Mfg. Co., Providence, R. I.
Leland-Gifford Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Royersford Fdry. & Mach. Co., Royersford, Penn.
Sigourney Tool Co., Hartford, Conn.
Taylor & Fenn Co., The, 54-70 Arch St., Hartford, Conn. 1 to 6 spindles, 7" from centre of spindle to face of column up to ¾" drill. Adjustable cutter distance between spindles. Furnished with either hand or power feed.

Drilling Machines, Turret
Langelier Mfg. Co., Providence, R. I.
National Automatic Tool Co., 7th and South N St., Richmond, Ind.

Drilling Machines, Vertical
Baker Bros., Toledo, Ohio.
Barnes Co., W. F. & John, 1995 Ruby St., Rockford, Ill.
Barnes Drill Co., Inc., 830 Chestnut, Rockford, Ill.
Baush Machine Tool Co., 604 Wason Ave., Springfield, Mass., U. S. A.
Complete line of multiple spindle drilling machines built to order for any work.
Cincinnati Bickford Tool Co., The, Oakley, Cincinnati, Ohio. Cable: Augustus, Cincinnati.
Regular type: 7 sizes and 88 styles, ranging from 21" to 42". High speed type: 7 sizes and 52 styles ranging from 20" to 42".
Furnished with or without a tapping attachment, with a cone, speed box or right-angle drive, with a motor and speed-box drive, with a belted motor, geared motor or variable speed motor drive with or without a cutting lubricant equipment and with a round, square or compound table.
Coats Mach. Tool Co., Inc., 30 Church St., N. Y. C.
Colburn Machine Tool Co., Franklin, Penn.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Harrington, Son & Co., Inc., Ed., Philadelphia, Pa.
Hoefer Mfg. Co., Freeport, Ill.
Types and sizes up to 36" gear tappers, compound tables, machines set in gang to order.
Knight Machinery Co., W. B., 2000 Lucas Ave., St. Louis, Mo.
Langelier Mfg. Co., Providence, R. I.
Leland-Gifford Co., Worcester, Mass.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Reed-Prentice Co., Worcester, Mass.
Royersford Fdry. & Mach. Co., Royersford, Penn
10", 14", 20" from smallest hole to 1¼".
Sigourney Tool Co., Hartford, Conn.
Silver Mfg. Co., The, Salem, Ohio.
20" Base Drills, 8 styles and sizes; automatic feed. Round or square base. Post and bench drills, 12 styles and sizes.

Drills, Center
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
New Process Twist Drill Co., Taunton, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, Ohio.
Union Twist Drill Co., Athol, Mass.

Drills, Ratchet
Cleveland Twist Drill Co., Cleveland, Ohio
Pratt & Whitney Co., Hartford, Conn.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.

Drills, Square Hole
Radical Boring Head Corp., 90 West St., N. Y. C.

Drills, Twist and Flat
Buckeye Twist Drill Co., Alliance, Ohio.
Celfor Tool Co., Buchanan, Mich.
Cleveland Twist Drill Co., E. 49th St. and Lakeside Ave., Cleveland, Ohio. Branches: New York, 30 Reade St.; Chicago, 9 N. Jefferson St.
Sizes No. 80 to 4" diameter (stock).
Hammacher, Schlemmer & Co., 13th St. and 4th Ave., New York City.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
New Process Twist Drill Co., Taunton, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, Ohio.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.

Dynamometers
General Electric Co., Schenectady, N. Y.
Sprague Electric Works, 527 W. 34th St., N. Y. C.

Electrical Instruments
Brown Instrument Co., Philadelphia, Penn.
General Electric Co., Schenectady, N. Y.
Wagner Electric Mfg. Co., St. Louis, Mo.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Penn.

Electrical Supplies
D & W Fuse Co., Providence, R. I.
General Electric Co., Schenectady, N. Y.
Sprague Electric Works, 527 W. 34th St., N. Y. C.
Wagner Electric Mfg. Co., St. Louis, Mo.

Elevating Trucks (See Trucks)

Elevators and Conveyors
Caldwell & Co., Inc., W. E., Louisville, Ky.
Link-Belt Co., 39th St. and Stewart Ave., Chicago, Ill. Philadelphia and Indianapolis.

Emery Wheels (See Grinding Wheels)

Enamels, Machinery
Felton, Sibley & Co., Inc., 136 N. 4th St., Phila.
Moller & Schumann Co., 8 Gerry St., Brooklyn,

Engineers, Lubrication
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Richardson-Phenix Co., 119 Reservoir Ave., Milwaukee, Wis.

Engineers, Mechanical and Electrical
Carroll Engineering Co., The, Dayton, Ohio.
Harris Eng. Co., The, H. E., Bridgeport, Conn.
Hartford Special Mchy. Co., The, 287 Homestead Ave., Hartford, Conn.
Krasberg Mfg. Co., 410-420 Orleans St., Chicago, Ill.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

Engines, Gas and Gasoline
Backus Water Motor Co., Newark, N. J.

Engines, Steam
American Blower Co., 1400 Russell St., Detroit.
Nazel Engineering & Machine Works, 4039 N. 5th St., Philadelphia, Penn.

Engraving Machinery
Gorton Machine Co., Geo., Racine, Wis.
Keller Mechanical Engraving Co., Brooklyn, N. Y.
Agents: England, France, Italy, Alfred Herbert, Ltd.
For automatically engraving dies, stamps, etc., up to 22"x15".

Expanders, Tube
Watson-Stillman Co., 42 Church St., N. Y. City.

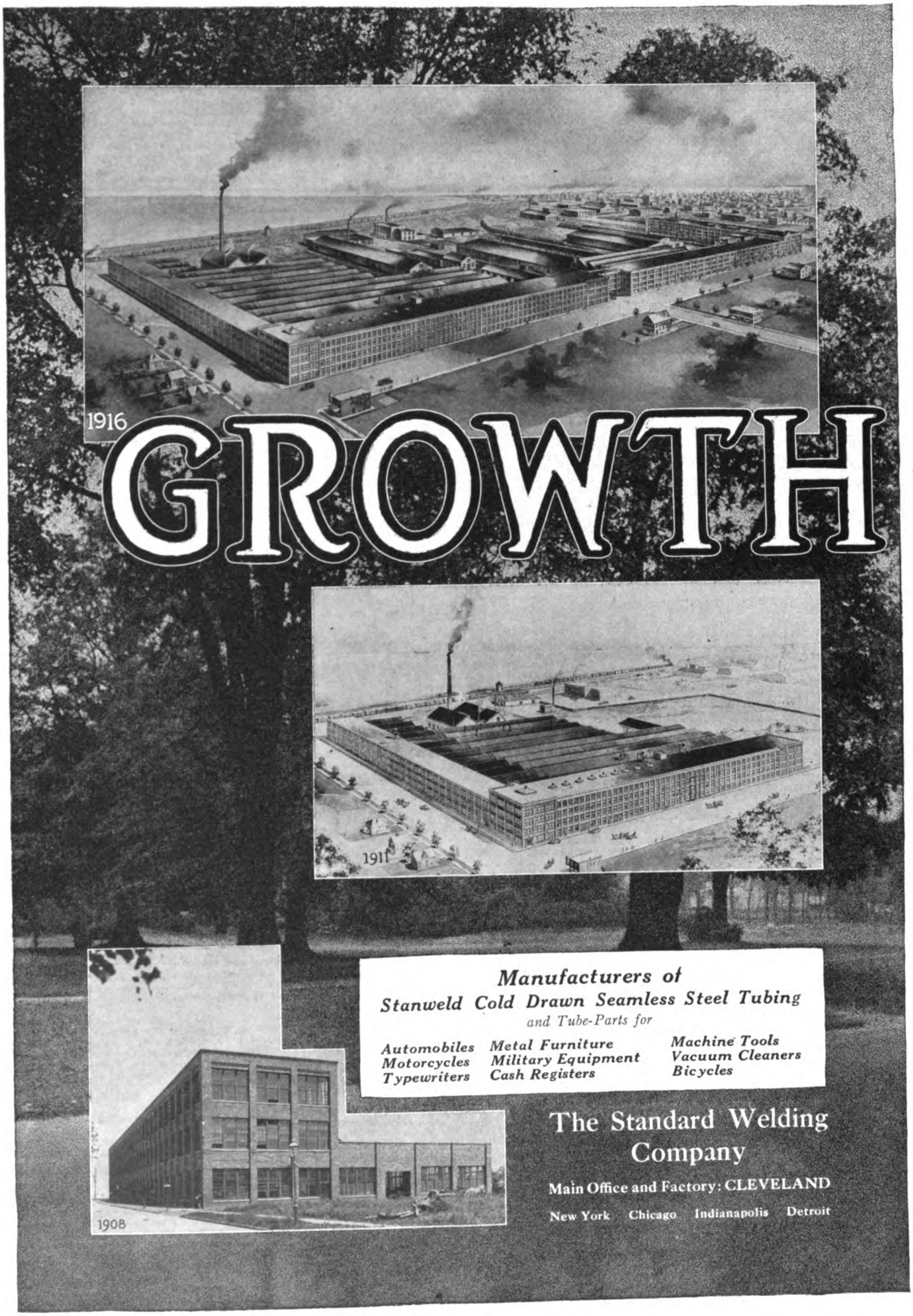
Eyeglasses, Safety (See Goggles, Safety)

Fans, Electric
Crocker-Wheeler Co., Ampere, N. J.
Fidelity Electric Co., Lancaster, Penn.
General Electric Co., Schenectady, N. Y.
Sprague Electric Works, 527 W. 34th St., N. Y. C
Westinghouse Elec. & Mfg. Co., Pittsburgh, Penn

Fans, Exhaust
American Blower Co., 1400 Russell St., Detroit.
Backus Water Motor Co., Newark, N. J.
General Electric Co., Schenectady, N. Y.
Mechanical Appliance Co., Milwaukee, Wis.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Penn.

File Handles
Doane Mfg. Co., Alls Station, Boston, Mass.
Western Tool & Mfg. Co., Springfield, Ohio.

Files and Rasps
Barnett, G. & H., Philadelphia, Penn.
Hammacher, Schlemmer & Co., 13th St. and 4th Ave., New York City.
Montgomery & Co., 108 Fulton St., N. Y. City.
Nicholson File Co., Providence, R. I. Cable: Nicholson, Providence.
The following brands: Nicholson, Kearney & Foot, Eagle, McClellan, J. Barton Smith, Arcade, American, Great Western, Superior rasps, Swiss pattern, extra (X + F), fine; jewelers.


1916
GROWTH
1911
1908
Manufacturers of
Stanweld Cold Drawn Seamless Steel Tubing
and Tube-Parts for
Automobiles
Motorcycles
Typewriters
Metal Furniture
Military Equipment
Cash Registers
Machine Tools
Vacuum Cleaners
Bicycles
The Standard Welding Company
Main Office and Factory: CLEVELAND
New York Chicago Indianapolis Detroit

Simonds Mfg. Co., Fitchburg, Mass. Established 1832. 17th St. and Western Ave., Chicago, Ill.; 90 West Broadway, N. Y. C.
Makers of saws, machine knives, files, sheet and bar steel.

Filing Machines
Ames Co., B. C., Waltham, Mass.
Anderson Die Machine Co., Bridgeport, Conn.
Cochrane-Bly Co., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Oliver Instrument Co., 1168 Cass Ave., Detroit, Mich.
Rearwin, W. D., Mill Ave., N. W., Grand Rapids, Mich. Length of stroke adjustable from 0 to 7". Irregular shape files can be used in this machine Weight 375 lb.

Filler, Iron (See Cements, Iron)

Fittings, Hydraulic
Elmes, Chas. F., 1001 Fulton St., Chicago, Ill.
Watson-Stillman Co., 42 Church St., N. Y. City.

Flexible Shafts
Errington, F. A., 39 Cortlandt St., N. Y. City.
Gem Mfg. Co., 3257 Spruce St., Pittsburgh, Pa. ½ to 1⅝" core.
Stow Mfg. Co., Binghamton, N. Y. 85 Queen Victoria St., London, E. C., England.

Fluxes
Basic Mineral Co., North Side, Pittsburgh, Penn. Foreign Agents: R. Martens & Co., Inc., 24 State St., New York City.

Forging Dies
Keller Mechanical Engraving Co., Brooklyn, N. Y. Agents: England, France, Italy, Alfred Herbert, Ltd.

Forging Machinery
Acme Machinery Co., Cleveland, Ohio. Cable Address: Acme, Cleveland.
Billings & Spencer Co., Hartford, Conn.
National Machinery Co., Tiffin, Ohio.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss & Co., E. W., 1 Adams St., Brooklyn, N. Y.
Camden Forge Co., Mt. Ephraim Ave., Camden, N. J.
Page-Storms Drop Forge Co., Chicopee, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.
Williams Co., J. H., 35 Richards St., Brooklyn.

Forgings, Hammer
Billings & Spencer Co., Hartford, Conn.
Camden Forge Co., Mt. Ephraim Ave., Camden, N. J.
Smooth forged, rough turned or finished complete.
Halcomb Steel Co., Syracuse, N. Y.
Hobson, Houghton & Co., 83 Beekman St., N. Y.
Page-Storms Drop Forge Co., Chicopee, Mass.
Williams Co., J. H., 35 Richards St., Brooklyn.

Foundry Supplies
Berger Mfg. Co., Canton, Ohio.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Paxson Co., J. W., 1021 Delaware Ave., Phila.
Whiting Foundry Equipment Co., Harvey, Ill.

Foundry Systems
McLain, David, 909 Goldsmith Blg., Milwaukee, Wis.

Fountains, Drinking
Manufacturing Equipment & Engineering Co., 209 Washington St., Boston, Mass.

Furnaces, Heat Treating, Oil and Gas
American Gas Furnace Co., 24 John St., N. Y. C.
Brown & Sharpe Mfg. Co., Providence, R. I.
General Electric Co., Schenectady, N. Y.
Gilbert & Barker Mfg. Co., 11 Union St., Springfield, Mass.
Rockwell Co., W. S., 50 Church St., N. Y. City.
Strong Carlisle Hammond Co., Cleveland, Ohio.

Furnaces and Ovens, Electric
Brown Instrument Co., Philadelphia, Penn.
General Electric Co., Schenectady, N. Y.

Furniture, Machine Shop
Berger Mfg. Co., Canton, Ohio. Boston, New York, Philadelphia, Chicago, St. Louis, Minneapolis, San Francisco.
Berger's sectional steel bins and shelving. Types: Closed, open and rack. Combine strength, flexibility and economy with convenience and safety. They afford 25% more storage capacity than wood, will hold heavy loads and are practically indestructible. Fire-retardant and cannot warp, split or rot. Factory tote boxes—strong, light and durable; facilitate handling of stock. See advertisement.
Garwood Bronze and Iron Wks., Garwood, N. J.
Manufacturing Equipment & Engineering Co., 209 Washington St., Boston, Mass.
New Britain Machine Co., New Britain, Conn.
Pressed steel bench legs; frictionless bench drawers; countershaft standards for bench lathes; seat supports for locker rooms; work stands and vise stands, portable and stationary; storage racks for bar stock; tool storage racks; blacksmiths' tool rack and work stands; pantop racks; skeleton-frame racks; lathe tool-racks with drawer; revolving screw racks; stock rack, guide and support for turret lathe or screw machine; shop shelving; pivot base racks; adjustable scraping tables; molders' ramming stands; adjustable stools, wood seats; rungs for permanent ladders; stanchions for guard rails and machine guards; nesting and stacking tote-boxes, electrically welded.
Western Tool & Mfg. Co., Springfield, Ohio.

Gages, Dial
Ames Co., B. C., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Randall & Stickney, Waltham, Mass.
Starrett Co., L. S., Athol, Mass.

Gages, Measuring
Becker Milling Mach. Co., Hyde Park, Mass.
Bicknell-Thomas Co., Greenfield, Mass.
To order for all purposes; also scred thread testing gages.
Brown & Sharpe Mfg. Co., Providence, R. I.
Carroll Engineering Co., The, Dayton, Ohio.
Cleveland Twist Drill Co., Cleveland, Ohio.
Adjustable limit and snap, adjustable for size and wear.
Grayson Tool & Mfg. Co., Indianapolis, Ind.
Greenfield Tap & Die Corp., Greenfield, Mass.
Gronkvist Drill Chuck Co., 18 Morris St., Jersey City, N. J.
"Johansson" combination standard gages, furnished in systems to give all sizes in .00005", .0001", .0005", .001", 64ths, 32nds, 16ths and mm. Accuracy .00001". Prices according to combination.
"Johansson" adjustable limit snap gages, adjustable for wear, different sizes and changing limits. Made with insulated grip. Capacity of smallest size is 0-¼"; capacity of largest size 11"-12".
"Johansson" tolerance plug gages, all sizes up to 8". Reversible, interchangeable measuring members. Light weight.
Harris Eng. Co., The, H. E., Bridgeport, Conn.
Hartford Special Mchy. Co., The, 287 Homestead Ave., Hartford, Conn.
Bench taper gage, with a wide range for tool-room and manufacturing requirements. Adjustable to measure any size taper from nothing up to a No. 14 Browne & Sharpe taper. More accurate than a ring gage. In operation it sets on the bench on its adjustable stand, enabling the operator to set the gage at just the correct height for his eyes, so he may look through the gage toward the light. Send for circular.
Krasberg Mfg. Co., 410-420 Orleans St., Chicago, Ill.
Mehl Mach. Tool & Die Co., Roselle, N. J.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Sanford Mfg. Co., F. C., Bridgeport, Conn.
Simplex Tool Co., Woonsocket, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Union Caliper Co., Orange, Mass.
Walker Co., O. S., Worcester, Mass.
Wells Bros. Co., Greenfield, Mass.
Williams Co., J. H., 35 Richards St., Brooklyn.

Gages, Recording
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Penn.

Gas, Compressed
Davis-Bournonville Co., Jersey City, N. J.
International Oxygen Co., 115 Bway., New York.
Linde Air Products Co., 42nd St. Bldg., N. Y. C.
Oxweld Acetylene Co., Chicago, Ill.

Gaskets
Graton & Knight Mfg. Co., Worcester, Mass.

Gear Cutting Machines
Adams Co., 1902 Bridge Ave., Dubuque, Iowa.
American Die & Tool Co., Reading, Penn.
Barber-Colman Co., Rockford, Ill.
Becker Milling Machine Co., Hyde Park, Mass.
Bilgram Machine Works, 1233 Spring Garden St., Philadelphia, Penn.
Brown & Sharpe Mfg. Co., Providence, R. I.
For spur and bevel gears. 3 sizes. For spur gears only. 5 sizes.
Descriptive circular on request.
Cincinnati Gear Cutting Machine Co., The, Cincinnati, Ohio, U. S. A. Cable: "Tools."
Full automatic spur gear cutters; capacities 26"x10" to 84"x24".
Fellows Gear Shaper Co., The, Springfield, Vt.
No. 6—capacity for spur gears 35" pitch diameter, 5" face, 4 diametrical pitch; for internal gears 26" pitch diameter, 3" face, 4 pitch. No. 65—capacity 35" pitch diameter, 5" face, 6 diametral pitch. Weight of No. 6, 3,855 lb.; weight of No. 65, 4,116 lb. No. 6 machine cuts spurs and internals only and uses a cutter of the generating type. No. 65 is a machine for helicals only and uses a cutter of the generating type.
Flather Mfg. Co., E. J., Nashua, N. H.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Disc cutter type for spur gears. Horizontal cutting type. Sizes—36", 60", 72". Vertical cutting type. Sizes—36", 60", 120".
For spur and bevel gears. Horizontal cutting type 62" and 74". Vertical cutting type 24" and 48".
Hobbing type for spur, helical and worm gears. Sizes: 12", 18", 36", 72".
Multiple spindle type for roughing out spur and bevel gears. 24" for cutting 2 gears at one time up to 11" dia. or 3 gears at one time up to 5½" dia. 48" for cutting 2 gears at one time up to 18" dia. or 3 gears at one time up to 9" dia.
Harrington, Son & Co., Inc., Ed., Philadelphia.
Lees-Bradner & Co., Cleveland, Ohio.
M.-C. Mfg. Co., 28 Congress St., Newark, N. J.
Newark Gear Cutting Machine Co., Newark, N. J.
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Prentiss Tool & Supply Co., Singer Bldg., N. Y. C.
Strong, Carlisle, Hammond Co., Cleveland, Ohio.
Waltham Mach. Works, High St., Waltham, Mass.
Whiton Mach. Co., D. E., New London, Conn.

Gear Tempering Machinery
Gleason Works, Rochester, N. Y.

Gear Testing Machinery
Adams Co., 1902 Bridge St., Dubuque, Iowa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Gleason Works, Rochester, N. Y.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cast
Brown & Sharpe Mfg. Co., Providence, R. I.
Brown Co., A. & F., 79 Barclay St., N. Y. City.
Citroen Gear Co., Paris, France.
Cleveland Worm & Gear Co., Cleveland, Ohio.
Doehler Die Casting Co., Court and Ninth St., Brooklyn, N. Y.
Franklin Mfg. Co., 400 S. Geddes St., Syracuse.
Grant Gear Works, Inc., 151 Pearl St., Boston.
Horsburgh & Scott Co., Cleveland, Ohio.
Meisel Press Mfg. Co., 946 Dor. Ave., Boston.
Philadelphia Gear Works, Vine St. and Reading R.R., Philadelphia, Penn.
Van Dorn & Dutton Co., Cleveland, O. New York, Baltimore, Atlanta, Denver, Salt Lake City and San Francisco.

Gears, Cut and Worm
Adams Co., 1902 Bridge Ave., Dubuque, Iowa.
Baush Machine Tool Co., 604 Wason Ave., Springfield, Mass., U. S. A.
Worm gears for automobile and machine drives.
Bilgram Machine Works, 1233 Spring Garden St., Philadelphia, Penn.
Boston Gear Works, Norfolk Downs, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Brown Co., A. & F., 79 Barclay St., N. Y. City.
Cambridge Machine Co., Cambridge, Ohio.
Chicago (Ill.) Rawhide Mfg. Co., 1301 Elston Ave.
Citroen Gear Co., Paris, France.
Cleveland Worm & Gear Co., The, Cleveland, O. Cable: Gearing.
Worm gear speed reductions. Straight type worm. All worms ground after hardening to correct distortion. Worm reduction cases supplied complete.
Earle Gear & Machine Co., 101 E. Wyoming Ave., Philadelphia, Penn.
Farrel Foundry & Machine Co., Ansonia, Conn.
Fawcus Machine Co., Pittsburgh, Penn.
Flather Mfg. Co., E. F., Nashua, N. H.
Foote Bros. Gear & Mach. Co., 210 N. Carpenter St., Chicago, Ill.
Cut gears all kinds, spur and worm gear speed reducers.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
General Electric Co., Schenectady, N. Y.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Inc., 151 Pearl St., Boston.
Horsburgh & Scott Co., Cleveland, Ohio.
Link-Belt Co., 39th St. and Stewart Ave., Chicago, Ill. Philadelphia and Indianapolis.
M.-C. Mfg. Co., 28 Congress St., Newark, N. J.
Meisel Press Mfg. Co., 946 Dor. Ave., Boston.
Newark Gear Cutting Machine Co., Newark, N. J.
New Process Gear Corporation, Syracuse, N. Y.
Spur, worm, spiral, bevel and internal gears of any metal. Spur and bevel gears and pinions of rawhide and vulcanized fiber.
Spur gears up to 60 in. in diameter, plane bevels up to 50 in., and generated bevels of from 3 to 12 pitch up to 18 in. in diameter.
New Process noiseless gears and pinions. Spurs and bevels up to 36 in. diameter.
Furnished as all rawhide blanks, all rawhide with teeth cut or complete with any desired metal hubs, collars, shrouds, flanges or bushings.
Cutting, generating and finishing tools and carbonizing, hardening and heat-treating facilities to meet requirements of economical quantity and quality production. Service includes designing (when necessary), pattern work, furnishing castings, forgings or bar stocks and complete finishing.
Philadelphia Gear Works, Vine St. and Reading R.R., Philadelphia, Penn.
Sawyer Gear Works, 5121 St. Clair, Cleveland, O.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Van Dorn & Dutton Co., Cleveland, O. New York, Baltimore, Atlanta, Denver, Salt Lake City and San Francisco.

Gears, Herringbone
Citroen Gear Co., Paris, France.
Fawcus Machine Co., Pittsburgh, Penn.
Meisel Press Mfg. Co., 946 Dor. Ave., Boston.

Gears, Rawhide (See Gears, Cut and Worm)

Generators, Electric
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., Schenectady, N. J.
Reliance Electric & Engineering Co., 1044 Ivanhoe Rd., Cleveland, Ohio.

Sprague Electric Works, 527 W. 34th St., N. Y. C.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Penn.

Generators, Gas
Internationl Oxygen Co., 115 Broadway, N. Y.

Graphite
Felton, Sibley & Co., Inc., 136 N. 4th St., Phila.

Greases, Lubricating
Cataract Refining & Mfg. Co., Buffalo, N. Y. Cable Address: "Catarefin," London, 36 Kingsway.
Houghton & Co., E. F., 240 W. Somerset St., Philadelphia, Penn.
Oil City Oil & Grease Co., Oil City, Penn.
Texas Company, Dept. A, 17 Battery Pl., N. Y. C. Houston, Texas. Manufacturers of all kinds of lubricants.
White & Bagley Co., Worcester, Mass.

Grinding Machines, Ball Bearing Race
Heald Machine Co., Worcester, Mass., U. S. A. Cable Address: "Heald." Branches: Chicago, Detroit, Cleveland, Cincinnati. Foreign Agents: Alfred Herbert, Ltd., England, Italy, France, Belgium, Switzerland, Spain and Portugal. Ludw. Loewe & Co., Germany and Austria. F. W. Horne Co., Japan. Wilh. Lonesson & Co., Ltd., Sweden, Denmark and Norway. Post Van Der Burg & Co., Holland.
Landis Tool Co., Waynesboro, Penn. Cable: Landis, Waynesboro.
Rivett Lathe & Grinder Co., Brighton, Boston, Mass. Cable: Edrivett. One size. Ball races up to 5" dia. No. 11 grinder with automatic oscillating motion and cross feed. See our advertisement on inside of back cover.
Van Norman Machine Tool Co., Wilbraham Ave., Springfield, Mass.

Grinding Machines, Bench
Athol Machine Co., Athol, Mass.
Blount Co., J. G., Woodland St., Everett, Mass.
Clark Elec. Co., Jas., Jr., 521 Main St., Louisville, Ky.
Diamond Machine Co., Providence, R. I.
Forbes & Myers, 172 Union St., Worcester, Mass.
Hisey-Wolf Machine Co., Cincinnati, Ohio.
Safety Emery Wheel Co., Larch St., Springfield, O.
Union Twist Drill Co., Athol, Mass.
U. S. Electrical Tool Co., Cincinnati, Ohio.
Van Norman Machine Tool Co., Wilbraham Ave., Springfield, Mass.
Walker Co., O. S., Worcester, Mass.
Worcester Pattern & Model Co., Worcester, Mass.

Grinding Machines, Center
Cincinnati Electrical Tool Co., Cincinnati, Ohio.
Gem Mfg. Co., 3257 Spruce St., Pittsburgh, Pa.
Greenfield Machine Co., Greenfield, Mass.
Hisey-Wolf Machine Co., Cincinnati, Ohio.
Stow Mfg. Co., Binghamton, N. Y.
Wilmarth & Morman Co., 1187 Monroe Ave., Grand Rapids, Mich.

Grinding Machines, Chucking
Bryant Chucking Grinder Co., Springfield, Vt.
Heald Machine Co., Worcester, Mass., U. S. A. Cable Address: "Heald." Branches: Chicago, Detroit, Cleveland, Cincinnati. Foreign Agents: Alfred Herbert, Ltd., England, Italy, France, Belgium, Switzerland, Spain and Portugal. Ludw. Loewe & Co., Germany and Austria. F. W. Horne Co., Japan. Wilh. Lonesson & Co., Ltd., Sweden, Denmark and Norway. Post Van Der Burg & Co., Holland.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder Co., Brighton, Boston.

Grinding Machines, Cutter and Reamer
Brown & Sharpe Mfg. Co., Providence, R. I. 2 sizes cuters 6" dia., 6" long; saws to 24" dia.
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Gould & Eberhardt, Newark, N. J. For single or gang cutters, any pitch or size to 10" dia.
Greenfield Machine Co., Greenfield, Mass. Swings 6¾"x21" on centers or 11" on holder; 12 attachments for tool making and sharpening. Weight 650 lb.
Heald Machine Co., 10 New Bond St., Worcester, Mass.
Ingersoll Milling Machine Co., The, Rockford, Ill. Grinds cutters only; 4¼ to 24 inches, also to 36 inches. Catalogue No. 35 for description. Advertisement page 8.
Landis Tool Co., Waynesboro, Penn.
LeBlond Machine Tool Co., R. K., Cincinnati, O.
Leland-Gifford Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Oesterlein Machine Co., Cincinnati, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Union Twist Drill Co., Athol, Mass.
U. S. Electrical Tool Co., Cincinnati, Ohio.
Walker Co., O. S., Worcester, Mass.
Wells & Son Co., F. E., Greenfield, Mass.
Wilmarth & Morman Co., 1187 Monroe Ave., Grand Rapids, Mich.

Grinding Machines, Cylindrical
Brown & Sharpe Mfg. Co., Providence, R. I. 4 sizes. Range 10"x24" to 12"x60". Descriptive circular on request.
Bryant Chucking Grinder Co., Springfield, Vt.
Greenfield Machine Co., Greenfield, Mass. For work under 12"x2½" in diameter.
Heald Machine Co., Worcester, Mass., U. S. A. Cable Address: "Heald." Branches: Chicago, Detroit, Cleveland, Cincinnati. Foreign Agents: Alfred Herbert, Ltd., England, Italy, France, Belgium, Switzerland, Spain and Portugal. Ludw. Loewe & Co., Germany and Austria. F. W. Horne Co., Japan. Wilh. Lonesson & Co., Ltd., Sweden, Denmark and Norway. Post Von Der Burg & Co., Holland.
Hisey-Wolf Machine Co., Cincinnati, Ohio.
Landis Tool Co., Waynesboro, Penn. Cable: Landis, Waynesboro. Universal and plain. Sizes, universal No. 1, No. 1½, No. 2, No. 3, No. 4. Nos. 2, 3 and 4 are also built with 16" swing, and are used for finishing tools and a variety of straight or taper parts, both external and internal. Attachments, such as magnetic chuck, gear-cutter attachment, side mill grinding attachment, etc. Plain—Sizes 6", 10", 12", 20", 30", 40" swings in standard lengths. These manufacturing machines are intended for finishing straight and taper spindles, shafts, rolls, tubing and all other work within their range which can be revolved on dead centers. Plain machines also built with gap in the bed to suit the location of the projection on the work, 16" and 20" swing. Especially valuable for grinding locomotive piston rods.
Leland-Gifford Co., Worcester, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Norton Grinding Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Van Norman Machine Tool Co., Wilbraham Ave., Springfield, Mass.
Walker Co., O. S., Worcester, Mass.
Young, Corley & Dolan, Inc., 149 Bway., N. Y. C.

Grinding Machines, Die
Bignall & Keeler Machine Co., Edwardsville, Ill. Cable: Bikeeler.
Diamond Machine Co., Providence, R. I.
Geometric Tool Co., New Haven, Conn. 545 W. Washington Blvd., Chicago. Cable: Metric. Geometric chaser or die grinder for grinding any make of thread chaser, whether standard or special. Also for ordinary tool grinding.
Heald Machine Co., Worcester, Mass., U. S. A. Cable Address: "Heald." Branches: Chicago, Detroit, Cleveland, Cincinnati. Foreign Agents: Alfred Herbert, Ltd., England, Italy, France, Belgium, Switzerland, Spain and Portugal. Ludw. Loewe & Co., Germany and Austria. F. W. Horne Co., Japan. Wilh. Lonesson & Co., Ltd., Sweden, Denmark and Norway. Post Von Der Burg & Co., Holland.
Murchey Mach. & Tool Co., 64 Porter St., Detroit.
National Machinery Co., Tiffin, Ohio.

Grinding Machines, Disk
Besly & Co., Charles H., Chicago. Works at Beloit, Wis. Single (horizontal) spindle—No. of grinder: 1, 10, 8, 12, 14, 17, 21. Size disc wheel: 12", 18", 20", 23" and 26", 26" and 30", 30", 36". Double (horizontal) spindle—No. of grinder: 26, 6. Size of disc wheel: 18", 20". Patternmakers' grinders—Each size made in 3 types: A type, disc wheel and worktable one end; B type, disc wheel and worktable both ends; C type, disc wheel and worktable one end, roll sanding attachment at other end. Size disc wheel: 30", 40". Vertical spindle or gravity feed disc grinder—Size disc wheel: 53".
Diamond Machine Co., Providence, R. I.
Landis Machine Co., Waynesboro, Penn.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.

Grinding Machines, Drill
Hisey-Wolf Machine Co., Cincinnati, Ohio.
La Salle Machine & Tool Co., La Salle, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Safety Emery Wheel Co., Larch St., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Penn.
Sterling Grinding Wheel Co., Tiffin, Ohio.
U. S. Electrical Tool Co., Cincinnati, Ohio.
Wells & Son Co., F. E., Greenfield, Mass.
Wilmarth & Morman Co., 1187 Monroe Ave., Grand Rapids, Mich. Makers of New Yankee drill grinder, which has only two adjustments for grinding any drill. Illustrated catalog gives full description.

Grinding Machines, Electric
Chicago Pneumatic Tool Co., Fischer Bldg., Chicago, Ill.

Grinding Machines, Face
Diamond Machine Co., Providence, R. I. For facing off locomotive guide bars, automobile crank cases, motor frames, etc. 30" ring wheel. Work up to 84" in length, 24⅜" in height with guard flap removed and up to 17" with guard flap in place. Belt or motor driven, 15-hp. standard type motor.

Grinding Machines, Floor
Diamond Machine Co., Providence, R. I.
Norton Co., Worcester, Mass.
Quinn & Co., 224 E. 9th St., Cincinnati, Ohio. Belt grinding and polishing machines.
Sterling Grinding Wheel Co., Tiffin, Ohio.

Grinding Machines, Internal
Brown & Sharpe Mfg. Co., Providence, R. I.
Bryant Chucking Grinder Co., Springfield, Vt.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Greenfield Machine Co., Greenfield, Mass.
Heald Machine Co., Worcester, Mass., U. S. A. Cable Address: "Heald." Branches: Chicago, Detroit, Cleveland, Cincinnati. Foreign Agents: Alfred Herbert, Ltd., England, Italy, France, Belgium, Switzerland, Spain and Portugal. Ludw. Loewe & Co., Germany and Austria. F. W. Horne Co., Japan. Wilh. Lonesson & Co., Ltd., Sweden, Denmark and Norway. Post Von Der Burg & Co., Holland.
Hisey-Wolf Machine Co., Cincinnati, Ohio.
Landis Tool Co., Waynesboro, Penn. Cable: Landis, Waynesboro. For straight and taper internal grinding fixtures. Will grind holes ¼" diam. or larger and up to 12" long.
Leland-Gifford Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder Co., Brighton, Boston, Mass. Cable: Edrivett. Two sizes. No. 3 grinder with power feed, No. 8 hand feed.
U. S. Electrical Tool Co., Cincinnati, Ohio.
Van Norman Machine Tool Co., Wilbraham Ave., Springfield, Mass.
Walker Co., O. S., Worcester, Mass.

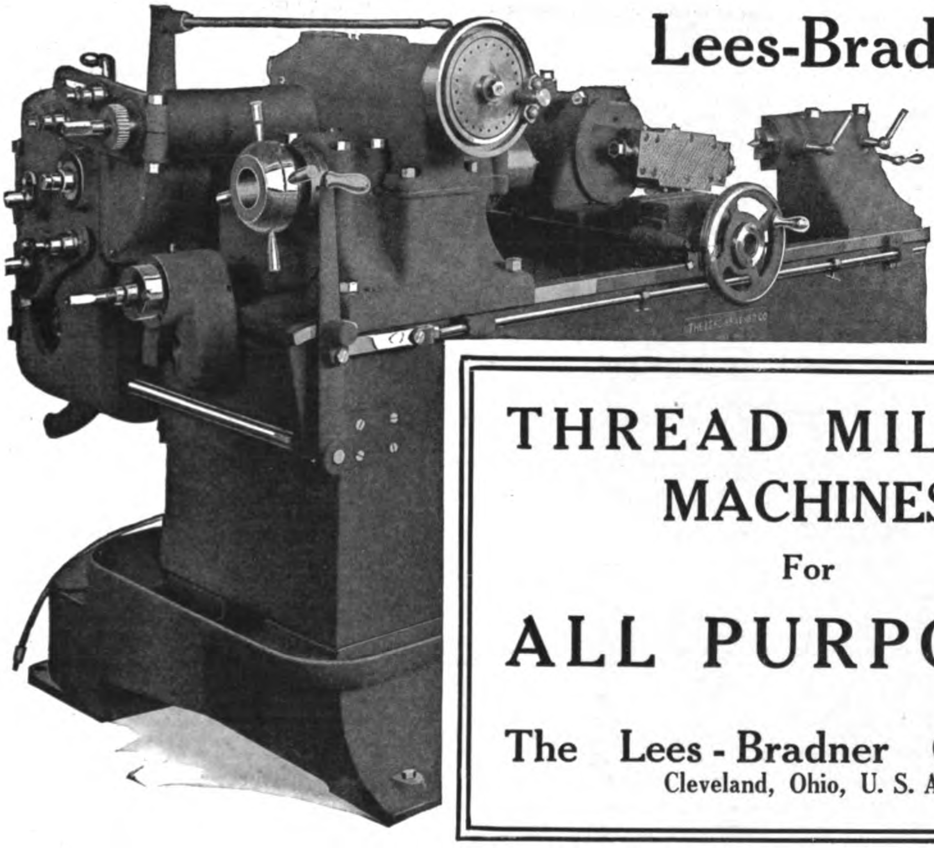
Grinding Machines, Portable
Armstrong-Blum Mfg. Co.
Chicago Pneumatic Tool Co., Chicago, Ill.
Clark Elec. Co., Jas., Jr., 521 Main, Louisville, Ky.
Gem Mfg. Co., 3257 Spruce St., Pittsburgh, Penn.
Independent Pneumatic Tool Co., Thor Bldg., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York. "Little David" pneumatic grinders.
Neil & Smith Electric Tool Co., Cincinnati, Ohio.
Quinn & Co., 224 E. 9th St., Cincinnati, Ohio. Belt grinding and polishing machines.
Stow Mfg. Co., Binghamton, N. Y.
U. S. Electrical Tool Co., Cincinnati, Ohio.

Grinding Machines, Ring Wheel
Besly & Co., Charles H., Chicago. Single spindle, size wheels, 10", 12", 15", 16", 18", 24", 30". Double spindle, size wheels, 18".
Diamond Machine Co., Providence, R. I.

Grinding Machines, Snagging
Forbes & Myers, 172 Union St., Worcester, Mass.
La Salle Machine & Tool Co., La Salle, Ill.
Walker Co., O. S., Worcester, Mass.
Wells & Son Co., F. E., Greenfield, Mass.

Grinding Machines, Surface
Blanchard Machine Co., The, 64 State St., Cambridge, Mass. One size; range 30" diameter by 12" high; either 26" or 30" magnetic chuck; made with countershaft, belted motor and direct motor drive; approximate weight, 8,500 lb. For finishing flat surfaces on castings, forgings, stampings or pieces of bar stock; either hardened or soft; rough or machined. Domestic Agents: Prentiss Tool & Supply Co., Motch & Merryweather Machinery Co., Marshall & Huschart Machinery Co., W. E. Shipley Machinery Co., Kemp Machinery Co., Robinson, Cary & Sands Co., Pacific Tool & Supply Co. Canada: Williams & Wilson, Ltd., A. R. Williams Machinery Co., Ltd. Great Britain: C. W. Burton, Griffiths & Co.
Brown & Sharpe Mfg. Co., Providence, R. I. One size. Grinds work 18"x6"x9½".
Detrick & Harvey Mach. Co., Baltimore, Md.
Diamond Machine Co., Providence, R. I. For grinding dies of all classes, scale beams, jigs, surfacing magnetic chucks, surfacing milling machine tables, surfacing knife grinders, general and miscellaneous surfacing, etc. Four sizes to grind 24", 36", 48", 60" in length, 12" in width, 12" in height under 12" wheel. Extra width and height at extra price. Furnished belt or motor driven. (Special motor.)
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Grayson Tool & Mfg. Co., Indianapolis, Ind.
Heald Machine Co., Worcester, Mass., U. S. A. Cable Address: "Heald." Branches: Chicago, Detroit, Cleveland, Cincinnati. Foreign Agents: Alfred Herbert, Ltd., England, Italy, France, Belgium, Switzerland, Spain and Portugal. Ludw. Loewe & Co., Germany and Austria. F. W. Horne Co., Japan. Wilh. Lonesson & Co., Ltd., Sweden, Denmark and Norway. Post Von Der Burg & Co., Holland.
La Salle Machine & Tool Co., La Salle, Ill.
Leland-Gifford Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rowbottom Machine Co., The, Waterbury, Conn.
Safety Emery Wheel Co., Larch St., Sprinfield, O.
Walker Co., O. S., Worcester, Mass.
Wilmarth & Morman Co., 1187 Monroe Ave., Grand Rapids, Mich.

Grinding Machines, Tool
Barnes Co., W. F. & John, 1995 Ruby St., Rockford, Ill.
Blake & Johnson Co., The, Waterbury, Conn.
Blount Co., J. G., Woodland St., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
Diamond Machine Co., Providence, R. I.
Forbes & Myers, 172 Union St., Worcester, Mass.
Greenfield Machine Co., Greenfield, Mass. Universal tool and cutter grinder for tool making and sharpening.
Landis Machine Co., Waynesboro, Penn.
Landis Tool Co., Waynesboro, Penn.
La Salle Machine & Tool Co., La Salle, Ill.



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ALL PURPOSES

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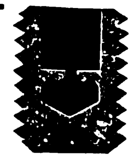

There's a big difference in Safety Set Screws both outside and **inside.**

That is why we have cut these two apart—**to show you.** Look at the finish of the Allen Screw; perfect clean cut threads, solid point with plenty of metal to take the strain and above all the clean, cut socket.

Then look at the **broached** screw in the small cut. You can see the difference in a moment. That's because the Allen patented process makes a clean hole which a broach cannot possibly **imitate.** That's the word, and pretty poor imitation at that.

Write us for free samples and circular No. 10.

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Hartford - Connecticut

Peoples Life Insurance Bldg. - - - Chicago, Ill.
173 Princess Street - - - Manchester, England

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Leland-Gifford Co., Worcester, Mass.
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Oesterlein Machine Co., Cincinnati, Ohio.
Quinn & Co., 224 E. 9th St., Cincinnati, Ohio.
Belt grinding and polishing machines.
Ransom Mfg. Co., Oshkosh, Wis.
Royersford Fdry. & Mach. Co., Royersford, Penn.
Five sizes, for wheels 6" to 20", double head.
Safety Emery Wheel Co., Larch St., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Penn.
Standard Tool Co., Cleveland, Ohio.
Sterling Grinding Wheel Co., Tiffin, Ohio.
Taylor & Fenn Co., The, Hartford, Conn.
Union Twist Drill Co., Athol, Mass.
U. S. Electrical Tool Co., Cincinnati, Ohio.
Vitrified Wheel Co., Westfield, Mass.
Walker Co., O. S., Worcester, Mass.
Wells & Son Co., F. E., Greenfield, Mass.
Wilmarth & Morman Co., 1187 Monroe Ave., Grand Rapids, Mich.
Worcester Pattern & Model Co., Worcester, Mass.

Grinding Wheels
American Emery Wheel Wks., Providence, R. I.
Corundum wheels, carbolite wheels, emery wheels. All sizes, shapes, grits, grades.
Carborundum Co., Niagara Falls, N. Y. N. Y. City, Chicago, Boston, Phila., Cleveland, Cincinnati, Pittsburgh, Milwaukee, Grand Rapids, Manchester, Eng.; Dusseldorf, Germany.
Carborundum and Aloxite grinding wheels.
Dickinson, Thomas L., 64 Nassau St., N. Y. City.
Norton Co., Worcester, Mass. New York, 151 Chambers St.; Chicago, 11 N. Jefferson St.; Niagara Falls, N. Y.; Chippewa, Ont., Can.; Bauxite, Ark.; Wesseling, Bz. Coln, Germany.
Sizes up to 6' diam. made of Alundum and Crystolon.
Safety Emery Wheel Co., Larch St., Springfield, O.
Agents: Farmer & Co., London; Adler & Eisenchitz, Milan; Allied Machinery Co. of America, Paris.
Springfield Grinding Co., Springfield, Mass., U. S. A. Address inquiries to factory, Chester, Mass., U. S. A. Cable Address: "Maxf," Springfield, U. S. A.
"Maxf" grinding wheels; vitrified, silicate or elastic wheels, made from both natural and artificial abrasives, tested and passed upon in our own laboratory before using; made in all sizes of every grade, grain and shape, for every purpose. Our expert engineers are prepared to take up your grinding problems and ascertain the best grain and grade for your particular work. See advertisement.
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Vitrified Wheel Co., Westfield, Mass.

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Grooving Machine Oil
Fischer Machine Co., Philadlephia, Penn

Gun-Barrel Machinery
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Reed-Prentice Co., Worcester, Mass.

Hammers, Belt Driven
Beaudry & Co., Inc., 141 Milk St., Boston, Mass.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Boye & Emmes Mach. Tool Co., Cincinnati, Ohio.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Toledo Machine & Tool Co., Toledo, Ohio.

Hammers, Lead
Field, Charles H., Providence, R. I.

Hammers, Pneumatic
Independent Pneumatic Tool Co., Thor Bldg., Chicago, Ill.

Hammers, Power
Beaudry & Co., Inc., 141 Milk St., Boston, Mass.
Bliss & Co., E. W., 1 Adams St., Brooklyn, N. Y.
Nazel Eng'g & Mach. Wks., 4039 N. 5th St., Philadelphia, Penn.
Five sizes from 75 lb. to 850 lb. Self-contained, pneumatic or belt or motor drive.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.

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Ingersoll-Rand Co., 11 Broadway, New York.
"Little David" riveters, chippers, calkers, scalers.

Hangers, Shafting
Ball & Roller Bearing Co., Danbury, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fafnir Bearing Co., New Britain, Conn.
Hess-Bright Mfg. Co., Front St. and Erie Ave., Philadelphia, Penn.
New Departure Mfg. Co., Bristol, Conn.
Royersford Fdry. & Mach. Co., Royersford, Penn.
S K F Ball Bearing Co., Hartford, Conn. Cable Address: Skayef, Hartford.
Shaft hangers, post hangers, rigid pillow blocks and pedestal type pillow blocks are made in all standard sizes. The well-known S K F self-aligning Swedish crucible steel ball bearings are used in these hangers. Catalog sent on request.

Hardening, Casehardening and Tempering
Williams & Co., J. H. Brooklyn, N. Y.

Hardness Measuring Instruments
Shore Instrument & Mfg. Co., 555 W. 22nd St., New York City.

Heating and Ventilating Equipment
American Blower Co., 1400 Russell St., Detroit.
Houghton & Co., E. F., 240 W. Somerset St., Philadelphia, Penn.

Hobbing Machines
Adams Co., 1901 Bridge Ave., Dubuque, Iowa.
Barber-Colman Co., Rockford, Ill.
Boston Gear Works, Norfolk Downs, Mass.
Gould & Eberhardt, Newark, N. J.
Four sizes: 12", 18", 36", 72". For cutting spur, helical or worm gears.
Lees-Bradner Co., Cleveland, Ohio.
M.-C. Mfg. Co., 28 Congress St., Newark, N. J.
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn

Hobs
Barber-Colman Co., Rockford, Ill.
Boston Gear Works, Norfolk Downs, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Gould & Eberhardt, Newark, N. J.
All pitches, carbon or high speed steel, also specially ground teeth form hobs.
Greenfield Tap & Die Corp., Greenfield, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

Hoists, Electric
Chisholm-Moore Mfg. Co., Cleveland, Ohio.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., Schenectady, N. Y.
Link-Belt Co., 39th St. and Stewart Ave., Chicago, Ill.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger Co., Milwaukee, Wis.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Sprague Electric Works, 527 W. 34th St., N. Y. C.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Penn.
Yale & Towne Mfg. Co., 9 E. 40th St., N. Y. C.

Hoists, Hand
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm-Moore Mfg. Co., Cleveland, Ohio.
Ford Chain Block & Mfg. Co., 140 W. Oxford St., Philadelphia, Penn.
Harrington, Son & Co., Inc., Ed., Philadelphia, Pa.
Reading Chain Block Co., Reading, Penn.
Wright Mfg. Co., Lisbon, Ohio.
High-speed hoists, screw hoists, differential blocks and steel trolleys.
Yale & Towne Mfg. Co., 9 E. 40th St., N. Y. C.

Hoists, Pneumatic
Independent Pneumatic Tool Co., Thor Bldg., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
Worthington Pump & Machinery Corporation, 115 Broadway, New York City.

Hose, Steel
Sprague Electric Works, 527 W. 34th St., N. Y. C.

Igniters, Gas Engine
Doehler Die Casting Co., Court and Ninth St., Brooklyn, N. Y.

Indexing Machines
Springfield Mach. Tool Co., Springfield, Ohio.

Indicators, Sight Flow
Richardson-Phenix Co., 119 Reservoir Ave., Milwaukee, Wis.

Indicators, Speed and Test
Brown & Sharpe Mfg. Co., Providence, R. I.
Brown Instrument Co., Philadelphia, Penn.
Johnson & Miller, 42 Murray St., New York City.
Norton Grinding Co., Worcester, Mass.
Robinson Co., C. E., Orange, Mass.
Starrett Co., L. S., Athol, Mass.
Veeder Mfg. Co., 15 Sargeant St., Hartford, Conn.

Inspectors
Souther Engineering Corp., Hy., Hartford, Conn.

Jacks, Hydraulic
Watson-Stillman Co., 42 Church St., N. Y. City.

Japans
Moller & Schumann Co., 8 Gerry St., Brooklyn,

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Atlantic Motor & Supply Co., West Somerville, Mass.
Becker Milling Mach. Co., Hyde Park, Mass.
Bicknell-Thomas Co., Greenfield, Mass.
Carroll Engineering Co., The, Dayton, Ohio.
Columbus Die Tool & Mach. Co., Columbus, Ohio.
Cowdrey Mach. Wks., C. H., Fitchburg, Mass.
Dover Parts Co., Geo. W., Providence, R. I.
Excel Mfg. Co., Boston, Mass.
Federal Screw Corp., Providence, R. I.
Fenn Mfg. Co., Hartford, Conn.
Gardam & Son, Wm., 108-114 Park Pl., N. Y. C.
Gem City Machine Co., Dayton, Ohio.
Tools, dies, jigs, fixtures, models, all kinds of tool-room work.
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Grant Mfg. & Machine Co., 85 Silliman Ave., Bridgeport, Conn.
Grayson Tool & Mfg. Co., Indianapolis, Ind.
Harris Eng. Co., The H. E., Bridgeport, Conn.
Hartford Special Machinery Co., The, 287 Homestead Ave., Hartford, Conn.
Krasberg Mfg. Co., 410-420 Orleans St., Chicago, Ill.

Mailometer Co., Detroit, Mich.
Marvin & Casler, Canastota, N. Y.
Mehl Mach. Tool & Die Co., Roselle, N. J.
New shop, new machinery; competent, accurate, expert machinists.
Modern Tool Die & Mach. Co., Columbus, Ohio.
Mutual Mach. Co., 27 Wells St., Hartford, Conn.
Nelson Tool Co., Inc., 781 E. 142nd St., N. Y. C.
Reynolds Pattern & Machine Co., Moline, Ill.
Rowbottom Machine Co., The, Waterbury, Conn.
Sanford Mfg. Co., F. C., Bridgeport, Conn.
Sheffield Mach. & Tool Co., The, Dayton, Ohio.
Simplex Tool Co., Woonsocket, R. I.
Sloan & Chace Mfg. Co., Newark, N. J.
Steel Products Engineering Co., Cleveland, Ohio.
Stevens Mfg. Co., Dayton, Ohio.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Wadell, Bowen & Jackson, Rahway, N. J.

Kettles, Soda
Brown & Sharpe Mfg. Co., Providence, R. I.
Gray & Prior Mach. Co., Hartford, Conn.
Manufacturers Equipment & Engineering Co., 209 Washington St., Boston, Mass.

Key Seating Machines
Baker Bros., Toledo, Ohio.
Chattanooga Machinery Co., Chattanooga, Tenn.
Cable: Radcliffe.
For keyseats $\frac{1}{16}$" to 5" wide, 6" to 40" long. Weight, 400 lb. to 5,000 lb.
Cuts internal keyways in straight and taper holes with no limit to outside diameter of work. Cutter bar is self-contained with feeding mechanism and self-relieving cutter. Cutters are placed in and removed from bar without use of wrenches or tools. Work centered by bushings fitting to bore. Belt or motor driven.
Lapointe Machine Tool Co., The, Hudson, Mass.
Cable Address: "Lapointe," Hudson.
Horizontal type, 4 sizes, capacity up to 4" wide.
La Salle Machine & Tool Co., La Salle, Ill.
Mitts & Merrill, 913 Tilden St., Saginaw, Mich.
Morton Mfg. Co., Muskegon Heights, Mich.
Stationary keyway cutters, 18 to 48" stroke.
National Mach. Tool Co., Cincinnati, Ohio.
Internal portable keyseaters.
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.

Keys, Machine
Lapointe Co., J. N., New London, Conn. Cable Address: Lapointe, New London.
Moltrup Steel Products Co., Beaver Falls, Penn.
Finished gib head and plain taper, all kinds.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Morton Mfg. Co., Muskegon Heights, Mich.
Standard Gauge Steel Co., Beaver Falls, Penn.
Whitney Mfg. Co., The, Hartford, Conn., U. S. A.
Machine keys and cutters for the Woodruff system of keying.
Williams Co., J. H., 35 Richards St., Brooklyn.

Knives, Machine
Coes Wrench Co., Worcester, Mass.

Knurl Holders
Armstrong Bros. Tool Co., 315 N. Francisco Ave., Chicago, Ill.
Graham Mfg. Co., Providence, R. I.
For turret machines only.
McCroskey Reamer Co., Meadville, Penn.
Williams Co., J. H., 35 Richards St., Brooklyn.

Lamp Brackets, Adjustable
Newman Mfg. Co., 717 Sycamore St., Cincinnati, Ohio.

Lamps
Benjamin Elec. Mfg. Co., 120 Sangamon St., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Penn.

Lathe Attachments
Dalton Mach. Co., Inc., 1911 Park Ave., N. Y. C.

Lathe Pans, Portable
New Britain Machine Co., New Britain, Conn.
Cast-iron, double and single types, all sizes.

Lathe Tools
Armstrong Bros. Tool Co., 315 N. Francisco Ave., Chicago, Ill.
Chard Lathe Co., Newcastle, Ind., U. S. A. Cable Address: "Chard, Newcastle."
Pratt & Whitney Co., Hartford, Conn.
Union Caliper Co., Orange, Mass.
Western Tool & Mfg. Co., Springfield, Ohio.
Williams Co., J. H., 35 Richards St., Brooklyn.

Lathes, Automatic and Semi-Automatic
Coats Mach. Tool Co., Inc., 30 Church St., N. Y. C.
Greaves, Klusman Tool Co., Cincinnati, Ohio.
Jones & Lamson Machine Co., Springfield, Vt., U. S. A. Cable Address: Turret. Branch: Jones & Lamson Machine Co., 97 Queen Victoria St., London, E. C., England. Cable: Turretorum.
Sizes: 14" Fay automatic lathe; swings 14" over bar, 11" over carriage, takes 17" between centers; automatic feed 10".
For finishing work held on centers or on centered arbors; especially for second operation work carried on arbors. Universal cam adjustments and tool holders permit the use of ordinary forged lathe tools for complicated operations. Machine is entirely automatic, except for changing work.

Agents: Germany, Switzerland, Austria-Hungary, M. Koyemann, Charlottenstrasse 112, Dusseldorf, Germany; France, Spain and Belgium, F. Auberty & Co., 91 Rue de Maubeuge, Paris.
National-Acme Mfg. Co., Windsor, Vt., U. S. A. Cable: "Machine," Windsor, Vt.
Gridley multiple-spindle automatics. 3 sizes: ¾"x4½", 1¼"x5½" and 2¼"x7". Hold four bars of stock in the spindle-carrying cylinder, which revolves step by step, bringing each spindle with its bar successuvely into alignment with each tool. The tool slide upon which the tools are mounted and whose axis is concentric with that of the cylinder does not revolve, but through its automatically controlled longitudinal movement it feeds the tools to the work.
Potter & Johnston Machine Co., Pawtucket, R. I. "P. J. Manufacturing Automatics." 4 sizes, 5A, 6A, 7A, 8A. Range of work varies from about 2½" diam. to 40" diam.
Steinle Turret Machine Co., Madison, Wis. Cable Address: Steinle, Madison.
Full-swing side carriage turret lathes and special attachments. Sizes 24-in. Steinle turret lathe; swings 24 in. over V's, 21 in. over carriage, traverse of turret 56 in. Both carriages are screw cutting, with reversible feeds in aprons, moved back and forth automatically. Lathe requires only one belt direct from line shaft. Belt-driven machine can be changed to electric drive at any time. Manufacture the following attachments to be used on Steinle lathes: High-speed drilling attachment; pistonring cutting, boring and cutting-off attachment; cone pulley turning attachment, etc. Designed to increase production and extend life of machine.

Lathes, Bench

Ames Co., B. C., Waltham, Mass.
Blount Co., J. G., Woodland St., Everett, Mass.
Dalton Mach. Co., Inc., 1911 Park Ave., N. Y. C.
Oliver Mfg. Co., W. W., Buffalo, N. Y. Cable: Oliver, Buffalo.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder Co., Brighton, Boston, Mass. Cable: Edrivett.
Five sizes. Capacities: 7" to 8½" swing, 18" to 22" between centers.
No. 3½, No. 4 and No. 5 plain bench lathes; No. 6, chasing bar lathe; No. 8, back geared screw-cutting lathe.
See our advertisement on inside of back cover.
Seneca Falls Mfg. Co., 687 Water St., Seneca Falls, N. Y.
9" and 11" "Star" screw-cutting bench lathes, 10" speed and woodturning bench lathes.
Stark Tool Co., Watlham, Mass.
Waltham Mach. Works, High St., Waltham, Mass.
Wells & Son Co., F. E., Greenfield, Mass.

Lathes, Boring

Davenport Locomotive Wks., Davenport, Iowa
Detrick & Harvey Machine Co., Baltimore, Md. Cable: Detharvey.
For boring light and heavy guns. 3" to 6". Any length of bed.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Potter & Johnston Machine Co., Pawtucket, R. I.
Root & Vandervoort Eng'g. Co., East Moline, Ill.

Lathes, Chucking (See Lathes, Horizontal Turret)

Lathes, Engine

Acme Machine Tool Co., Buck St., Cincinnati, O. Cable Address: Acme.
American Tool Works Co., The, Cincinnati, U. S. A. Cable: "Lathe, Cincinnati."
Sizes 14, 16, 18, 20, 24, 27, 30, 36, 42".
Five different types of headstocks: Single back geared, double back geared, triple geared, patented geared head for belt and for motor drive. Quick change gear type and patented top Vee bed.
See our advertisement on pages 14 and 15.
Bailey, R. W., 122 S. Michigan Ave., Chicago, Ill.
Barnes Co., W. F. & John, 1995 Ruby St., Rockford, Ill.
Barnes Drill Co., Inc., 830 Chestnut, Rockford, Ill. Sliding extension gap type.
Blount Co., J. G., Woodland St., Everett, Mass.
Boye & Emmes Mach. Tool Co., Cincinnati, Ohio.
Bradford Mach. Tool Co., Cincinnati, Ohio.
Bullard Mach. Tool Co., Bridgeport, Conn.
Special single purpose machines for turning shells and projectiles.
Carroll Jamieson Mach. Co., Batavia, Ohio.
Champion Tool Works Co., 2424 Spring Grove Ave., Cincinnati, Ohio.
Chard Lathe Co., Newcastle, Ind., U. S. A. Cable Address: "Chard, Newcastle."
Sizes 18", 20", 24", 28". Semi- and quick-change. Four-step, single back gear, and three-step, double back gear.
Cincinnati Lathe & Tool Co., Oakley, Cincinnati, O. Sizes 14, 16 and 18 in.
Cleveland Crane & Eng'g Co., Wickliffe, Ohio.
Coats Mach. Tool Co., Inc., 30 Church St., N. Y. C.
Dalton Mach. Co., Inc., 1911 Park Ave., N. Y. C.
Davis Mach. Tool Co., Inc., 311 St. Paul St., Rochester, N. Y.
Detroit Precision Tool Co., Detroit, Mich.
Douglas, W. & B., Middletown, Conn.
"Connecticut" high-duty lathes for turning and boring high carbon steel forgings and other materials at fast speeds. Heavy, rigid and powerful. See advertisement and send for catalog.
Dreses Machine Tool Co., Cincinnati, Ohio.
Dunlap Mfg. Co., Columbus, Ohio.
21" high duty, heavy construction, for shell machining; 4 speeds, 6" double belt drive, back gear ratio 11 to 1. Send for Circular "A."
Earle Gear & Machine Co., 101 East Wyoming Ave., Philadelphia, Penn.
Fitchburg Machine Works, Fitchburg Mass.
Flather & Co., Inc., Nashua, N. H.
Greaves, Klusman Tool Co., Cincinnati, Ohio.
Harrington, Son & Co., Inc., Ed., Philadelphia, Pa.
Hendey Machine Co., The, Torrington, Conn. Cable: Hendey, Torrington. Branches: Singer Bldg., New York City; Oliver Bldg., Boston; Sharples Bldg., Chicago.
Sizes made—12, 14, 16, 18, 20, 24" swing; lengths of bed from 4' to 24' according to swing. Quick change geared. Have taper bearings with ring oiling system for main spindle, and gearing is so arranged that extra gears can be added in train without limit for cutting extra threads if wanted.
Agents: Sherritt & Stoer, Philadelphia; Syracuse Supply Co., Syracuse and Buffalo; W. M. Pattison Supply Co., Cleveland, Dayton, Detroit; Colcord-Wright Mchy. & Supply Co., St. Louis; Pacific Tool & Supply Co., San Francisco; A. R. Williams Mchy. Co., Toronto; Williams & Wilson, Montreal; Chas. Churchill & Co., London; D. Drury & Co., Johannesburg.
Hill, Clarke & Co., Inc., 156 Oliver, Boston, Mass.
Himoff Mach. Co., Inc., 128 Mott St., N. Y. C.
Houston, Stanwood & Gamble Co., Cincinnati, O.
30-in. swing, heavy pattern, high powered lathe, with special purpose headstock, all-geared and designed to transmit 20 hp.
Jenckes Knitting Mach. Co., Pawtucket, R. I.
Turns up to 5 pieces simultaneously according to length.
LeBlond Machine Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Machine Tool Co., Cincinnati, O. Cable: Drill.
Sizes 14 to 48" swing, any length bed. Quick change gear, screw-cutting engine lathes, cone head. Also with single pulley, all geared selective head.
Monarch Machine Tool Co., Sidney, Ohio.
14", 16", 18" and 20" swing.
Morris Mach. Tool Co., Cincinnati, Ohio.
16" quick change and semi-quick change; 16" double and single back gear; 18" double and single back gear.
Mueller Machine Tool Co., Cincinnati, Ohio.
National-Acme Mfg. Co., Cleveland, Ohio.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Pittsburgh Machine Tool Co., Braddock, Penn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., Singer Bldg., N. Y. C.
Reed-Prentice Co., Worcester, Mass.
Sebastian Lathe Co., 117 Culvert St., Cincinnati, O.
Seneca Falls Mfg. Co., The, 687 Water St., Seneca Falls, N. Y.
9", 11" and 13" "Star" screw cutting engine lathes, and 12", 14" and 16" Seneca Falls quick change engine lathes with a large line of attachments.
Springfield Machine Tool Co., The, Springfield, Ohio. Cable: Montanus.
Sizes 14, 16, 18, 20, 24, 30, 36-in. swing. Capacities—Any length beds and all special equipment. Three sizes Fox monitor lathes, 15, 18 and 20" swing. Single pulley all geared head lathes, 14, 16, 18" swing.
Strong Carlisle Hammond Co., Cleveland, Ohio.
Symington Co., The T. H., Rochester, N.Y., U.S.A.
Toomey, Inc., Frank, Philadelphia, Penn.
Walcott Lathe Co., Calhoun St., Jackson, Mich. Made in 14-, 18-, 20- and 25-in. sizes.
Young, Corley & Dolan, Inc., 149 Broadway, N. Y.

Lathes, Extension and Gap

American Tool Works Co., Cincinnati, Ohio.
Barnes Drill Co., 830 Chestnut St., Rockford, Ill. 14-24" and 22-36" sizes.
Harrington, Son & Co., Inc., Ed., Philadelphia, Pa.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.

Lathes, Foot Power

Barnes Co., W. F. & John, 1995 Ruby St., Rockford, Ill.
Reed-Prentice Co., Worcester, Mass.
Seneca Falls Mfg. Co., 687 Water St., Seneca Falls, N. Y.
9" and 11" Star foot power screw-cutting engine lathes, 10" foot power speed and woodturning lathes.
Wells & Son Co., F. E., Greenfield, Mass.

Lathes, Horizontal Turret

Acme Machine Tool Co., Buck St., Cincinnati, Ohio. Cable Address: Acme.
Flat turret type (two sizes), bar work 2¼" and 3¼" diameter. Chucking work 12" and 16" diameter. High turret type (four sizes), 14" to 20" swing.
American Tool Wks. Co., Cincinnati, Ohio.
Blount Co., J. G., Woodland St., Everett, Mass.
Bradford Mach. Tool Co., Cincinnati, Ohio.
Champion Tool Wks. Co., 2424 Spring Grove Ave., Cincinnati, Ohio.
Cleveland Crane & Engineering Co., Wickliffe, O.
Davis Machine Tool Co., Inc., 311 St. Paul St., Rochester, N. Y.
Dreses Machine Tool Co., 227-241 W. McMicken Ave., Cincinnati, O. Cable: Dreses, Cincinnati. Sizes—13" to 20" swing.
With plain and universal slides. Plain and friction back geared. Power feed Belt and motor driven.
Himoff Mach. Co., Inc., 128 Mott St., N. Y. C.
Jones & Lamson Machine Co., Springfield, Vt., U. S. A. Cable: Turret. Branch: Jones & Lamson Machine Co., 97 Queen Victoria St., London, E. C., England. Cable: Turretorum.
Sizes — 2¼", 3" and double spindle; 12" and 14" swing respectively for single spindle, and 10" for double spindle, or 17" when used as a single spindle machine.
Has flat turret and cross sliding head, universal tool holders and simple forged tools. Complicated work set up quickly without special tooling; suitable for small lots or continuous manufacturing. Double spindle machine similar in principle and equipment, but does two pieces of work at the same time, for high production work, 2¼ and 3" machines also sold with bar outfits.
Agents: Germany, Switzerland, Austria-Hungary, M. Koyemann, Charlottenstrasse 112, Dusseldorf, Germany; France, Spain and Belgium, F. Auberty & Co., 91 Rue de Maubeuge, Paris.
Millholland Mach. Co., W. K., Indianapolis, Ind.
Potter & Johnston, Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Co., Worcester, Mass.
Springfield Machine Tool Co., Springfield, Ohio.
Stecher Co., The Chas., 1576 Crossing St., Chicago.
Steinle Turret Machine Co., Madison, Wis. Cable Address: Steinle, Madison.
Warner & Swasey Co., The Cleveland, Ohio. Cable Address: Swasey, Cleveland.
Universal hollow hexagon turret lathe with hollow hexagon turret. Two sizes, for bar work, 2½" to 3¼" and 3½" to 4½"; for chucking work, 12" to 16½" and 16" to 21¼". Turret lathes, plain or geared friction head, four sizes, 12" to 20" swing over ways.

Lathes, Polishing (See Buffing or Polishing Machines)

Lathes, Speed and Hand

Garvin Mach. Co., Spring and Varick St., N. Y. C.
LeBlond Machine Tool Co., R. K., Cincinnati, O.
Reed-Prentice Co., Worcester, Mass.
Seneca Falls Mfg. Co., The, 687 Water St., Seneca Falls, N. Y.
10" swing, 3', 4' or 5' bed, speed or hand lathes.
Wells & Son Co., F. E., Greenfield, Mass.

Lathes, Vertical Turret

Bullard Machine Tool Co., Bridgeport, Conn.
Bullard vertical turret lathe, "New Era" type 18" size; capacity, 22 diam., height from face of chuck table to underside of turret saddle 10½"; from face of table to face of turret 22". 24" size, capacity 26" diam., 20" height under crossrail, 28½" under turret face, table 24½" diam. 34" size, 36" diam., 24½" height under crossrail, 33" under turret face, table 32½" diam. 36" size, 38" diam., 24½" height under crossrail, 35" under turret face, table 34" diam. 42" size, 44" diam., 33" height under crossrail, 43½" under turret face, table 42⅝" diam. Also made without side head for large diameter work, requiring simple operations.
Agents: Australia, Benson Bros., Sydney; France, Fenwick Freres & Co., Paris; England, Alfred Herbert, Coventry; The Netherlands, Landre & Glinderman, Amsterdam; Russia, Russian Metal Trading Co., Iznosskoff, Suckau & Co., Petrograd and Moscow; Germany, Heinrich Dreyer, Berlin; Sweden, Axel Ryden, Stockholm.
Foster Machine Co., Elkhart, Ind.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.

Lathes, Wood Turning

Barnes Co., W. F. & John, 1995 Ruby St., Rockford, Ill.
Seneca Falls Mfg. Co., The, 687 Water St., Seneca Falls, N. Y.
10" swing, 3', 4' and 5' bed, woodturning lathes.
Wells & Son Co., F. E., Greenfield, Mass.

Letters and Figures

Hoggson & Pettis Mfg. Co., New Haven, Conn.
Matthews & Co., Jas. H., Pittsburgh, Penn.
Shoder & Lombard Stamp & Die Co., 251 Canal St., N. Y. C.

Lock Nut

Visiok Ltd., 3, St. Brides House, Salisbury Sq., London, E. C. Agent in America: J. Rowland Kay Co., Conway Bldg., Chicago, Ill.

Lighting Fixtures

Newman Mfg. Co., 717 Sycamore St., Cincinnati, O.

Lockers, Clothes

Berger Mfg. Co., Canton Ohio. Boston, New York, Philadelphia, Chicago, St. Louis, Minneapolis, San Francisco.
Manufacturing Equipment & Engineering Co., 209 Washington St., Boston, Mass.

Locomotive Box Boring Machines

Detrick & Harvey Mach. Co., Baltimore, Md.
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.

Lubricants

Cataract Refining & Mfg. Co., Buffalo, N. Y. Cable Address: "Catarefin," London, 36 Kingsway.
Crescent Oil Co., 50 Church St., New York City.
Houghton & Co., E. F., 240 W. Somerset St., Philadelphia, Penn.
Oil City Oil & Grease Co., Oil City, Penn.
Texas Company, Dept. A, 17 Batery Place, N. Y.

White & Bagley Co., Worcester, Mass.
Cylinder, engine and machine oils. "Minolard" cutting oil for automatics.

Lubricating Systems
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Richardson-Phenix Co., 119 Reservoir Ave., Milwaukee, Wis.
Oil filters and automatic systems for circulating, filtering and sterilizing cutting oils and compounds.

Lubricators
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Richardson-Phenix Co., 119 Reservoir Ave., Milwaukee, Wis.

Machinery Dealers
Coats Mach. Tool Co., Inc., 30 Church St., N. Y. C.
Co-Operative Used Machinery Co., 50 Church St., New York City.
McCoy & Brandt, Pittsburgh, Penn.

Machinists' Small Tools
Athol Machine Co., Athol, Mass.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, Ohio.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hammacher & Schlemmer Co., 13th St. and 4th Ave., New York City.
Mehl Mach. Tool & Die Co., Roselle, N. J.
Pratt & Whitney Co., Hartford, Conn.
Randall & Stickney, Waltham, Mass.
Robinson Co., C. E., Orange, Mass.
Slocomb Co., J. T., Providence, R. I.
Smith & Hemenway Co., 150 Chambers St., N.Y. C
Standard Tool Co., Cleveland, Ohio.
Starrett Co., L. S., Athol, Mass.
Bevels, calipers, clamps, cut-nippers, dividers, gages, hack-saws and frames, levels, micrometers outside and inside, nail sets, plumb bobs, drivers, indicators, squares, straight edges, tapes, transits, Vernier calipers, wrenches.
Our steel rules, micrometers and other measuring tools are graduated to read in metric as well as English. Goods carefully packed for ocean shipment. Catalog in English or Spanish free.
Stevens Mfg. Co., Dayton, Ohio.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Union Caliper Co., Orange, Mass.
Williams Co., J. H., 35 Richards St., Brooklyn.

Mandrels, Expanding
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.

Mandrels, Solid
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., E. 49th St. and Lakeside Ave., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, Ohio.

Measuring Machines
Norma Co. of America, 1790 Bway., New York.
Pratt & Whitney Co., Hartford, Conn.

Metal Finishes
Moller & Schumann Co., 8 Gerry St., Brooklyn.

Metallurgists
McLain, David, 909 Goldsmith Bldg., Milwaukee, Wis. Iron and steel and foundryman. Originator of McLain's System. Mixing by analysis. Scientific melting. Semi-steel.

Meters, Steam Flow
General Electric Co., Schenectady, N. Y.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
475 sizes. 12 sets for tool-room use.
Randall & Stickney Co., Waltham, Mass.
Slocomb Co., J. T., Providence, R. I. Chicago store, R. R. Street & Co., 541 W. Washington St. Sizes ½"—1" to 24", each with a range of 1" and corresponding sizes in metric measure. Capacities 24" to 27", 27" to 30", 30" to 33", 33" to 36"; nearest sizes metric graduated to $^1/_{100}$ millimeters, and English $^1/_{1000}$" and $^1/_{10000}$".
Starrett Co., L. S., Athol, Mass.

Milling Attachments
Adams Co., 1902 Bridge Ave., Dubuque, Iowa.
Becker Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Hendey Mach. Co., Torrington, Conn.
Ingersoll Milling Machine Co., The, Rockford, Ill.
Attachments for special purposes applied to old and new Ingersoll machines particularly.
Advertisement page 8.
Kearney & Trecker Co., Milwaukee, Wis.
Kempsmith Mfg. Co., Milwaukee, Wis.
South American Representative: J. & J. Drysdale Co., Ltd., Buenos Ayres, Calle Perú 440.
Representative for Russia: Iznosskoff, Suckau & Co., Petrograd and Moscow.
LeBlond Machine Tool Co., R. K., Cincinnati, O.
Potter & Johnston Machine Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder Co., Brighton, Boston.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Van Norman Machine Tool Co., Wibraham Ave., Springfield, Mass.

Milling Machines, Automatic
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio. 12", 18", 24" table travel.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Bench
Ames Co., B. C., Waltham, Mass.
Carter & Hakes Machine Co., Winsted, Conn.
Grayson Tool & Mfg. Co., Indianapolis, Ind.
Pratt & Whitney Co., Hartford, Conn.
Stark Tool Co., Waltham, Mass.
Van Norman Machine Tool Co., Wilbraham Ave., Springfield, Mass.

Milling Machines, Hand
Adams Co., 1902 Bridge Ave., Dubuque, Iowa.
Becker Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Carter & Hakes Machine Co., Winsted, Conn.
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
All commercial sizes, cone driven and single pulley, high power, with table range from 18"x6"x15" to 50"x14"x21"; 1 hp. to 20 hp.; 1,400 lb. to 10,000 lb.
Coats Mach. Tool Co., Inc., 30 Church St., N. Y. C.
Davenport Mfg. Co., Meadville, Penn.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Pratt & Whitney Co., Hartford, Conn.
Standard Engineering Co., Pawtucket, R.I., U.S.A.
"Standard" hand milling machines; hand and weight feed. Built for extremely accurate work. Heavy and rigid with a wide base. Box type knee. Cross-feed screw nut, vertical adjusting screw nut, and main spindle bearing are all of phosphor bronze. Spindle is of 50 carbon crucible analysis steel. Extra wide table.
Steptoe Co., The John, Northside, Cincinnati, O.
Van Norman Machine Tool Co., Wilbraham Ave., Springfield, Mass.
Whitney Mfg. Co., The, Hartford, Conn., U. S. A.
Wisconsin Miller Mfg. Co., Station A, Milwaukee, Wis.

Milling Machines, Horizontal and Planer Type
Adams Co., 1902 Bridge Ave., Dubuque, Iowa.
Beaman & Smith Co., Providence, R. I.
Becker Milling Machine Co., Hyde Park, Mass.
Hill, Clarke & Co., Inc., 156 Oliver, Boston, Mass.
Ingersoll Milling Machine Co., The, Rockford, Ill.
All sizes and designs—ask for bulletin 36. Specialists in this line of fixed and adjustable crossrail machines.
Advertisement page 8.
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.

Milling Machines, Oil Grooving
Chattanooga Machinery Co., Chattanooga, Tenn.
Fischer Machine Co., Philadelphia, Penn.
National Machine Tool Co., Cincinnati, Ohio.
Internal port. oil groovers for drilling mach.

Milling Machines, Plain
Adams Co., 1902 Bridge Ave., Dubuque, Iowa.
Becker Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
19 sizes—9 cone drive, 10 constant speed. Range of feeds from 18"x6"x15" to 50"x14"x21".
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
All commercial sizes, cone driven and single pulley, high power, with table range from 18"x6"x15" to 50"x14"x21"; 1 hp. to 20 hp.; 1,400 lb. to 10,000 lb.
Coats Mach. Tool Co., Inc., 30 Church St., N. Y. C.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Gooley & Edlund, Cortland, N. Y.
Manufacturing type, 12¼" between housing, 12" swing, 8 feed changes.
Vandyck, Churchill & Co., N. Y.; Chandler, Farquhar & Co., Boston, Mass.; English & Miller Co., Detroit, Mich.; Brown & Zortman, Pittsburgh, Pa. Foreign Agents: Allied Machinery Co. of America, Paris, Petrograd, Brussels, Turin, Budapest and Balkan States; C. W. Burton, Griffiths & Co., London, Manchester and Glasgow; Barandiaran, Metivier, Gazeau & Cia, San Sebastian, Spain.
Hendey Machine Co., Torrington, Conn. Cable: "Hendey." Branches: Oliver Bldg., Boston; Singer Bldg., New York City, and 565 Washington Blvd., Chicago.
Sizes—Nos. 1, 2, 3 and 4. Belt cone types in Nos. 1, 2 and 3; all geared drive types in Nos 2, 3 and 4.
Agents: W. M. Pattison Supply Co., Cleveland, Detroit; Syracuse Supply Co., Syracuse, Buffalo; Sherritt & Stoer Co., Philadelphia; Laughlin-Barney Mchy. Co., Pittsburgh; A. R. Williams Mchy. Co., Toronto, Winnipeg, St. John and Vancouver; Williams & Wilson, Ltd., Montreal; C. W. Burton, Griffiths & Co., London.
Hill, Clarke & Co., Inc., 156 Oliver St., Boston.
Ingersoll Milling Machine Co., The, Rockford, Ill.
For knee type machines. Make specialty of combined horizontal and vertical machines. Bulletin 31-I.
See advertisement, page 8.
Kearney & Trecker Co., Milwaukee, Wis.
Kempsmith Mfg. Co., Station A, Milwaukee, Wis.
Cable: Kempsmith, Milwaukee.
Three sizes, 2 sizes Lincoln type.
South American Representative: J. & J. Drysdale Co., Ltd., Buenos Ayres, Calle Perú 440.
Representative for Russia: Iznosskoff, Suckau & Co., Petrograd and Moscow.
LeBlond Machine Tool Co., R. K., Cincinnati, O.
Morton Mfg. Co., Muskegon Heights, Mich.
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Potter & Johnston Machine Co., Pawtucket, R. I.
Steptoe Co., The John, Northside, Cincinnati, O.
Van Norman Mach. Tool Co., Wilbraham Ave., Springfield, Mass.
Warner & Swasey Co., The, Cleveland, Ohio.

Milling Machines, Portable
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Underwood & Co., H. B., 1026 Hamilton St Philadelphia, Penn.

Milling Machines, Thread
Pratt & Whitney Co., Hartford, Conn.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Waltham Mach. Works, High St., Waltham, Mass.

Milling Machines, Universal
Becker Milling Machine Co., Hyde Park, Mass
Brown & Sharpe Mfg. Co., Providence, R. I.
11 sizes—4 cone drive, 7 constant speed.
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
All commercial sizes, cone driven and single pulley, high power, with table range from 22"x8"x18" to 50"x14"x20"; 2 hp. to 20 hp.; 3,000 lb. weight to 10,000 lb.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Hendey Machine Co., Torrington, Conn. Cable: Hendey. Branches: New York, Boston, Chicago. Sizes Nos. 1, 2, 3, 4. Belt cone type in Nos. 1, 2, 3; all gear drive type in Nos. 1, 2, 3, 4.
Hill, Clarke & Co., Inc., 156 Oliver St., Boston.
Kearney & Trecker Co., Milwaukee, Wis.
Kempsmith Mfg. Co., Station A, Milwaukee, Wis. Cable: Kempsmith, Milwaukee. Three sizes.
South American Representative: J. & J. Drysdale Co., Ltd., Buenos Ayres, Calle Perú 440.
Representative for Russia: Iznosskoff, Suckau & Co., Petrograd and Moscow.
LeBlond Machine Tool Co., R. K., Cincinnati, O.
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Oesterlein Machine Co., Cincinnati, Ohio.
Potter & Johnston Machine Co., Pawtucket, R. I.
Automatic milling machines for continuous milling equipped with two tables mounted on turret base.
Van Norman Machine Tool Co., Wilbraham Ave., Springfield, Mass.

Milling Machines, Vertical
Adams Co., 1901 Bridge Ave., Dubuque, Iowa.
Becker Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
4 sizes—2 cone drive, 2 constant speed.
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
Cone driven and single pulley, high power, with table range from 28"x12"x20" to 42"x15"x22"; 7½ hp. to 20 hp.; 5,200 lb. weight to 8,000 lb.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Hill, Clarke & Co., Inc., 156 Oliver St., Boston.
Ingersoll Milling Machine Co., The, Rockford, Ill.
Get bulletin No. 31-I. Advertisement page 8.
Kearney & Trecker Co., Milwaukee, Wis.
Knight Machinery Co., W. B., 2000 Lucas Ave., St. Louis, Mo.
LeBlond Machine Tool Co., R. K., Cincinnati, O.
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Potter & Johnston Machine Co., Pawtucket, R. I.
Automatic milling machines for continuous milling equipped with two tables mounted on turret base.
Rockford Milling Machine Co., Rockford, Ill.
Van Norman Mach. Tool Co., Wilbraham Ave., Springfield, Mass.

Milling Machines, Worm
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Waltham Mach. Works, High St., Waltham, Mass.

Molds, Lead
Field, Charles H., Providence, R. I.

Motors, Electric
C & C Elec. & Mfg. Co., Garwood, N. J.
Crocker-Wheeler Co., Ampere, N. J.
Emerson Elec. Mfg. Co., St. Louis, Mo.
A.C. and D.C. 1 hp. and smaller. Specialists in fractional horsepower sizes for motor-operated machines. Samples furnished to manfrs.
Fidelity Electric Co., Lancaster, Penn.
General Electric Co., Schenectady, N. Y.
Mechanical Appliance Co., Milwaukee, Wis.
Watson motors, A.C. and D.C.
Branch Offices: Chicago, 327 So. La Salle St.; Detroit, 64 High St.; Philadelphia, 1328 Chestnut St.; Cleveland, 500 Erie Bldg.; New York City, Dudley-Curry Electric & Supply Co., 154 Nassau St.; Boston, New England Appliance Co., 294 Washington St.
Reliance Electric & Engineering Co., 1044 Ivanhoe Road, Cleveland, Ohio. Branches: New York, Philadelphia, Chicago.

D. C. Constant speed. Adjustable speed field resistance control type, speed ranges up to 1:4. Adjustable speed armature shifting type speed ranges up to 1:10. Armature shifting type provides unlimited running speeds within its range. A. C. Squirrel cage and slip ring types.
Parts for changing belt-driven machine tools to motor-drive designed, manufactured and applied.
Sprague Electric Works, 527 W. 34th St., N. Y. C.
Stow Mfg. Co., Binghamton, N. Y.
Wagner Electric Mfg. Co., St. Louis, Mo.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Penn.

Name Plates
Matthews & Co., Jas. H., Pittsburgh, Penn.

Nut Tappers (See Bolt and Nut Machinery)

Oil Burners
Best, W. N., Inc., 11 Broadway, New York Sity.
Gilbert & Barker Mfg. Co., 11 Union St., Springfield, Mass.

Oil and Grease Cups
Bay State Stamping Co., Worcester, Mass.
Bowen Mfg. Co., Auburn, N. Y. New York City, Chicago, San Francisco.
Doehler Die Casting Co., Court and Ninth St., Brooklyn, N. Y. Branch: Toledo, Ohio. Cable: Doehler, Brooklyn.
Wahlstrom Tool Co., Brooklyn, N. Y.

Oilers
American Tube & Stamping Co., Bridgeport, Conn.
Gem Mfg. Co., 3257 Spruce St., Pittsburgh, Pa. Patent and plain spouts, brazed steel, ¼, ½, ¾, 1 pt.
Richardson-Phenix Co., 119 Reservoir Ave., Milwaukee, Wis.

Oil Filtering Systems
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Oil & Waste Saving Mach. Co., Real Estate Trust Bldg., Philadelphia, Penn.
Richardson-Phenix Co., 119 Reservoir Ave., Milwaukee, Wis.
Oil filters and automatic systems for circulating, filtering and sterilizing cutting oils and compounds.

Oils
Cataract Refining & Mfg. Co., Buffalo, N. Y. Cable: Address: "Catarefin," London, 36 Kingsway.
Crescent Oil Co., 30 Church St., New York City.
Houghton & Co., E. F., 240 W. Somerset St., Philadelphia, Penn.
Texas Company, Dept. A, 17 Battery Pl., N. Y. C.
White & Bagley Co., Worcester, Mass.

Oil Stones
American Emery Wheel Works, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y. New York City, Chicago, Boston, Philadelphia, Cleveland, Cincinnati, Pittsburgh, Milwaukee, Grand Rapids, Manchester, Eng.; Dusseldorf, Germany.
Norton Co., Worcester, Mass.
Vitrified Wheel Co., Westfield, Mass.

Oxygen
Davis-Bournonville Co., Jersey City, N. J.
International Oxygen Co., 115 Bway., N. Y. C.
Linde Air Products Co., The, 42nd St. Bldg., N. Y. C.
Oxygen for welding, cutting and decarbonizing made by the patented Linde Process—compressed in standard approved type cylinders with special Linde regulating valves—Linde customers entitled to free use of as many cylinders as are required. Linde Oxygen is produced by 15 plants and distributed direct to consumers from 40 Distributing Stations throughout the country. For prices of Linde Oxygen and address of Distributing Stations write The Linde Air Products Co., 42nd St. Bldg., New York, N. Y., or Kohl Bldg., San Francisco, Calif.
Metals Welding Co., Cleveland, Ohio.

Packing, Hydraulic
Chicago (Ill.) Rawhide Mfg. Co., 1301 Elston Ave.
Graton & Knight Mfg. Co., Worcester, Mass.
Houghton & Co., E. F., 240 W. Somerset St., Philadelphia, Penn.

Packing, Steam
Graton & Knight Mfg. Co., Worcester, Mass.
Greene, Tweed & Co., 109 Duane St., N. Y. City.

Paints, Machinery
Felton, Sibley & Co., Inc., 136 N. 4th St., Phila.
Moller & Schumann Co., 8 Gerry St., Brooklyn.

Pattern Shop Machinery (See Woodworking Machinery)

Patterns, Wood and Metal
Mehl Mach. Tool & Die Co., Roselle, N. J. Automatic or hand feeds. Steel cut gears.
Fitchburg Machine Works, Fitchburg, Mass.

Phosphor Bronzes
American Bronze Co., Berwyn, Penn. 429 Ford Bldg., Detroit, Mich. Cable: Ambrocom, Phila.
Bunting Brass & Bronze Co., 726 Spencer St., Toledo, Ohio.
Germann Bronze Co., 345 W. 19th St., Erie, Penn.
Titanium Alloy Mfg. Co., The, Niagara Falls, N. Y.

Pipe Bending Machines
Treadwell Engineering Co., 88 West St., N. Y. C.
Underwood & Co., H. B., 1026 Hamilton St., Philadelphia, Penn.

Pipe Cutting and Threading Machines
Bignall & Keeler Mach. Wks., Edwardsville, Ill. Cable: Bikeeler.
Nine sizes, capacities ¼" to 2", ¼" to 3", 1" to 4", 1¼" to 6", 2½" to 8", 3½" to 10", 4" to 12", 7" to 16", 8" to 18".
Curtis & Curtis Co., The, 66 Garden St., Bridgeport, Conn.
Forbes patent pipe-cutting and threading machinery; hand, belt or electric power. Also machines for cutting off the ends of shells, pipe, etc.
Detrick & Harvey Mach. Co., Baltimore, Md.
Greenfield Tap & Die Corp., Greenfield, Mass.
Landis Machine Co., Waynesboro, Penn.
Murchey Mach. & Tool Co., 64 Porter St., Detroit.
Saunders Sons, D., Yonkers, N. Y.
Standard Engineering Co., Ellwood City, Penn.
Treadwell Engineering Co., 88 West St., N. Y. C.
Trimont Mfg. Co., 55 Amory St., Roxbury, Mass. "Trimo" pipe cutters, hand operater, 3 sizes, cutting pipe ⅛" to 8".
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Brubaker & Bros., W. L., Millersburg, Penn.
Butterfield & Co., Derby Line, Vt.
Cleveland Twist Drill Co., Cleveland, Ohio
Greenfield Tap & Die Corp., Greenfield, Mass.
Pratt & Whitney Co., Hartford, Conn.
Saunders Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, Ohio.
Trimont Mfg. Co., 55 Amory St., Roxbury, Mass.
Wells & Son Co., F. E., Greenfield, Mass.
Wells Bros. Co., Greenfield, Mass.
Williams Co., J. H., 35 Richards St., Brooklyn.

Piston-Ring Machines
Heald Machine Co., 10 New Bond St., Worcester, Mass.
National-Acme Mfg. Co., Windsor, Vt., U. S. A. Cable: "Machine," Windsor, Vt.
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Walker Co., O. S., Worcester, Mass.

Planer, Parallels
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Walker Co., O. S., Worcester, Mass.

Planing Machines
American Tool Works Co., The, Cincinnati, U. S. A. Cable: "Lathe, Cincinnati."
Sizes 24, 26, 28, 30, 36, 42, 48, 60" between housings. Built with 1, 2, 3 or 4 heads and 6 different types of drive: Single speed, belt or motor drive; double speed through 2-speed countershaft; 4 speed, through patented cone speed variator for belt or motor drive and with variable speed motor drive with reversing motor equipment. All sizes are equipped aluminum tight pulleys.
See our advertisement on pages 14 and 15.
Betts Machine Co., Wilmington, Del.
Cincinnati Planer Co., The, Cincinnati, Ohio. Cable: Planer.
22" to 96" planers, frog and switch, shoe and wedge and cylinder planers.
Patent "Tu-Speed" type, quick reverse aluminum pulleys, all gearing inside beds, safety locking device, simplex feed gears, patent power elevating device, patent tumbler and dogs, ball bearings on feed screws.
Agents: Prentiss Tool & Supply Co., New York; W. E. Shipley Mchy. Co., Philadelphia; Motch & Merryweather Co., Cleveland, Ohio; Marshall & Huschart Co., Chicago.
Cleveland Planer Works, 3148 Superior Ave., Cleveland, Ohio. Open side, frog and switch. Seven sizes. Capacities 26" to 72", any length.
Coats Mach. Tool Co., Inc., 30 Church St., N. Y. C.
Detrick & Harvey Machine Co., Baltimore, Md. Cable: Detharvey.
Open side. 30" to 96". For wide work beyond limits of double housing planes. Spiral gear drive. Open side convertible. 42" to 96". For double housing planer work. Addition of outer housing turns open side planer into double housing planer. Spiral pinion drive. Double housing—42" to 120". For uninterrupted double housing planer work. Spur gear drive. All beds of closed box type. Motor or belt driven
Gray Co., The G. A., Cincinnati, Ohio. Cable: Address: "Gray, Cincinnati."
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Hill, Clarke & Co., Inc., 156 Oliver St., Boston.

Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Ohio Machine Tool Co., Leighton St., Kenton, O.
Prentiss Tool & Supply Co., Singer Bldg., N. Y. C.
Sellers & Co., Inc., Wm., Philadelphia, Penn.
Strong Carlisle Hammond Co., Cleveland, Ohio.
Toomey, Inc., Frank, Philadelphia, Penn.
Woodward & Powell Planer Co., Worcester, Mass.

Planing Machines, Portable
Morton Mfg. Co., Muskegon Heights, Mich.
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.

Planing Machines, Rotary
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Underwood & Co., H. B., 1026 Hamilton St., Philadelphia, Penn.

Plate Rolls
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.

Pneumatic Tools
Chicago Pneumatic Tool Co., Fischer Bldg., Chicago, Ill.
Independent Pneumatic Tool Co., Thor Bldg., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.

Pressed Steel Parts
Geuder, Paeschke & Frey Co., 1301 St. Paul Ave., Milwaukee, Wis.
New Britain Machine Co., New Britain, Conn.

Presses, Arbor
Atlas Press Co., 310 Park St., Kalamazoo, Mich.
Barnes Co., W. F. & John, 1995 Ruby St., Rockford, Ill.
Crane Puller Co., 54 Lake St., Arlington, Mass.
Metalwood Mfg. Co., Detroit, Mich.
Wilmarth & Morman Co., 1187 Monroe Ave., Grand Rapids, Mich.

Presses, Banding
Cleveland Crane & Engineering Co., Wickliffe, O.
Metalwood Mfg. Co., Detroit, Mich.

Presses, Broaching
Atlas Press Co., 310 Park St., Kalamazoo, Mich
Bliss & Co., E. W., 1 Adams St., Brooklyn, N. Y.
Metalwood Mfg. Co., Detroit, Mich.

Presses, Drop and Forging
Billings & Spencer Co., Hartford, Conn.
Bliss & Co., E. W., 1 Adams St., Brooklyn, N. Y.
Elmes, Chas. F., 1001 Fulton St., Chicago, Ill.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Toledo Machine & Tool Co., Toledo, Ohio.

Presses, Foot and Hand
Atlas Press Co., 310 N. Park St., Kalamazoo, Mich.
Bliss & Co., E. W., 1 Adams St., Brooklyn, N. Y.
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Royersford Fdry. & Mach. Co., Royersford, Penn. Heavy machine for light metal stamping.
Shuster Co., The F. B., New Haven, Conn.
Taylor & Fenn Co., The, Hartford, Conn.

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Barnes Co., W. F. & John, 1995 Ruby St., Rockford, Ill.
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Cleveland Crane & Engineering Co., Wickliffe, O.
Elmes, Chas. F., 1001 Fulton, Chicago, Ill.
Metalwood Mfg. Co., Detroit, Mich.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Watson-Stillman Co., 42 Church St., N. Y. City.

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Bethlehem Steel Co., Machinery Dept., South Bethlehem, Penn.
Bliss & Co., E. W., 1 Adams St., Brooklyn, N. Y.
Metalwood Mfg. Co., Detroit, Mich.

Presses, Power
Barnes Co., W. F. & John, 1995 Ruby St., Rockford, Ill.
Blake & Johnson Co., The—Waterbury, Conn.
Bliss & Co., E. W., 1 Adams St., Brooklyn, N. Y.
Ferracute Machine Co., Bridgeton, N. J.
La Salle Machine & Tool Co., La Salle, Ill.
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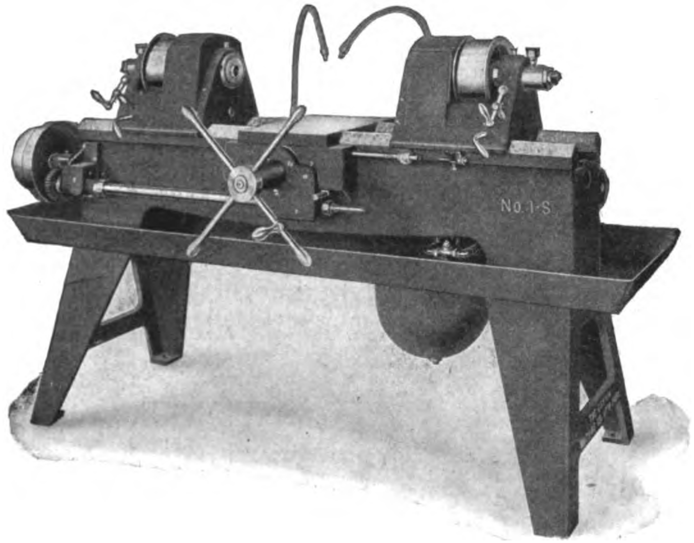

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Screw Feed, Back Geared, 3 to 1. Use Code......Crust Clutch.

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Union Caliper Co., Orange, Mass.

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Armstrong-Blum Mfg. Co., Chicago, Ill.

Punches, Hydraulic
Watson-Stillman Co., 42 Church St., N. Y. City.

Punches, Power
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Ferracute Machine Co., Bridgeton, N. J.
Long & Allstatter Co., Hamilton, Ohio.
Mitts & Merrill, 913 Tilden St., Saginaw, Mich.
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Royersford Fdry. & Mach. Co., Royersford, Penn.
Union Caliper Co., Orange, Mass.
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Fawcus Machine Co., Pittsburgh, Penn.
Grant Gear Works, Inc., 151 Pearl St., Boston.
Horsburgh & Scott Co., Cleveland, Ohio.
Meisel Press Mfg. Co., 946 Dor. Ave., Boston.
Moltrup Steel Products Co., Beaver Falls, Penn.
Newark Gear Cutting Machine Co., Newark, N. J.
New Britain Machine Co., New Britain, Conn.
Philadelphia Gear Works, Vine St. and Reading R.R., Philadelphia, Penn.
Van Dorn & Dutton Co., Cleveland, Ohio.

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Radiators, Japanning Oven
American Gas Furnace Co., 24 John St., N. Y. C.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Ingersoll-Rand Co., 11 Broadway, New York City.

Reamer Holders
Colburn Mach. Tool Co., Franklin, Penn.

Reamers, Expanding
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Reamers, Solid
Brown & Sharpe Mfg. Co., Providence, R. I.
Brubaker & Bros., W. L., Millersburg, Penn.
Butterfield & Co., Derby Line, Vt.
Celfor Tool Co., Buchanan, Mich.
Cleveland Twist Drill Co., E. 49th St. and Lakeside Ave., Cleveland, Ohio. New York, 30 Reade St.; Chicago, 9 N. Jefferson St. Reamers of all sizes and types.
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Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Co., Hartford, Conn.
Reed Mfg. Co., Erie, Penn.
Standard Tool Co., Cleveland, Ohio.
Union Twist Drill Co., Athol, Mass.
Wells & Son Co., F. E., Greenfield, Mass.
Western Tool & Mfg. Co., Springfield, Ohio.
Whitman & Barnes Mfg. Co., Akron, Ohio.

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Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Penn.
Calculagraph Co., 1438 Jewelers Bldg., N. Y. C.

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Cook Co., The, Asa S., 605 Franklin Ave., Hartford, Conn. Rivet Heading and Upsetting Machinery.
National Machinery Co., Tiffin, Ohio.

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Independent Pneumatic Tool Co., Thor Bldg., Chicago, Ill.
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Adt & Son, John, New Haven, Conn.
Grant Mfg. & Machine Co., 85 Silliman Ave., Bridgeport, Conn.
Long & Allstatter Co., Hamilton, Ohio.
Shuster Co., The F. B., New Haven, Conn.
Stecher Co., The Chas., 1576 Crossing St., Chicago.
Toledo Electric Welder Co., 4100 Langland St., Cincinnati, Ohio. Cable: Tolcin, Cincinnati. Riveting by electric welding process.
Townsend Mfg. Co., H. P., Hartford, Conn.

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Standard Engineering Co., Ellwood City, Penn.

Rules, Steel
Brown & Sharpe Mfg. Co., Providence, R. I.
Hammacher, Schlemmer & Co., 13th St. and 4th Ave., New York City.
Starrett Co., L. S., Athol, Mass.
Union Caliper Co., Orange, Mass.

Rust Preventives
Houghton & Co., E. F., 240 W. Somerset St., Philadelphia, Penn.

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Geuder, Paeschke & Frey Co., 1301 St. Paul Ave., Milwaukee, Wis.
Safety Engineering Co., 1440 Schofield St., Cleveland, Ohio.

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American Fdry. Equipment Co., 52 Vanderbilt Ave., New York City.
Betton, J. M., 26 Park Place, New York City.
Mott Sand Blast Co., 1157 E. 138th St., N. Y. C.
Pangborn Corp., Hagerstown, Md.
Paxson Co., J. W., 1021 N. Delaware Ave., Philadelphia, Penn.

Sand-Sifting Machinery
Link-Belt Co., 39th St. and Stewart Ave., Chicago. Philadelphia and Indianapolis.

Saw Frames and Blades, Hack
Atkins Co., E. C., Indianapolis, Ind.
Coats Mach. Tool Co., Inc., 30 Church St., N. Y. C.
Diamond Saw & Stamping Wks., Buffalo, N. Y. Trade-mark "Sterling." 8" to 36" blades.
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Racine Tool & Machine Co., 1400 Jones Ave., Racine, Wis.
Simonds Mfg. Co., Fitchburg, Mass. New York, Chicago, Montreal, Memphis, New Orleans, San Francisco, Portland, Seattle, Vancouver, St. Johns.
Smith & Hemenway Co., 150 Chambers St., N. Y.
Starrett Co., L. S., Athol, Mass.
Thompson & Son Co., Hy. G., New Haven, Conn.
Union Caliper Co., Orange, Mass.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Metal
Armstrong-Blum Mfg. Co., 347 N. Francisco Ave., Chicago, Ill.
Atkins Co., E. C., Indianapolis, Ind.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Coats Mach. Tool Co., Inc., 30 Church St., N. Y. C.
Cochrane-Bly Co., Rochester, N. Y.
Diamond Saw & Stamping Wks., Buffalo, N. Y. Trade-mark "Sterling." Capacity 5x5" to 8x12".
Earle Gear & Machine Co., 101 E. Wyoming Ave., Philadelphia, Penn.
Gorton Machine Co., Geo., Racine, Wis.
Hoefer Mfg. Co., Freeport, Ill.
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Nutter & Barnes Co., Hinsdale, N. H.
Peerless Machine Co., 1615 Racine St., Racine, Wis.
Quality Saw & Tool Works, Springfield, Mass.
Racine Tool & Machine Co., 1400 Jones Ave., Racine, Wis. Four sizes, 6"x6", 8"x8", 12"x12", 12"x15".
Union Twist Drill Co., Athol, Mass.
Vandyck Churchill Co., 93 Liberty St., N. Y. C.
West Haven Mfg. Co., New Haven, Conn.

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Diamond Saw & Stamping Wks., Buffalo, N. Y. Trade-mark "Sterling." Capacity 5x5" to 8x12".
Peerless Machine Co., 1615 Racine St., Racine, Wis.
Quality Saw & Tool Works, Springfield, Mass.
Racine Tool & Machine Co., 1400 Jones Ave., Racine, Wis.
Thompson & Son Co., Hy. G., New Haven, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.
West Haven Mfg. Co., New Haven, Conn.

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Cochrane-Bly Co., Rochester, N. Y. Automatic 10" to 15" and 10", 24" capacities.
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Nutter & Barnes Co., Hinsdale, N. H.

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Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Huther Bros. Saw Mfg. Co., Rochester, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Quality Saw & Tool Works, Springfield, Mass.
Seneca Falls Mfg. Co., 687 Water St., Seneca Falls, N. Y.
Simonds Mfg. Co., Fitchburg, Mass. New York, Chicago, Montreal, Memphis, New Orleans, San Francisco, Portland, Seattle, Vancouver, St. Johns.
Union Twist Drill Co., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Saws, Metal Band
Atkins Co., E. C., Indianapolis, Ind.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Greaves, Klusman Tool Co., Cincinnati, Ohio.
Quality Saw & Tool Works, Springfield, Mass.
Racine Tool & Machine Co., 1400 Jones Ave., Racine, Wis.
Simonds Mfg. Co., Fitchburg, Mass. New York, Chicago, Montreal, Memphis, New Orleans, San Francisco, Portland, Seattle, Vancouver, St. Johns.
West Haven Mfg. Co., New Haven, Conn.

Saws, Screw Slotting
Atkins Co., E. C., Indianapolis, Ind.
Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Fitchburg, Mass. New York, Chicago, Montreal, Memphis, New Orleans, San Francisco, Portland, Seattle, Vancouver, St. Johns.

They HAD to use "CRATER"

We have as a customer for "CRATER," a large Iron and Steel Company who operate a large battery of coke ovens, in conjunction with their mills.

They made their own "lubricant"

As a byproduct they obtain a coal tar, which they formerly employed for "lubricating" their gears, and which they sold to outside trade.

This cost them next to nothing.

They tried "CRATER"

One of our salesmen, with a faith in "CRATER" that knows no obstacles, induced them to accept a sample of TEXACO CRATER COMPOUND. He assisted in the application of this sample to several worn gears. In quick time they realized its value as a real lubricant, and preserver of gears.

On a cost basis

They spoke about the cost. A comparative test against their own product was inaugurated.

"CRATER" won out

This test showed that so little "CRATER" was needed to lubricate the gears properly, and that it stood up against the high radiated heat, the pressure, and the chemical vapors so well, that they could not afford to be without it. "CRATER" saved many times its cost in gear life—to say nothing of the increased service from machines by eliminating replacements and delays.

They sell the other BUT THEY USE "CRATER"

They order it in carload lots now. They use "CRATER" on all their gears, cables, and elevator chains.

It pays them.

They sell their own product to customers outside, BUT THEY USE "CRATER."

Write for the book

If you want to know a little more about this remarkable lubricant, ask for a copy of the "CRATER BOOK." It details some of the properties, performance, and uses of "CRATER," and illustrates a few of the gears on which "CRATER" is working with success. However, if you really want to see how much "CRATER" will save in your plant, arrange for a trial order. We will be glad to send you a sufficient quantity for a test, with instructions for the best way of applying it.

SAVE THE GEARS

This is all very simple.

We want to remind our readers of the fact that TEXACO CRATER COMPOUND is a straight mineral lubricant made by a Company which has a background of unlimited success in the manufacture and application of the right oil for any purpose whatever.

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THE TEXAS COMPANY

Houston - - New York

Department "A." 17 Battery Place, N. Y.

TEXACO

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TEXACO

Starrett Co., L. S., Athol, Mass.
Union Twist Drill Co., Athol, Mass.

Saw Tables, Universal
Baker Bros., Toledo, Ohio.
Colburn Machine Tool Co., Franklin, Penn.

Scales
National Scale Co., Montgomery St., Chicopee Falls, Mass.

Screw Drivers
Nell & Smith Electric Tool Co., Cincinnati, Ohio.
Page-Storms Drop Forge Co., Chicopee, Mass.
Starrett Co., L. S., Athol, Mass.

Screw Driving Machines, Automatic
Reynolds Pattern & Machine Co., Moline, Ill.

Screw-Machine Work
Ball & Roller Bearing Co., Danbury, Conn.
Barnes Co., The Wallace, 38 Wallace St., Bristol, Conn.
Cincinnati Automatic Machine Co., Oakley, Cincinnati, Ohio.
Cincinnati Screw Co., Twightwee, Ohio.
Eastern Machine Screw Corp., New Haven, Conn.
Federal Screw Corp., Providence, R. I.
Murcott-Duden Co., 253 Broadway, N. Y. C.
National-Acme Mfg. Co., Cleveland, Ohio.
Sears-Cross Co., Bush Terminal, Brooklyn, N. Y.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Union Caliper Co., Orange, Mass.
Worcester Machine Screw Co., Worcester, Mass.

Screw Machinery, Wood and Lag
Cook Co., The, Asa S., 605 Franklin Ave., Hartford, Conn. Automatic Wood and Lag Screw Machy.
Townsend Mfg. Co., H. P., Hartford, Conn.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
3 sizes. Both cone and constant speed drives. Nos. 00 and 00G—Stock to 5/16"; turn to 1¼"; feed 2". Nos. 0 and 0G—Stock to ½"; turn 1¾"; feed 3". Nos. 2 and 2G—Stock to ⅞"; turn 2"¼; feed 4".
Cincinnati Automatic Machine Co., Oakley, Cincinnati. Cable: Hayden.
Sizes ¾x3" and 1½x5". Five spindles, single-belt drive, index plates on machine. Each of 9 tools has its own cam. Starting and stopping lever on each side of machine.
Agents: Prentiss Tool & Supply Co., New York; Motch & Merryweather, Cleveland, Detroit and Pittsburgh; Marshall & Huschart Machy. Co., Chicago, St. Louis, Indianapolis; W. E. Shipley Machy. Co., Philadelphia.
Cleveland Automatic Machine Co., 2269 Ashland Rd., Cleveland, Ohio. Cable: "Clyne."
Sizes made—¼, ⅜, ½, ⅝, ¾, ⅞, 1, 1 1/16, 1¼, 1½, 2¼, 2½, 2¾, 3¼, 4, 4¼, 5½, 6¾, 7¾. Produce pieces from bar of 3/16" to 7¾" diameter up to 18" long.
Full automatic machines.
Agents: (Foreign) Chas. Churchill & Co., 9-15 Leonard St., London, Birmingham and Manchester, England, and also Glasgow, Scotland. (Domestic) J. B. Anderson, 211 Mt. Gowen Ave., Philadelphia, Pa.; H. E. Nunn, 565 West Washington St., Chicago, Ill.
Davenport Machine Tool Co., New Bedford, Mass.
One size—½" diameter and turns 2" long.
est operation, single belt or motor equipment.
Agents: C. W. Burton, Griffiths & Co. for Great Britain; Benson Bros. at Sidney for Australia; Schuchardt & Schutte for Germany.
Macnab Machy. Co., John, 90 West St., N. Y. C. Eastern representative; John Macnab, Hyde, England, European representative.
Single spindle: ¾"x2½"; 1¼"x3½"; 1⅝"x6"; 2"x6". Four or five holes in turret, self-contained motor drive if necessary.
National-Acme Manufacturing Co., The, 7500 Stanton Ave., Cleveland, Ohio. Branches: New York, Chicago, Boston, Detroit, Windsor, Vt., and Montreal.
The "Acme" automatic four-spindle screw machine, eight tool positions, simultaneous tool cutting, piece completed in the time of the longest operation, single belt or motor equipment.
Gridley multiple-spindle automatics. 3 sizes: 3¼"x4½", 1¼"x5½" and 2¼"x7".
Gridley single-spindle automatics. 3 sizes, handling bars not larger than 2¼", 3¼" and 4¼" in diameter.
Agents: C. W. Burton, Griffiths & Co. for Great Britain; Benson Bros. at Sidney for Australia; Schuchardt & Schutte for Germany.
New Britain Machine Co., New Britain, Conn. 2008 W. Grand Blvd., Detroit; 949 Otis Bldg., Chicago; Cleveland.
"New Britain" Six-Spindle Automatic. Three sizes: 1"x5", 1⅝"x7", 2½"x9"; single-belt or motor drive; chrome-nickel steel spindles, hardened and ground; adjustable straight bronze spindle bearings with ball-bearing thrust; right-hand tools; heavy tool-slide with no overhang. Spindle cylinder has capacity for six bars of stock and, by revolving through an angle of 60° at each indexing, brings the work in line with the several tools for the required operations. The tool-slide advances the tools automatically to the work, withdrawing upon completion of the operations to give clearance for indexing.
Agents: Coats Machine Tool Co., Ltd., Caxton House, London, Glasgow and Newcastle-on-Tyne.

Townsend Mfg. Co., H. P., Hartford, Conn.

Screw Machines, Plain or Hand
Acme Machine Tool Co., Cincinnati, Ohio. Cable: Acme.
Five sizes. Automatic chuck capacity ⅝" to 2¼", 11" to 20" swing. Plain or friction geared head with or without automatic feed to turret.
Brown & Sharpe Mfg. Co., Providence, R. I.
Wire feed. 5 sizes. Stock from ⅝" to 1½"; turn 2¼" to 10". Both automatic and roller feed type. Plain. 2 sizes, 1½"x8", 1⅝"x10".
Dreses Machine Tool Co., 227-241 W. McMicken Ave., Cincinnati, O. Cable Address: Dreses.
Sizes—1", 1½" and 2¼" stock.
Plain, friction back geared, belt and motor driven.
Foster Machine Co., Elkhart, Ind.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Himoff Mach. Co., Inc., 128 Mott St., N. Y. C.
Jones & Lamson Machine Co., Springfield, Vt., U. S. A. Cable Address: Turret. Branch: Jones & Lamson Machine Co., 97 Queen Victoria St., London, E. C., England. Cable: Turretorum.
Sizes made: 2½" and 3". Capacities: for bar stock up to 2¼" diameter by 24" long, and up to 3" diameter by 36" long, respectively.
Has flat turret and universal tool outfit. Duplicate lathe work made from the bar, in large quantities or small. Also sold with chucking outfit.
Agents: Germany, Switzerland, Austria-Hungary, M. Koyemann, Charlottenstrasse 112, Dusseldorf, Germany; France, Spain and Belgium, F. Auberty & Co., 91 Rue de Maubeuge, Paris.
Millholland Mach. Co., W. K., Indianapolis, Ind.
Pratt & Whitney Co., Hartford, Conn.
Stecher Co., The Charles, 1576 Crossing St., Chicago. Plain and friction heads.
Warner & Swasey Co., The, Cleveland, Ohio. Cable Address: Swasey, Cleveland.
5 sizes, capacity through automatic chuck ⅝" to 2¼", swing over ways 11" to 20". Plain or geared friction head, with or without automatic feed to turret.
Wells & Son Co., F. E., Greenfield, Mass.

Screw Plates
Bay State Tap & Die Co., Mansfield, Mass.
Brubaker & Bros., W. L., Millersburg, Pa. New York, Chicago, Pittsburgh, San Francisco.
Butterfield & Co., Derby Line, Vt.
Card Mfg. Co., S. W., Mansfield, Mass. Cable: Card, Mansfield. N. Y. Office: 62 Reade St.
All sizes in machine screw and fractional in V, U. S. standard, Whitworth, International and French standards (metric system), B. A. standard, S. A. E. standard, A. S. M. E. standard.
Automobile, bicycle, blacksmiths', diamond favorite, gunsmith, improved machinists', motorcycle, paragon, watchmakers'.
Screw plate stocks: Diamond, Favorite, Improved Machinists', Paragon.
Berlin store, Arthur Kayser, Mgr., Alte Jacobstrasse, 24. Chas. Churchill & Co., London, Birmingham, Manchester and Glasgow. Market & Co., Paris. Fenwick Freres & Co., Turin. Ignacz Szekely, Budapest. V. Lowener, Stockholm, Copenhagen. A. A. Kampfraath (Brussels), Ltd., Brussels. Hans Schulze, Vienna and Brum, Austria. Andrews & George, Yokohoma, Tokyo, Osaka. J. Lambercier & Co., Geneva
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.

Screws, Cap and Set
Allen Mfg. Co., 135 Sheldon St., Hartford, Conn.
Bristol Co., Waterbury, Conn.
Cincinnati Screw Co., Twightwee, Ohio.
Hammacher, Schlemmer & Co., 13th St. and 4th Ave., New York City.
Metals Welding Co., The, Cleveland, Ohio.
Progressive Mfg. Co., Torrington, Conn.
Worcester Machine Screw Co., Worcester, Mass.

Screws, Machine
Allen Mfg. Co., 135 Sheldon St., Hartford, Conn.
Bristol Co., Waterbury, Conn.
Brown Bag Filling Machine Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Automatic Machine Co., Oakley, Cincinnati.
Federal Screw Corp., Providence, R. I.
Hammacher, Schlemmer & Co., 13th St. and 4th Ave., New York City.
Jones & Lamson Machine Co., Springfield, Vt.
Metals Welding Co., The, Cleveland, Ohio.
Murcott-Duden Co., 253 Broadway, N. Y. City.
Progressive Mfg. Co., Torrington, Conn.
Sears-Cross Co., Bush Terminal, Brooklyn, N. Y.
Worcester Machine Screw Co., Worcester, Mass.

Screws, Safety Set
Allen Mfg. Co., 135 Sheldon St., Hartford, Conn.
Bristol Co., Waterbury, Conn.
Hammacher, Schlemmer & Co., 13th St. and 4th Ave., New York City.
Progressive Mfg .Co., Torrington, Conn.

Second-Hand Machinery
Co-Operative Used Machinery Co., 50 Church St., New York City.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Harris Bros. Co., St. Paul, Minn.
Hill, Clarke & Co., Inc., 156 Oliver St., Boston.
McCoy & Brandt, Pittsburgh, Penn.
Modern Machy Exchange, 182 Center St., N. Y. C.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.

Prentiss Tool & Supply Co., Singer Bldg., N. Y. C.
Simmons Machine Co., Inc., 985 Broadway, Albany, N. Y.
Strong Carlisle Hammond Co., Cleveland, Ohio.
Toomey, Inc., Frank, Philadelphia, Penn.

Separators, Oil and Waste
Oil & Waste Saving Mach. Co., Real Estate Trust Bldg., Philadelphia, Penn.

Shafting
Camden Forge Co., Mt. Ephraim Ave., Camden, N. J.

Shafts, Crank and Jack
New Process Gear Corporation, Syracuse, N. Y. Automobile jack shafts.
Standard Gauge Steel Co., Beaver Falls, Penn.

Shaping Machines
American Tool Works Co., The, Cincinnati, U. S. A. Cable: "Lathe, Cincinnati."
Sizes 15, 16, 20, 24, 28 inches stroke. 15" shapers are single geared, all other sizes are back geared. Four types: Cone drive, geared speed box for belt and motor drive and direct connected variable speed motor drive without speed box.
Special equipment for mould work and for tool-room requirements for all sizes.
See our advertisement on pages 14 and 15.
Coats Mach. Tool Co., Inc., 30 Church St., N. Y. C.
Cincinnati Shaper Co., The, Cincinnati, Ohio, U. S. A. Cable: "Tools."
16", 20", 24", 28", 32" strokes. Back geared pillar shapes. 18", 22" 26", 36" strokes. Traverse head shapers. Two types, one or two heads, on beds up to 20 ft. long. Crank planers.
Fitchburg Machine Works, Fitchburg, Mass.
Gould & Eberhardt, Newark, N. J.
Seven sizes: 14", 16", 20", 28", 32". For spiral gears—4 sizes: 12", 18", 36", 72".
Grayson Tool & Mfg. Co., Indianapolis, Ind.
Hendey Machine Co., Torrington, Conn. Cable "Hendey." Branches: Boston, N. Y., Chicago.
Sizes—15, 20, 24 and 28" stroke.
Friction clutch driven, having double gear drive to double rack in ram. Speed of ram constant whether running long or short stroke; length and position of stroke of ram easily changed while machine is in motion. 15" and 20" shapers furnished with adjustable table only; 24" and 28" stroke machines furnished with both solid and adjustable table as desired, also regularly equipped with power down feed.
Agents: Pacific Tool & Supply Co., San Francisco ;Colcord-Wright Mchy. & Supply Co., St. Louis; W. M. Pattison Supply Co., Cleveland, Detroit; Syracuse Supply Co., Syracuse, Buffalo; Sherritt & Stoer Co., Phila.; Laughlin-Barney Mchy. Co., Pittsburgh; A. R. Williams Mchy. Co., Toronto, Winnipeg, St. John and Vancouver; Williams & Wilson, Ltd., Montreal; Chas. Churchill & Co., Ltd., London.
Kelly Co., R. A., P. O. Box 488, Xenia, Ohio.
Morton Mfg. Co., Muskegon Heights, Mich.
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Ohio Machine Tool Co., Leighton St., Kenton, O.
Potter & Johnston, Pawtucket, R. I. Cable: Arran, Pawtucket.
15"-24" stroke.
Prentiss Tool & Supply Co., Singer Bldg., N. Y. C.
Rhodes Mfg. Co., Hartford, Conn., U. S. A. Cable Address: Rhodes, Hartford.
Both vertical and horizontal crank shapers. Our vertical shapers will operate at any angle from 0 to 10° so that irregular pieces may be shaped without resetting. Also build combined vertical and horizontal shapers that may be used for either purpose.
Smith & Mills Co., Cincinnati, Ohio.
Springfield Mach. Tool Co., Springfield, Ohio. Cable: Montanus. 12", 15" and 20" crank, 16", 20" and 25" back geared.
Steptoe Co., The John, Northside, Cincinnati, O.
Strong, Carlisle, Hammond Co., Cleveland, Ohio.

Shapes, Cold-Drawn Steel
Moltrup Steel Products Co., Beaver Falls, Penn.
Union Drawn Steel Co., Beaver Falls, Penn.

Shears, Hand
Armstrong-Blum Mfg. Co., 347 N. Francisco Ave., Chicago, Ill.
Oliver Mfg. Co., W. W., Buffalo, N. Y. Cable: Oliver, Buffalo.

Shears, Power
Bethlehem Steel Co., Machinery Dept., South Bethlehem, Penn.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Canton Fndy. & Mach. Co., Canton, Ohio.
Ferracute Machine Co., Bridgeton, N. J.
Groos Co., 16th and Owen Ave., Racine, Wis.
Long & Allstatter Co., Hamilton, Ohio.
Mitts & Merrill, 913 Tilden St., Saginaw, Mich.
Niagara Mach. & Tool Works, Buffalo, N. Y.
Royersford Fdry. & Mach. Co., Royersford, Penn.
Toledo Machine & Tool Co., Toledo, Ohio.
Union Twist Drill Co., Athol, Mass.

Shell Machinery, Special
Langelier Mfg. Co., Providence, R. I.
Root & Vandervoort Eng'g. Co., East Moline, Ill.
Symington Co., The T. H., Rochester, N.Y., U.S.A.
25 different machines designed especially for manufacturing shells and fuse sockets from 3"

to 6" in diameter. Machines are made for the single purpose of one operation and are operated with unskilled labor. Machine furnished complete with tools ready to operate.

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Ferracute Machine Co., Bridgeton, N. J.
Niagara Mach. & Tool Works, Buffalo, N. Y.
Savage Co., Inc., W. J., Knoxville, Tenn.
For cutting sheet metal and plates in any conceivable shape without springing or buckling material. Capacity up to $\frac{3}{16}$" inclusive.
Stecher Co., The Charles, 1576 Crossing St., Chicago. Can making.
Toledo Machine & Tool Co., Toledo, Ohio.

Shelving, Steel (See Furniture, Machine Shop)

Slide Rests
Betts Machine Co., Wilmington, Del.
Reed-Prentice Co., Worcester, Mass.

Slotters, Opening Stud
Errington, F. A., 39 Cortlandt St., N. Y. City.

Slotting Machines
Armstrong Bros. Tool Co., 315 N. Francisco Ave., Chicago, Ill.
Baker Bros., Toledo, Ohio.
Betts Machine Co., Wilmington, Del.
Garvin Mach. Co., Spring and Varick St., N. Y. C.
Newton Machine Tool Works, 23rd and Vine St. Philadelphia, Penn.
Niles-Bement-Pond Co., 111 Broadway, N. Y. C.
Sellers & Co., Inc., Wm., Philadelphia, Penn.

Soap, Hand
White & Bagley Co., Worcester, Mass.
"Cleanzum."

Sockets and Sleeves
Cleveland Twist Drill Co., E. 49th St. and Lakeside Ave., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, Ohio.
Whitman & Barnes Mfg. Co., Akron, Ohio.

Special Machinery and Tools
Atlantic Motor & Supply Co., West Somerville, Mass.
Becker Milling Mach. Co., Hyde Park, Mass.
Bicknell-Thomas Co., Greenfield, Mass.
Bilgram Machine Works, 1233 Spring Garden St., Philadelphia, Penn.
Blanchard Machine Co., 64 State St., Cambridge, Mass.
Cambridge Machine Co., Cambridge, Ohio.
Carroll Engineering Co., The, Dayton, Ohio.
Coats Mach. Tool Co., Inc., 30 Church St., N. Y. C.
Columbus Die Tool & Mach. Co., Columbus, Ohio.
Cowdrey Mach. Wks., C. H., Fitchburg, Mass.
Crane Puller Co., 54 Lake St., Arlington, Mass.
Dexter Co., I. H., 27 Walker St., New York.
Earle Gear & Machine Co., 101 E. Wyoming Ave., Philadelphia, Penn.
Fawcus Machine Co., Pittsburgh, Penn.
Fenn Mfg. Co., Hartford, Conn.
Fischer Machine Co., Philadelphia, Penn.
Foster Machine Co., Elkhart, Ind.
Gardam & Sons, Wm, 108-114 Park Pl., N. Y. C.
Garvin Mach. Co., Spring and Varick St., N. Y.C.
Gem City Machine Co., Dayton, Ohio.
Genesee Precision Tool & Die Co., Rochester, N.Y.
Grayson Tool & Mfg. Co., Indianapolis, Ind.
Harris Eng. Co., The H. E., Bridgeport, Conn.
Hartford Special Machinery Co., The, 287 Homestead Ave., Hartford, Conn.
Hoefer Mfg. Co., Freeport, Ill.
Holyoke Machine Co., Worcester, Mass.
International Oxygen Co., 115 Broadway, N. Y.
Krasberg Mfg. Co., 410-420 Orleans St., Chicago, Ill.
Langelier Mfg. Co., Providence, R. I.
Luster-Jordan Co., Norristown, Penn.
Mallometer Co., Detroit, Mich.
Marvin & Casler Co., Canastota, N. Y.
Mehl Mach. Tool & Die Co., Roselle, N. J.
Designers and builders of watch, clock, typewriter, adding machines and the like. New shop, new machinery, accurate, competent, expert machinists.
Meisel Press Mfg. Co., 946 Dor. Ave., Boston.
Modern Tool Die & Mach. Co., Columbus, Ohio.
Nazel Engineering & Machine Works, 4039 N 5th St., Philadelphia, Penn.
New England Mchy. Co., Stiles St., New Haven, Conn.
Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn.
Oxweld Acetylene Co., Chicago, Ill.
Peerless Machine Co., 1615 Racine St., Racine, Wis.
Reynolds Pattern & Machine Co., Moline, Ill.
Rowbottom Machine Co., Waterbury, Conn.
Sanford Mfg. Co., F. C., Bridgeport, Conn.
Sheffield Mach. & Tool Co., The, Dayton, Ohio.
Simonds Mfg. Co., Pittsburgh, Penn.
Sloan & Chace Mfg. Co., Newark, N. J.
Stecher Co., The Chas., 1576 Crossing St., Chicago.
Steel Products Engineering Co., Springfield, Ohio.
Stevens Mfg. Co., Dayton, Ohio.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Underwood & Co., H. B., 1026 Hamilton St., Philadelphia, Penn.
Waltham Machine Wks., High St., Waltham, Mass.

Springs
Barnes Co., Wallace, 38 Wallace St., Bristol, Conn.

Sprockets and Chains
American Chain Co., Bridgeport, Conn.
Baldwin Chain & Mfg. Co., Worcester, Mass.
All American sizes both roller and block.
Bilgram Machine Works, 1233 Spring Garden St., Philadelphia, Penn.
Boston Gear Works, Norfolk Downs, Mass.
Caldwell & Son Co., H. W., 17th St. and Western Ave., Chicago, Ill.
Grant Gear Works, Inc., 151 Pearl St., Boston.
Link-Belt Co., 39th St. and Stewart Ave., Chicago, Ill. Philadelphia and Indianapolis.
Morse Chain Co., Ithaca, N. Y.
Philadelphia Gear Works, Vine St. and Reading R.R., Philadelphia, Penn.
Whitney Mfg. Co., The, Hartford, Conn., U. S. A.
Sprockets for chains of silent type. Three types of chains—roller, block and silent, in various American sizes.

Squares
Starrett Co., L. S., Athol, Mass.

Stampings, Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bay State Stamping Co., Worcester, Mass.
Blum & Co., Julius, 510-512 W. 24th St., N. Y. C.
Gem Mfg. Co., 3257 Spruce St., Pittsburgh, Penn.
Geuder, Paeschke & Frey Co., 1301 St. Paul Ave., Milwaukee, Wis.
Kales-Haskel Co., Detroit, Mich.
Krasberg Mfg. Co., 410-420 Orleans St., Chicago, Ill.
New Britain Machine Co., New Britain, Conn.

Stampings, Welded
Standard Welding Co., W. 76th St., Cleveland, O.
Branches: Ford Bldg., Detroit; U. S. Express Bldg., New York City; Peoples Gas Bldg., Chicago; Merchants Bank Bldg., Indianapolis. Cable: Stanweld.

Stamps, Steel
Hoggson & Pettis Mfg. Co., The, New Haven, Conn., U. S. A.
Hand cut steel stamps, letters and figures; also marking machine rolls and machine stamps.
Keller Mechanical Engraving Co., Brooklyn, N. Y.
Agents: England, France, Italy, Alfred Herbert, Ltd.
Matthews & Co., Jas. H., Pittsburgh, Penn.
Schwerdtle Stamp Co., 39 Canal St., Bridgeport, Conn.
Schoder & Lombard S. & D. Co., 251 Canal, N. Y.

Stands, Portable (See Furniture, Machine Shop)

Steam Specialties
Dart Mfg. Co., E. M., Providence, R. I.
Reliance Gauge Column Co., 6009 Carnegie Ave., Cleveland, Ohio.

Steel, Cold and Hot Rolled Sheet
American Tube & Stamping Co., Bridgeport, Conn.
Blum & Co., Julius, 510-512 W. 24th St., N. Y. C.
Century Steel Co., Equitable Bldg., N. Y. C.

Steel Hardness Measuring Instruments
Shore Instrument & Mfg. Co., 555 W. 22nd St., New York City. "Sceleroscope."

Steel Heat Testing Instruments
Shore Instrument & Mfg. Co., 555 W. 22nd St., New York. "Pyroscope."

Steel, Shafting and Free Cutting Screw
Blum & Co., Julius, 510-512 W. 24th St., N. Y. C.

Steel, Sheet
Century Steel Co., Equitable Bldg., N. Y. C.
Hobson, Houghton & Co., 83 Beekman St., N. Y. C.
Jessop & Sons, Inc., Wm., 91 John St., N. Y. C.
Moltrup Steel Products Co., Beaver Falls, Penn.
Union Drawn Steel Co., Beaver Falls, Penn.
Ward's Sons, Edgar T., 25 Purchase St., Boston.

Steels, Alloy
American Comp. Co., 469 Atlantic Ave., Boston.
American Tube & Stamping Co., Bridgeport, Conn.
Apex Steel Sorp., 50 Church St., New York City.
Century Steel Co., Equitable Bldg., N. Y. C.
Firth-Sterling Steel Co., McKeesport, Penn.
Halcomb Steel Co., Syracuse, N. Y.
Hawkridge Bros. Co., 303 Congress St., Boston.
Vanadium Alloys Steel Co., Pittsburgh, Penn.
Vulcan Crucible Steel Co., Aliquippa, Penn.

Steels, Carbon Tool
American Comp. Co., 469 Atlantic Ave., Boston.
American Tube & Stamping Co., Bridgeport, Conn.
Apex Steel Sorp., 50 Church St., New York City.
Armstrong Bros. Tool Co., 315 N. Francisco Ave., Chicago, Ill.
Boker & Co., Inc., H., 101 Duane St., N. Y. C.
Century Steel Co., Equitable Bldg., N. Y. C.
Cleveland Twist Drill Co., E. 49th St. and Lakeside Ave., Cleveland, Ohio. New York, 30 Reade St.; Chicago, 9 N. Jefferson St.
Firth-Sterling Steel Co., McKeesport, Penn.
Halcomb Steel Co., Syracuse, N. Y. Branches: Chicago, Cleveland, Philadelphia, New York. Trade-mark "Ketos."
Hawkridge Bros. Co., 303 Congress St., Boston.
Hobson, Houghton & Co., 83 Beekman St., N. Y. C.
Jessop & Sons, Inc., Wm., 91 John St., N. Y. C.
Swedish Iron & Steel Co., 12 Platt St., N. Y. C.
Union Drawn Steel Co., Beaver Falls, Penn.
Vanadium Alloys Steel Co., Pittsburgh, Penn.
Vulcan Crucible Steel Co., Aliquippa, Penn.
Ward's Sons, Edgar T., 25 Purchase St., Boston.
Western Tool & Mfg. Co., Springfield, Ohio.

Steels, Chrome
Century Steel Co., Equitable Bldg., N. Y. C.
Firth-Sterling Co., McKeesport, Penn.
Halcomb Steel Co., Syracuse, N. Y.
Hawkridge Bros. Co., 303 Congress St., Boston.
Jessop & Sons, Inc., Wm., 91 John St., N. Y. C.
Vanadium Alloys Steel Co., Pittsburgh, Penn.
Vulcan Crucible Steel Co., Aliquippa, Penn.
Williams Co., J. H., 35 Richards St., Brooklyn.

Steels, High-Speed
American Comp. Co., 469 Atlantic Ave., Boston.
Apex Steel Sorp., 50 Church St., New York City.
Armstrong Bros. Tool Co., 315 N. Francisco Ave., Chicago, Ill.
Boker & Co., Inc., H., 101 Duane St., N. Y. C.
Century Steel Co., Equitable Bldg., N. Y. C.
Cleveland Twist Drill Co., E. 49th St. and Lakeside Ave., Cleveland, Ohio. New York, 30 Reade St.; Chicago, 9 N. Jefferson St.
Firth-Sterling Steel Co., McKeesport, Penn.
Halcomb Steel Co., Syracuse, N. Y. Branches: Chicago, Cleveland, Philadelphia, New York. Trade-mark "Dreadnought."
Hawkridge Bros. Co., 303 Congress St., Boston
Haynes-Stellite Works, Kokomo, Ind.
Hobson, Houghton & Co., 83 Beekman St., N. Y. C.
Vanadium Alloys Steel Co., Pittsburgh, Penn.
Vulcan Crucible Steel Co., Aliquippa, Penn.
"Vulcan-Cobalt" for turning shells.
Ward's Sons, Edgar T., 25 Purchase St., Boston.
Williams Co., J. H., 35 Richards St., Brooklyn.

Stocks, Die (See Taps and Dies)

Stools, Shop
Manufacturing Equipment & Engineering Co., 209 Washington St., Boston, Mass.
New Britain Machine Co., New Britain, Conn.

Straightening Machinery
Crane Puller Co., 54 Lake St., Arlington, Mass.
Langelier Mfg. Co., Providence, R. I.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Shuster Co., The F. B., New Haven, Conn.
75 sizes. 1" and smaller, various shapes.
Springfield Machine Tool Co., Springfield, Ohio.
Cable: Montanus.
Bench straightening press, 3 sizes.

Swaging Machines
Excelsior Needle Co., Torrington, Conn. Cable Address: Excelsior.
Sizes—Nos. 00, 1, 2, 3, 3½, tube. Capacities: $\frac{1}{16}$", $\frac{3}{32}$", $\frac{3}{16}$", ⅜", ¾", 2", 1⅝". 30 lb., $100; 100 lb., $200; 500 lb., $350; 850 lb., $450; 1,750 lb., $550; 2,450 lb., $600; 2,100 lb., $600.
Taper, point and reduce all kinds of solid and tubular or hollow metals.
Agents: Coventry Swagging Co., Ltd., White Friars Lane, Coventry, England; Societe Arronyme des Establissement de Fenwick Freres & Co., 8, Rue de Rocroi, Paris, France.
Langelier Mfg. Co., Providence, R. I.

Switches and Switchboards
C & C Elec. & Mfg. Co.—Garwood, N. J.
General Electric Co., Schenectady, N. Y.
Gerstner & Sons, H., 22 Columbia St., Dayton, O.
Sprague Electric Works, 527 W. 34th St., N. Y. C.
Wagner Electric Mfg. Co., St. Louis, Mo.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Penn.

Tachometers
Bristol Co., Waterbury, Conn.

Tap Extractors, Broken
Walton Co., The, Hartford, Conn.
Sixteen sizes from No. 8 to 1¼" tops.

Tap Holders
Errington, F. A., 39 Cortlandt St., N. Y. City
Greenfield Tap & Die Corp., Greenfield, Mass.
Warner & Swasey Co., Cleveland, Ohio.

Taper Pins
Brown & Sharpe Mfg. Co., Providence, R. I.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, Ohio.

Tapes, Measuring
Starrett Co., L. S., Athol, Mass.

Tapping Machines and Attachments
Acme Machinery Co, Cleveland, Ohio Cable Address: Acme, Cleveland.
American Tool Works Co., Cincinnati, Ohio.
Baker Bros., Toledo, Ohio.
Beaman & Smith Co., Providence, R. I.
Bicknell-Thomas Co., Greenfield, Mass.
Cincinnati Bickford Tool Co., Oakley, Cincinnati, O
Errington, F. A., 39 Cortlandt St., New York City.
Evans Stamping & Plating Co., Taunton, Mass.
Capacities up to ¼". Hand or foot operated.
Cable Address: "Paragon, Taunton."
Fenn Mfg. Co., Hartford, Conn.
Garvin Mach. Co., Spring and Varick St., N. Y. C
Harris Eng. Co., The H. E., Bridgeport, Conn.
Hoefer Mfg. Co., Freeport, Ill.
Langelier Mfg. Co., Providence, R. I.
Moline Tool Co., Moline, Ill.
Wells & Son Co., F. E., Greenfield, Mass.
Whitney Mfg. Co., The, Hartford, Conn., U. S. A.
Cable Address: "Whitney, Hartford."
"Hollm Patent" friction tapping device. Three

sizes, ¼" to ⅝" taps, ¼" to ⅝" taps, 7/16" to 1¼" taps. This device is interchangeable with our "Presto" chuck.

Taps and Dies
Bay State Tap & Die Co., Mansfield, Mass.
Brubaker & Bros., W. L., Millersburg, Pa. New York, Chicago, Pittsburgh, San Francisco.
Butterfield & Co., Derby Line, Vt.
Card Mfg. Co., S. W., Mansfield, Mass. N. Y. Office: 62 Reade St. Cable: Card, Mansfield. All sizes in V., U. S. standard, S. A. E. standard, A. S. M. E. standard, Whitworth standard, French and International standards (metric system), Lowenherz standard, B. A. standard. Taps—Beaman & Smith, bicycle taper, bit-brace, blacksmith, combined pipe, tap and drill, flexible stay-bolt, harbor masters', jewelers', machine or nut, machine screw, machinists' hand, mud plug, patch bolt, pipe, pipe hob, pulley, small watchmakers'. Dies—Favorite, machine or solid bolt, Paragon, round, adj. pipe, round adjustable, Smith patent adjustable, spring screw threading, solid sq. pipe, die holders. Berlin store, Arthur Kayser, Mgr., Alte Jakobstrasse, 24. European Agents: Chas. Churchill & Co., London, Birmingham, Manchester and Glasgow. Markt & Co., Ltd., Paris. Ignacz Szekely, Budapest. V. Lowener, Stockholm, R. S. Stokvis & Zonen, Ltd., Roterdam, Copenhagen, Christiania. R. S. Stokvis & Fils, Brussels. Andrews & George, Yokohama, Tokyo, Osaka. J. Lambercier & Co., Geneva. C. Civita, Milano, Italy. R. D'Auglignac, Barcelona, Spain.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hammacher, Schlemmer & Co., 13th St. and 4th Ave., New York City.
Harris Eng. Co., The H. E., Bridgeport, Conn.
Manufacturers Equipment Co., Chicago, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Murchey Mach. & Tool Co., 64 Porter St., Detroit.
Pratt & Whitney Co., Hartford, Conn.
Reed Mfg. Co., Erie, Penn. Pipe or bolt, solid or adjustable, ⅛" to 4".
Saunders Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, Ohio.
Wells & Son Co., F. E., Greenfield, Mass.
Wells Bros. Co., Greenfield, Mass.

Taps, Collapsing
Errington, F. A., 39 Cortlandt St., N. Y. City.
Geometric Tool Co., New Haven, Conn. 545 W. Washington Blvd., Chicago. Cable: Metric. For cutting all classes of internal screw threads above ¾ in.
Manufacturers Equipment Co., Chicago, Ill.
Murchey Mach. & Tool Co., 64 Porter St., Detroit.
Victor Tool Co., Waynesboro, Penn.

Testing Metals and Materials
Souther Engineering Corp., Hy., Hartford, Conn.

Thermometers
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Penn.

Thread-Cutting Tools
Armstrong Bros. Tool Co., 315 N. Francisco Ave., Chicago, Ill.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Harris Eng. Co., The, H. E., Bridgeport, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Krasberg Mfg. Co., 410-420 Orleans St., Chicago, Ill.
Landis Machine Co., Waynesboro, Penn. Sizes ½" to 4".
Murchey Mach. & Tool Co., 64 Porter St., Detroit.
National Machinery Co., Tiffin, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder Co., Brighton, Boston.
Union Caliper Co., Orange, Mass.
Williams Co., J. H., 35 Richards St., Brooklyn.

Tool Chests
Gerstner & Sons, H., 22 Columbia St., Dayton, O. Twenty-eight styles carried in stock. Special cases and chests made to order.
Union Tool Chest Works, Rochester, N. Y.

Tool Holders
Armstrong Bros. Tool Co., 315 N. Francisco Ave., Chicago, Ill.
Celfor Tool Co., Buchanan, Mich.
Pratt & Whitney Co., Hartford, Conn.
Rex Mfg. Co., Hyde Park, Boston, Mass., U. S. A. Rex tool post for multiple spindle and single tool work. Narrow, allowing close setting. Swivels any direction. Fits any lathe by means special T-nut.
Union Caliper Co., Orange, Mass.
Western Tool & Mfg. Co., Springfield, Ohio.
Williams Co., J. H., 35 Richards St., Brooklyn.

Tools, Small (See Machinists' Small Tools)

Torches, Blow
Gem Mfg. Co., 3257 Spruce St., Pittsburgh, Pa.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

Transformers
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., Schenectady, N. Y.
Wagner Electric Mfg. Co., St. Louis, Mo.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Penn.

Transmission Machinery
American Pulley Co., 29th and Bristol, Phila., Pa. 33 Greene St., N. Y. City; 124 S. Clinton St., Chicago; 165 Pearl St., Boston; 536 First Ave., S., Seattle. Cable: Amerpulley.
Caldwell Co., Inc., W. E., Louisville, Ky.
Holyoke Machine Co., Worcester, Mass.
Link-Belt Co., 39th St. and Stewart Ave., Chicago, Ill. Philadelphia and Indianapolis.
O. K. Clutch & Mchy. Co., Columbia, Penn.
Rockwood Mfg. Co., The, Indianapolis, Ind.

Traps, Steam
American Blower Co., 1400 Russell St., Detroit.
Houghton & Co., E. F., 240 W. Somerset St., Philadelphia, Penn.
Reliance Gauge Column Co., 6009 Carnegie Ave., Cleveland, Ohio.

Trolleys and Tramways
Chisholm-Moore Mfg. Co., Cleveland, Ohio.
Harrington, Son & Co., Inc., Ed., Philadelphia, Pa.
Wright Mfg. Co., Lisbon, Ohio.

Trucks
Clark Co., Geo. P., Windsor Locks, Conn. Two sizes, capacity 1,000 lb.; 4 sizes, capacity 2,200 lb. Elevating, hand and special trucks made to order.
Cowan Truck Co., Holyoke, Mass., U. S. A. Cable Address: "Cowantruck," Holyoke. Complete line of hand and electric elevating trucks ranging in price from \$60 to \$1,800 to handle loads from 1,500 to 5,000 lb. Send for catalog.
General Electric Co., Schenectady, N. Y.
National Scale Co., Montgomery St., Chicopee Falls, Mass. "National-Chapman" elevating trucks, 15 models, including combination scale elevating trucks. Capacities 2,500 to 4,000 lb.
New Britain Machine Co., 20 Chestnut St., New Britain, Conn. 2008 W. Grand Blvd., Detroit.

Tube Mill Machinery, Seamless and Welded
Standard Engineering Co., Ellwood City, Penn.

Tubing, Flexible
Almond, T. R., 6 Maple Ave., Ashburnham, Mass.

Tubing, Seamless Steel and Brass and Copper
Blum & Co., Julius, 510 W. 24th St., N. Y. City.
Elyria Iron & Steel Co., E. 131st St., Cleveland, O.
Murcott-Duden Co., 253 Broadway, N. Y. C.
Standard Welding Co., W. 76th St., Cleveland, O. Branches: Ford Bldg., Detroit; U. S. Express Bldg., New York City; Peoples Gas Bldg., Chicago; Merchants Bank Bldg., Indianapolis. Cable: Stanweld. Electrical welded. Made by the electric welding process.
Ward's Sons, Edgar T., 25 Purchase St., Boston.

Turntables
Canton Foundry & Mach. Co., Canton, Ohio.
Link-Belt Co., 39th St. and Stewart Ave., Chicago, Ill. Philadelphia and Indianapolis.

Turret Heads
Almond, T. R., 6 Maple Ave., Ashburnham, Mass.

Turrets, Tool Post
American Tool Wks. Co., Cincinnati, Ohio. Cable: Lathes, Cincinnati. For application to any standard make of lathe. Turret holes, rough bored to be finished by customers after turret has been mounted on lathe. Templet of lathe bed or crossbridge required.
Newman Mfg. Co., 717 Sycamore St., Cincinnati, Ohio. Can be attached to any ordinary lathe, screw machine or turret machine; also manufacturing a tailstock turret for any lathe for drilling, reaming, boring, tapping, etc.
Phoenix Mfg. Co., Eau Claire, Wis.

Unions, Pipe
Dart Mfg. Co., E. M., Providence, R. I.

Universal Joints
Baush Machine Tool Co., 604 Wason Ave., Springfield, Mass., U. S. A.
Boston Gear Works, Norfolk Downs, Mass.
Gray & Prior Mach. Co., Hartford, Conn.
Mutual Mach. Co., 27 Wells St., Hartford, Conn.

Valves
Elmes, Chas. F., 1001 Fulton St., Chicago, Ill.
Metalwood Mfg. Co., Detroit, Mich.
Richardson-Phenix Co., 119 Reservoir Ave., Milwaukee, Wis.
Watson-Stillman Co., 42 Church St., N. Y. City.
Worthington Pump & Machinery Corporation, 115 Broadway, New York City.

Varnishes
Felton, Sibley & Co., Inc., 136 N. 4th St., Phila.
Moller & Schumann Co., 8 Gerry St., Brooklyn.

Vise Stands
LeBlond Machine Tool Co., R. K., Cincinnati, O.
New Britain Machine Co., New Britain, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.

Vises, Drilling Machine
Armstrong Bros. Tool Co., 315 N. Francisco Ave., Chicago, Ill.
Armstrong-Blum Mfg. Co., 347 N. Francisco Ave., Chicago, Ill.
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
Graham Mfg. Co., Providence, R. I.
Hoggson & Pettis Mfg. Co., The, New Haven, Conn., U. S. A.
Horton & Son Co., E., Windsor Locks, Conn.

Vises, Metal Workers'
Athol Machine Co., Athol, Mass.
Fulton Mach. & Vise Co., Lowville, N. Y.
Hammacher, Schlemmer & Co., 13th St. and 4th Ave., New York City.
New Britain Machine Co., New Britain, Conn.
Reed Mfg. Co., Erie, Penn. 2-9" jaw, stationary or swivel base, and jaw.
Western Tool & Mfg. Co., Springfield, Ohio.

Vises, Planer and Shaper
American Tool Works Co., Cincinnati, Ohio.
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
Cincinnati Planer Co., Cincinnati, Ohio.
Graham Mfg. Co., Providence, R. I.
Hendey Machine Co., Torrington, Conn.
Hoggson & Pettis Mfg. Co., The, New Haven, Conn., U. S. A.

Vises, Milling Machine
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.

Vises, Pipe
Athol Machine Co., Athol, Mass.
Butterfield & Co., Derby Line, Vt.
Fulton Mach. & Vise Co., Lowville, N. Y.
Reed Mfg. Co., Erie, Penn. Pin or self-locking, ⅛" to 12" pipe.
Saunders Sons, D., Yonkers, N. Y.
Western Tool & Mfg. Co., Springfield, Ohio.
Williams & Co., J. H., 35 Richards St., Brooklyn.

Vises, Universal Machine
Becker Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
Hoggson & Pettis Mfg. Co., The, New Haven, Conn., U. S. A.
Horton & Son Co., E., Windsor Locks, Conn.
Kempsmith Mfg. Co., Station A, Milwaukee, Wis. Cable Address: Kempsmith, Milwaukee. South American Representative: J. & J. Drysdale Co., Ltd., Buenos Ayres, Calle Perú 440. Representative for Russia: Iznosskoff, Suckau Co., Petrograd and Moscow.
Skinner Chuck Co., New Britain, Conn.
Union Caliper Co., Orange, Mass.

Vises, Woodworkers'
Hammacher, Schlemmer & Co., 13th St., and 4th Ave., New York City.

Voltmeters
Bristol Co., Waterbury, Conn.
General Electric Co., Schenectady, N. Y.
Wagner Electric Mfg. Co., St. Louis, Mo.

Wash Stands and Bowls
Manufacturing Equipment & Engineering Co., 209 Washington St., Boston, Mass.

Washers
Kales-Haskel Co., Detroit, Mich.

Waste, Cotton and Wool
Royal Mfg. Co., Rahway, N. J. New York, 2 Rector St.; Chicago, Peoples Gas Bldg.; St. Louis, Syndicate Trust Bldg.; San Francisco, Wells-Fargo Bldg.

Welding, Electric
C & C Elec. & Mfg. Co., Garwood, N. J.
General Electric Co., Schenectady, N. Y.
Thomson Elec. Welding Co., Lynn, Mass., U. S. A.
Toledo Electric Welder Co., 4100 Langland St., Cincinnati, Ohio. Cable: Tolcin, Cincinnati.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

Welding Machines, Electric
C & C Electric & Mfg. Co., Garwood, N. J. Full automatic multiple circuit arc welders.
General Electric Co., Schenectady, N. Y.
Thomson Elec. Welding Co., Lynn, Mass., U. S. A. Electric resistance machines for all purposes.
Toledo Electric Welder Co., 4100 Langland St., Cincinnati, Ohio. Cable: Tolcin, Cincinnati. Electric, spot, butt and seam welding machines.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

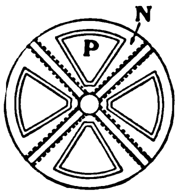
Welding Machines, Oxy-Acetylene
Davis-Bournonville Co., Jersey City, N. J.
Imperial Brass Mfg. Co., 1214 W. Harrison St., Chicago, Ill.
Linde Air Products Co., 42nd St. Bldg., N. Y. C.
Oxweld Acetylene Co., Chicago, Ill.

Welding, Oxy-Acetylene
Davis-Bournonville Co., Jersey City, N. J.
Linde Air Products Co., 42nd St. Bldg., N. Y. C.
Metals Welding Co., Cleveland, Ohio.
Oxweld Acetylene Co., Chicago, Ill.

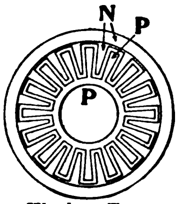
Wheels
Clark Co., Geo. P., Windsor Locks, Conn. Castor or truck wheels made of iron, rubber or fiber.

Wire
D & W Fuse Co., Providence, R. I.

THE WALKER LINE



Centering Type



Washer Type

The Power of the MAGNETIC CHUCK

There was a time when folks were "leary" of Magnetic Chucks but that was long ago.

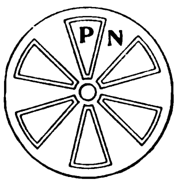
It's a "Safe Bet" that on your particular job a Walker Magnetic Chuck wlll split the costs.

No wonder they're growing more popular every day.

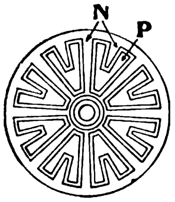
You don't need a special outfit for every new job. One Walker Magnetic Chuck will serve for any number of odd sized and odd shaped pieces.

Today is Catalog Day

Why not write for yours.



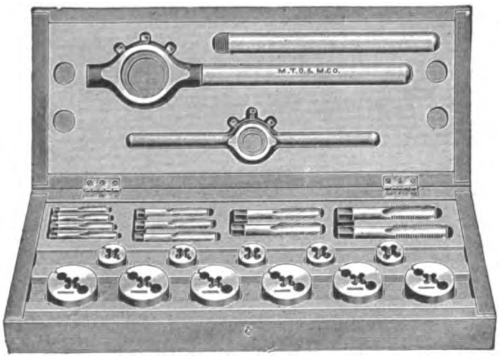
Standard Type



Multi-tooth Type

O. S. Walker Co. Successors To O. S. Walker & Co. Walker Grinder Co. **Worcester, Mass.**

A SET OF ROUND DIES



complete with holders, taps and wrenches is a valuable part of any shop equipment and especially so when the dies have the thread cutting ability possessed by "Morse" dies. They are accurately cut and relieved to reproduce threads that are clean and true to size.

Carried in stock in both adjustable and solid type in "V", U. S. S. and S. A. E. threads.

MORSE TWIST DRILL & MACHINE COMPANY
NEW BEDFORD MASS., U. S. A.

Halcomb Steel Co., Syracuse, N. Y.
Hammacher & Schlemmer Co., 13th St. and 4th Ave., New York City.

Wire Machinery

National Machinery Co., Tiffin, Ohio.
Rowbottom Machine Co., The, Waterbury, Conn.
Shuster Co., The F. B., New Haven, Conn.
100 rounds for rounds, squares, hexagons and flats. With and without cutting attachments.
Worthington Pump & Machinery Corporation, 115 Broadway, New York City.

Wire Welding

Apex Steel Corp., 50 Church St., New York City.
Swedish Iron & Steel Co., 12 Platt St., N. Y. C.

Wood-Working Machinery

Colburn Mach. Tool Co., Franklin, Penn.
Greaves, Klusman Tool Co., Cincinnati, Ohio.
Rowbottom Machine Co., Waterbury, Conn.
Seneca Falls Mfg. Co., The, 687 Water St., Seneca Falls, N. Y.
Victor scroll saws for foot or light power. Diamond mortising machine for foot power.
Worcester Pattern & Model Co., Worcester, Mass.

Wrenches, Drop Forged

Armstrong Bros. Tool Co., 315 N. Francisco Ave., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Page-Storms Drop Forge Co., Chicopee, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.
Williams Co., J. H., 35 Richards S., Brooklyn.

Wrenches, Machinist

Coes Wrench Co., Worcester, Mass.
Hammacher & Schlemmer Co., 13th St. and 4th Ave., New York City.
Page-Storms Drop Forge Co., Chicopee, Mass.
Trimont Mfg. Co., 55 Amory St., Roxbury, Mass.
"Trimo" all steel, 7 sizes, 6" to 21" inclusive; narrow for close quarter work, 12" size only with nut guard.
Williams Co., J. H., 35 Richards St., Brooklyn.

Wrenches, Pipe

Greene, Tweed & Co., 109 Duane St., N. Y. City
Greenfield Tap & Die Corp., Greenfield, Mass.
Page-Storms Drop Forge Co., Chicopee, Mass.
Pratt & Whitney Co., Hartford, Conn.
Starrett Co., L. S., Athol, Mass.
Trimont Mfg. Co., 55 Amory St., Roxbury, Mass
Cable: "Trimo."
Eight sizes, 6" to 48" inclusive in steel handles; 4 sizes, 6", 8", 10", 14" in wood handles, all with nut guards and steel frames; also made narrow for close quarter work, 3 sizes, 6", 8" and 10". "Trimo" chain wrenches, 7 sizes, taking pipe from ⅛" to 12".
Wells & Son Co., F. E., Greenfield, Mass.
Williams Co., J. H., 35 Richards St., Brooklyn.

Wrenches, Tap

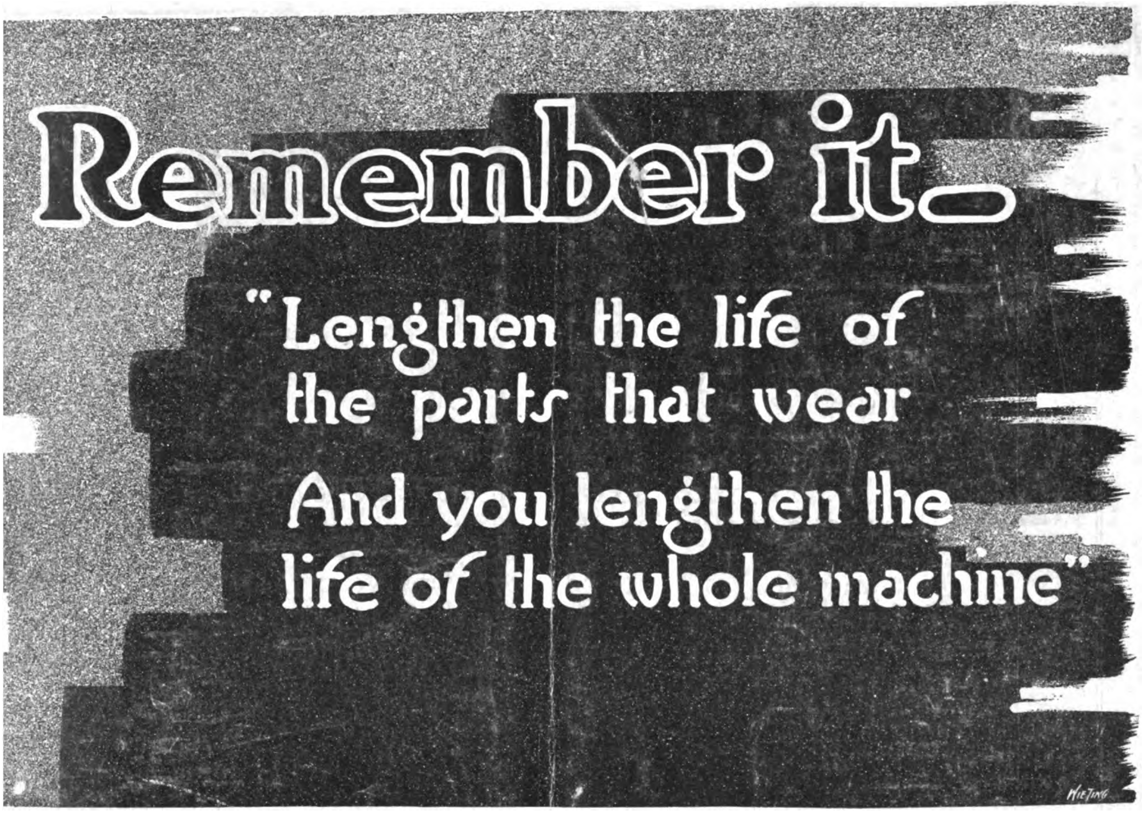
Bay State Tap & Die Co., Mansfield, Mass.
Butterfield & Co., Derby Line, Vt.
Card Mfg. Co., S. W., Mansfield, Mass. N. Y. Office: 62 Reade St. Cable: Card, Mansfield.
Horsfield and Card tap wrenches, all sizes.
Greenfield Tap & Die Corp., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.
Union Caliper Co., Orange, Mass.
Wells Bros. Co., Greenfield, Mass.

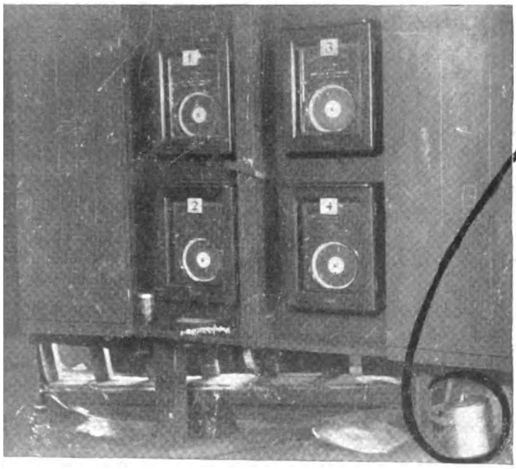
YEARS AGO—and not many at that—it was considered high treason and the limit of folly to *say* anything in an advertisement. Now nearly every advertisement has something to say—a different something every issue. You may have looked up an article in the *Buyers Cyclopedia* last week and found nothing in the ad that interested you. Try it again this week—ten to one there is a new story throwing new light from a new angle. This *Buyers Cyclopedia* is an epitome of what's in the buying section. Consult it as you would an index to your favorite author.

To be here is a badge of responsibility.
To buy from here is a guarantee of satisfaction.


LINDE A.P.CO.
LINDE OXYGEN
PRIVATE OXYGEN PLANT
Abnormal Business Conditions—
What We Are Doing To Meet Them
Chapter G.
Demonstrating That a Single Plant Service Cannot Compete With a Forty-Stations Service.
Linde success in meeting the tests imposed by abnormal conditions, has completely exposed the weakness of private plant service.
These private plants many of which have already fallen by the wayside, were installed on the theory that they would prove economical and dependable.
In actual practice the fallacy of the theory has been thoroughly exposed by balance sheet comparisons—comparisons of the cost of operation and the actual service rendered by these two competing sources of supply.
Among the factors contributing to the failure of the private plant, in all these cases are the following:
—Unlooked for increases in Oxygen consumption—far beyond the capacity of single plant service.
—Unlooked for operating trouble—involving temporary failure of supply and expensive repairs.
—Unlooked for operating expenses—upsetting manufacturing estimates.
—Unlooked for deterioration—upsetting investment calculations.
—And last, but not least, the extension of Linde Service through new factories and warehouses to provide a nearer and more convenient source of supply for each district.
These are but a few of the factors that have brought about the discontinuance of many private plants, by concerns who have written off their investments to place their dependence in Linde Oxygen exclusively.
In maintaining this service to these users, the Linde Company often finds it necessary to "shift the load" from one of its distributing stations to another—to meet suddenly increased and widely fluctuating demands.
This is service which the Linde Company alone can render—service made possible through the Company's chain of 40 distributing stations backed by its enormous manufacturing facilities.
In Chapter "H" we will comment on the service rendered to the Oxy-Acetylene Industry as a whole, by our staff of experts and engineers.
The Linde Air Products Company
42nd Street Bldg., New York City, N. Y.
"Largest Producers of Oxygen in the World"

INDEX TO AMERICAN ADVERTISERS





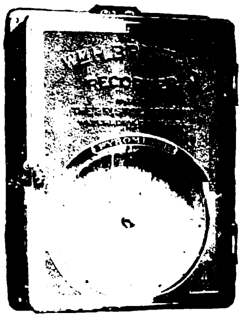
Jim Smith owns this pail

Jim Smith, operator, is dependent upon the two things shown in this picture; his dinner pail and his Bristol's Electric Pyrometers. Both supply a vital need. Jim relies upon them both for securing greater efficiency; they are necessities to himself and to his work.

TRADE MARK
BRISTOL'S
REG. U. S. PAT. OFFICE.

Electric Pyrometers

are rugged instruments of remarkable simplicity of design, requiring the minimum amount of attention.



The modern heat treatment of steel requires the use of Pyrometers. And to secure the greatest durability and most accurate results with the greatest ease requires the use of Bristol's Pyrometers.

Remember, Bristol's is the only Pyrometer equipped with the high-grade Weston movement, known and recognized the world over.

Write for a copy of Bulletin B-205.

THE BRISTOL CO. Waterbury, Conn., U. S. A.

BRANCH OFFICES:

Old South Bldg. Boston — 114 Liberty Street New York — Frick Bldg. Pittsburgh — Monadnock Bldg. Chicago — Rialto Bldg., San Francisco